

Mathematisches  
Forschungsinstitut  
Oberwolfach

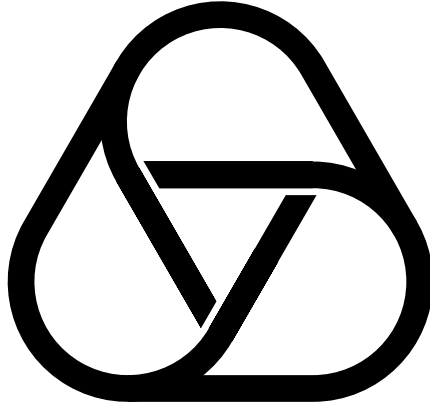
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*Leibniz*  
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# Jahresbericht Annual Report

# 2019





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# Jahresbericht 2019 – Annual Report 2019



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Gerhard Huisken (Bildrechte/image credits: Gerd Fischer)

## Vorwort des Direktors

Seit nunmehr 75 Jahren begegnen sich in Oberwolfach Mathematikerinnen und Mathematiker, um gemeinsam zu forschen! Zum Festakt am 5. Juli 2019 kamen zahlreiche Freunde, Förderer und Wegbegleiter des Instituts, um mit uns dieses besondere Jubiläum zu feiern und auf das bisher Erreichte zurückzublicken. Die hohe internationale Anerkennung des Instituts, seine herausragende Bedeutung für die mathematische Forschung und die damit verbundene Verantwortung für die Zukunft wurden vielfach in den Grußworten betont. Umso mehr freut es mich, dass im Jahr 2019 wieder viel dafür geleistet wurde, um das Institut zukunftssicherer zu machen.

Ein Bereich, der mir dabei sehr am Herzen liegt, ist die Nachwuchsförderung. Schon seit einigen Jahren unterstützt das MFO Nachwuchswissenschaftlerinnen und Nachwuchswissenschaftler bei den Reisekosten. Die bisherigen Fördermöglichkeiten umfassen das Programm „Oberwolfach Leibniz Graduate Students“, die „US Oberwolfach Junior Fellows“, finanziert durch die amerikanische National Science Foundation, sowie einen Reisekostenzuschuss für Teilnehmerinnen und Teilnehmer der Oberwolfach Seminare, finanziert durch die Carl Friedrich von Siemens Stiftung. Die „Simons Visiting Professorships“ der Simons Foundation stehen sowohl Nachwuchswissenschaftlern als auch etablierten

## Director's foreword

For 75 years now, mathematicians have been meeting in Oberwolfach to do research together! On July 5, 2019 we celebrated this special anniversary together with friends, supporters and companions of the MFO and gratefully looked back on what has been achieved so far. The high international recognition of the Institute, its outstanding importance for mathematical research and the associated responsibility for the future were emphasized in many greetings. Even more, I am pleased that in 2019 again lots of efforts were made to prepare the Institute for the future.

A very important issue to me is the promotion of young talents. For several years now, the MFO has been supporting junior scientists with regard to travel expenses. The existing funding opportunities include the “Oberwolfach Leibniz Graduate Students” program, the “US Oberwolfach Junior Fellows” funded by the American National Science Foundation, as well as a travel allowance for participants in the Oberwolfach Seminars funded by the Carl Friedrich von Siemens Foundation. The “Simons Visiting Professorships” of the Simons Foundation are open both to junior and senior researchers. So far, predominantly junior researchers from Europe and the USA have benefited from these existing

Forschern offen. Von den existierenden Töpfen profitierte bislang vor allem der europäische und US-amerikanische Nachwuchs. Es war uns ein großes Anliegen, ergänzend dazu weitere Fördermöglichkeiten für junge Mathematiker auch aus anderen Regionen der Welt zu erschließen. Dank der Oberwolfach Stiftung konnte mit der „Oberwolfach Foundation Fellowship“ in diesem Jahr eine solche Möglichkeit geschaffen werden. Der neue Grant erlaubt es uns pro Woche durchschnittlich einen Nachwuchswissenschaftler mit bis zu 1000 € zu unterstützen. Ich bedanke mich sehr herzlich bei der Oberwolfach Stiftung für diese großzügige Förderung!

Als weiteres Angebot für den wissenschaftlichen Nachwuchs fand im November 2019 das erste „Banach Center – Oberwolfach Graduate Seminar“ in Będlewo statt, zusätzlich zu den sechs jährlichen Oberwolfach Seminaren. Für die folgenden Jahre sind weitere Seminare geplant.

Schon länger nimmt das MFO am Leibniz Forschungsnetzwerk „Mathematical Modelling and Simulation“ (MMS) teil. Im Jahr 2019 beherbergte das Institut zum zweiten Mal die Leibniz MMS Summerschool für Nachwuchswissenschaftlerinnen und -wissenschaftler aus den Instituten der Leibniz-Gemeinschaft, parallel zu einem regulären Workshop.

Von großer Bedeutung für die Zukunftsfähigkeit des Instituts ist auch die Erhaltung der Infrastruktur. Nach den grundlegenden und aufwändigen Sanierungsprozessen der vergangenen Jahre können wir nun durch turnusmäßige Renovierungs- und Instandhaltungsmaßnahmen den Status der Gebäude erhalten und, wo es nötig ist, an neue Gegebenheiten anpassen. 2019 haben wir die Appartements für die Gäste des Programms „Research in Pairs“ erneuert, die neben den wöchentlichen Workshops den Hauptteil unseres wissenschaftlichen Programms ausmachen.

Eine gute und verlässliche finanzielle Ausstattung ist unabdingbar für den Betrieb des Instituts. Als Institut der Leibniz-Gemeinschaft erhalten wir den Hauptteil unserer Haushaltsmittel vom Bund und den Ländern, die nur wenige Wochen vor unserer Jubiläumsfeier die Fortsetzung des Paktes für Forschung und Innovation von 2021 bis 2030 beschlossen. Wir sind sehr erfreut und dankbar für die finanzielle Planungssicherheit, die wir dadurch erwarten können.

Auch die Unterstützung durch den Förderverein und die Oberwolfach Stiftung ist für uns von großem Wert. Ein herzliches Dankeschön an alle, die sich dort engagiert und gespendet haben! Ebenso danke ich unseren Drittmittelgebern:

It was very important to us, to open up further funding opportunities for young mathematicians also from other regions of the world. Thanks to the Oberwolfach Foundation, such an opportunity was created this year called “Oberwolfach Foundation Fellowship”. The new grant allows us to support an average of one junior researcher per week with up to 1000 €. A big thank you to the Oberwolfach Foundation for this generous support!

A further offer for junior scientists was the first “Banach Center - Oberwolfach Graduate Seminar” that took place in Będlewo in November 2019, in addition to the six annual Oberwolfach Seminars. More seminars are planned for the following years.

For several years the MFO has been participating in the Leibniz research network “Mathematical Modeling and Simulation” (MMS). In 2019 the Institute hosted again the Leibniz MMS Summerschool for young scientists from the institutes of the Leibniz Association, parallel to a regular workshop.

Maintaining the infrastructure is another essential issue for the Institute. After the fundamental renovation processes of recent years, we can now preserve the status of the buildings through regular renovation and maintenance measures. In 2019 we renewed the apartments for our guests in the “Research in Pairs” program, which together with the weekly Workshops makes up the main part of our scientific program.

Reliable financial resources are also vital for the running of the Institute. As a member of the Leibniz Association, we receive the majority of our budget from the federal and state governments. Just a few weeks before our anniversary celebrations they decided to continue the Pact for Research and Innovation from 2021 to 2030. We are very pleased and grateful for the financial planning security that we can expect now.

The support by the Friends of Oberwolfach and the Oberwolfach Foundation is also of great value for us. A big thank you to everyone who has donated or engaged there! I would also like to thank our third party donors: The Carl

Der Carl Friedrich von Siemens Stiftung, der National Science Foundation der USA und der Simons Foundation.

Friedrich von Siemens Foundation, the National Science Foundation of the USA and the Simons Foundation.

Nicht zuletzt lebt das Institut von Menschen, die ihr Wissen, ihre Ideen und ihre Arbeitskraft darin einbringen wollen. Ich freue mich sehr, dass im Oktober 2019 Matthias Hieber zum neuen stellvertretenden Direktor bestellt wurde und heiÙe ihn herzlich Willkommen. Er tritt im April 2020 die Nachfolge von Dietmar Kröner an. An dieser Stelle möchte ich Dietmar Kröner nochmals ein herzliches Dankeschön aussprechen für sein großartiges Engagement für das MFO und die mathematische Gemeinschaft.

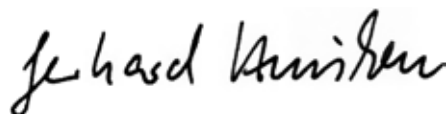
Last but not least, the Institute is carried by people who want to contribute their knowledge, their ideas and their workforce. I am very pleased that Matthias Hieber was appointed as the new Vice Director in October 2019 and I warmly welcome him at the Institute. He will succeed Dietmar Kröner in April 2020. At this point, I would like to thank Dietmar Kröner again for his great commitment to the MFO and the mathematical community.

Die Mitglieder der Wissenschaftlichen Kommission stellen durch ihre ehrenamtliche Arbeit die hohe Qualität unseres wissenschaftlichen Programms sicher. Ich freue mich sehr, dass wir 2019 wieder neue Mitglieder in diesem für uns essentiellen Gremium begrüÙen durften. Herzlichen Dank für ihr Engagement! Ich bedanke mich außerdem bei den Mitgliedern des Wissenschaftlichen Beirats und des Verwaltungsrats für ihre Arbeit, sowie bei den Mitgliedern der GMF für ihre Unterstützung.

The members of the Scientific Committee ensure the high quality of our scientific program through their voluntary work. I am very pleased that we were able to welcome new members to this essential board in 2019. Thank you very much for your commitment! I would also like to thank the members of the Scientific Advisory Board and the Administrative Council for their work, as well as the members of the GMF for their support.

Der vorliegende Bericht gibt Ihnen im Folgenden einen Überblick über all unsere Aktivitäten im Jahr 2019. Ein weiterer Höhepunkt neben unserer Jubiläumsveranstaltung war die Oberwolfach Vorlesung von Sara van de Geer, gehalten beim jährlichen Treffen der Mitglieder der Gesellschaft für Mathematische Forschung (GMF) und der beratenden Gremien des MFO im Oktober 2019. Von ihrem spannenden Vortrag hat uns Sara van de Geer freundlicherweise auch eine schriftliche Fassung zur Verfügung gestellt. Ich wünsche Ihnen viel Spaß bei der Lektüre!

The following report gives you an overview on all our activities in 2019. A further highlight in addition to our 75th anniversary was the Oberwolfach Lecture by Sara van de Geer, held at the annual meeting of the members of the Gesellschaft für Mathematische Forschung (GMF) and the advisory boards of the MFO in October 2019. Sara van de Geer kindly provided us with a written version of her exciting presentation. I hope you enjoy reading it!



Gerhard Huisken



## 1. Institutsnachrichten

### 1.1. 75-jähriges Jubiläum

Im Jahr 2019 feierte das MFO sein 75-jähriges Bestehen. Bei der Festveranstaltung am 5. Juli begrüßte Direktor Prof. Dr. Gerhard Huisken knapp 70 Gäste aus Wissenschaft, Politik und Wirtschaft.



*Gäste der Jubiläumsveranstaltung/guests at the anniversary (Bildrechte/image credits: Gerd Fischer)*

Theresia Bauer, Landesministerin für Wissenschaft, Forschung und Kunst in Baden-Württemberg, gratulierte dem MFO zu „75 Jahren wissenschaftlicher Exzellenz“. In ihrem Grußwort betonte sie die große Bedeutung internationaler Zusammenarbeit bei der Gestaltung des technologischen Wandels und der Bewältigung damit einhergehender Schwierigkeiten. Baden-Württemberg zähle dabei auf Oberwolfach mit seinen jährlich nahezu 3000 Gastforschern aus der ganzen Welt. Möglicherweise könne die Mathematik helfen, dort Brücken zu bauen, wo die Politik alleine nicht weiterkomme.



*Theresia Bauer*

## 1. News from the Institute

### 1.1. MFO celebrates 75 years

In 2019 the MFO celebrated its 75th anniversary. At the festive event on July 5th, Director Prof. Dr. Gerhard Huisken welcomed around 70 guests from science, politics and economics.

Theresia Bauer, State Minister for Science, Research and Art in Baden-Württemberg, congratulated the MFO for “75 years of scientific excellence”. She emphasized the great importance of international cooperation in shaping the current technological change and in solving associated problems. Baden-Württemberg counted on Oberwolfach with its nearly 3,000 guest researchers from all over the world every year. Mathematics could possibly help to build bridges where politics alone cannot make progress.



*Michael Meister*

Den Glückwünschen schloss sich Dr. Michael Meister, Mitglied des Bundestags und Parlamentarischer Staatssekretär im Bundesministerium für Bildung und Forschung, an. Er lobte insbesondere die intensive Nachwuchsförderung und die Projekte der Öffentlichkeitsarbeit des Instituts.

Als Vertreter der Leibniz-Gemeinschaft erläuterte Prof. Dr. Albert Sickmann (Sprecher der Sektion D) die besondere Rolle des Instituts als eine von zwei exzellenten „sozialen Forschungsinfrastrukturen“ innerhalb der Leibniz-Gemeinschaft. Die Ruhe und Abgeschlossenheit des Instituts sowie die Beibehaltung von Kreide und Tafel trotz Zeiten des digitalen Wandels seien gerade das Erfolgsgeheimnis von Oberwolfach.

Prof. Dr. Friedrich Götze (Vorstandsvorsitzender der Gesellschaft für Mathematische Forschung) erläuterte in seinem Grußwort die besondere Rolle der GMF für das MFO und beschrieb anhand entscheidender Stationen den Weg des Instituts von seiner Gründung bis zur Aufnahme in die Leibniz-Gemeinschaft.



*Albert Sickmann*

Dr. Wilhelm Krull (Generalsekretär der VolkswagenStiftung) knüpfte daran an und legte dar, wie viel besser manches in der Entwicklung des MFO gelaufen sei, als es ursprünglich geplant war. Die VolkswagenStiftung, die als Förderin an wichtigen Stationen dieser Entwicklung beteiligt war, sei darüber immer wieder überrascht und erfreut gewesen.

Auch die Klaus Tschira Stiftung hat das Institut entscheidend unterstützt und unter anderem gemeinsam mit der VolkswagenStiftung den Ausbau der Bibliothek finanziert. Beate Spiegel (Geschäftsführerin der Klaus Tschira Stiftung) betonte in ihrem Grußwort die große Bedeutung der Bibliothek für das MFO. Mit Oberwolfach verbinde sie das Interesse für Bücher, die inspirierten und zum Austausch mit anderen Menschen anregten. Die Bibliothek in Oberwolfach sei dafür der ideale Ort.

Dr. Michael Meister, Member of the German Federal Parliament and State Secretary at the Federal Ministry for Education and Science, continued with his greetings. He particularly praised the intensive promotion of junior researchers and the Institute's public relations projects.

As a representative of the Leibniz Association, Prof. Dr. Albert Sickmann (spokesman for Section D) emphasized the special role of the Institute as one of two excellent "social research infrastructures" within the Leibniz Association. The silence and seclusion of the Institute as well as sticking to chalk and blackboard in times of digital change were precisely the secret of Oberwolfach's success.

Prof. Dr. Friedrich Götze (Chair of the Gesellschaft für Mathematische Forschung) explained the special role of the GMF for the MFO and described the key stages of the Institute's path from the foundation to the membership in the Leibniz Association.



*Friedrich Götze*

Dr. Wilhelm Krull (General Secretary of the Volkswagen Foundation) followed up and pointed out how much better some things had gone in the development of the MFO than originally planned. The Volkswagen Foundation, which was involved in important stages of this development as a sponsor, had always been surprised and delighted.

The Klaus Tschira Stiftung also provided the Institute with decisive support and financed the expansion of the library together with the Volkswagen Foundation. In her greeting, Beate Spiegel (Managing Director of the Klaus Tschira Stiftung) emphasized the great importance of the library for the MFO. With Oberwolfach she shared an interest in books that inspire and encourage exchange with other people. The library in Oberwolfach was the ideal place for this.



*Wilhelm Krull*

Prof. Dr. Dr. h.c. Ursula Gather (Vorsitzende des Vereins zur Förderung des Mathematischen Forschungsinstituts Oberwolfach e.V.) überbrachte die Gratulation des Fördervereins und in Vertretung von Dr. Detlef Schneidawind auch die Glückwünsche der Oberwolfach Stiftung. Als besonderes Präsent zum Jubiläumsjahr kündigte sie die Bereitstellung von zusätzlichen 10.000 € für das neu geschaffene Programm der „Oberwolfach Foundation Fellows“ durch die Oberwolfach Stiftung an.

Prof. Dr. Cédric Villani (Député à l'Assemblée Nationale) sandte aus Paris eine Videobotschaft mit seinen Glückwünschen. Oberwolfach sei ein Ort wie kein anderer, den man wertschätzen, schützen, und stetig weiterentwickeln müsse.



*Ursula Gather*

Im Anschluss daran hielt Prof. Dr. Stefan Müller (Universität Bonn) einen Festvortrag, in dem er aus einer sehr persönlichen Perspektive heraus anschaulich darlegte, wie Oberwolfach Forscherinnen und Forscher in der Mathematik inspirieren und prägen kann. Er wählte als Beispiel dazu die Entwicklungen in der Forschung zu partiellen Differentialgleichungen in der Materialwissenschaft von ca. Ende der 1990er Jahre bis ca. Ende der 2000er Jahre. Während dieses Zeitraums wurde die Forschung in diesem Gebiet mehrfach durch Tagungen in Oberwolfach entscheidend vorangetrieben. Es ergaben sich



*Beate Spiegel überreicht ein Gemälde der Villa Bosch, dem Sitz der Klaus Tschira Stiftung/ Beate Spiegel presents a painting of the Villa Bosch, headquarter of the Klaus Tschira Stiftung*

Prof. Dr. Dr. h.c. Ursula Gather (Chair of the Förderverein "Friends of Oberwolfach") conveyed the congratulations of the "Friends of Oberwolfach" and on behalf of Dr. Detlef Schneidawind also of the Oberwolfach Foundation. As a special gift for the anniversary year, she announced that the Oberwolfach Foundation would provide an additional € 10,000 for the "Oberwolfach Foundation Fellows" program that was recently decided.

Prof. Dr. Cédric Villani (Député à l'Assemblée Nationale) sent a video message from Paris with his greetings. He stated that Oberwolfach was a place like no other, which needed to be cherished, protected and improved.



*Videobotschaft von Cédric Villani/video message of Cédric Villani*

Subsequently, Prof. Dr. Stefan Müller (University of Bonn) gave a celebratory lecture from a very personal perspective in which he vividly illustrated how Oberwolfach can inspire and influence researchers in mathematics. As an example, he described the developments in research on partial differential equations in materials science from around the end of the 1990s to around the end of the 2000s. During this period, research in this area was decisively pushed forward through conferences in Oberwolfach. This resulted in valuable knowledge for the development of new materials as well as fruitful



sowohl wertvolle Erkenntnisse für die Entwicklung neuer Materialien als auch fruchtbare Rückwirkungen für die Weiterentwicklung anderer, rein mathematischer Forschungsbereiche, wie Stefan Müller eindrücklich aufzeigte.

feedback for the further development of other, purely mathematical research areas, as Stefan Müller impressively demonstrated.



*Stefan Müller*



*Klaus Hulek*

Der Festakt wurde musikalisch von dem Klarinetten-Quartett „Clarisonos“ umrahmt.

The event was musically framed by the clarinet quartet "Clarisonos".

Gegen Abend verlagerten sich die Feierlichkeiten ins Gasthaus Hirschen in Oberwolfach. Dem Sektempfang im Garten des Gasthauses folgte ein gemeinsames Abendessen, begleitet von Tischreden von Freunden und Förderern des Instituts. Prof. Dr. Klaus Hulek überbrachte die Glückwünsche der Deutschen Mathematiker-Vereinigung. Erna Armbruster sprach in Vertretung des Bürgermeisters Matthias Bauernfeind die Gratulation der Gemeinde Oberwolfach aus. Prof. Dr. Willi Jäger, der lange Jahre Vorstandsvorsitzender der GMF und Mitglied im Verwaltungsrat des MFO war, gratulierte ebenfalls und erinnerte an manch besondere Begebenheit aus früheren Tagen.

In the evening the celebrations moved to the Hotel Hirschen in the village of Oberwolfach. The reception in the garden of the hotel was followed by a dinner, accompanied by speeches of friends and supporters of the Institute. Prof. Dr. Klaus Hulek brought the congratulations from the German Mathematical Society. Erna Armbruster congratulated on behalf of the mayor Matthias Bauernfeind and representing the municipality of Oberwolfach. Prof. Dr. Willi Jäger, who for many years was the chairman of the GMF and a member of the Administrative Council of the MFO, also congratulated and recalled some special occasions from earlier days.



*Erna Armbruster*



*Willi Jäger*

Für das MFO endete ein rundum gelungener Tag, an dem viele Menschen, auf deren Unterstützung der langjährige Erfolg des Instituts baut, ihre Verbundenheit zu Oberwolfach zum Ausdruck brachten.

An all around successful day ended for the MFO, on which many people, on whose support the long-term success of the Institute is based, expressed their commitment to Oberwolfach.

## 1.2. Oberwolfach Vorlesung 2019

Im Oktober 2019 hielt Prof. Dr. Sara van de Geer die Oberwolfach Vorlesung im Rahmen des jährlichen Treffens der Mitglieder der Gesellschaft für Mathematische Forschung und der beratenden Gremien des MFO. Wir bedanken uns sehr für den spannenden Vortrag und die nachfolgend dargestellte schriftliche Fassung.

## 1.2. Oberwolfach Lecture 2019

In October 2019 Prof. Dr. Sara van de Geer gave the Oberwolfach Lecture during the annual meeting of the members of the Gesellschaft für Mathematische Forschung and the boards of the MFO. We are very grateful for the exciting lecture and the written version presented below.

# Adaptation using total variation regularization

Sara van de Geer  
ETH, Zürich

## 1 Aims and main result

This report is based on joint work with Francesco Ortelli. We consider the signal-plus-noise model

$$Y = f^0 + \epsilon$$

where  $Y \in \mathbb{R}^n$  is a vector of observations,  $f^0 \in \mathbb{R}^n$  is the signal and  $\epsilon \in \mathbb{R}^n$  is unobservable noise. The unknown signal is estimated using a sparsity inducing penalty. In particular, for a given “analysis” matrix  $D \in \mathbb{R}^{m \times n}$  and tuning parameter  $\lambda > 0$ , we study the estimator

$$\hat{f} := \arg \min_{f \in \mathbb{R}^n} \left\{ \|Y - f\|_2^2/n + 2\lambda \|Df\|_1 \right\}.$$

An example is where  $D$  is the incidence matrix of a given graph, in which case  $\|Df\|_1$  is the total variation of  $f$  over this graph. Another example is where  $f$  is the vectorized version of a matrix and  $\|Df\|_1$  is a version of total variation in two dimensions. We aim at showing that  $\hat{f}$  has good convergence properties when  $(Df^0)_j = 0$  for many  $j \in [1 : m]$ , i.e., that the estimator  $\hat{f}$  adapts to the (unknown) number of active parameters of the signal  $f^0$ . More precisely, if  $f^0 \in \mathcal{N}_{-S_0} := \{f \in \mathbb{R}^n : (Df)_j = 0 \forall j \notin S_0\}$ , we would ideally want that

$$\|\hat{f} - f^0\|_2^2/n = \mathcal{O}_{\mathbf{P}}(r_{S_0}/n),$$

where  $r_{S_0} = \dim(S_0)$  is the dimension of  $\mathcal{N}_{-S_0}$ . We will show situations where this is modulo log-terms indeed the case. More generally, we show that the prediction error  $\|\hat{f} - f^0\|_2^2/n$  mimics a trade-off between approximation error and estimation error.

To state our main result we need to introduce some notation and the definition of “effective sparsity”. For subsets  $S \subset [1 : m]$  we define  $\mathcal{N}_{-S} := \{f \in \mathbb{R}^n : (Df)_j = 0 \forall j \notin S\}$  and  $r_S := \dim(\mathcal{N}_{-S})$ . In some examples we will enlarge  $\mathcal{N}_{-S}$  somewhat using an appropriate linear space  $\bar{\mathcal{N}}_{-S} \supset \mathcal{N}_{-S}$ . Write for a vector  $f \in \mathbb{R}^n$

$$f = f_{\bar{\mathcal{N}}_{-S}} + f_{\bar{\mathcal{N}}_{-S}^\perp}$$

where  $f_{\bar{\mathcal{N}}_{-S}}$  is the projection of  $f$  onto the linear space  $\bar{\mathcal{N}}_{-S}$  and  $f_{\bar{\mathcal{N}}_{-S}^\perp} := f - f_{\bar{\mathcal{N}}_{-S}}$  is its anti-projection. For a vector  $b \in \mathbb{R}^m$  we apply the notation  $b_S := \{b_j\}_{j \in S}$  and  $b_{-S} := \{b_j\}_{j \notin S}$ . We let  $\{\psi_j\}_{j \notin S} \subset \mathbb{R}^n$  be a dictionary, such that

$$f_{\bar{\mathcal{N}}_{-S}^\perp} = \sum_{j \notin S} \psi_j b_j, \quad b_{-S} := (Df)_{-S}.$$

**Definition** Let  $S$  be a subset of  $[1 : m]$  with cardinality  $s := |S|$ . Let  $q \in \mathbb{R}^m$  with  $q_S \in \{\pm 1\}^s$  a given sign configuration. We call  $q$  an interpolating vector (that interpolates the given signs at  $S$ ). For  $w_{-S}$  a vector of weights with entries  $0 \leq w_j \leq 1$ ,  $j \notin S$ , the effective sparsity is defined as

$$\Gamma^2(q_S, w_{-S}) := \min \left\{ n \|D^T q\|_2^2 : q \text{ interpolating, } |q_j| \leq 1 - w_j, j \notin S \right\}.$$

Interpolating vectors are closely related to dual certificates used in noiseless  $\ell_1$ -optimization.

The following theorem is an ‘‘analysis’’ variant of a result of Dalalyan et al. [2017] for the Lasso, see Ortelli and van de Geer [2019b] and Ortelli and van de Geer [2020].

**Theorem 1** Suppose that the entries of the noise vector  $\epsilon$  are independent standard Gaussians. Let  $\mathbf{f} \in \mathbb{R}^n$  be arbitrary and  $S := \{j : (D\mathbf{f})_j \neq 0\}$ . Let  $u > 0$  and  $v > 0$  be arbitrary. Take

$$\lambda \geq \frac{\sqrt{2 \log(2n) + 2u}}{n} \max_{j \notin S} \|\psi_j\|_2.$$

Then with probability at least  $1 - \exp[-u] - \exp[-v]$  it holds that

$$\begin{aligned} \|\hat{f} - f^0\|_2^2/n &\leq \|\mathbf{f} - f^0\|_2^2/n \\ &\quad + \left( \sqrt{\frac{r_S}{n}} + \sqrt{\frac{2v}{n}} + \Gamma(q_S, w_{-S}) \right)^2, \end{aligned}$$

with  $\Gamma^2(q_S, w_{-S})$  the effective sparsity with sign vector  $q_S := \{\text{sign}((D\mathbf{f})_j)\}_{j \in S}$  and weights

$$w_j = \frac{\sqrt{2 \log(2n) + 2u}}{n\lambda} \|\psi_j\|_2, \quad j \notin S.$$

In the above theorem one may take  $\mathbf{f} = f^0$  as a special case. One then sees that indeed in the bound for the prediction error occurs the term  $r_{S_0}/n$  sought for. The term  $2v/n$  can be thought of as an innocent parametric term. Less innocent may be the effective sparsity  $\Gamma^2(q_S, w_{-S})$ . In the rest of this report we show bounds for this quantity in some examples.

## 2 Functions of bounded variation

The result for this example is obtained in Dalalyan et al. [2017] using a different approach (instead of interpolating vectors they use a randomization device). Let

$$\|Df\|_1 := \sum_{i=2}^n |f_i - f_{i-1}| =: \text{TV}(f)$$

be the total variation of  $f$ . Define for  $f \in \mathbb{R}^n$ , the average  $\bar{f} := \sum_{i=1}^n f_i/n$ . We have

$$f_i - \bar{f} = \sum_{j=2}^n \psi_{i,j}^{\text{global}} b_j, \quad i = [1 : n]$$

where  $b_j = f_j - f_{j-1}$  and

$$\psi_{i,j}^{\text{global}} = \frac{j-1}{n} \mathbf{1}\{j \leq i\} - \frac{n-j+1}{n} \mathbf{1}\{j > i\}$$

forms the ‘‘global’’ dictionary. Thus  $|\psi_{i,j}^{\text{global}}|$  is  $\frac{1}{n} \times$  the number of times that one uses the  $j^{\text{th}}$  edge when passing from  $i$  to any other point  $i'$  (to the left or right of  $i$ ). One sees that the matrix  $\{\psi_j^{\text{global}}\}_{j=2}^n \in \mathbb{R}^{n \times (n-1)}$  has squared column lengths

$$\|\psi_j^{\text{global}}\|_2^2 = \frac{(j-1)(n-j+1)}{n}, \quad j \in [2 : n].$$

Let  $S = \{t_1 < t_2 \cdots < t_s\}$  be the locations of the jumps of  $\mathbf{f}$ . Write moreover  $t_0 := 1$  and  $t_{s+1} := n+1$  and let  $d_k := t_k - t_{k-1}$ ,  $k = 1, \dots, s+1$ . We take  $\bar{\mathcal{N}}_{-S} = \mathcal{N}_{-S}$ . Because the projection  $f_{\mathcal{N}_{-S}}$  is piecewise constant, taking the average value  $\bar{f}_k := \sum_{i=t_{k-1}}^{t_k-1} f_i/d_k$  in the interval  $[t_{k-1} : t_k - 1]$ , we have for  $f_{\mathcal{N}_{-S}^\perp}$  a local version of the above defined global dictionary. It follows that for  $k = 1, \dots, s+1$  and  $j \in [1 : d_k - 1]$

$$\|\psi_{t_{k-1}+1}\|_2^2 = \frac{j(d_k - j)}{d_k}.$$

Since for  $k \in [1 : s+1]$

$$\max_{1 \leq j \leq d_k - 1} \frac{j(d_k - j)}{d_k} \leq \frac{d_k}{4}$$

the requirement of Theorem 1 on the tuning parameter becomes

$$\lambda \geq \frac{\sqrt{2 \log(2n) + 2u}}{n} \max_{1 \leq k \leq s+1} \sqrt{d_k/4}.$$

Moreover, we may take the interpolating vector with

$$|q_{t_{k-1}+j}| = 1 - \sqrt{\frac{j(d_k - j)}{\max_{j' \in [1 : d_k - 1]} j'(d_k - j')}}}, \quad j \in [1 : d_k - 1], \quad k \in [2 : s]$$

and appropriately adjusted versions in the boundary intervals  $[t_0 + 1 : t_1 - 1]$  and  $[t_s + 1 : t_{s+1} - 1]$ . It can then be shown that

$$\Gamma^2(q_S, w_{-S}) \leq \text{const.} \sum_{k=1}^{s+1} \frac{n \log n}{d_k}.$$

Moreover, at locations  $t_k$ , with  $k \in [2 : s]$ , where the signs do not change (i.e.  $q_{t_k} = q_{t_{k-1}}$ ) one may choose ‘‘less steep’’ interpolations at these locations, showing that in the sum one may replace  $n \log n/d_k$  by  $n \log n$ .

In the case of approximately equally spaced jumps, one has  $d_k \asymp n/(s+1)$  for all  $k$ , so that one may take  $\lambda \asymp \sqrt{\log n/(n(s+1))}$  and

$$\Gamma^2(q_S, w_{-s}) = \mathcal{O}((s+1)^2 \log n).$$

This gives

$$\lambda^2 \Gamma^2(q_S, w_{-s}) = \mathcal{O}\left(\frac{(s+1) \log^2 n}{n}\right).$$

Thus, in that case we reached our aim up to log-terms. A similar conclusion holds if there are no sign-changes (corresponding to a monotone function  $\mathbf{f}$ ).

### 3 Higher order discrete derivatives

This example builds further on work by e.g. Tibshirani [2014] and Guntuboyina et al. [2020]. Write for  $f \in \mathbb{R}^n$ , and  $N \in \mathbb{N}$

$$\begin{aligned} (\Delta f)_j &:= f_j - f_{j-1}, \quad j \in [2 : n] \\ (\Delta^2 f)_j &:= (\Delta f)_j - (\Delta f)_{j-1}, \quad j \in [3 : n] \\ &\vdots \\ (\Delta^N f)_j &:= (\Delta^{N-1} f)_j - (\Delta^{N-1} f)_{j-1}, \quad j \in [N+1 : n]. \end{aligned}$$

Then  $\Delta^N f$  is the  $N^{\text{th}}$  order discrete derivative. When  $Df = \Delta^N f$ , we let  $t_1, \dots, t_s$  be the location of the jumps of  $\Delta^{N-1} \mathbf{f}$  and  $d_k := t_k - t_{k-1}$  the distance between jumps ( $k = [1 : s+1]$ , with  $t_0 = 0$  and  $t_{s+1} = n+1$ ). We let  $\tilde{\mathcal{N}}_{-s}$  be an  $N(s+1)$ -dimensional space being the direct sum of  $\mathcal{N}_{-s}$  and an appropriate space spanned  $(N-1)s$  additional variables. This allows us to get that

$$\|\psi_{t_{k-1}+j}\|_2^2 \asymp j^{2N-1} (d_k - j)^{2N-1} / d_k^{2N-1}, \quad j \in [N : d_k - 1].$$

See Ortelli and van de Geer [2019b] for the exact expression for the cases  $N = 2, 3$ . The condition of Theorem 1 on the tuning parameter becomes

$$\lambda \geq \text{const.} \frac{\sqrt{2 \log(2n) + 2u}}{n} \max_{1 \leq k \leq s+1} \sqrt{d_k^{2N-1}}$$

(where here and below, “const.” depends on  $N$ ). For the effective sparsity one obtains

$$\Gamma^2(q_S, w_{-s}) \leq \text{const.} \sum_{k=1}^{s+1} \frac{n \log n}{d_k^{2N-1}}$$

by taking the weights appropriately. For the case  $N = 2$  this can be done similarly to the case  $N = 1$ , but for  $N > 2$  one needs to do careful (discrete) “derivative matching”. In the case of approximately equally spaced jumps, one again has for  $\lambda \asymp n^{N-1} \sqrt{\log n/(n(s+1)^{2N-1})}$ , that

$$\lambda^2 \Gamma^2(q_S, w_{-s}) = \mathcal{O}\left(\frac{(s+1) \log^2 n}{n}\right).$$



## 4 Hardy-Krause variation

Let  $f \in \mathbb{R}^{n_1 \times n_2}$  and

$$(D_1 f D_2^T)_{i,j} := f_{i,j} - f_{i-1,j} - f_{i,j-1} + f_{i-1,j-1}, \quad i \in [2 : n_1], \quad j \in [2 : n_2].$$

Then  $\|D_1 f D_2^T\|_1$  is called the Hardy-Krause variation, see Fang et al. [2019] for recent important theoretical work. In Ortelli and van de Geer [2019a] we first apply an ANOVA decomposition. By orthogonality we can then deal with the main effects and interaction effects separately. For the interaction terms, the interpolating vector - now an interpolating matrix - is constructed using a rectangular tessellation of  $[1 : n_1] \times [1 : n_2]$  into  $s$  rectangles. Each rectangle in this tessellation contains an active point, and we interpolate the signs at these active points in such a way that at the border of the rectangles the interpolating vector is zero. This allows one to avoid boundary effects. The effective sparsity then involves the areas in the tessellation around the active points. If the active points are approximately on a regular grid, we obtain when taking  $\lambda \asymp \sqrt{\log n / (n\sqrt{s+1})}$  satisfying the condition of Theorem 1, an estimation error of order

$$\lambda^2 \Gamma(q_s, w_{-s}) = \mathcal{O}\left(\frac{(s+1) \log n}{n}\right) \sqrt{s+1}$$

(see Ortelli and van de Geer [2019a]). The extra factor  $\sqrt{s+1}$  comes from the fact that for  $s$  points on a regular grid in  $[0, 1]^d$

$$\frac{\text{distance in } \mathbb{R}^d}{\text{area in } \mathbb{R}^d} = \frac{\left(\frac{1}{s+1}\right)^{\frac{1}{d}}}{\frac{1}{s+1}} = \begin{cases} 1 & d = 1 \\ \sqrt{s+1} & d = 2 \end{cases},$$

where  $(1/(s+1))^{1/d}$  is the distance between two adjacent points at the same coordinate axis and the area concerns that of a square or (hyper-)cube with side lengths  $(1/(s+1))^{1/d}$ . It is as yet not clear whether the extra factor can be removed.

## 5 Total variation on a grid

Let now  $\mathcal{G} := (\mathcal{V}, \mathcal{E})$  be a graph with vertices  $\mathcal{V}$  and edges  $\mathcal{E}$ . The signal-plus-noise model on this graph is

$$Y_v = f_v^0 + \epsilon_v, \quad v \in \mathcal{V}.$$

The total variation over this graph is

$$\text{TV}(f) := \sum_{v \sim v'} |f_v - f_{v'}|,$$

where  $v \sim v'$  means that  $v$  and  $v'$  are adjacent nodes. With  $n := |\mathcal{V}|$  being the number of nodes, the total variation regularized least squares estimator is

$$\hat{f} := \arg \min_{f \in \mathbb{R}^n} \left\{ \sum_{v \in \mathcal{V}} |Y_v - f_v|^2/n + 2\lambda \text{TV}(f) \right\}$$

(see Sadhanala et al. [2016]). As for the path graph discussed in Section 2, the projection  $f_{\mathcal{N}_{-S}}$  is piecewise constant on  $s$  subgraphs: on each subgraph its value is the average of  $f$  over that subgraph. Thus again as for the path graph, a dictionary  $\{\psi_{v,e} : v \in \mathcal{V}, e \notin S\}$  can be obtained by taking  $|\psi_{v,e}|$  as  $1/n$  times the number of paths starting at  $v$  and that use the edge  $e$  when going to another node within the subgraph. We refer to Ortelli and van de Geer [2018] for dealing with trees, where these paths are uniquely defined. If there are cycles, one has several choices for the paths, i.e. several choices for the dictionary.

In this section we look at the two dimensional  $\sqrt{n} \times \sqrt{n}$  grid (with  $\sqrt{n}$  an integer) and penalty proportional to

$$\|Df\|_1 + \|fD^T\|_1, \quad f \in \mathbb{R}^{\sqrt{n} \times \sqrt{n}}$$

where

$$\begin{aligned} (Df)_{j,k} &= f_{j,k} - f_{j-1,k}, \quad j \in [2 : \sqrt{n}], k \in [1 : \sqrt{n}], \\ (fD^T)_{j,k} &= f_{j,k} - f_{j,k-1}, \quad j \in [1 : \sqrt{n}], k \in [2 : \sqrt{n}]. \end{aligned}$$

Clearly, the corresponding graph has many cycles. As an illustration, say the subgraphs are the left and the right  $\sqrt{n}/2 \times \sqrt{n}$  grid. In other words,  $\mathbf{f}$  has two rectangular equally sized regions of different “color”. As paths, we can choose straight lines which are rounded off so that one stays on the grid. In that case one finds

$$\max_{e \notin S} \|\psi_e\|_2^2 \asymp \log n,$$

leading to the choice  $\lambda \asymp \log n/n$  in Theorem 1. For the effective sparsity we find the bound

$$\Gamma^2(q_S, w_{-S}) \leq \text{const.} n \sqrt{n}.$$

This is roughly saying that there are  $\sqrt{n}$  jumps, and the interpolating vector is almost zero outside the active set because of the large noise weights  $\{\|\psi_e\|_2\}_{e \notin S}$ , near the boundary. Thus for  $\lambda \asymp \log n/n$

$$\lambda^2 \Gamma^2(q_S, w_{-S}) = \mathcal{O}\left(\frac{\log^2 n}{\sqrt{n}}\right)$$

which corresponds to the rate given in Hütter and Rigollet [2016] and Sadhanala et al. [2017].

One may also choose different paths that avoid edges near the boundary of the two regions of  $\mathbf{f}$ . Then overall the noise weights increase:

$$\max_{e \notin S} \|\psi_e\|_2^2 = \mathcal{O}(n^{1/4} \log n)$$

for certain such paths. This leads to the choice  $\lambda \asymp n^{-\frac{7}{8}} \log n$  in Theorem 1. For the effective sparsity we get

$$\Gamma^2(q_S, w_{-S}) \leq \text{const.} n \log n$$

which is smaller than what we had before because the noise weights are now small enough at the boundary of the two regions of  $\mathbf{f}$  to allow a smooth interpolation. We thus find

$$\lambda^2 \Gamma^2(q_S, w_{-S}) = \mathcal{O}\left(\frac{\log^3 n}{n^{3/4}}\right).$$

Using a different method of proof Chatterjee and Goswami [2019] derive this rate for the constrained problem and show that it cannot be improved.

## 6 Conclusion

We have illustrated that total variation regularization can adapt to unknown regularity in the underlying signal. The approach based on interpolating vectors unifies the proofs for the cases considered. It will be of interest to extend results to other penalties applied in image reconstruction problems for example.

The results can be generalized to loss functions other than least squares, such as logistic loss (see van de Geer [2020], where moreover a redundant log-term is removed).

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## 2. Wissenschaftliches Programm

Das wissenschaftliche Programm wird vom Direktor in Zusammenarbeit mit der Wissenschaftlichen Kommission der Gesellschaft für Mathematische Forschung entschieden. Dieses Gremium basiert auf der ehrenamtlichen Arbeit von circa 20-25 hochkarätigen Mathematikern und Mathematikerinnen, welche die gesamte Breite der Mathematik vertreten. Die Wissenschaftliche Kommission begutachtet alle wissenschaftlichen Veranstaltungen des Instituts vor ihrer Genehmigung. Das Programm wird in einem wettbewerblichen Verfahren nach streng wissenschaftlichen Kriterien gestaltet. Wie in den Vorjahren erhielt das MFO wesentlich mehr Anträge als genehmigt werden konnten.

### 2.1. Übersicht der Aktivitäten

Das Mathematische Forschungsinstitut Oberwolfach hat sechs zentrale wissenschaftliche Programme: Workshops, Miniworkshops, die Oberwolfach Arbeitsgemeinschaft, die Oberwolfach Seminare, das Research in Pairs Programm und die Oberwolfach Leibniz Fellows. Im Rahmen dieser Programme gibt es spezielle Fördermöglichkeiten für den wissenschaftlichen Nachwuchs sowie etablierte Forscherinnen und Forscher.

#### Das Workshop Programm

Der Hauptteil des Programms besteht aus etwa 40 einwöchigen Workshops pro Jahr an denen jeweils ca. 50 Personen teilnehmen. Alternativ können zwei Workshops halber Größe parallel stattfinden. Die Workshops werden von international führenden Expertinnen und Experten der jeweiligen Fachgebiete organisiert. Teilnehmen kann nur, wer auf ihre Empfehlung hin vom Direktor persönlich eingeladen wurde.

#### Simons Visiting Professors

Das Simons Visiting Professors (SVP) Programm wird durch die Simons Foundation finanziert. Das Programm unterstützt jährlich bis zu 40 führende Forscherinnen und Forscher von außerhalb Europas, die eine Teilnahme an einem Oberwolfacher Workshop mit einem Aufenthalt an einer europäischen Universität kombinieren möchten. Die Höhe der Förderung beträgt 135 € pro Tag des Gastaufenthalts an der Universität und wird für bis zu zwei Wochen gezahlt. Die beteiligten Universitäten stellen Unterkünfte für die Dauer des Besuchs an der Universität zur Verfügung und tragen die Reisekosten innerhalb Europas zwischen Oberwolfach und der Universität. Über die Förderung entscheidet der Direktor auf Vorschlag der Organisatorinnen und Organisatoren eines Workshops.

## 2. Scientific program

The Director of the Institute decides on the scientific program in cooperation with the Scientific Committee of the Gesellschaft für Mathematische Forschung. The committee is based on the honorary work of about 20 to 25 top-class mathematicians, covering all areas of mathematics. The Scientific Committee examines all scientific events at the Institute prior to their approval. The program is fixed in a competitive procedure according to strictly scientific criteria. As in the preceding years, the MFO received many more proposals than could be approved.

### 2.1. Overview on the activities

The Mathematisches Forschungsinstitut Oberwolfach focuses on six central scientific programs: Workshops, Mini-Workshops, the Oberwolfach Arbeitsgemeinschaft, the Oberwolfach Seminars, the Research in Pairs program, and the Oberwolfach Leibniz Fellows. Within these programs, there are special funding opportunities for junior researchers and established researchers.

#### The Workshop program

The main scientific program consists of about 40 week-long Workshops per year, each with about 50 participants. Alternatively, there can be two parallel Workshops of half size (about 25 participants). The Workshops are organized by internationally leading experts in the relevant fields. Participation is subject to a personal invitation by the Director after recommendation of the organizers.

#### Simons Visiting Professors

The Simons Visiting Professors (SVP) program is funded by the Simons Foundation. The program annually supports up to 40 Simons Visiting Professors, distinguished scientists from outside Europe, who wish to combine an invitation to an Oberwolfach Workshop with a research visit to a European university of up to two weeks. The program provides support to each Simons Visiting Professor by Oberwolfach amounting to 135 € per day of the university visit. Additionally, the participating universities are required to provide accommodation for the duration of the visit at the university as well as travel expenses within Europe between Oberwolfach and the university as a matching of this support. The SVP awards are decided by the Director on suggestion of the organizers of a Workshop.

## Das Miniworkshop Programm

Im Rahmen dieses Programms können jährlich 12 einwöchige Miniworkshops mit jeweils etwa 15 Teilnehmenden veranstaltet werden. Das Programm richtet sich besonders an den wissenschaftlichen Nachwuchs. Da über die Themen erst ein halbes Jahr im Voraus entschieden wird, ist es möglich, auf aktuelle Entwicklungen schnell zu reagieren.

## Die Oberwolfach Arbeitsgemeinschaft

Die Idee der Arbeitsgemeinschaft ist es, sich unter Anleitung international anerkannter Spezialisten durch eigene Vorträge in ein neues, aktuelles Gebiet einzuarbeiten. Die Arbeitsgemeinschaft findet zweimal jährlich für jeweils eine Woche statt und wird von Prof. Dr. Gerd Faltings und Prof. Dr. Andreas Thom organisiert. Sie richtet sich sowohl an den wissenschaftlichen Nachwuchs als auch an etablierte Forscherinnen und Forscher.

## Die Oberwolfach Seminare

Die Oberwolfach Seminare sind einwöchige Veranstaltungen, die sechsmal im Jahr stattfinden. Sie werden von führenden Experten der jeweiligen Fachgebiete organisiert und wenden sich an Promovierende und Postdoktoranden aus aller Welt. Das Ziel ist es, 25 Teilnehmerinnen und Teilnehmer in ein besonders aktuelles Arbeitsgebiet einzuführen.

Wir freuen uns, dass die Carl Friedrich von Siemens Stiftung die Oberwolfach Seminare von Sommer 2008 bis 2022 substanziell unterstützt.

## Das Research in Pairs Programm

Ein weiterer Schwerpunkt ist das Programm Research in Pairs (RiP). Dieses Programm ermöglicht es jeweils zwei bis vier Forschungsgästen aus verschiedenen Institutionen am MFO gemeinsam an einem vorher festzulegenden Projekt zu arbeiten. Ein Aufenthalt dauert zwischen zwei Wochen und drei Monaten.

## Oberwolfach Leibniz Fellows

In diesem Postdoktoranden-Programm werden besonders qualifizierte Nachwuchsforscherinnen und -forscher in einer entscheidenden Phase ihrer wissenschaftlichen Laufbahn durch die Bereitstellung idealer Arbeitsbedingungen in einem internationalen Umfeld gefördert. Einzelpersonen oder Kleingruppen können sich für die Durchführung eines Forschungsprojekts in Oberwolfach von einem bis zu drei Monaten bewerben. Entscheidend ist die Einbindung der Oberwolfach Leibniz Fellows in eine

## The Mini-Workshop program

This program offers 12 week-long Mini-Workshops per year, each with about 15 participants. These Mini-Workshops are aimed especially at junior researchers. Since the subjects are fixed only half a year before the Mini-Workshops take place, they allow to react to recent developments.

## The Oberwolfach Arbeitsgemeinschaft

The idea of the Oberwolfach Arbeitsgemeinschaft (study group) is to learn about a new active topic by giving a lecture on it, guided by leading international specialists. The Arbeitsgemeinschaft meets twice per year for one week each time and is organized by Prof. Dr. Gerd Faltings and Prof. Dr. Andreas Thom. It is aimed both at senior and junior researchers.

## The Oberwolfach Seminars

The Oberwolfach Seminars are week-long events taking place six times per year. They are organized by leading experts in the field and address postdocs and Ph.D. students from all over the world. They aim at introducing 25 participants to a particularly hot development.

We are pleased that the Carl Friedrich von Siemens Foundation substantially supports the Oberwolfach Seminars from summer 2008 to 2022.

## The Research in Pairs program

A further main activity of the Institute is the Research in Pairs (RiP) program. This program is aimed at small groups of two to four researchers from different places working together at the Mathematisches Forschungsinstitut Oberwolfach for two weeks up to three months on a specific project.

## Oberwolfach Leibniz Fellows

The focus of this postdoctoral program is to support excellent junior researchers in an important period of their scientific career by providing ideal working conditions in an international atmosphere. Outstanding junior researchers can apply to carry out a research project, individually or in small groups, for a period from one to three months. Oberwolfach Leibniz Fellows should be involved in an active research group with an established senior researcher at a university or another research institute.

aktive Arbeitsgruppe mit einem etablierten Wissenschaftler einer Universität oder einer Forschungseinrichtung.

Wir danken der Leibniz-Gemeinschaft für die Anschubfinanzierung des Projekts in den Jahren 2007-2009.

### Oberwolfach Leibniz Graduate Students

Seit Beginn des Jahres 2009 unterstützt das MFO die Teilnahme von im Durchschnitt fünf Oberwolfach Leibniz Graduate Students (OWLG) an den Oberwolfach Workshops. Gefördert werden exzellente Doktorandinnen und Doktoranden oder frisch Promovierte bis zu zwei Jahre nach der Promotion, insbesondere durch Reisekostenunterstützung. Es handelt sich um fünf zusätzliche Plätze pro Workshop, die für die OWLG reserviert sind und nicht durch etablierte Forscher besetzt werden dürfen.

Wir danken der Leibniz-Gemeinschaft für die Anschubfinanzierung des Projekts in den Jahren 2009-2011.

### US Junior Oberwolfach Fellows

Das MFO fördert die Teilnahme von herausragenden Nachwuchsforscherinnen und -forschern US-amerikanischer Universitäten in allen einwöchigen Programmen des Instituts. Diese Förderung ist möglich dank der Unterstützung der amerikanischen National Science Foundation (NSF).

### Oberwolfach Foundation Fellows

Seit dem Jahr 2019 gibt es ein neues Förderprogramm der Oberwolfach Stiftung, das es dem MFO erlaubt, eingeladene exzellente Nachwuchsforscherinnen- und -forscher bei ihren Reisekosten zu unterstützen. Das MFO kann durchschnittlich einer Person pro Woche bis zu 1000 € der Reisekosten erstatten. Bewerben können sich alle eingeladenen Teilnehmerinnen und Teilnehmer, deren Promotion nicht länger als 10 Jahre zurückliegt, und die nachweislich von Orten mit unzureichender Unterstützung für den wissenschaftlichen Nachwuchs kommen.

### Publikationen

Das MFO veröffentlicht insgesamt vier Publikationsreihen und unterstützt dabei die Idee von Open Access. Mit Ausnahme der Buchreihe „Oberwolfach Seminars“ sind alle Veröffentlichungen elektronisch frei verfügbar.

Um die Ergebnisse der Workshops einem international weiten Kreis zugänglich zu machen wurde 2004 die Buchserie „Oberwolfach Reports“

We thank the Leibniz Association for the initial funding of the project in the years 2007-2009.

### Oberwolfach Leibniz Graduate Students

Since the beginning of 2009, the MFO has been supporting the participation of an average of five doctoral students per Oberwolfach Workshop. This program fosters excellent graduate students and recent post docs (the Ph.D./Dr. degree must be received not more than two years ago), in particular by the reimbursement of travel costs. For this program, each Oberwolfach Workshop is given an extra capacity of five places which may not be taken by senior researchers.

We thank the Leibniz Association for the initial funding of the project in the years 2009-2011.

### US Junior Oberwolfach Fellows

The MFO supports the participation of outstanding junior researchers from US universities in all weekly programs of the Institute. This is possible thanks to the support of the National Science Foundation (NSF).

### Oberwolfach Foundation Fellows

Starting in 2019, there is a new grant of the Oberwolfach Foundation to support invited excellent junior researchers with regard to their travel to the MFO. This grant allows the MFO to reimburse travel expenses up to an amount of 1000 € for one junior researcher on average in every week. Invited participants coming from places with insufficient support for junior researchers to the MFO, with Dr./Ph.D. not longer than 10 years ago, can apply.

### Publications

The MFO has four distinct publication series and supports the idea of open access. Hence, all publications are freely available, with the exception of the book series “Oberwolfach Seminars”.

The Oberwolfach Reports (OWR) were initiated in 2004 in collaboration with the Publishing House of the European Mathematical Society. They

(OWR) in Zusammenarbeit mit dem Publishing House der European Mathematical Society gegründet. Sie erscheint jährlich mit vier Ausgaben von insgesamt mehr als 3.000 Seiten in einer Auflage von 300 Stück. Die OWR beinhalten erweiterte Kurzfassungen aller Vorträge der Workshops, Miniworkshops und Arbeitsgemeinschaften im Umfang von jeweils ein bis drei Seiten.

„Oberwolfach Seminars“ (OWS) ist eine Buchreihe in Zusammenarbeit mit Springer Nature, die den Inhalt der Oberwolfach Seminare für ein größeres Publikum zugänglich macht.

In den „Oberwolfach Preprints“ (OWP) werden hauptsächlich Resultate von längerfristigen Forschungsaufenthalten (RiP und OWLF) publiziert.

Die „Schnappschüsse moderner Mathematik aus Oberwolfach“ richten sich an die mathematisch interessierte Öffentlichkeit und erklären mathematische Ideen und Probleme in verständlicher Art und Weise. Sie werden von Teilnehmenden des wissenschaftlichen Programms am MFO geschrieben. Ein Team aus Editorinnen und Editoren unterstützt sie bei der Aufbereitung der komplizierten Sachverhalte für ein breites Publikum.

### Preise

Der Oberwolfach Preis wird etwa alle drei Jahre von der Gesellschaft für Mathematische Forschung e.V. und der Oberwolfach Stiftung an europäische Nachwuchsforscherinnen und -forscher verliehen. Der Preis ist für ausgezeichnete Errungenschaften in jeweils wechselnden Gebieten der Mathematik ausgelobt. Das MFO verleiht ebenfalls etwa alle drei Jahre zusammen mit der Oberwolfach Stiftung den John Todd Award für Nachwuchsforscherinnen und -forscher auf dem Gebiet der numerischen Analysis. Der Oberwolfach Preis ist mit 10.000 Euro und der John Todd Award mit 1.000 Euro dotiert.

### Teilnahme am Leibniz MMS Netzwerk

Als Mitglied der Leibniz-Gemeinschaft nimmt das MFO am Netzwerk „Mathematical Modelling and Simulation“ (MMS) teil. Das Thema spielt in vielen Aktivitäten des Instituts eine Rolle. Im Jahr 2019 beschäftigten sich insgesamt 29 einwöchige Veranstaltungen mit verschiedenen Aspekten dieses Forschungsfeldes. In diesem Jahr war das Institut außerdem erneut Gastgeber für die Leibniz MMS Summerschool für Nachwuchsforscherinnen- und -forscher aus den Leibniz-Instituten.

appear quarterly in an edition of 300 copies. The four issues comprise more than 3,000 pages per year. The OWR are comprised of official reports of every workshop, containing extended abstracts of the given talks during Workshops, Mini-Workshops and Arbeitsgemeinschaften, of one up to three pages per talk.

„Oberwolfach Seminars“ (OWS) is a book series in collaboration with Springer Nature. In this series, the material of the Oberwolfach Seminars for junior researchers is made available to an even larger audience.

The „Oberwolfach Preprints“ (OWP) mainly contain research results related to a longer stay in Oberwolfach (RiP and OWLF).

The „snapshots of modern mathematics from Oberwolfach“ address to everyone who is interested in mathematics and explain mathematical problems and ideas in an accessible and understandable way. They are written by participants of the scientific program at the MFO, who volunteer to explain an important aspect of their research. A team of editors assists them in communicating complicated matters to a broad audience.

### Prizes

The Oberwolfach Prize is awarded by the Gesellschaft für Mathematische Forschung e.V. and by the Oberwolfach Foundation to European junior researchers. The prize is awarded for excellent achievements in changing fields of mathematics. Furthermore, the Oberwolfach Foundation awards in cooperation with the MFO approximately every three years the John Todd Award to junior scientists in numerical analysis. The Oberwolfach Prize amounts to 10,000 Euro and the John Todd Award to 1,000 Euro.

### Participation in the Leibniz MMS Network

As a member of the Leibniz Association, the MFO participates in the Leibniz network „Mathematical Modelling and Simulation“ (MMS). The topic is present in many activities at Oberwolfach. In 2019 a total of 29 week-long events covered various aspects of the MMS area of research. This year the Institute hosted again the Leibniz MMS Summerschool for junior researchers from the Leibniz Institutes.



## Banach Center - Oberwolfach Graduate Seminars

In Ergänzung zu den sechs jährlichen Oberwolfach Seminaren starteten im Jahr 2019 die „Banach Center - Oberwolfach Graduate Seminars“. Die Seminare werden in Zusammenarbeit mit dem Forschungsinstitut für Mathematik (Banach Center) der Polnischen Akademie der Wissenschaften (IMPAN) organisiert und finden im Konferenzzentrum Będlewo statt. Sie richten sich an Promovierende und Postdoktoranden aus der ganzen Welt.

### Weitere Aktivitäten und Dienste

Das Institut beherbergte im Jahr 2019 erneut die abschließende Trainingswoche für besonders begabte Schülerinnen und Schüler zur Vorbereitung auf die Internationale Mathematik-Olympiade. Als Dienste für die Öffentlichkeit sind außerdem das Museum für Mineralien und Mathematik (MiMa), die Oberwolfach Fotosammlung und die Oberwolfach References for Mathematical Software (ORMS) zu nennen.

## 2.2. Jahresprogramm 2019

Im Jahr 2019 wurden während 42 Wochen 43 Workshops durchgeführt, 12 Miniworkshops während 4 Wochen, 6 Oberwolfach Seminare während 3 Wochen und 2 Arbeitsgemeinschaften während 2 Wochen. Insgesamt nahmen mehr als 2700 Forscherinnen und Forscher aus aller Welt an allen Programmen teil, davon ca. 25% aus Deutschland, 39% aus anderen europäischen Ländern und 36% aus dem nichteuropäischen Ausland. Das Institut legt großen Wert darauf, dass alle Gebiete der Mathematik und ihre Grenzgebiete, auch im Hinblick auf Anwendungen, vertreten sind. Das folgende Tagungsprogramm belegt diese Politik.

### Workshops

- 06.01. - 12.01.2019 Graph Theory**  
Organizers: Jim Geelen, Waterloo  
Daniel Kral, Brno  
Alex Scott, Oxford
- 13.01. - 19.01.2019 Arithmetic of Shimura Varieties**  
Organizers: Laurent Fargues, Paris  
Ulrich Goertz, Essen  
Eva Viehmann, Garching  
Torsten Wedhorn, Darmstadt
- 20.01. - 26.01.2019 Surface, Bulk, and Geometric Partial Differential Equations: Interfacial, stochastic, non-local and discrete structures**  
Organizers: Charles M. Elliott, Warwick  
Harald Garcke, Regensburg  
Ralf Kornhuber, Berlin

## Banach Center - Oberwolfach Graduate Seminars

In addition to the six annual Oberwolfach seminars, the "Banach Center - Oberwolfach Graduate Seminars" started in 2019. The seminars are organized in cooperation with the Institute of Mathematics (Banach Center) of the Polish Academy of Sciences (IMPAN) and take place at the conference center in Będlewo. They are aimed at doctoral candidates and postdocs from all around the world.

### Further activities and services

In 2019 the Institute again hosted the final training week for especially gifted pupils to prepare for the International Mathematical Olympiad. As further services provided for the general public the Museum for Minerals and Mathematics (MiMa), the Oberwolfach Photo Collection and the Oberwolfach References for Mathematical Software (ORMS) are to be mentioned.

## 2.2. Annual schedule 2019

In the year 2019 43 workshops have taken place during 42 weeks, as well as 12 Mini-Workshops during 4 weeks, 6 Oberwolfach Seminars during 3 weeks and 2 Arbeitsgemeinschaften during 2 weeks. In total, more than 2700 researchers from all over the world attended the Oberwolfach research program, about 25% from Germany, 39% from other European countries, and 36% from non-European countries. The Institute emphasizes that all fields of mathematics and related areas are represented, including applications. The following scientific program gives proof of this policy.

- 27.01. - 02.02.2019 Tomographic Inverse Problems: Theory and Applications**  
Organizers: Martin Burger, Münster  
Bernadette Hahn, Würzburg  
Eric Todd Quinto, Medford
- 03.02. - 09.02.2019 Nonlinear Evolution Equations: Analysis and Numerics**  
Organizers: Marlis Hochbruck, Karlsruhe  
Herbert Koch, Bonn  
Sung-Jin Oh, Seoul  
Alexander Ostermann, Innsbruck
- 10.02. - 16.02.2019 Singularities and Homological Aspects of Commutative Algebra**  
Organizers: Aldo Conca, Genova  
Steven Dale Cutkosky, Columbia  
Srikanth Iyengar, Salt Lake City

- 17.02. - 23.02.2019 Moist Processes in the Atmosphere**  
Organizers: Boualem Khouider, Victoria Rupert Klein, Berlin Leslie Smith, Madison
- 24.02. - 02.03.2019 Non-Archimedean Geometry and Applications**  
Organizers: Vladimir Berkovich, Rehovot Walter Gubler, Regensburg Peter Schneider, Münster Annette Werner, Frankfurt
- 10.03. - 16.03.2019 Uncertainty Quantification**  
Organizers: Oliver Ernst, Chemnitz Fabio Nobile, Lausanne Claudia Schillings, Mannheim Tim Sullivan, Berlin
- 17.03. - 23.03.2019 Contemporary Coding Theory**  
Organizers: Marcus Greferath, Aalto Camilla Hollanti, Aalto Joachim Rosenthal, Zürich
- 24.03. - 30.03.2019 Representations of Finite Groups**  
Organizers: Joseph Chuang, London Meinolf Geck, Stuttgart Radha Kessar, London Gabriel Navarro, València
- 14.04. - 20.04.2019 Combinatorics, Probability and Computing**  
Organizers: Michael Krivelevich, Tel Aviv Oliver Riordan, Oxford Angelika Steger, Zürich
- 21.04. - 27.04.2019 Mathematical Methods in Quantum Molecular Dynamics**  
Organizers: Tucker Carrington, Kingston George A. Hagedorn, Blacksburg Caroline Lasser, Munich
- 28.04. - 04.05.2019 Tropical Geometry: new directions**  
Organizers: Ilia Itenberg, Paris Hannah Markwig, Tübingen Grigory Mikhalkin, Genève Eugenii Shustin, Tel Aviv
- 05.05. - 11.05.2019 Statistical and Computational Aspects of Learning with Complex Structure**  
Organizers: Sara van de Geer, Zürich Markus Reiß, Berlin Philippe Rigollet, Boston
- 12.05. - 18.05.2019 Geometry and Physics of Higgs Bundles**  
Organizers: Lara B. Anderson, Blacksburg Tamás Hausel, Klosterneuburg Rafe Mazzeo, Stanford Laura P. Schaposnik, Chicago
- 19.05. - 25.05.2019 Nonlinear Hyperbolic Problems: modeling, analysis, and numerics**  
Organizers: Rinaldo M. Colombo, Brescia Philippe G. LeFloch, Paris Christian Rohde, Stuttgart Konstantina Trivisa, College Park
- 26.05. - 01.06.2019 Foundations and New Horizons for Causal Inference**  
Organizers: Nicolai Meinshausen, Zürich Jonas Peters, Copenhagen Thomas Richardson, Seattle Bernhard Schölkopf, Tübingen
- 02.06. - 08.06.2019 Mixed-integer Nonlinear Optimization: a hatchery for modern mathematics**  
Organizers: Leo Liberti, Palaiseau Sebastian Sager, Magdeburg Angelika Wiegele, Klagenfurt
- 16.06. - 22.06.2019 Logarithmic Enumerative Geometry and Mirror Symmetry**  
Organizers: Dan Abramovich, Providence Michel van Garrel, Hamburg Helge Ruddat, Mainz
- 16.06. - 22.06.2019 Statistical Methodology and Theory for Functional and Topological Data**  
Organizers: Aurore Delaigle, Parkville Alexander Meister, Rostock Victor Panaretos, Lausanne Larry Wasserman, Pittsburgh
- 23.06. - 29.06.2019 Algebraic K-theory**  
Organizers: Thomas Geisser, Tokyo Lars Hesselholt, Copenhagen Annette Huber-Klawitter, Freiburg Moritz Kerz, Regensburg
- 30.06. - 05.07.2019 Differentialgeometrie im Grossen**  
Organizers: Gérard Besson, Grenoble Ursula Hamenstädt, Bonn Michael Kapovich, Davis Ben Weinkove, Evanston
- 07.07. - 13.07.2019 Dynamische Systeme**  
Organizers: Marie-Claude Arnaud, Avignon Hakan Eliasson, Paris Helmut Hofer, Princeton Vadim Kaloshin, College Park
- 14.07. - 20.07.2019 Mathematical Theory of Water Waves**  
Organizers: Mark Groves, Saarbrücken Mariana Haragus, Besancon Erik Wahlén, Lund
- 14.07. - 20.07.2019 Mathematical Foundations of Isogeometric Analysis**  
Organizers: Annalisa Buffa, Lausanne Tom Hughes, Austin Angela Kunoth, Köln Carla Manni, Roma
- 21.07. - 27.07.2019 Partial Differential Equations**  
Organizers: Guido De Philippis, Trieste Richard M. Schoen, Irvine Peter M. Topping, Warwick
- 28.07. - 03.08.2019 Computational Multiscale Methods**  
Organizers: Björn Engquist, Austin Daniel Peterseim, Augsburg
- 04.08. - 10.08.2019 Homotopy Theory**  
Organizers: Jesper Grodal, Copenhagen Michael Hill, Los Angeles Birgit Richter, Hamburg
- 11.08. - 17.08.2019 C\*-Algebras**  
Organizers: Mikael Rørdam, Copenhagen Dima Shlyakhtenko, Los Angeles Andreas Thom, Dresden Stefaan Vaes, Leuven

- 18.08. - 24.08.2019 Mathematical Aspects of Hydrodynamics**  
Organizers: Peter Constantin, Princeton  
Anna Mazzucato, University Park  
Gregory Seregin, Oxford  
Edriss S. Titi, Rehovot/  
College Station
- 25.08. - 31.08.2019 Geometric, Algebraic, and Topological Combinatorics**  
Organizers: Gil Kalai, Jerusalem  
Isabella Novik, Seattle  
Francisco Santos, Santander  
Volkmar Welker, Marburg
- 01.09. - 07.09.2019 Innovative Approaches to the Numerical Approximation of PDEs**  
Organizers: Stephan Dahlke, Marburg  
Gitta Kutyniok, Berlin  
Ricardo H. Nochetto, College Park  
Rob Stevenson, Amsterdam
- 08.09. - 14.09.2019 Many-Body Quantum Systems**  
Organizers: Christian Hainzl, Tübingen  
Benjamin Schlein, Zürich  
Robert Seiringer, Klosterneuburg  
Simone Warzel, München
- 15.09. - 21.09.2019 Large Scale Stochastic Dynamics**  
Organizers: Thierry Bodineau, Palaiseau  
Fabio Toninelli, Lyon  
Bálint Tóth, Bristol/Budapest
- 22.09. - 28.09.2019 Toric Geometry**  
Organizers: Jürgen Hausen, Tübingen  
Diane Maclagan, Coventry  
Hal Schenck, Ames
- 29.09. - 05.10.2019 New Developments in Representation Theory of p-adic Groups**  
Organizers: Jessica Fintzen, Ann Arbor/  
Cambridge  
Wee Teck Gan, Singapore  
Shuichiro Takeda, Columbia
- 27.10. - 02.11.2019 Subfactors and Applications**  
Organizers: Dietmar Bisch, Nashville  
Terry Gannon, Edmonton  
Vaughan Jones, Nashville  
Yasuyuki Kawahigashi, Tokyo
- 03.11. - 09.11.2019 Analytic Number Theory**  
Organizers: Jörg Brüdern, Göttingen  
Kaisa Matomäki, Turku  
Robert C. Vaughan, University Park  
Trevor D. Wooley, West Lafayette
- 17.11. - 23.11.2019 Heat Kernels, Stochastic Processes and Functional Inequalities**  
Organizers: Masha Gordina, Storrs  
Takashi Kumagai, Kyoto  
Laurent Saloff-Coste, Ithaca  
Karl-Theodor Sturm, Bonn
- 01.12. - 07.12.2019 Groups, Dynamics, and Approximation**  
Organizers: Emmanuel Breuillard, Cambridge  
Alex Furman, Chicago  
Nicolas Monod, Lausanne  
Andreas Thom, Dresden
- 08.12. - 14.12.2019 Random Matrices**  
Organizers: László Erdős, Klosterneuburg  
Friedrich Götze, Bielefeld  
Alice Guionnet, Lyon
- 15.12. - 21.12.2019 Modular Forms**  
Organizers: Jan Hendrik Bruinier, Darmstadt  
Atsushi Ichino, Kyoto  
Tamotsu Ikeda, Kyoto  
Özlem Imamoglu, Zürich

## Miniworkshops

- 03.03. - 09.03.2019 Mathematical Aspects of Nonlinear Wave Propagation in Solid Mechanics**  
Organizers: Giuseppe Saccomandi, Perugia  
Yasemin Sengül, Istanbul  
Luigi Vergori, Perugia
- 03.03. - 09.03.2019 Lorentz Gas Dynamics: particle systems and scaling limits**  
Organizers: Alessia Nota, Bonn  
Chiara Saffirio, Zürich  
Juan Velázquez, Bonn
- 03.03. - 09.03.2019 Cohomology of Hopf Algebras and Tensor Categories**  
Organizers: Henning Krause, Bielefeld  
Sarah Witherspoon, College Station  
James Zhang, Seattle
- 07.04. - 13.04.2019 Recent Progress in Path Integration on Graphs and Manifolds**  
Organizers: Batu Güneysu, Berlin  
Matthias Keller, Potsdam  
Kazumasa Kuwada, Sendai  
Anton Thalmaier, Luxembourg
- 07.04. - 13.04.2019 Reflection Groups in Negative Curvature**  
Organizers: Mikhail Belolipetsky, Rio de Janeiro  
Vincent Emery, Bern  
Ruth Kellerhals, Fribourg
- 07.04. - 13.04.2019 Mathematics of Crystallisation**  
Organizers: Stefan Adams, Warwick  
Michael Baake, Bielefeld  
Markus Heydenreich, München
- 06.10. - 12.10.2019 Operator Algebraic Quantum Groups**  
Organizers: Michael Brannan, College Station  
Martijn Caspers, Delft  
Moritz Weber, Saarbrücken  
Anna Wysoczanska-Kula, Wrocław
- 06.10. - 12.10.2019 Degeneration Techniques in Representation Theory**  
Organizers: Evgeny Feigin, Moscow  
Ghislain Fourier, Aachen  
Martina Lanini, Rome

**06.10. - 12.10.2019 Self-adjoint Extensions in New Settings**  
Organizers: Ugo Boscain, Paris  
Aleksy Kostenko, Wien  
Konstantin Pankrashkin, Orsay

**10.11. - 16.11.2019 Algebraic Tools for Solving the Yang–Baxter Equation**  
Organizers: Eric Jespers, Brussels  
Victoria Lebed, Caen  
Wolfgang Rump, Stuttgart  
Leandro Vendramin, Buenos Aires

**10.11. - 16.11.2019 Rank One Groups and Exceptional Algebraic Groups**  
Organizers: Tom De Medts, Gent  
Bernhard Mühlherr, Gießen  
Anastasia Stavrova, St. Petersburg

**10.11. - 16.11.2019 Seshadri Constants**  
Organizers: Thomas Bauer, Marburg  
Lucja Farnik, Krakow  
Krishna Hanumanthu, Kelambakkam  
Jack Huizenga, University Park

## Oberwolfach Seminare

**09.06. - 15.06.2019 Anisotropic Spaces and their Applications to Hyperbolic and Parabolic Systems**  
Organizers: Viviane Baladi, Paris  
Mark Demers, Fairfield  
Giovanni Forni, College Park  
Sébastien Gouëzel, Nantes

**09.06. - 15.06.2019 Beyond Numerical Homogenization**  
Organizers: Daniel Peterseim, Augsburg  
Houman Owhadi, Pasadena

**20.10. - 26.10.2019 Growth in Finite and Infinite Groups**  
Organizers: Laurent Bartholdi, Göttingen/Lyon  
Harald Helfgott, Göttingen  
Matthew Tointon, Cambridge

**20.10. - 26.10.2019 Topological Cyclic Homology and Arithmetic**  
Organizers: Dustin Clausen, Bonn  
Lars Hesselholt, Copenhagen  
Akhil Mathew, Chicago

**24.11. - 30.11.2019 Structure-preserving Methods for Nonlinear Hyperbolic Problems**  
Organizers: Alina Chertok, Raleigh  
Philippe G. LeFloch, Paris  
Giovanni Russo, Catania

**24.11. - 30.11.2019 Wave Phenomena: Analysis and Numerics**  
Organizers: Marlis Hochbruck, Karlsruhe  
Andreas Rieder, Karlsruhe  
Roland Schnaubelt, Karlsruhe  
Christian Wieners, Karlsruhe

## Arbeitsgemeinschaften

**31.03. - 06.04.2019 Elliptic Cohomology according to Lurie**  
Organizers: Paul Goerss, Evanston  
Jacob Lurie, Cambridge MA  
Thomas Nikolaus, Münster

**13.10. - 18.10.2019 Zimmer's Conjecture**  
Organizers: Aaron Brown, Chicago  
David Fisher, Bloomington  
Sebastian Hurtado-Salazar, Chicago

## Fortbildungen/Training activities

**19.05. - 24.05.2019 Trainings- und Abschluss-Seminar für die Internationale Mathematik-Olympiade**  
Organizer: Jürgen Prestin, Lübeck

**27.10. - 1.11.2019 Leibniz MMS Summerschool: Modern Programming Languages for Science and Statistics – R and Julia**  
Organizers: Patricio Farrell (WIAS)  
Jürgen Fuhrmann (WIAS)  
Alexander Linke (WIAS)  
Jörg Polzehl (WIAS)  
Chris Rackauckas (JuliaLab / MIT)  
Karsten Tabelow (WIAS)

**17.11. - 23.11.2019 Banach Center – Oberwolfach Graduate Seminar: Mathematics of Deep Learning**  
Organizers: Gitta Kutyniok, Berlin  
Philipp Grohs, Wien



## 2.3. Workshops

### Workshop 1902



**06.01. – 12.01.2019**

Organizers:

#### **Graph Theory**

Jim Geelen, Waterloo

Daniel Kral, Brno

Alex Scott, Oxford

#### **Abstract**

Graph theory is a rapidly developing area of mathematics. Recent years have seen the development of deep theories, and the increasing importance of methods from other parts of mathematics. The workshop on Graph Theory brought together together a broad range of researchers to discuss some of the major new developments. There were three central themes, each of which has seen striking recent progress: the structure of graphs with forbidden subgraphs; graph minor theory; and applications of the entropy compression method. The workshop featured major talks on current work in these areas, as well as presentations of recent breakthroughs and connections to other areas. There was a particularly exciting selection of longer talks, including presentations on the structure of graphs with forbidden induced subgraphs, embedding simply connected 2-complexes in 3-space, and an announcement of the solution of the well-known Oberwolfach Problem.

#### **Participants**

Alon, Noga (Tel Aviv), Bonamy, Marthe (Talence), Carmesin, Johannes (Birmingham), Chudnovsky, Maria (Princeton), Conlon, David (Oxford), Delcourt, Michelle (Waterloo), Diestel, Reinhard (Hamburg), Dujmovic, Vida (Ottawa), Dvorak, Zdenek (Praha), Fox, Jacob (Stanford), Geelen, James F. (Waterloo), Grzesik, Andrzej (Kraków), Haxell, Penny E. (Waterloo), Joret, Gwenaël (Bruxelles), Kaiser, Tomáš (Plzen), Kneip, Jakob (Hamburg), Kostochka, Alexandr V. (Urbana), Kral, Daniel (Brno), Kühn, Daniela (Birmingham), Kwon, O-joung (Incheon), Lagoutte, Aurélie (Aubièrre), Leader, Imre (Cambridge), Liebenau, Anita (Sydney), Liu, Chun-Hung (College Station), Lovász, László (Budapest), Lovász, László Miklós (Cambridge), McCarty, Rose (Waterloo), Micek, Piotr (Kraków), Mohar, Bojan (Burnaby), Morrison, Natasha (Rio de Janeiro), Nelson, Peter (Waterloo), Nešetřil, Jaroslav (Praha), Noel, Jonathan (Coventry), Norin, Sergey (Montreal), Ossona de Mendez, Patrice (Paris), Osthus, Deryk (Birmingham), Oum, Sang-il (Daejeon), Pendavingh, Rudi (Eindhoven), Pokrovskiy, Alexey (London), Postle, Luke (Waterloo), Scott, Alexander (Oxford), Sereni, Jean-Sébastien (Strasbourg), Seymour, Paul (Princeton), Spirkl, Sophie (Piscataway), Stein, Maya Jakobine (Santiago Centro, RM), Sudakov, Benjamin (Zürich), Thomassé, Stéphan (Lyon), Thomassen, Carsten (Lyngby), Trotignon, Nicolas (Lyon), van der Pol, Jorn (Waterloo), Volec, Jan (Atlanta), Vušković, Kristina (Leeds), Whittle, Geoff (Wellington), Wollan, Paul (Roma), Yepremyan, Liana (Oxford)



**13.01. – 19.01.2019**

Organizers:

**Arithmetic of Shimura Varieties**

Laurent Fargues, Paris

Ulrich Goertz, Essen

Eva Viehmann, Garching

Torsten Wedhorn, Darmstadt

**Abstract**

Arithmetic properties of Shimura varieties are an exciting topic which has roots in classical topics of algebraic geometry and of number theory such as modular curves and modular forms. This very active research field has contributed to some of the most spectacular developments in number theory and arithmetic geometry in the last twenty years. Shimura varieties and their equal characteristic analogue, moduli spaces of shtukas, are closely related to the Langlands program (classical as well as p-adic). A particular case is given by moduli spaces of abelian varieties, a classical object of study in algebraic geometry.

**Participants**

Andreatta, Fabrizio (Milano), Anschütz, Johannes (Bonn), Bertoloni Meli, Alexander (Berkeley), Boyer, Pascal (Villetaneuse), Breutmann, Paul (Paris), Bruinier, Jan Hendrik (Darmstadt), Chen, Miaofen (Shanghai Shi), Dospinescu, Gabriel (Lyon), Faltings, Gerd (Bonn), Fargues, Laurent (Paris), Goren, Eyal Z. (Montreal), Görtz, Ulrich (Essen), Haines, Thomas (College Park), Hamacher, Paul (Garching bei München), Hansen, David (New York), Hartl, Urs (Münster), He, Xuhua (College Park), Hesse, Jens (Darmstadt), Hong, Serin (Ann Arbor), Howard, Benjamin V. (Chestnut Hill), Ivanov, Alexander (Bonn), Kim, Wansu (Seoul), Koskivirta, Jean-Stefan (London), Kret, Arno (Amsterdam), Kudla, Stephen S. (Toronto), Lan, Kai-Wen (Minneapolis), Lau, Eike (Bielefeld), Le Bras, Arthur-César (Bonn), Levin, Brandon W. (Tucson), Ludwig, Judith (Heidelberg), Madapusi Pera, Keerthi (Chestnut Hill), Mieda, Yoichi (Tokyo), Mihatsch, Andreas (Bonn), Milićević, Elizabeth (Haverford), Morel, Sophie (Princeton), Nguyen, Kieu Hieu (Villetaneuse), Nie, Sian (Beijing), Pappas, Georgios (East Lansing), Pilloni, Vincent (Lyon), Rapoport, Michael (Bonn), Richarz, Timo (Essen), Rozensztajn, Sandra (Lyon), Shen, Xu (Beijing), Shin, Sug Woo (Berkeley), Smithling, Brian (Baltimore), Stroth, Benoit (Villetaneuse), Taibi, Olivier N. (Lyon), Tian, Yichao (Bonn), Viehmann, Eva (Garching bei München), Wedhorn, Torsten (Darmstadt), Xue, Cong (Cambridge), Zhang, Chao (Taipei), Zhu, Xinwen (Pasadena)





**20.01. – 26.01.2019**

**Surface, Bulk, and Geometric Partial Differential Equations: Interfacial, stochastic, non-local and discrete structures**

Organizers:

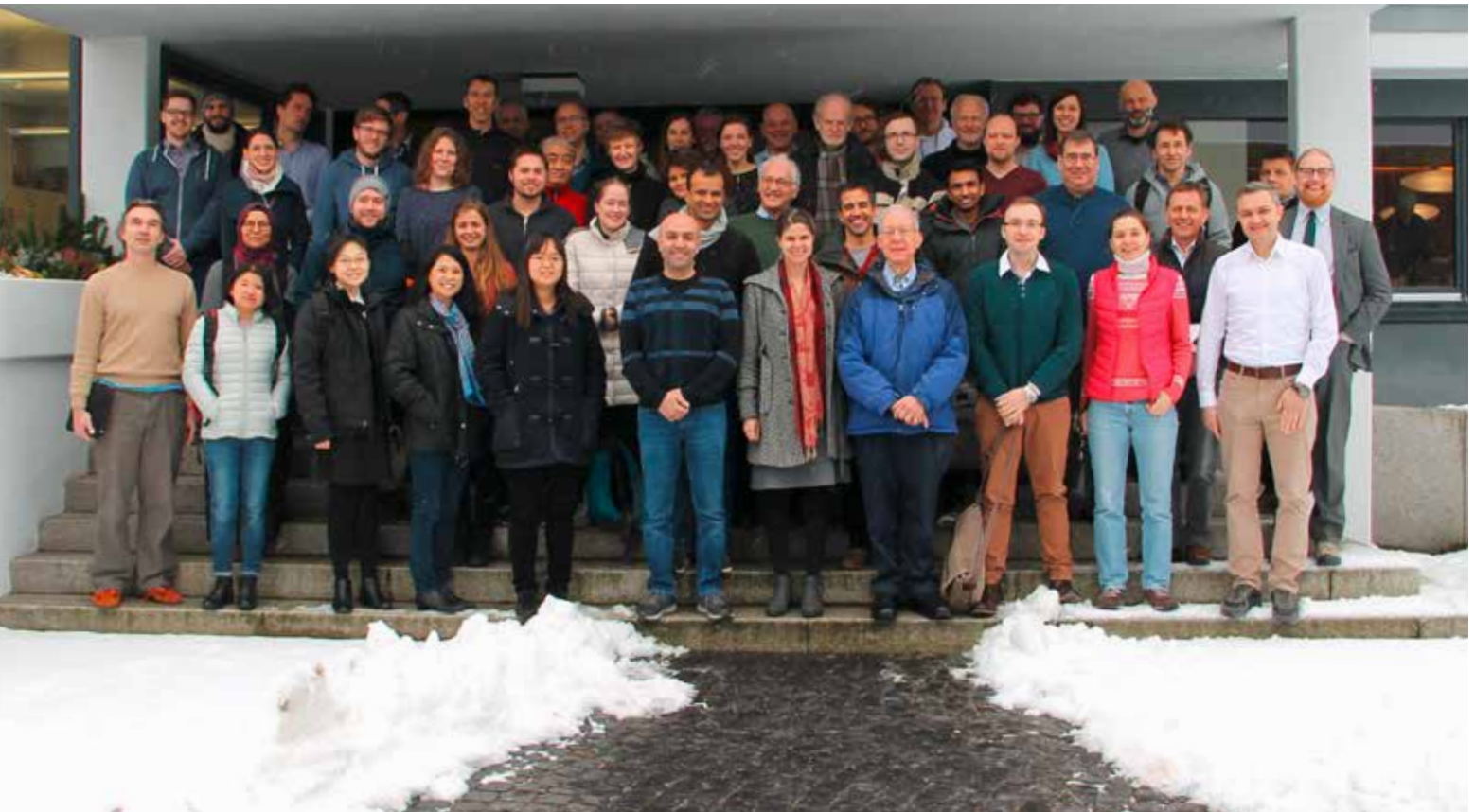
Charles M. Elliott, Warwick  
Harald Garcke, Regensburg  
Ralf Kornhuber, Berlin

**Abstract**

Partial differential equations in complex domains with free boundaries and interfaces continue to be flourishing research areas at the interfaces between PDE theory, differential geometry, numerical analysis and applications. Main themes of the workshop have been PDEs on evolving domains, phase field approaches, interactions of bulk and surface PDEs, curvature driven evolution equations. Applications particular from biology, such as cell and cancer modelling and fluid as well solid mechanics have been subjects of the conference.

**Participants**

Abels, Helmut (Regensburg), Agosti, Abramo (Milano), Alphonse, Amal C. (Berlin), Bartels, Sören (Freiburg i. Br.), Berlyand, Leonid (University Park), Bretin, Elie (Villeurbanne), Chambolle, Antonin (Palaiseau), Church, Lewis (Coventry), Djurdjevac, Ana (Berlin), Dunbar, Oliver (Coventry), Ebenbeck, Matthias (Regensburg), Elliott, Charles M. (Coventry), Garcke, Harald (Regensburg), Geiersbach, Caroline (Wien), Giga, Mi-Ho (Tokyo), Giga, Yoshikazu (Tokyo), Gräser, Carsten (Berlin), Harder, Hanne (Dresden), Hatcher, Luke (Coventry), Herbert, Philip (Coventry), Hintermüller, Michael (Berlin), Hinze, Michael (Hamburg), King, John R. (Nottingham), Knopf, Patrik (Regensburg), Kornhuber, Ralf (Berlin), Kovács, Balázs (Tübingen), Lam, Andrew (Shatin, N.T., Hong Kong), Laux, Tim (Berkeley), Liu, Chun (University Park), Lubich, Christian (Tübingen), Luckhaus, Stephan (Leipzig), Mackenzie, John A. (Glasgow), Masnou, Simon (Villeurbanne), Metzger, Stefan (Chicago), Miura, Tatsu-Hiko (Tokyo), Otto, Felix (Leipzig), Pozzi, Paola (Essen), Reusken, Arnold (Aachen), Rocca, Elisabetta (Pavia), Röger, Matthias (Dortmund), Schmitz, Felicitas (Regensburg), Sethian, James A. (Berkeley), Stevens, Angela (Münster), Stinner, Björn (Coventry), Tang, Bao Quoc (Graz), Thorpe, Matthew (Cambridge), van Gennip, Yves (Delft), Venkataraman, Chandrasekhar (Brighton), Voigt, Axel (Dresden), Walker, Shawn W. (Baton Rouge), Werner, Philipp (Erlangen)



**27.01. – 02.02.2019**

Organizers:

**Tomographic Inverse Problems: Theory and Applications**

Martin Burger, Münster  
Bernadette Hahn, Würzburg  
Eric Todd Quinto, Medford

### **Abstract**

This was the tenth Oberwolfach conference on the mathematics of tomography. The field rests on the interplay between the theoretical and applied; practical questions lead to new mathematics and pure mathematics motivates new algorithms. This workshop encompassed classical areas such as X-ray computed tomography (CT) as well as new modalities and applications such as dynamic imaging, Compton scattering tomography, hybrid imaging, optical tomography or multi-energy CT and addressed inter alia the use of methods from machine learning.

### **Participants**

Ambartsoumian, Gaik (Arlington), Arridge, Simon R. (London), Banert, Sebastian (Stockholm), Betcke, Marta M. (London), Boman, Jan (Stockholm), Brandt, Christina (Hamburg), Burger, Martin (Erlangen), Chung, Julianne (Blacksburg), Courdurier, Matias (Estación Central Santiago), Desbat, Laurent (La Tronche), Finch, David V. (Corvallis), Föcke, Janic (Erlangen), Frerking, Lena (Hamburg), Friel, Jürgen (Regensburg), Gouia-Zarrad, Rim (Sharjah), Grathwohl, Christine (Karlsruhe), Hahn, Bernadette (Würzburg), Haltmeier, Markus (Innsbruck), Hauptmann, Andreas (London), Hutterer, Victoria (Linz), Ilmavirta, Joonas (Jyväskylä), Jiang, Jiahua (Blacksburg), Jiang, Ming (Beijing), Jorgensen, Jakob (Manchester), Kadu, Ajinkya (Utrecht), Katsevich, Alexander (Orlando), Kienle Garrido, Melina (Würzburg), Kinzel, Meike (Münster), Kluth, Tobias (Bremen), Kohr, Holger (Eindhoven), Krishnan, Venkateswaran (Bengaluru), Kurusa, Arpád (Szeged), Louis, Alfred K. (Saarbrücken), Maaß, Peter (Bremen), Maier, Andreas (Erlangen), Mokso, Rajmund (Lund), Natterer, Frank (Münster), Nickl, Richard (Cambridge), Quinto, Eric Todd (Medford), Ramlau, Ronny (Linz), Richter, Annika B. (Würzburg), Rieder, Andreas (Karlsruhe), Rigaud, Gaël (Würzburg), Scherzer, Otmar (Wien), Schönlieb, Carola-Bibiane (Cambridge), Schotland, John C. (Ann Arbor), Schuster, Thomas (Saarbrücken), Sherina, Ekaterina (Wien), Siltanen, Samuli (University of Helsinki), Vogelgesang, Jonas (Saarbrücken), Wald, Anne (Saarbrücken), Wang, Qian (Lowell), Zhang, Xiaoqun (Shanghai)





**03.02. - 09.02.2019**

Organizers:

**Nonlinear Evolution Equations: Analysis and Numerics**

Marlis Hochbruck, Karlsruhe

Herbert Koch, Bonn

Sung-Jin Oh, Seoul

Alexander Ostermann, Innsbruck

### **Abstract**

The qualitative theory of nonlinear evolution equations is an important tool for studying the dynamical behavior of systems in science and technology. A thorough understanding of the complex behavior of such systems requires detailed analytical and numerical investigations of the underlying partial differential equations.

### **Participants**

Bahouri, Hajer (Créteil), Bambusi, Dario (Milano), Bizon, Piotr (Kraków), Burq, Nicolas (Orsay), Candy, Timothy (Bielefeld), Carle, Constantin (Karlsruhe), Celledoni, Elena (Trondheim), Chartier, Philippe (Rennes), Cicmilovic, Dimitrije (Bonn), Côte, Raphaël (Strasbourg), D'Ancona, Piero (Roma), Dörich, Benjamin (Karlsruhe), Duyckaerts, Thomas (Villetaneuse), Einkemmer, Lukas (Innsbruck), Faou, Erwan (Bruz), Gander, Martin (Genève), Grébert, Benoit (Nantes), Herr, Sebastian (Bielefeld), Hiptmair, Ralf (Zürich), Hochbruck, Marlis (Karlsruhe), Holden, Helge (Trondheim), Hundertmark, Dirk (Karlsruhe), Ifrim, Mihaela (Berkeley), Jahnke, Tobias (Karlsruhe), Karabash, Illia (Bonn), Kinoshita, Shinya (Bielefeld), Koch, Herbert (Bonn), Kovács, Balázs (Tübingen), Kropielnicka, Karolina (Gdańsk), Leibold, Jan (Karlsruhe), Lenzmann, Enno (Basel), Liao, Xian (Karlsruhe), Lopez-Fernandez, Maria (Roma), Lubich, Christian (Tübingen), Maier, Bernhard (Karlsruhe), Makridakis, Charalambos (Brighton), Marzuola, Jeremy L. (Chapel Hill), Monk, Peter (Newark), Nakanishi, Kenji (Kyoto), Nicaise, Serge (Valenciennes), Oh, Sung-Jin (Seoul), Onkes, Lisa (Bonn), Piazzola, Chiara (Innsbruck), Residori, Mirko (Innsbruck), Risebro, Nils Henrik (Oslo), Ritschl, Tillman (Bonn), Schnaubelt, Roland (Karlsruhe), Schörkhuber, Birgit (Karlsruhe), Schratz, Katharina (Karlsruhe), Sonnendrücker, Eric (Garching bei München), Spitz, Martin (Karlsruhe), Tataru, Daniel (Berkeley), Tolomeo, Leonardo (Edinburgh)





**10.02. - 16.02.2019**

**Singularities and Homological Aspects  
of Commutative Algebra**

Organizers:

Aldo Conca, Genova  
Steven Dale Cutkosky, Columbia  
Srikanth Iyengar, Salt Lake City

**Abstract**

Commutative algebra has recently witnessed a number of spectacular developments, resulting in the resolution of long-standing problems. The new techniques and perspectives, such as methods from the theory of perfectoid spaces, are leading to an extraordinary transformation in the field. There is also remarkable progress on the study of singularities in positive characteristics, and in particular on the problem of resolution of singularities. This workshop brought together researchers driving these developments with a broader group of young researchers in commutative algebra and allied fields, with the aim of spurring new collaborations and progress.

**Participants**

André, Yves (Paris), Benito, Angélica (Madrid), Bignalet-Cazalet, Rémi (Genova), Boij, Mats (Stockholm), Bravo, Ana (Madrid), Brenner, Holger (Osnabrück), Bruns, Winfried (Osnabrück), Caviglia, Giulio (West Lafayette), Chardin, Marc (Paris), Conca, Aldo (Genova), Cossart, Vincent (Versailles), Cutkosky, Steven Dale (Columbia), D'Ali, Alessio M. (Coventry), Das, Suprajo (Columbia), Ertl, Veronika (Regensburg), Faber, Eleonore (Leeds), Gélinas, Vincent (Dublin), Grifo, Eloísa (Ann Arbor), Herzog, Jürgen (Essen), Hibi, Takayuki (Osaka), Hironaka, Heisuke (Cambridge), Huneke, Craig (Charlottesville), Iyengar, Srikanth B. (Salt Lake City), Juhnke-Kubitzke, Martina (Osnabrück), Katthän, Lukas (Frankfurt am Main), Kummini, Manoj (Tamil Nadu), Ma, Linqun (West Lafayette), Masuti, Shreedevi K. (Tamil Nadu), McCullough, Jason G. (Ames), Michalek, Mateusz (Leipzig), Miller, Claudia (Syracuse), Mourtada, Hussein (Paris), Piltant, Olivier (Versailles), Polini, Claudia (Notre Dame), Raicu, Claudiu (Notre Dame), Reguera, Ana J. (Valladolid), Römer, Tim (Osnabrück), Rossi, Maria Evelina (Genova), Sam, Steven V. (La Jolla), Schober, Bernd (Hannover), Schwede, Karl (Salt Lake City), Singh, Anurag (Salt Lake City), Smith, Gregory G. (Kingston), Srinivasan, Hema (Columbia), Takagi, Shunsuke (Tokyo), Teissier, Bernard (Paris), Temkin, Michael (Jerusalem), Tucker, Kevin (Chicago), Ulrich, Bernd (West Lafayette), Varbaro, Matteo (Genova), Walker, Mark E. (Lincoln), Werner, Annette (Frankfurt am Main), Zhang, Wenliang (Chicago)





**17.02. - 23.02.2019**

Organizers:

**Moist Processes in the Atmosphere**

Boualem Khouider, Victoria

Rupert Klein, Berlin

Leslie Smith, Madison

**Abstract**

Processes related to water in the atmosphere lead to severe uncertainties in weather forecasting and climate research. Atmospheric water vapor and cloud water strongly influence the Earth's energy budget. Given the critical green-house effect of water vapor, it seems astounding that climate modellers cannot with certainty state whether the Earth's cloud system has a positive or negative influence on the global mean temperature. The formation of clouds involves small-scale processes currently unresolved by climate models, and thus cloud cover is one of the main sources of uncertainty. This large uncertainty has its roots in the extremely wide range of length and time scales associated with moist processes, which pose an equally wide range of challenges to mathematical and computational modelling. One of the main goals of this workshop was to show the path forward for current and future applied mathematical scientists, to work hand in hand across the disciplines of mathematics, physics, and atmospheric science, in order to tackle the complex problem of dynamical and thermodynamical processes associated with clouds and moisture.

**Participants**

Back, Larissa (Madison), Bartman, Piotr (Kraków), Baumgartner, Manuel (Mainz), Berner, Judith D. (Boulder), Brenowitz, Noah (Seattle), Burkhardt, Ulrike (Oberpfaffenhofen-Wessling), Cao, Yining (Bloomington), Craig, George C. (München), Crommelin, Daan T. (Amsterdam), Cullen, Mike (Exeter), Dias, Juliana (Boulder), Doerffel, Tom (Berlin), Feireisl, Eduard (Praha), Franzke, Christian (Hamburg), Gaßmann, Almut (Kühlungsborn), Giraldo, Francis X. (Monterey), Goswami, Bidyut B. (Abu Dhabi), Grabowski, Wojciech W. (Boulder), Han, Ying (Beijing), Hieber, Matthias (Darmstadt), Hirt, Mirjam (München), Hofmanová, Martina (Bielefeld), Hottovy, Scott (Annapolis), Janjic Pfander, Tijana (München), Khouider, Boualem (Victoria), Klein, Rupert (Berlin), Lukáčová-Medvidová, Mária (Mainz), Moncrieff, Mitchell (Boulder), Montgomery, Michael T. (Monterey), Mukhopadhyay, Parthasarathi (Pune), Müller, Annette (Berlin), Muraki, David James (Burnaby), Olesik, Michael A. (Kraków), Perrot, Xavier (Paris), Pfahl, Stephan (Berlin), Polzin, Robert Malte (Berlin), Rosemeier, Juliane (Mainz), Seifert, Axel (Offenbach am Main), Smith, Leslie M. (Madison), Smith, Roger K. (München), Spichtinger, Peter (Mainz), Stechmann, Samuel N. (Madison), Thual, Sulian (Shanghai Shi), Titi, Edriss S. (Rehovot), Yano, Jun-Ichi (Toulouse)



**24.02. - 02.03.2019**

Organizers:

**Non-Archimedean Geometry and Applications**

Vladimir Berkovich, Rehovot  
Walter Gubler, Regensburg  
Peter Schneider, Münster  
Annette Werner, Frankfurt

**Abstract**

The workshop focused on recent developments in non-Archimedean analytic geometry with various applications to other fields. We had 19 one hour talks. All talks were followed by lively discussions, in the form of plenary questions and also in the form of blackboard discussions in smaller groups. The topics of the talks included applications to complex geometry, mirror symmetry,  $p$ -adic Hodge theory, tropical geometry, resolution of singularities,  $p$ -adic dynamical systems and diophantine geometry.

**Participants**

Abramovich, Dan (Providence), Alon, Gil (Tel Aviv), Ardakov, Konstantin (Oxford), Battiston, Giulia (Heidelberg), Berger, Laurent (Lyon), Berkovich, Vladimir G. (Rehovot), Bertapelle, Alessandra (Padova), Bode, Andreas (Oxford), Botero, Ana Maria (Regensburg), Burgos Gil, José Ignacio (Madrid), Canton, Eric (Ann Arbor), Chambert-Loir, Antoine (Paris), de Shalit, Ehud (Jerusalem), Ducros, Antoine (Paris), Fenzl, Thomas (Regensburg), Gubler, Walter (Regensburg), Hahn, Marvin A. (Frankfurt am Main), Hartl, Urs (Münster), Hellmann, Eugen (Münster), Hübner, Katharina (Heidelberg), Huyghe, Christine (Strasbourg), Jell, Philipp (Atlanta), Jonsson, Mattias (Ann Arbor), Künnemann, Klaus (Regensburg), Lamboglia, Sara (Frankfurt am Main), Lau, Eike (Bielefeld), Liu, Ruochuan (Beijing), Liu, Yifeng (New Haven), Loeser, Francois (Paris), Martiensen, Rosemarie (Frankfurt am Main), Mazzon, Enrica (London), Mihatsch, Andreas (Bonn), Mincheva, Kalina (New Haven), Molho, Sam (Jerusalem), Nicaise, Johannes (London), Nickel, Matthias (Frankfurt am Main), Pille-Schneider, Léonard (Palaiseau), Poineau, Jérôme (Caen), Rabinoff, Joseph (Atlanta), Schmidt, Tobias (Rennes), Schneider, Peter (Münster), Shokrieh, Farbod (København), Sustretov, Dmitry (Moscow), Temkin, Michael (Jerusalem), Thuillier, Amaury (Villeurbanne), Tyomkin, Ilya (Beer-Sheva), Ulirsch, Martin (Frankfurt am Main), Vilsmeier, Christian (Regensburg), Wanner, Veronika (Regensburg), Wedhorn, Torsten (Darmstadt), Werner, Annette (Frankfurt am Main), Włodarczyk, Jaroslaw (West Lafayette), Zorbach, Adrian (Frankfurt am Main)





**10.03. - 16.03.2019**

Organizers:

### **Uncertainty Quantification**

Oliver Ernst, Chemnitz

Fabio Nobile, Lausanne

Claudia Schillings, Mannheim

Tim Sullivan, Berlin

### **Abstract**

Uncertainty quantification (UQ) is concerned with including and characterising uncertainties in mathematical models. Major steps comprise proper description of system uncertainties, analysis and efficient quantification of uncertainties in predictions and design problems, and statistical inference on uncertain parameters starting from available measurements. Research in UQ addresses fundamental mathematical and statistical challenges, but has also wide applicability in areas such as engineering, environmental, physical and biological applications. This workshop focussed on mathematical challenges at the interface of applied mathematics, probability and statistics, numerical analysis, scientific computing and application domains. The workshop served to bring together experts from those disciplines in order to enhance their interaction, to exchange ideas and to develop new, powerful methods for UQ.

### **Participants**

Agapiou, Sergios (Nicosia), Bachmayr, Markus (Mainz), Barth, Andrea (Stuttgart), Bochkina, Natalia (Edinburgh), Chernov, Alexey (Oldenburg), Chkrebti, Oxana A. (Columbus), Cockayne, Jon (Coventry), Dashti, Masoumeh (Brighton), Dette, Holger (Bochum), de Wiljes, Jana (Potsdam), Djurdjevac, Ana (Berlin), Dubinkina, Svetlana (Amsterdam), Dunlop, Matthew (New York), Eigel, Martin (Berlin), Ernst, Oliver (Chemnitz), Fischer, Lisa (Berlin), Fox, Colin (Dunedin), Gottschalk, Hanno (Wuppertal), Haario, Heikki (Lappeenranta), Haji Ali, Abdul-Lateef (Oxford), Hosseini, Bamdad (Pasadena), Kazashi, Yoshihito (Lausanne), Kekkonen, Hanne (Cambridge), Klebanov, Ilja (Berlin), Kostina, Ekaterina A. (Heidelberg), Kouri, Drew Philip (Albuquerque), Kuo, Frances Y. (Sydney), Lang, Annika (Göteborg), Latz, Jonas (Garching bei München), Lie, Han Cheng (Berlin), Mackey, Lester (Stanford), Marzouk, Youssef M. (Cambridge), Nickl, Richard (Cambridge), Nobile, Fabio (Lausanne), Ottobre, Michela (Edinburgh), Owhadi, Houman (Pasadena), Pichler, Alois (Chemnitz), Reich, Sebastian (Potsdam), Reiß, Markus (Berlin), Rudolf, Daniel (Göttingen), Scheichl, Robert (Heidelberg), Schlather, Martin (Mannheim), Schwab, Christoph (Zürich), Simoni, Anna (Palaiseau), Sprungk, Björn (Göttingen), Strauch, Claudia (Mannheim), Sullivan, Tim (Berlin), Teckentrup, Aretha (Edinburgh), Tempone, Raul F. (Thuwal), Ullmann, Elisabeth (Garching bei München), Wang, Andi Q. (Oxford), Weißmann, Simon (Mannheim)





**17.03. - 23.03.2019**

Organizers:

**Contemporary Coding Theory**

Marcus Greferath, Aalto

Camilla Hollanti, Aalto

Joachim Rosenthal, Zürich

**Abstract**

Coding Theory naturally lies at the intersection of a large number of disciplines in pure and applied mathematics. A multitude of methods and means has been designed to construct, analyze, and decode the resulting codes for communication. This has suggested to bring together researchers in a variety of disciplines within Mathematics, Computer Science, and Electrical Engineering, in order to cross-fertilize generation of new ideas and force global advancement of the field. Areas to be covered are Network Coding, Subspace Designs, General Algebraic Coding Theory, Distributed Storage and Private Information Retrieval (PIR), as well as Code-Based Cryptography.

**Participants**

Alfarano, Gianira N. (Zürich), Barbero, Ángela I. (Valladolid), Bossert, Martin (Ulm), Boston, Nigel (Madison), Braun, Michael (Darmstadt), Byrne, Eimear (Dublin), Climent, Joan Josep (Alicante), Etzion, Tuvi (Haifa), Geil, Olav (Aalborg), Gluesing-Luerssen, Heide (Lexington), Gnilke, Oliver W. (Aalto), Gorla, Elisa (Neuchâtel), Grassl, Markus (Erlangen), Greferath, Marcus (Aalto), Guruswami, Venkatesan (Pittsburgh), Helleseth, Tor (Bergen), Hollanti, Camilla (Aalto), Holzbaur, Lukas (München), Horlemann-Trautmann, Anna-Lena (St. Gallen), Hu, Sihuang (Aachen), Jurrius, Relinde (Den Helder), Kelley, Christine A. (Lincoln), Kiermaier, Michael (Bayreuth), Kramer, Gerhard (München), Lieb, Julia (Aveiro), Lobillo Borrero, Francisco Javier (Granada), Manganiello, Felice (Clemson), Médard, Muriel (Cambridge), Mesnager, Sihem (Saint-Denis), Nebe, Gabriele (Aachen), Neri, Alessandro (Zürich), Östergård, Patric R. J. (Aalto), Özbudak, Ferruh (Ankara), Pavčević, Mario O. (Zagreb), Pinto, Raquel (Aveiro), Ravagnani, Alberto (Dublin), Roessing, Cornelia (Dublin), Rosenthal, Joachim (Zürich), Roth, Ronny (Haifa), Sacikara, Elif (Tuzla/Istanbul), Schmidt, Kai Uwe (Paderborn), Sheekey, John (Dublin), Skachek, Vitaly (Tartu), Solé, Patrick (Marseille), Soljanin, Emina (Piscataway), Storme, Leo (Gent), Sudan, Madhu (Cambridge), Tajeddine, Razane (Aalto), Vardy, Alexander (La Jolla), Vontobel, Pascal O. (Hong Kong), Wassermann, Alfred (Bayreuth), Weger, Violetta (Zürich), Weiss, Charlene (Paderborn), Willems, Wolfgang (Magdeburg), Ytrehus, Øyvind (Bergen), Zemor, Gilles (Talence), Zumbärgel, Jens (Passau)





**24.03. - 30.03.2019**

Organizers:

**Representations of Finite Groups**

Joseph Chuang, London

Meinolf Geck, Stuttgart

Radha Kessar, London

Gabriel Navarro, València

**Abstract**

The workshop covered a wide variety of aspects of representation theory of finite groups and its relations to other areas of mathematics, including Lie theory, homotopy theory, homological algebra, number theory and combinatorics. In fifteen lectures of 50 minutes each and twelve shorter contributions of 30 minutes each, speakers presented recent progress in the representation theory of finite groups and proposed new research directions. Plenty of time was available outside of the lectures for informal discussion between participants, either on continuing research cooperation or on new projects.

**Participants**

Benson, David J. (Aberdeen), Bessenrodt, Christine (Hannover), Boltje, Robert (Santa Cruz), Bouc, Serge (Amiens), Brunat, Olivier (Paris), Cabanes, Marc (Paris), Carlson, Jon F. (Athens), Chuang, Joseph (London), Craven, David A. (Birmingham), Danz, Susanne (Eichstätt), Dudas, Olivier (Paris), Eaton, Charles W. (Manchester), Eisele, Florian (London), Erdmann, Karin (Oxford), Fayers, Matthew (London), Geck, Meinolf (Stuttgart), Geline, Michael (DeKalb), Giannelli, Eugenio (Cambridge), Grodal, Jesper (København), Henke, Ellen (Aberdeen), Hetz, Jonas (Stuttgart), Hiß, Gerhard (Aachen), Kessar, Radha (London), Koshitani, Shigeo (Chiba-Shi), Külshammer, Burkhard (Jena), Lacabanne, Abel (Louvain-la-Neuve), Lassueur, Caroline (Kaiserslautern), Linckelmann, Markus (London), Livesey, Michael (Jena), Lübeck, Frank (Aachen), Lynd, Justin (Lafayette), Malle, Gunter (Kaiserslautern), Margolis, Leo (Bruxelles), Mazza, Nadia (Lancaster), Morotti, Lucia (Hannover), Navarro, Gabriel (Burjassot), Rickard, Jeremy (Bristol), Rizo, Noelia (Burjassot), Robinson, Geoffrey R. (Brampton), Ruhstorfer, Lucas (Wuppertal), Sambale, Benjamin (Jena), Schaeffer Fry, Amanda A. (Denver), Semeraro, Jason (Leicester), Serwene, Patrick (London), Späth, Britta (Wuppertal), Symonds, Peter (Manchester), Taylor, Jay (Tucson), Tent, Joan (Burjassot), Thévenaz, Jacques (Lausanne), Tiep, Pham Huu (Piscataway), Tong-Viet, Hung P. (Binghamton), Turull, Alexandre (Gainesville), Vallejo Rodriguez, Carolina (Madrid), Williamson, Geordie (Sydney)





**14.04. - 20.04.2019**

Organizers:

**Combinatorics, Probability and Computing**

Michael Krivelevich, Tel Aviv

Oliver Riordan, Oxford

Angelika Steger, Zürich

**Abstract**

The main theme of this workshop was the use of probabilistic methods in combinatorics and theoretical computer science. Although these methods have been around for decades, they are being refined all the time: they are getting more and more sophisticated and powerful. Another theme was the study of random combinatorial structures, either for their own sake, or to tackle extremal questions. The workshop also emphasized connections between probabilistic combinatorics and discrete probability.

**Participants**

Allen, Peter (London), Balister, Paul (Memphis), Balogh, Jozsef (Urbana), Bohman, Thomas A. (Pittsburgh), Böttcher, Julia (London), Coja-Oghlan, Amin (Frankfurt am Main), Conlon, David (Oxford), Ferber, Asaf (Cambridge), Fox, Jacob (Stanford), Friedgut, Ehud (Rehovot), Gamarnik, David (Cambridge), Ghaffari, Mohsen (Zürich), Gishboliner, Lior (Ramat Aviv, Tel Aviv), Haeupler, Bernhard (Pittsburgh), Haxell, Penny E. (Waterloo), Heckel, Annika (Oxford), Kahn, Jeff (Piscataway), Kang, Mihyun (Graz), Keevash, Peter (Oxford), Knierim, Charlotte (Zürich), Krivelevich, Michael (Tel Aviv), Kronenberg, Gal (Tel Aviv), Kühn, Daniela (Birmingham), Kwan, Matthew A. (Stanford), Letzter, Shoham (Zürich), Linial, Nathan (Jerusalem), Long, Eoin Patrick (Oxford), Lubetzky, Eyal (New York), Martinsson, Anders (Zürich), Molloy, Mike (Toronto), Montgomery, Richard H. (Cambridge), Mousset, Frank (Ramat Aviv, Tel Aviv), Nenadov, Rajko (Zürich), Osthus, Deryk (Birmingham), Panagiotou, Konstantinos (München), Perkins, Will (Chicago), Person, Yury (Ilmenau), Peruvemba Narayanan, Bhargav (Piscataway), Pokrovskiy, Alexey (London), Riordan, Oliver M. (Oxford), Rödl, Vojtech (Atlanta), Sahasrabudhe, Julian (Cambridge), Samotij, Wojciech (Tel Aviv), Saueremann, Lisa (Stanford), Schacht, Mathias (Hamburg), Scott, Alexander (Oxford), Shapira, Asaf (Ramat Aviv, Tel Aviv), Steger, Angelika (Zürich), Sudakov, Benjamin (Zürich), Szabó, Tibor (Berlin), Taraz, Anusch (Hamburg), Tetali, Prasad (Atlanta), Warnke, Lutz P. (Atlanta), Welzl, Emo (Zürich), Zhao, Yufei (Cambridge)





**21.04. - 27.04.2019**

Organizers:

**Mathematical Methods in Quantum Molecular Dynamics**

Tucker Carrington, Kingston

George A. Hagedorn, Blacksburg

Caroline Lasser, Munich

### **Abstract**

The workshop has brought together chemists, mathematicians, and physicists developing new mathematical methods for studying the motion of atoms in molecules and in reacting chemical systems. Thereby, the main focus was on dynamical properties of quantum molecular systems in many dimensions. The development of mathematical methods for quantum molecular systems is an intrinsically interdisciplinary field of research, whose progress can be improved by opening additional channels of communication between the different disciplines. The workshop has contributed to advance the exchange of ideas related to development of new methods as well as the creation of personal links between mathematicians and theorists in chemistry and physics.

### **Participants**

Agostini, Federica (Orsay), Alavi, Ali (Cambridge), Althorpe, Stuart (Cambridge), Batista, Victor S. (New Haven), Bergold, Paul (Garching bei München), Burghardt, Irene (Frankfurt am Main), Carrington, Tucker (Kingston), Ceruti, Gianluca (Tübingen), Fábri, Csaba (Budapest), Fermanian-Kammerer, Clotilde (Créteil), Gamble, Stephanie (Blacksburgh), Goddard, Ben (Edinburgh), Gradinaru, Vasile C. (Zürich), Kapral, Raymond (Toronto), Kelly, Aaron (Halifax), Larsson, Elisabeth (Uppsala), Larsson, Henrik R. (Pasadena), Lasorne, Benjamin (Montpellier), Lasser, Caroline (Garching bei München), Leclerc, Arnaud (Metz), Lubich, Christian (Tübingen), Manthe, Uwe (Bielefeld), Marcelli, Giovanna (Tübingen), Mátyus, Edit (Budapest), Mendive-Tapia, David (Nantes), Meyer, Hans-Dieter (Heidelberg), Miller, William H. (Berkeley), Oseledets, Ivan (Moscow), Peláez-Ruiz, Daniel (Lille), Roy, Pierre-Nicholas (Waterloo), Schneider, Reinhold (Berlin), Schröder, Markus (Heidelberg), Scribano, Yohann (Montpellier), Stamm, Benjamin (Aachen), Teramoto, Hiroshi (Sapporo), Teufel, Stefan (Tübingen), Tissot, Olivier (Mainz), Vanicek, Jiri (Lausanne), Weike, Thomas (Bielefeld), Wodraszka, Robert (Kingston), Worth, Graham (London)





**28.04. - 04.05.2019**

Organizers:

**Tropical Geometry: new directions**

Ilia Itenberg, Paris

Hannah Markwig, Tübingen

Grigory Mikhalkin, Genève

Eugenii Shustin, Tel Aviv

### **Abstract**

The workshop Tropical Geometry: New Directions was devoted to a wide discussion and exchange of ideas between the leading experts representing various points of view on the subject, notably, to new phenomena that have opened themselves in the course of the last 4 years. This includes, in particular, refined enumerative geometry (using positive integer  $q$ -numbers instead of positive integer numbers), unexpected appearance of tropical curves in scaling limits of Abelian sandpile models, as well as a significant progress in more traditional areas of tropical research, such as tropical moduli spaces, tropical homology and tropical correspondence theorems.

### **Participants**

Adiprasito, Karim (Jerusalem), Arnal, Charles (Paris), Aroca, Fuensanta (Cuernavaca), Bertrand, Benoît (Tarbes), Bihan, Frederic (Le Bourget-du-Lac), Björklund, Johan (Gävle), Blechman, Lev (Ramat Aviv, Tel Aviv), Blomme, Thomas (Paris), Bousseau, Pierrick (London), Brugallé, Erwan (Nantes), Cavalieri, Renzo (Fort Collins), Chen, Xujia (Stony Brook), Cueto, Maria Angelica (Columbus), Degtyarev, Alexander (Bilkent), Finashin, Sergey (Ankara), Fock, Vladimir V. (Strasbourg), Gathmann, Andreas (Kaiserslautern), Georgieva, Penka (Paris), Goldner, Christoph (Tübingen), Götttsche, Lothar (Trieste), Gross, Andreas (Fort Collins), Gubler, Walter (Regensburg), Hahn, Marvin A. (Frankfurt am Main), Itenberg, Ilia (Paris), Jaramillo Puentes, Andrés (Nantes), Kalinin, Nikita (St. Petersburg), Kharlamov, Viatcheslav (Strasbourg), Lang, Lionel (Stockholm), Lopez de Medrano Alvarez, Lucia (Cuernavaca Morelos), Maclagan, Diane (Coventry), Markwig, Hannah (Tübingen), Matessi, Diego (Milano), Mikhalkin, Grigory (Genève), Nishinou, Takeo (Tokyo), Orevkov, Stepan Yuri (Toulouse), Rau, Johannes (Tübingen), Raz, Or (Jerusalem), Ren, Yue (Leipzig), Renaudineau, Arthur (Villeneuve d'Ascq), Ruddat, Helge (Mainz), Shaw, Kristin (Oslo), Shkolnikov, Mikhail (Klosterneuburg), Shustin, Eugenii (Ramat Aviv, Tel Aviv), Sportiello, Andrea (Villetaneuse), Temkin, Michael (Jerusalem), Tyomkin, Ilya (Beer-Sheva), Ulirsch, Martin (Frankfurt am Main), Viro, Oleg J. (Stony Brook), Yamamoto, Yuto (Tokyo), Zharkov, Ilia (Manhattan)



**05.05. - 11.05.2019**

**Statistical and Computational Aspects of Learning  
with Complex Structure**

Organizers:

Sara van de Geer, Zürich  
Markus Reiß, Berlin  
Philippe Rigollet, Boston

**Abstract**

The recent explosion of data that is routinely collected has led scientists to contemplate more and more sophisticated structural assumptions. Understanding how to harness and exploit such structure is key to improving the prediction accuracy of various statistical procedures. The ultimate goal of this line of research is to develop a set of tools that leverage underlying complex structures to pool information across observations and ultimately improve statistical accuracy as well as computational efficiency of the deployed methods. The workshop focused on recent developments in regression and matrix estimation under various complex constraints such as physical, computational, privacy, sparsity or robustness. Optimal-transport based techniques for geometric data analysis were also a main topic of the workshop.

**Participants**

Allen, Genevera (Houston), Altmeyer, Randolph (Berlin), Bach, Francis (Paris), Behr, Merle (Berkeley), Besold, Franz (Berlin), Bochkina, Natalia (Edinburgh), Bühlmann, Peter (Zürich), Bunea, Florentina (Ithaca), Butucea, Cristina (Palaiseau), Candès, Emmanuel J. (Stanford), Carpentier, Alexandra (Magdeburg), Čevič, Domagoj (Zürich), Chen, Yuansi (Berkeley), Dalalyan, Arnak (Palaiseau), Dette, Holger (Bochum), Donoho, David L. (Stanford), Duchi, John (Stanford), Foygel Barber, Rina (Chicago), Györfi, Laszlo (Budapest), Klopp, Olga (Cergy-Pontoise), Levina, Elizaveta (Ann Arbor), Loh, Po-Ling (Madison), Loubes, Jean-Michel (Toulouse), Mammen, Enno (Heidelberg), Mémoli, Facundo (Columbus), Moitra, Ankur (Cambridge), Montanari, Andrea (Stanford), Mücke, Nicole (Stuttgart), Mukherjee, Sayan (Durham), Munk, Axel (Göttingen), Nickl, Richard (Cambridge), Nowak, Robert D. (Madison), Ortelli, Francesco (Zürich), Reiß, Markus (Berlin), Rigollet, Philippe (Cambridge), Rinaldo, Alessandro (Pittsburgh), Rohde, Angelika (Freiburg i. Br.), Schmidt-Hieber, Johannes (Enschede), Schnass, Karin (Innsbruck), Spokoiny, Vladimir G. (Berlin), Stankewitz, Bernhard (Berlin), Suvorikova, Alexandra (Potsdam), Tan, Yan Shuo (Berkeley), Trabs, Mathias (Hamburg), Tsybakov, Alexandre B. (Palaiseau), van de Geer, Sara (Zürich), Villar, Soledad (New York), Wahl, Martin (Berlin), Wang, Sven (Cambridge), Weed, Jonathan (Cambridge), Zhu, Ji (Ann Arbor)





**12.05. - 18.05.2019**

Organizers:

**Geometry and Physics of Higgs Bundles**

Lara B. Anderson, Blacksburg  
Tamás Hausel, Klosterneuburg  
Rafe Mazzeo, Stanford  
Laura P. Schaposnik, Chicago

**Abstract**

This workshop focused on interactions between the various perspectives on the moduli space of Higgs bundles over a Riemann surface. This subject draws on algebraic geometry, geometric topology, geometric analysis and mathematical physics, and the goal was to promote interactions between these various branches of the subject. The main current directions of research were well represented by the participants, and the talks included many from both senior and junior participants.

**Participants**

Aghaee, Nezhla (Bern), Alessandrini, Daniele (Heidelberg), Andersen, Jørgen E. (Aarhus), Anderson, Lara B. (Blacksburg), Bielawski, Roger (Hannover), Biswas, Indranil (Mumbai), Bradlow, Steve (Urbana), Daemi, Aliakbar (Stony Brook), Davison, Ben (Edinburgh), Felisetti, Camilla (Genève), Fredrickson, Laura (Stanford), Hamilton, Eloise (Oxford), Hausel, Tamas (Klosterneuburg), Heinloth, Jochen (Essen), Heller, Sebastian (Hamburg), Hitchin, Nigel J. (Oxford), Horn, Johannes (Heidelberg), Katz, Sheldon (Urbana), Katzarkov, Ludmil (Wien), Kaur, Inder (Rio de Janeiro), Li, Qionglin (Tianjin), Logares, Marina (Plymouth, Devon), Maloni, Sara (Charlottesville), Mazzeo, Rafe (Stanford), McIntosh, Ian (Heslington, York), Meneses-Torres, Claudio (Kiel), Mochizuki, Takuro (Kyoto), Mukhopadhyay, Swarnava (Mumbai), Ott, Andreas (Heidelberg), Pantev, Tony (Philadelphia), Pei, Du (Pasadena), Peón-Nieto, Ana (Genève), Rayan, Steven (Saskatoon), Rincón Hidalgo, Alejandra (Berlin), Rubio, Roberto (Bellaterra-Barcelona), Saberi, Ingmar (Heidelberg), Schaposnik M., Laura P. (Chicago), Simpson, Carlos (Nice), Swoboda, Jan (Heidelberg), Tanaka, Yuuji (Oxford), Teschner, Jörg (Hamburg), Weiss, Hartmut (Kiel), Wentworth, Richard A. (College Park), Wilkin, Graeme (Singapore), Wolf, Michael (Houston), Yang, Mengxue (Chicago)



**19.05. - 25.05.2019**

**Nonlinear Hyperbolic Problems: modeling, analysis, and numerics**

Organizers:

Rinaldo M. Colombo, Brescia  
Philippe G. LeFloch, Paris  
Christian Rohde, Stuttgart  
Konstantina Trivisa, College Park

**Abstract**

The workshop gathered together leading international experts, as well as most promising young researchers, working on the modelling, the mathematical analysis, and the numerical methods for nonlinear hyperbolic partial differential equations (PDEs). The meeting focussed on addressing outstanding issues and identifying promising new directions in all three fields, i.e. modelling, analysis, and numerical discretization. Key questions settled around the lack of well-posedness theories for multidimensional systems of conservation laws and the use of hyperbolic modelling beyond the classical topic of gas dynamics. A focal point in numerics has been the discretization of random evolutions and uncertainty quantification. Equally important, new multi-scale methods and schemes for asymptotic regimes have been considered.

**Participants**

Amadori, Debora (L'Aquila), Benzoni-Gavage, Sylvie (Villeurbanne), Bianchini, Stefano (Trieste), Bouchut, Francois (Marne-la-Vallée), Bressan, Alberto (University Park), Cao, Yangyang (Paris), Chalons, Christophe (Versailles), Chertock, Alina (Raleigh), Chiarello, Felisia Angela (Sophia-Antipolis), Colombo, Rinaldo M. (Brescia), Crippa, Gianluca (Basel), Dafermos, Constantine M. (Providence), Daneri, Sara (L'Aquila), Freistühler, Heinrich (Konstanz), Garavello, Mauro (Milano), Gieselmann, Jan (Darmstadt), Goatin, Paola (Sophia-Antipolis), Guerra, Graziano (Milano), Hanke, Andrea (Aachen), Herty, Michael (Aachen), Kim, Eun Heui (Long Beach), Klingenberg, Christian (Würzburg), Kröner, Dietmar (Freiburg i. Br.), Krupa, Sam G. (Austin), Kurganov, Alexander (Shenzhen), LeFloch, Philippe G. (Paris), Li, Yachun (Shanghai), Liu, Tai-Ping (Taipei), Lukáčová-Medvidová, Mária (Mainz), Marcati, Pierangelo (L'Aquila), Marcellini, Francesca (Milano), May, Sandra (Dortmund), Perrollaz, Vincent (Tours), Ridder, Johanna (University Park), Rohde, Christian (Stuttgart), Rossi, Elena (Sophia-Antipolis), Serre, Denis (Lyon), Shen, Wen (University Park), Székelyhidi Jr., László (Leipzig), Tadmor, Eitan (College Park), Torrilhon, Manuel (Aachen), Trivisa, Konstantina (College Park), Tzavaras, Athanasios E. (Thuwal), Warnecke, Gerald (Magdeburg), Weber, Franziska (Pittsburgh), Wiebe, Bettina (Mainz), Wiebe, Maria (Stuttgart)





**26.05. - 01.06.2019**

Organizers:

**Foundations and New Horizons for Causal Inference**

Nicolai Meinshausen, Zürich  
Jonas Peters, Copenhagen  
Thomas Richardson, Seattle  
Bernhard Schölkopf, Tübingen

**Abstract**

While causal inference is established in some disciplines such as econometrics and biostatistics, it is only starting to emerge as a valuable tool in areas such as machine learning and artificial intelligence. The mathematical foundations of causal inference are fragmented at present. The aim of the workshop Foundations and new horizons for causal inference was to unify existing approaches and mathematical foundations as well as exchange ideas between different fields. We regard this workshop as successful in that it brought together researchers from different disciplines who were able to learn from each other not only about different formulations of related problems, but also about solutions and methods that exist in the different fields.

**Participants**

Bareinboim, Elias (West Lafayette), Bauer, Stefan (Tübingen), Blei, David (New York), Bottou, Leon (New York), Bühlmann, Peter (Zürich), Čevid, Domagoj (Zürich), Cooper, Gregory (Pittsburgh), Deistler, Manfred (Wien), Didelez, Vanessa (Bremen), Drton, Mathias (Seattle), Eberhardt, Frederick (Pasadena), Engelke, Sebastian (Genève), Geneletti, Sara (London), Gnecco, Nicola (Genève), Hansen, Niels Richard (København), Heinze-Deml, Christina (Zürich), Hyvarinen, Aapo (London), Jakobsen, Martin Emil (København), Janzing, Dominik (Tübingen), Lauritzen, Steffen (København), Li, Jinzhou (Zürich), Liu, Lin (Cambridge), Lu, Chaochao (Cambridge), Maathuis, Marloes (Zürich), Meinshausen, Nicolai (Zürich), Mohan, Karthika (Berkeley), Mukherjee, Sach (Bonn), Newey, Whitney K. (Cambridge), Perkovic, Emilija (Seattle), Peters, Jonas (København), Pfister, Niklas (Zürich), Plecko, Drago (Zürich), Richardson, Thomas S. (Seattle), Robins, James M. (Boston), Rothenhäusler, Dominik (Zürich), Rotnitzky, Andrea (Boston), Runge, Jakob (Jena), Schmidt, Ludwig (Berkeley), Schölkopf, Bernhard (Tübingen), Sebag, Michele (Gif-sur-Yvette), Shah, Rajen Dinesh (Cambridge), Shpitser, Ilya (Baltimore), Smucler, Ezequiel (Buenos Aires), Sontag, David (Cambridge), Tian, Jin (Ames), Uhler, Caroline (Cambridge), von Kügelgen, Julius (Cambridge), Wang, Linbo (Toronto), Weichwald, Sebastian (Tübingen), Yang, Fan (Stanford), Yu, Bin (Berkeley), Zhang, Kun (Pittsburgh)





**02.06. - 08.06.2019**

**Mixed-integer Nonlinear Optimization: a hatchery for modern mathematics**

Organizers:

Leo Liberti, Palaiseau  
Sebastian Sager, Magdeburg  
Angelika Wiegele, Klagenfurt

**Abstract**

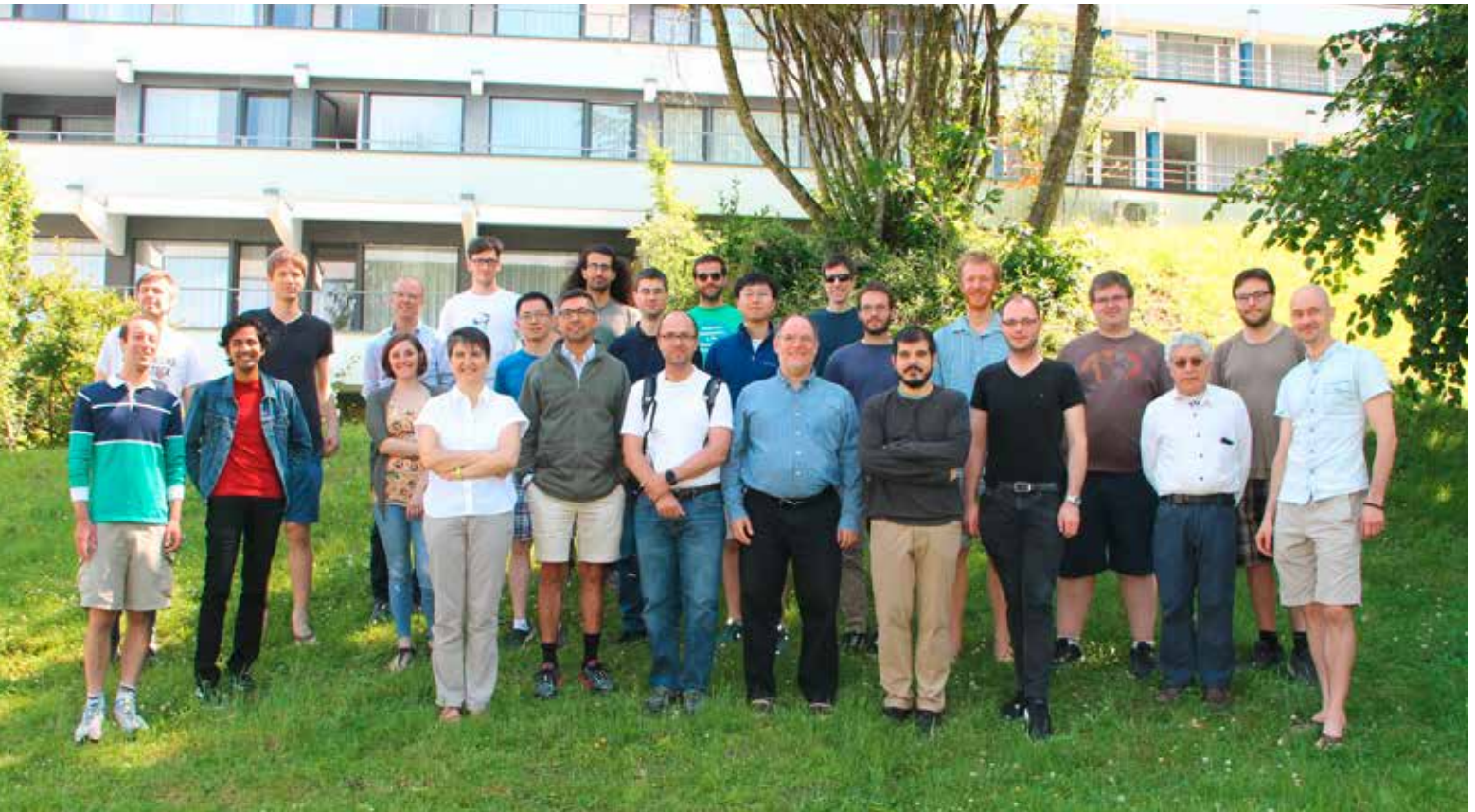
Mixed-Integer Nonlinear Programming (MINLP) refers to one of the hardest Mathematical Programming (MP) problem classes, involving both nonlinear functions as well as continuous and integer decision variables. MP is a formal language for describing optimization problems, and is traditionally part of Operations Research (OR), which is itself at the intersection of mathematics, computer science, engineering and econometrics. The scientific program has covered the three announced areas (hierarchies of approximation, mixed-integer nonlinear optimal control, and dealing with uncertainties) with a variety of tutorials, talks, short research announcements, and a special "open problems" session.

**Participants**

Ahmadi, Amir Ali (Princeton), Anstreicher, Kurt M. (Iowa City), Averkov, Gennadiy (Magdeburg), Belotti, Pietro (Birmingham), Bienstock, Daniel (New York), Buchheim, Christoph (Dortmund), Cerulli, Martina (Palaiseau), D'Ambrosio, Claudia (Palaiseau), de Klerk, Etienne (Tilburg), De Santis, Marianna (Roma), Dür, Mirjam (Augsburg), Fampa, Marcia (Rio de Janeiro), Frangioni, Antonio (Pisa), Fügenschuh, Armin (Cottbus), Gaar, Elisabeth (Klagenfurt), Galli, Laura (Pisa), Gleixner, Ambros (Berlin), Gusmeroli, Nicolò (Klagenfurt), Hahn, Mirko (Magdeburg), Helmberg, Christoph (Chemnitz), Kaibel, Volker (Magdeburg), Khajavirad, Aida (New York), Kirches, Christian (Braunschweig), Laurent, Monique (Amsterdam), Lee, Jon X. (Ann Arbor), Leyffer, Sven (Argonne), Liberti, Leo (Palaiseau), Liers, Frauke (Erlangen), Linderoth, Jeffrey T. (Madison), Lodi, Andrea (Montreal), Manns, Paul (Braunschweig), Martin, Alexander (Erlangen), Merkert, Maximilian (Magdeburg), Misener, Ruth (London), Nannicini, Giacomo (Yorktown Heights), Palagi, Laura (Roma), Piccialli, Veronica (Roma), Potschka, Andreas (Heidelberg), Rendl, Franz (Klagenfurt), Sager, Sebastian (Magdeburg), Sahinidis, Nick (Pittsburgh), Scheiderer, Claus (Konstanz), Schrot, Ihno (Heidelberg), Schultz, Rüdiger (Essen), Schweighofer, Markus (Konstanz), Speakman, Emily (Magdeburg), Tawarmalani, Mohit (West Lafayette), Ulbrich, Stefan (Darmstadt), Vallentin, Frank (Köln), Wiegele, Angelika (Klagenfurt), Zhao, Shudian (Klagenfurt)



## Workshop 1925a



**16.06. - 22.06.2019**

Organizers:

### **Logarithmic Enumerative Geometry and Mirror Symmetry**

Dan Abramovich, Providence

Michel van Garrel, Hamburg

Helge Ruddat, Mainz

### **Abstract**

The new field of log enumerative geometry has formed at the crossroads of mirror symmetry, Gromov-Witten theory and log geometry. This workshop has been the first to promote this field and bring together the junior and senior experts of this quickly evolving topic. Spontaneous exchange, unforeseen mutual benefit as well as having each participant give a presentation allowed for novel progress and insight.

### **Participants**

Abramovich, Dan (Providence), Argüz, Hülya (London), Bae, Younghan (Zürich), Barrott, Lawrence Jack (Taipei), Battistella, Luca (Bonn), Bousseau, Pierrick (London), Carocci, Francesca (Edinburgh), Chen, Qile (Chestnut Hill), Fantechi, Barbara (Trieste), Felten, Simon (Mainz), Gabele, Tim (Hamburg), Graber, Tom (Pasadena), Mandel, Travis (Edinburgh), Molcho, Samouil (Jerusalem), Nabijou, Navid (Glasgow), Ogus, Arthur (Berkeley), Olsson, Martin (Berkeley), Pandharipande, Rahul (Zürich), Parker, Brett Damian (Clayton), Pomerleano, Daniel (Boston), Ranganathan, Dhruv (Cambridge), Ruddat, Helge (Mainz), Talpo, Mattia (Pisa), Ulirsch, Martin (Frankfurt am Main), van Garrel, Michel (Coventry), Wise, Jonathan (Boulder)





**16.06. - 22.06.2019**

**Statistical Methodology and Theory for Functional and Topological Data**

Organizers:

Aurore Delaigle, Parkville  
Alexander Meister, Rostock  
Victor Panaretos, Lausanne  
Larry Wasserman, Pittsburgh

**Abstract**

The workshop focuses on the statistical analysis of complex data which cannot be represented as realizations of finite-dimensional random vectors. An example of such data are functional data. They arise in a variety of climate, biological, medical, physical and engineering problems, where the observations can be represented by curves and surfaces. Fast advances in technology continuously produce a deluge of bigger data with even more complex structures such as arteries in the brain, bones of a human body or social networks. This has sparked enormous interest in more general statistical problems where the random observations are elements of abstract topological spaces. The workshop aimed at stimulating development of new statistical methods for these types of data and was an ideal platform for discussing their theoretical properties (e.g. asymptotic optimality), computational performance, and new exciting applications in areas such as machine learning, image analysis, biometrics and econometrics.

**Participants**

Chen, Ying (Singapore), Cuevas, Antonio (Madrid), Delaigle, Aurore (Parkville), Dette, Holger (Bochum), Dryden, Ian (Nottingham), Fasy, Brittany (Bozeman), Ferraty, Frédéric (Toulouse), Györfi, Laszlo (Budapest), Härdle, Wolfgang K. (Berlin), Huckemann, Stephan (Göttingen), Jirak, Moritz (Braunschweig), Kneip, Alois R. (Bonn), Lila, Eardi (Cambridge), Liu, Regina Y. (Piscataway), Marron, James Stephen (Chapel Hill), Meister, Alexander (Rostock), Müller, Hans-Georg (Davis), Panaretos, Victor M. (Lausanne), Rohde, Angelika (Freiburg i. Br.), Tavakoli, Shahin (Coventry), Turner, Katharine (Acton), Wang, Jane-Ling (Davis), Zemel, Yoav (Göttingen)





**23.06. - 29.06.2019**

Organizers:

**Algebraic K-theory**

Thomas Geisser, Tokyo

Lars Hesselholt, Copenhagen

Annette Huber-Klawitter, Freiburg

Moritz Kerz, Regensburg

**Abstract**

Algebraic K-theory has seen a fruitful development during the last three years. Part of this recent progress was driven by the use of 1-categories and related techniques originally developed in algebraic topology. On the other hand we have seen continuing progress based on motivic homotopy theory which has been an important theme in relation to algebraic K-theory for twenty years.

**Participants**

Asok, Aravind (Los Angeles), Ayoub, Joseph (Zürich), Binda, Federico (Regensburg), Bräunling, Oliver (Freiburg i. Br.), Clausen, Dustin (København), Cortinas, Guillermo (Buenos Aires), Deglise, Frederic (Dijon), Esnault, Hélène (Berlin), Geisser, Thomas H. (Tokyo), Gerhardt, Teena M. (East Lansing), Gupta, Rahul (Freiburg i. Br.), Haesemeyer, Christian (Parkville), Hesselholt, Lars (København), Höning, Eva (Hamburg), Hornbostel, Jens (Wuppertal), Hoyois, Marc (Los Angeles), Huber-Klawitter, Annette (Freiburg i. Br.), Iwasa, Ryomei (København), Jannsen, Uwe (Regensburg), Kahn, Bruno (Paris), Kelly, Shane (Tokyo), Kerz, Moritz (Regensburg), Levine, Marc (Essen), Lichtenbaum, Stephen (Providence), Mathew, Akhil (Chicago), Morin, Baptiste (Toulouse), Morrow, Matthew (Paris), Nikolaus, Thomas (Münster), Niziol, Wiesława (Lyon), Ostvaer, Paul Arne (Oslo), Panin, Ivan A. (St. Petersburg), Ravi, Charanya (Regensburg), Röndigs, Oliver (Osnabrück), Rosenschon, Andreas (München), Rülling, Kay (Berlin), Saito, Shuji (Tokyo), Schlichting, Marco (Coventry), Schmidt, Alexander (Heidelberg), Spitzweck, Markus (Osnabrück), Strunk, Florian (Regensburg), Suzuki, Takashi (Tokyo), Szamuely, Tamas (Pisa), Tabuada, Goncalo (Cambridge), Tamme, Georg (Regensburg), Walker, Mark E. (Lincoln), Wang, Guozhen (Shanghai Shi), Weibel, Charles A. (New Brunswick), Wendt, Matthias (Wuppertal), Wickelgren, Kirsten G. (Atlanta), Yakerson, Maria (Osnabrück), Yamazaki, Takao (Sendai), Zakharevich, Inna (Ithaca)





**30.06. - 05.07.2019**

Organizers:

**Differentialgeometrie im Grossen**

G rard Besson, Grenoble  
Ursula Hamenst dt, Bonn  
Michael Kapovich, Davis  
Ben Weinkove, Evanston

**Abstract**

The topics discussed at the meeting reflected current trends in global differential geometry. These topics included complex geometry, Einstein metrics, geometric flows, metric geometry and manifolds satisfying curvature bounds. The workshop was attended by specialists in differential geometry and its neighboring fields from around the world, ranging from graduate students to scientific leaders in their areas.

**Participants**

Avramidi, Grigori (Bonn), Besson, G rard (Grenoble), Beyrer, Jonas (Heidelberg), B hm, Christoph (M nster), Collier, Brian (College Park), Delcroix, Thibaut (Strasbourg), Di Cerbo, Luca (Gainesville), Di Nezza, Eleonora (Paris), Edwards, Gregory (Notre Dame), Erlandsson, Viveka (Bristol), Fine, Joel (Bruxelles), Galaz-Garcia, Fernando (Karlsruhe), Guedj, Vincent (Toulouse), Haissinsky, Peter (Marseille), Kapovich, Misha (Davis), Kleiner, Bruce (New York), LeBrun, Claude (Stony Brook), Liu, Jiawei (Magdeburg), Lotay, Jason (Oxford), Lytchak, Alexander (K ln), Macbeth, Heather (Cambridge), M der-Baumdicker, Elena (Darmstadt), Malchiodi, Andrea (Pisa), Matthiesen, Henrik (Chicago), Melnick, Karin (Bonn), Mohsen, Jean-Paul (Marseille), Mondello, Gabriele (Roma), Nguyen-Phan, Tu Tam (Bonn), Panov, Dmitri (London), Petrunin, Anton (University Park), Phong, Duong H. (New York), Porti, Joan (Bellaterra), Sch fer, Johannes (Bonn), Schulze, Felix (London), Searle, Catherine (Wichita), Shen, Xi Sisi (Evanston), Smillie, Peter (Pasadena), Spotti, Cristiano (Aarhus), Stadler, Stephan (M nchen), Suvaina, Ioana (Nashville), Szekelyhidi, Gabor (Notre Dame), Topping, Peter M. (Coventry), Wang, Jian (Saint-Martin-d'H res), Weinkove, Ben (Evanston), Wilking, Burkhard (M nster), Zheng, Kai (Shanghai Shi), Zhu, Xuwen (Berkeley)





**07.07. - 13.07.2019**

Organizers:

**Dynamische Systeme**

Marie-Claude Arnaud, Avignon

Hakan Eliasson, Paris

Helmut Hofer, Princeton

Vadim Kaloshin, College Park

**Abstract**

This workshop continued the biannual series at Oberwolfach on Dynamical Systems that started as the "Moser-Zehnder meeting" in 1981. The main themes of the workshop are the new results and developments in the area of dynamical systems, in particular in Hamiltonian systems and symplectic geometry. This year special emphasis where laid on different kinds of spectra (in contact geometry, in Riemannian geometry, in dynamical systems and in symplectic topology).

**Participants**

Abbondandolo, Alberto (Bochum), Albers, Peter (Heidelberg), Arnaud, Marie-Claude (Avignon), Baladi, Viviane (Paris), Balint, Peter (Budapest), Bechara, David (Bochum), Berger, Pierre (Villetaneuse), Bramham, Barney (Bochum), Buhovski, Lev (Ramat Aviv, Tel Aviv), Chaika, Jonathan M. (Salt Lake City), Clarke, Andrew (London), Cristofaro-Gardiner, Daniel (Santa Cruz), Crovisier, Sylvain (Orsay), De Simoi, Jacopo (Toronto), Fish, Joel W. (Boston), Forni, Giovanni (College Park), Frauenfelder, Urs Adrian (Augsburg), Gidea, Marian (New York), Ginzburg, Viktor L. (Santa Cruz), Gouezel, Sebastien (Nantes), Guardia, Marcel (Barcelona, Catalonia), Gurel, Basak Zehra (Orlando), Hofer, Helmut W. (Princeton), Hryniewicz, Umberto (Rio de Janeiro), Hutchings, Michael (Berkeley), Jäger, Tobias (Jena), Kaloshin, Vadim Y. (College Park), Knak, Sonja (Bochum), Knauf, Andreas (Erlangen), Krikorian, Raphael (Paris), Le Calvez, Patrice (Paris), Leguil, Martin (Toronto), Liverani, Carlangelo (Roma), Melbourne, Ian (Coventry), Ojeda Santana, Juan Salvador (Bochum), Pan, Yi (Paris), Pirnaspasov, Abror (Bochum), Polterovich, Leonid V. (Ramat Aviv, Tel Aviv), Saglam, Murat (Bochum), Salomão, Pedro A. S. (São Paulo), Schlenk, Felix (Neuchâtel), Schwarz, Matthias (Leipzig), Seara, Tere (Barcelona, Catalonia), Seyfaddini, Sobhan (Paris), Sorrentino, Alfonso (Roma), Turaev, Dmitry V. (London), van Koert, Otto (Seoul), Viterbo, Claude (Paris), Wei, Qiaoling (Beijing), Young, Lai-Sang (New York), Zehmisch, Kai (Gießen), Zhang, Ke (Toronto)





**14.07. - 20.07.2019**

Organizers:

**Mathematical Theory of Water Waves**

Mark Groves, Saarbrücken  
Mariana Haragus, Besançon  
Erik Wahlén, Lund

**Abstract**

Water waves, that is waves on the surface of a fluid (or the interface between different fluids) are omnipresent phenomena. However, as Feynman wrote in his lecture, water waves that are easily seen by everyone, and which are usually used as an example of waves in elementary courses, are the worst possible example; they have all the complications that waves can have. These complications make mathematical investigations particularly challenging and the physics particularly rich. Indeed, expertise gained in modelling, mathematical analysis and numerical simulation of water waves can be expected to lead to progress in issues of high societal impact (renewable energies in marine environments, vorticity generation and wave breaking, macro-vortices and coastal erosion, ocean shipping and near-shore navigation, tsunamis and hurricane-generated waves, floating airports, ice-sea interactions, ferrofluids in high-technology applications,...). The workshop was mostly devoted to rigorous mathematical theory for the exact hydrodynamic equations; numerical simulations, modelling and experimental issues were included insofar as they had an evident synergy effect.

**Participants**

Ai, Albert (Berkeley), Ambrose, David M. (Philadelphia), Bridges, Thomas J. (Guildford), Brüll, Gabriele (Karlsruhe), Buffoni, Boris (Lausanne), Clamond, Didier (Nice), Ehrnstrom, Mats (Trondheim), Geyer, Anna (Delft), Groves, Mark D. (Saarbrücken), Haragus, Mariana (Besançon), Henry, David (Cork), Hewer, Benedikt (Saarbrücken), Hur, Vera Mikyoung (Urbana), Ifrim, Mihaela (Berkeley), Iguchi, Tatsuo (Yokohama), Milewski, Paul A. (Bath), Nilsson, Dag (Trondheim), Oliveras, Katie (Seattle), Schneider, Guido (Stuttgart), Sun, Shu-Ming (Blacksburg), Tataru, Daniel (Berkeley), Wahlén, Erik (Lund), Walsh, Samuel (Columbia), Wang, Zhan (Beijing), Wheeler, Miles (Wien), Wu, Sijue (Ann Arbor)





**14.07. - 20.07.2019**

Organizers:

**Mathematical Foundations of Isogeometric Analysis**

Annalisa Buffa, Lausanne

Tom Hughes, Austin

Angela Kunoth, Köln

Carla Manni, Roma

**Abstract**

Isogeometric analysis is a recent technology for numerical simulation, unifying computer aided design and finite element analysis. It offers a true design-through-analysis pipeline by employing the same representation models for both creating geometries and approximating the solution of partial differential equations defined on those geometries. This combined concept leads to improved convergence and smoothness properties of the solutions and dramatically faster overall simulations. Even though substantial progress has been made in the isogeometric context over the last few years, there are several profound theoretical issues that are not yet well understood and that are currently investigated by researchers in numerical analysis, approximation theory, and applied geometry. The workshop reported the substantial progress, both from the theoretical and applicative point of view. It offered a meeting point for leading scientists from isogeometric analysis and the mentioned mathematically relevant fields, and provided a rich and open ground of discussion within a diversified audience, profiting of different backgrounds and various perspectives.

**Participants**

Boschert, Sandra (Köln), Bressan, Andrea (Pavia), Buffa, Annalisa (Lausanne), Elber, Gershon (Haifa), Evans, John A. (Boulder), Giannelli, Carlotta (Firenze), Harbrecht, Helmut (Basel), Hughes, Thomas J.R. (Austin), Jüttler, Bert (Linz), Kunoth, Angela (Köln), Kvamsdal, Trond (Trondheim), Langer, Ulrich (Linz), Lyche, Tom (Oslo), Manni, Carla (Roma), Mantzaflaris, Angelos (Sophia-Antipolis), Mourrain, Bernard (Sophia-Antipolis), Peters, Jörg (Gainesville), Puppi, Riccardo (Lausanne), Reali, Alessandro (Pavia), Sande, Espen (Roma), Sangalli, Giancarlo (Pavia), Serra Capizzano, Stefano (Como), Speleers, Hendrik (Roma), Takacs, Thomas (Linz), Toshniwal, Deepesh (Delft), Wei, Xiaodong (Lausanne), Zhang, Yongjie Jessica (Pittsburgh)



## Workshop 1930



**21.07. - 27.07.2019**

Organizers:

### **Partial Differential Equations**

Guido De Philippis, Trieste  
Richard M. Schoen, Irvine  
Peter M. Topping, Warwick

### **Abstract**

The workshop dealt with nonlinear partial differential equations and some applications in geometry, touching several different topics such as geometric flows, minimal surfaces, semi-linear equations and calculus of variations. The meeting was attended by 54 participants with broad geographic representation. The program consisted of 21 talks and left sufficient time for discussions.

### **Participants**

Alberti, Giovanni (Pisa), Bruè, Elia (Pisa), Carlotto, Alessandro (Zürich), Choi, Kyeongsu (Cambridge), Colombo, Maria (Zürich), del Pino, Manuel (Bath), De Philippis, Guido (Trieste), De Rosa, Antonio (New York), Deruelle, Alix (Paris), Feehan, Paul M. N. (Piscataway), Figalli, Alessio (Zürich), Haslhofer, Robert (Toronto), Hershkovits, Or (Stanford), Hirsch, Jonas (Trieste), Hochard, Raphael (Talence), Huisken, Gerhard (Tübingen), Kapouleas, Nicolaos (Providence), Kuwert, Ernst (Freiburg i. Br.), Lamm, Tobias (Karlsruhe), Li, Chao (Princeton), Maggi, Francesco (Austin), Malchiodi, Andrea (Pisa), Mantoulidis, Christos (Cambridge), Matthiesen, Henrik (Chicago), Mingione, Giuseppe R. (Parma), Mooney, Connor (Irvine), Musso, Monica (Bath), Neumayer, Robin (Evanston), Pigati, Alessandro (Zürich), Pratelli, Aldo (Pisa), Rindler, Filip (Coventry), Rivière, Tristan (Zürich), Ros-Oton, Xavier (Zürich), Rupflin, Melanie (Oxford), Scheuer, Julian (New York), Schoen, Richard (Irvine), Schulz, Mario B. (Zürich), Schulze, Felix (London), Serra, Joaquim (Zürich), Sesum, Natasa (Piscataway), Sharp, Ben G. (Leeds), Simon, Miles (Magdeburg), Song, Antoine Y. (Princeton), Spolaor, Luca (Cambridge), Struwe, Michael (Zürich), Sturm, Karl-Theodor (Bonn), Terracini, Susanna (Torino), Tonegawa, Yoshihiro (Tokyo), Topping, Peter M. (Coventry), Valtorta, Daniele (Zürich), Velichkov, Bozhidar (Saint-Martin-d'Hères), White, Brian (Stanford), Wickramasekera, Neshan (Cambridge), Zhou, Xin (Santa Barbara)





**28.07. - 03.08.2019**

Organizers:

**Computational Multiscale Methods**

Björn Engquist, Austin  
Daniel Peterseim, Augsburg

**Abstract**

Many physical processes in material sciences or geophysics are characterized by inherently complex interactions across a large range of nonseparable scales in space and time. The resolution of all features on all scales in a computer simulation easily exceeds today's computing resources by multiple orders of magnitude. The observation and prediction of physical phenomena from multiscale models, hence, requires insightful numerical multiscale techniques to adaptively select relevant scales and effectively represent unresolved scales. This workshop enhanced the development of such methods and the mathematics behind them so that the reliable and efficient numerical simulation of some challenging multiscale problems eventually becomes feasible in high performance computing environments.

**Participants**

Arjmand, Doghony (Lausanne), Bochev, Pavel B. (Albuquerque), Borcea, Liliana (Ann Arbor), Brenner, Susanne C. (Baton Rouge), Carstensen, Carsten (Berlin), Chen, Yanping (Guangzhou), Chung, Eric T. (Shatin, N.T., Hong Kong), D'Elia, Marta (Albuquerque), Donato, Patrizia (Saint-Etienne-du-Rouvray), Efendiev, Yalchin (College Station), Ehrlacher, Virginie (Marne-la-Vallée), Engquist, Björn (Austin), Feischl, Michael (Wien), Fischer, Julian (Klosterneuburg), Frederick, Christina (Newark), Gallistl, Dietmar (Enschede), Gedicke, Joscha (Wien), Georgoulis, Emmanuil H. (Leicester), Gunzburger, Max D. (Tallahassee), Henning, Patrick (Stockholm), Keil, Tim (Münster), Kornhuber, Ralf (Berlin), Lamacz, Agnes (Essen), Lang, Annika (Göteborg), Larson, Mats G. (Umeå), Lochner, Tanja (Augsburg), Lukáčová-Medvidová, Mária (Mainz), Luskin, Mitchell B. (Minneapolis), Maier, Roland (Augsburg), Makridakis, Charalambos (Brighton), Malqvist, Axel (Göteborg), Morgenstern, Philipp (Hannover), Ohlberger, Mario (Münster), Otto, Felix (Leipzig), Owjadi, Houman (Pasadena), Peter, Malte (Augsburg), Peterseim, Daniel (Augsburg), Pouchon, Timothée (Lausanne), Schedensack, Mira (Münster), Scheichl, Robert (Heidelberg), Schweizer, Ben (Dortmund), Smetana, Kathrin (Enschede), Spillane, Nicole (Palaiseau), Sung, Li-yeng (Baton Rouge), Teckentrup, Aretha (Edinburgh), Tsai, Yen-Hsi Richard (Austin), Varga, Mario (Dresden), Verfürth, Barbara (Augsburg), Wohlmuth, Barbara (Garching bei München), Yang, Yunan (New York), Yserentant, Harry (Berlin), Zhang, Lei (Shanghai Shi)





**04.08. - 10.08.2019**

Organizers:

**Homotopy Theory**

Jesper Grodal, Copenhagen

Michael Hill, Los Angeles

Birgit Richter, Hamburg

**Abstract**

The workshop covered a wide variety of topics in homotopy theory, from foundational questions to particular computational techniques, and it explored connections to related fields. Participants from all career stages attended, ranging from advanced graduate students to senior faculty, and the workshop also represented almost all research areas in homotopy theory. The workshop consisted of 23 talks, ranging in length from 30 minutes to an hour.

**Participants**

Bachmann, Tom (Essen), Balmer, Paul (Los Angeles), Barthel, Tobias (København), Barwick, Clark (Edinburgh), Beaudry, Agnès (Boulder), Berglund, Alexander (Stockholm), Bergner, Julie (Charlottesville), Bernard, Calista (Stanford), Bohmann, Anna Marie (Nashville), Böhme, Benjamin (Bonn), Brantner, Lukas B. (Oxford), Castellana Vila, Natàlia (Bellaterra), Cirici, Joana (Barcelona, Catalonia), Clausen, Dustin (København), Dundas, Björn Ian (Bergen), Galatius, Soren (København), Gerhardt, Teena M. (East Lansing), Goerss, Paul G. (Evanston), Greenlees, John (Coventry), Grodal, Jesper (København), Haine, Peter (Cambridge), Hausmann, Markus (København), Heard, Drew K. (Regensburg), Henn, Hans-Werner (Strasbourg), Heuts, Gijs (Utrecht), Hill, Michael (Los Angeles), Höning, Eva (Hamburg), Hoyois, Marc (Los Angeles), Hunt, Joshua (København), Kedziorek, Magdalena (Utrecht), Krause, Achim (Münster), Kuhn, Nicholas J. (Charlottesville), Kupers, Alexander (Cambridge), Land, Markus (Regensburg), Lindenstrauss, Ayelet (Bloomington), May, Clover (Los Angeles), Meier, Lennart (Utrecht), Nariman, Sam (Evanston), Nikolaus, Thomas (Münster), Ormsby, Kyle M. (Portland), Ozornova, Viktoriya (Bochum), Patchkoria, Irakli (Aberdeen), Pstragowski, Piotr (Evanston), Reeh, Sune Precht (Bellaterra), Richter, Birgit (Hamburg), Rognes, John (Oslo), Schlank, Tomer (Jerusalem), Schwede, Stefan (Bonn), Wang, Guozhen (Shanghai Shi), Wickelgren, Kirsten G. (Durham), Yanovski, Lior (Jerusalem), Zeng, Mingcong (Utrecht)





**11.08. - 17.08.2019**

Organizers:

**C\*-Algebras**

Mikael Rørdam, Copenhagen  
Dima Shlyakhtenko, Los Angeles  
Andreas Thom, Dresden  
Stefaan Vaes, Leuven

**Abstract**

The subject of Operator Algebras is a flourishing broad area of mathematics which has strong ties to many other areas in mathematics including Functional/Harmonic Analysis, Topology, (non-commutative) Geometry, Geometric Group Theory, Dynamical Systems, Descriptive Set Theory, Model Theory, Random Matrices and many more. The goal of the Oberwolfach meeting was to give its participants a global view of the subject to maintain and strengthen contacts between researchers from these different directions, making it possible for the most important developments and techniques to be disseminated.

**Participants**

Alekseev, Vadim (Dresden), Borys, Clemens (København), Boutonnet, Rémi (Talence), Brugger, Rahel (Dresden), Charlesworth, Ian Lorne (Berkeley), Courtney, Kristin (Münster), Cuntz, Joachim (Münster), Dadarlat, Marius (West Lafayette), de Laat, Tim (Münster), de la Salle, Mikael (Lyon), Echterhoff, Siegfried (Münster), Elliott, George A. (Toronto), Farah, Ilijas (Toronto), Gabe, James (Wollongong), Geffen, Shirly (Beer-Sheva), Gerasimova, Maria (Dresden), Gillaspay, Elizabeth (Missoula), Hoff, Daniel (Los Angeles), Houdayer, Cyril (Orsay), Ioana, Adrian (La Jolla), Jekel, David (Los Angeles), Kawahigashi, Yasuyuki (Tokyo), Kennedy, Matthew (Waterloo), Kerr, David (College Station), Larsen, Nadia S. (Oslo), Li, Kang (Warszawa), Li, Xin (London), Lin, Huaxin (Eugene), Musat, Magdalena E. (København), Nelson, Brent (East Lansing), Ozawa, Narutaka (Kyoto), Paulsen, Vern I. (Waterloo), Peterson, Jesse D. (Nashville), Pisier, Gilles (College Station), Popa, Sorin (Los Angeles), Putnam, Ian F. (Victoria), Raum, Sven (Stockholm), Rørdam, Mikael (København), Shalit, Orr (Haifa), Shlyakhtenko, Dimitri (Los Angeles), Strung, Karen (Nijmegen), Szabó, Gábor (Leuven), Thiel, Hannes (Münster), Thom, Andreas B. (Dresden), Tikuisis, Aaron (Ottawa), Vaes, Stefaan (Leuven), Valette, Alain (Neuchâtel), Voiculescu, Dan-Virgil (Berkeley), Wasilewski, Mateusz (Leuven), White, Stuart (Glasgow), Willett, Rufus E. (Honolulu), Winter, Wilhelm (Münster), Yamashita, Makoto (Oslo)





**18.08. - 24.08.2019**

Organizers:

**Mathematical Aspects of Hydrodynamics**

Peter Constantin, Princeton

Anna Mazzucato, University Park

Gregory Seregin, Oxford

Edriss S. Titi, Rehovot/College Station

**Abstract**

The workshop dealt with the partial differential equations that describe fluid motion and related topics. These topics included both inviscid and viscous fluids in two and three dimensions. Some talks addressed aspects of fluid dynamics such as the construction of wild weak solutions, compressible shock formation, inviscid limit and behavior of boundary layers, as well as both polymer/fluid and structure/fluid interaction.

**Participants**

Bardos, Claude (Paris), Berselli, Luigi Carlo (Pisa), Brenier, Yann (Paris), Buckmaster, Tristan J. (Princeton), Chae, Dongho (Seoul), Constantin, Peter (Princeton), Cordoba, Diego (Madrid), Coti Zelati, Michele (London), Danchin, Raphael (Créteil), Drivas, Theodore D. (Princeton), Farhat, Aseel (Tallahassee), Farwig, Reinhard (Darmstadt), Feireisl, Eduard (Praha), Flandoli, Franco (Pisa), Gallay, Thierry (Gières), Gancedo, Francisco (Sevilla), Grujic, Zoran O. (Charlottesville), Hieber, Matthias (Darmstadt), Ibdah, Hussain Ali Taha (College Station), Ibrahim, Slim (Victoria), Ignatova, Mihaela (Princeton), Iyer, Gautam (Pittsburgh), Jang, Juhi (Los Angeles), Jia, Hao (Minneapolis), Korobkov, Mikhail (Shanghai), Kukavica, Igor (Los Angeles), Lemarié-Rieusset, Pierre-Gilles (Evry), Liu, Xin (Berlin), Mazzucato, Anna (University Park), Mucha, Piotr B. (Warszawa), Nečasová, Šárka (Praha), Nobili, Camilla (Hamburg), Nussenzveig-Lopes, Helena J. (Rio de Janeiro), Otto, Felix (Leipzig), Seregin, Gregory A. (Oxford), Shilkin, Timofey (St. Petersburg), Shkoller, Steve (Davis), Shnirelman, Alexander (Montreal), So, Seungwook (Princeton), Székelyhidi Jr., László (Leipzig), Titi, Edriss S. (Rehovot), Tsai, Tai-Peng (Vancouver), Vasseur, Alexis F. (Austin), Vicol, Vlad (New York), Wu, Jiahong (Stillwater)





**25.08. - 31.08.2019**

Organizers:

**Geometric, Algebraic, and Topological Combinatorics**

Gil Kalai, Jerusalem

Isabella Novik, Seattle

Francisco Santos, Santander

Volkmar Welker, Marburg

**Abstract**

The 2019 Oberwolfach meeting "Geometric, Algebraic and Topological Combinatorics" was organized by Gil Kalai (Jerusalem), Isabella Novik (Seattle), Francisco Santos (Santander), and Volkmar Welker (Marburg). It covered a wide variety of aspects of Discrete Geometry, Algebraic Combinatorics with geometric flavor, and Topological Combinatorics. Some of the highlights of the conference included (1) Karim Adiprasito presented his very recent proof of the  $g$ -conjecture for spheres (as a talk and as a "Q&A" evening session) (2) Federico Ardila gave an overview on "The geometry of matroids", including his recent extension with Denham and Huh of previous work of Adiprasito, Huh and Katz.

**Participants**

Adiprasito, Karim (Jerusalem), Ardila, Federico (San Francisco), Averkov, Gennadiy (Cottbus), Babson, Eric (Davis), Barcelo, Hélène (Berkeley), Benedetti, Bruno (Coral Gables), Billera, Louis J. (Ithaca), Björner, Anders (Stockholm), Blagojevic, Pavle (Berlin), Codenotti, Giulia (Berlin), Conca, Aldo (Genova), Datta, Basudeb (Bengaluru), De Loera, Jesús A. (Davis), Di Rocco, Sandra (Stockholm), Doolittle, Joseph S. (Berlin), Elias, Benjamin (Eugene), Frick, Florian (Pittsburgh), Goac, Xavier (Vandoeuvre-lès-Nancy), Goodarzi, Afshin (Stockholm), Hersh, Patricia L. (Raleigh), Holmsen, Andreas (Daejeon), Joswig, Michael (Berlin), Juhnke-Kubitzke, Martina (Osnabrück), Kahle, Matthew K. (Columbus), Kalai, Gil (Jerusalem), Kathän, Lukas (Frankfurt am Main), Klee, Steven (Seattle), Lam, Thomas (Ann Arbor), Linial, Nathan (Jerusalem), Liu, Gaku (Leipzig), Maclagan, Diane (Coventry), Mikhalkin, Grigory (Genève), Nevo, Eran (Jerusalem), Nill, Benjamin (Magdeburg), Novik, Isabella (Seattle), Olarte, Jorge Alberto (Berlin), Paták, Pavel (Klosterneuburg), Patáková, Zuzana (Klosterneuburg), Payne, Sam (Austin), Postnikov, Alexander (Cambridge), Proudfoot, Nicholas (Eugene), Rincon, Felipe (London), Samper Casas, Jose Alejandro (Leipzig), Santos, Francisco (Santander), Sanyal, Raman (Frankfurt am Main), Skopenkov, Arkadij B. (Moscow), Swartz, Edward (Ithaca), Tancer, Martin (Praha), Tran, Ngoc Mai (Austin), Venturello, Lorenzo (Leipzig), Wachs, Michelle L. (Coral Gables), Wagner, Uli (Klosterneuburg), Welker, Volkmar (Marburg), Zheng, Hailun (Ann Arbor)





**01.09. - 07.09.2019**

Organizers:

**Innovative Approaches to the Numerical Approximation of PDEs**

Stephan Dahlke, Marburg  
Gitta Kutyniok, Berlin  
Ricardo H. Nochetto, College Park  
Rob Stevenson, Amsterdam

**Abstract**

This workshop was about the numerical solution of PDEs for which classical approaches, such as the finite element method, are not well suited or need further (theoretical) underpinnings. A prominent example of PDEs for which classical methods are not well suited are PDEs posed in high space dimensions. New results on low rank tensor approximation for those problems were presented. Other presentations dealt with regularity of PDEs, the numerical solution of PDEs on surfaces, PDEs of fractional order, numerical solvers for PDEs that converge with exponential rates, and the application of deep neural networks for solving PDEs.

**Participants**

Ali, Mazen (Ulm), Bachmayr, Markus (Mainz), Berner, Julius (Wien), Bertrand, Fleurianne (Berlin), Borthagaray, Juan Pablo (Salto), Brunken, Julia (Münster), Dahlke, Stephan (Marburg), Dahmen, Wolfgang (Columbia), Deckelnick, Klaus (Magdeburg), Dienes, Lars (Bielefeld), Elliott, Charles M. (Coventry), Feischl, Michael (Wien), Glas, Silke (Ithaca), Grasedyck, Lars (Aachen), Harbrecht, Helmut (Basel), Keding, Philipp (Marburg), Kressner, Daniel (Lausanne), Kunoth, Angela (Köln), Kutyniok, Gitta (Berlin), Mehrmann, Volker (Berlin), Melenk, Jens M. (Wien), Nobile, Fabio (Lausanne), Oden, J. Tinsley (Austin), Ohlberger, Mario (Münster), Oseledets, Ivan (Moscow), Oswald, Peter (Bonn), Perugia, Ilaria (Wien), Raasch, Thorsten (Siegen), Reusken, Arnold (Aachen), Salgado, Abner J. (Knoxville), Schmidlin, Marc (Basel), Schneider, Cornelia (Erlangen), Schneider, Reinhold (Berlin), Schratz, Katharina (Karlsruhe), Schwab, Christoph (Zürich), Sieber, Alexander (Marburg), Smears, Iain (London), Stamm, Benjamin (Aachen), Steinbach, Olaf (Graz), Stevenson, Rob P. (Amsterdam), Stinner, Björn (Coventry), Tsogtgerel, Gantumur (Montreal), Vazquez, Rafael (Lausanne), Wagner, Barbara A. (Berlin), Wihler, Thomas P. (Bern), Wohlmuth, Barbara (Garching bei München), Zanotti, Pietro (Milano)





**08.09. - 14.09.2019**

Organizers:

**Many-Body Quantum Systems**

Christian Hainzl, Tübingen

Benjamin Schlein, Zürich

Robert Seiringer, Klosterneuburg

Simone Warzel, München

**Abstract**

The interaction among fundamental particles in nature leads to many interesting effects in quantum statistical mechanics; examples include superconductivity for charged systems and superfluidity in cold gases. It is a huge challenge for mathematical physics to understand the collective behavior of systems containing a large number of particles, emerging from known microscopic interactions. In this workshop we brought together researchers working on different aspects of many-body quantum mechanics to discuss recent developments, exchange ideas and propose new challenges and research directions.

**Participants**

Bahns, Dorothea (Göttingen), Basti, Giulia (Zürich), Benedikter, Niels (Klosterneuburg), Boccato, Chiara (Klosterneuburg), Boßmann, Lea (Tübingen), Brennecke, Christian (Cambridge), Correggi, Michele (Pisa), Derezinski, Jan (Warszawa), de Roeck, Wojciech (Leuven), Deuchert, Andreas (Klosterneuburg), Duell, Maximilian (München), Feliciangeli, Dario (Klosterneuburg), Fraas, Martin (Blacksburg), Giacomelli, Emanuela (Tübingen), Gontier, David (Paris), Griesemer, Marcel (Stuttgart), Hainzl, Christian (Tübingen), He, Yukun (Zürich), Jauslin, Ian (Princeton), Joye, Alain (Saint-Martin-d'Hères), Knörrer, Horst (Zürich), Knowles, Antti (Genève), Lampart, Jonas (Dijon), Langmann, Edwin (Stockholm), Loss, Michael (Atlanta), Lundholm, Douglas (Stockholm), Müller, Peter (München), Nachtergaele, Bruno (Davis), Napiórkowski, Marcin (Warszawa), Ogata, Yoshiko (Tokyo), Panati, Annalisa (La Garde), Phan Thanh, Nam (München), Porta, Marcello (Tübingen), Rademacher, Simone (Zürich), Rejzner, Kasia (Heslington, York), Saffirio, Chiara (Zürich), Salmhofer, Manfred (Heidelberg), Schaub, Marcel (München), Schlein, Benjamin (Zürich), Seiringer, Robert (Klosterneuburg), Sere, Eric (Paris), Sigal, Michael (Toronto), Sohinger, Vedran (Coventry), Sok, Jeremy (Basel), Solovej, Jan Philip (København), Teufel, Stefan (Tübingen), Triay, Arnaud (Paris), Ueltschi, Daniel (Coventry), Von Soosten, Per (Cambridge), Warzel, Simone (Garching bei München), Yngvason, Jakob (Wien), Young, Amanda (Tucson)





**15.09. - 21.09.2019**

Organizers:

**Large Scale Stochastic Dynamics**

Thierry Bodineau, Palaiseau

Fabio Toninelli, Lyon

Bálint Tóth, Bristol/Budapest

**Abstract**

The goal of this workshop was to explore the recent advances in the mathematical understanding of the macroscopic properties which emerge on large space-time scales from interacting microscopic particle systems. There were 55 participants, including postdocs and graduate students, working in diverse intertwining areas of probability and statistical mechanics. During the meeting, 29 talks of 45 minutes were scheduled and an evening session was organised with 10 more short talks of 10 minutes, mostly by younger participants. These talks addressed the following topics: randomness emerging from deterministic dynamics, hydrodynamic limits, interface growth models and slow convergence to equilibrium in kinetically constrained dynamics.

**Participants**

Balázs, Márton (Bristol), Basile, Giada (Roma), Basu, Riddhipratim (Bengaluru), Bauerschmidt, Roland (Cambridge), Bernardin, Cédric (Nice), Blondel, Oriane (Villeurbanne), Bodineau, Thierry (Palaiseau), Bolthausen, Erwin (Zürich), Cannizzaro, Giuseppe (Coventry), Caputo, Pietro (Roma), Carvalho Goncalves, Ana Patrícia (Lisboa), Chhita, Sunil (Durham), Dagallier, Benoit (Palaiseau), Daus, Esther (Wien), Erignoux, Clément (Roma), Faggionato, Alessandra (Roma), Fernandez-Montero, Alejandro (Palaiseau), Ferrari, Patrik L. (Bonn), Funaki, Tadahisa (Tokyo), Gallagher, Isabelle (Paris), Grevin, Dante (Buenos Aires), Hannani, Amirali (Paris), Hartarsky, Ivailo (Paris), Helmuth, Tyler (Bristol), Huvneers, Francois (Paris), Ioffe, Dmitri (Haifa), Klose, Tom (Berlin), Komorowski, Tomasz (Warszawa), Lacoïn, Hubert (Rio de Janeiro), Landim, Claudio (Rio de Janeiro), Laslier, Benoit (Paris), Lefevere, Raphael (Paris), Lerouillois, Vincent (Villeurbanne), Liverani, Carlangelo (Roma), Lukkarinen, Jani (Helsinki), Lutsko, Christopher (Bristol), Marchesani, Stefano (L'Aquila (AQ)), Martinelli, Fabio (Roma), Mukherjee, Chiranjib (Münster), Nota, Alessia (Bonn), Olla, Stefano (Paris), Pulvirenti, Mario (Roma), Ráth, Balázs (Budapest), Sasada, Makiko (Tokyo), Shapira, Assaf (Paris), Simon, Marielle (Villeneuve d'Ascq), Simonella, Sergio (Lyon), Spohn, Herbert (Garching bei München), Stauffer, Alexandre (Roma), Suda, Hayate (Tokyo), Szabó, Réka (Paris), Szasz, Domokos (Budapest), Toninelli, Fabio (Villeurbanne), Toth, Balint (Budapest), Xu, Lu (Paris)





**22.09. - 28.09.2019**

Organizers:

**Toric Geometry**

Jürgen Hausen, Tübingen

Diane Maclagan, Coventry

Hal Schenck, Ames

### Abstract

Toric geometry is a subfield of algebraic geometry with rich interactions with geometric combinatorics, and many other fields of mathematics. A toric variety  $X$  is a partial compactification of an algebraic torus  $T$  with an action of  $T$  on  $X$  extending the action of  $T$  on itself. In the normal case there is a combinatorial dictionary between the algebraic geometric properties of the variety  $X$  and the combinatorics of an associated polyhedral-geometric object, which allows geometric examples and counterexamples to be constructed using geometric combinatorics. Toric varieties also arise as good choices for ambient spaces for interesting varieties (generalizing projective space), and as degenerations of more general varieties. They are now part of the tool kit of most practicing algebraic geometers. For this reason, experts in toric geometry now work in a diverse range of sub-areas of algebraic geometry and related fields. An important function of this workshop was to bring a representative selection of these experts, who would not normally attend the same conferences, together, to exchange ideas, techniques, and problems.

### Participants

Adiprasito, Karim (Jerusalem), Anderson, Dave (Columbus), Arzhantsev, Ivan (Moscow), Batyrev, Victor V. (Tübingen), Berkesch, Christine (Minneapolis), Borisov, Lev A. (Piscataway), Bossinger, Lara (Oaxaca de Juárez), Brion, Michel (Gières), Dickenstein, Alicia (Buenos Aires), Di Rocco, Sandra (Stockholm), Faber, Eleonore (Leeds), Galuppi, Francesco (Leipzig), Grassi, Antonella (Philadelphia), Haase, Christian (Berlin), Harada, Megumi (Hamilton), Hausen, Jürgen (Tübingen), He, Yang-Hui (London), He, Zhuang (Boston), Hering, Milena (Edinburgh), Hische, Christoff (Tübingen), Ilten, Nathan (Burnaby), Jelisiejew, Joachim (Warszawa), Kahle, Thomas (Magdeburg), Kaveh, Kiumars (Pittsburgh), Laface, Antonio (Concepcion), Lamboglia, Sara (Frankfurt am Main), Lanini, Martina (Roma), Lorscheid, Oliver (Rio de Janeiro), Maclagan, Diane (Coventry), Manon, Christopher (Lexington), Michalek, Mateusz (Leipzig), Mohammadi, Fatemeh (Bristol), Monin, Leonid (Bristol), Nill, Benjamin (Magdeburg), Payne, Sam (Austin), Petracci, Andrea (Berlin), Regeta, Andriy (Tübingen), Rietsch, Konstanze (London), Sato, Hiroshi (Fukuoka), Schaller, Karin (Berlin), Schenck, Henry K. (Ames), Smith, Gregory G. (Kingston), Sombra, Martín (Barcelona, Catalonia), Sottile, Frank (College Station), Spenko, Spela (Bruxelles), Stillman, Michael (Ithaca), Süß, Hendrik (Manchester), Teissier, Bernard (Paris), Wang, Weikun (College Park), Wisniewski, Jaroslaw (Warszawa), Wrobel, Milena (Oldenburg)





**29.09. - 05.10.2019**

**New Developments in Representation Theory  
of  $p$ -adic Groups**

Organizers:

Jessica Fintzen, Ann Arbor/Cambridge  
Wee Teck Gan, Singapore  
Shuichiro Takeda, Columbia

**Abstract**

The representation theory of  $p$ -adic groups has played an important role in the Langlands program. It has seen significant progress in the past two decades, including various instances of the local Langlands correspondences, construction of supercuspidal representations and questions on periods and distinction. This workshop explored new ideas and further developments in this subject.

**Participants**

Adler, Jeff (Washington), Adrian, Moshe (Queens), Atobe, Hiraku (Sapporo), Aubert, Anne-Marie (Paris), Bushnell, Colin J. (London), Chan, Charlotte (Cambridge), Ciubotaru, Dan (Oxford), Dat, Jean-Francois (Paris), DeBacker, Stephen (Ann Arbor), Emory, Melissa (Toronto), Fintzen, Jessica (Cambridge), Gan, Wee Teck (Singapore), Gurevich, Nadya (Beer-Sheva), Haley, Jacob (Ann Arbor), Hanzer, Marcela (Zagreb), Hendrickson, Andrew (Singapore), Henniart, Guy (Orsay), Ichino, Atsushi (Kyoto), Imai, Naoki (Tokyo), Karimian pour, Camelia (Toronto), Kim, Ju-Lee (Cambridge), Kurinczuk, Robert (London), Lanard, Thomas (Wien), Lapid, Erez M. (Rehovot), Latham, Peter (London), Li, Wen-Wei (Beijing), Liu, Baiying (West Lafayette), Luo, Caihua (Göteborg), Ma, Jiajun (Shanghai Shi), Matringe, Nadir (Poitiers), Mayeux, Arnaud (Paris), Minguez, Alberto (Wien), Murnaghan, Fiona (Toronto), Nevins, Monica (Ottawa), Oi, Masao (Kyoto), Romano, Beth (Cambridge), Sakellaridis, Yiannis (Baltimore), Savin, Gordan (Salt Lake City), Sécherre, Vincent (Versailles), Solleveld, Maarten (Nijmegen), Stevens, Shaun (Norwich), Suzuki, Miyu (Kyoto), Takeda, Shuichiro (Columbia), Tsai, Cheng-Chiang (Stanford), Vignéras, Marie-France (Paris), Waldspurger, Jean-Loup (Paris), Wan, Chen (Cambridge), Wang, Chuijia (Singapore), Xu, Bin (Beijing)





**27.10. - 02.11.2019**

Organizers:

**Subfactors and Applications**

Dietmar Bisch, Nashville

Terry Gannon, Edmonton

Vaughan Jones, Nashville

Yasuyuki Kawahigashi, Tokyo

**Abstract**

The theory of subfactors connects diverse topics in mathematics and mathematical physics such as tensor categories, vertex operator algebras, quantum groups, quantum topology, free probability, quantum field theory, conformal field theory, statistical mechanics, condensed matter physics and, of course, operator algebras. We invited an international group of researchers from these areas and many fruitful interactions took place during the workshop.

**Participants**

Anantharaman-Delaroche, Claire (Orléans), Arano, Yuki (Kyoto), Bisch, Dietmar H. (Nashville), Bischoff, Marcel (Athens), Brothier, Arnaud (Sydney), Carpi, Sebastiano (Pescara), Del Vecchio, Simone (Leipzig), Galindo, César (Bogotá), Gannon, Terry J. (Edmonton), Ghosh, Shamindra Kumar (Kolkata), Giorgetti, Luca (Roma), Grossman, Pinhas (Sydney), Hartglass, Mike (Santa Clara), Henriques, André G. (Oxford), Huang, Yi-Zhi (Piscataway), Izumi, Masaki (Kyoto), Jaffe, Arthur (Cambridge), Karlsson, Eilind (Karlstad), Kawahigashi, Yasuyuki (Tokyo), Lechner, Gandalf (Cardiff), Liu, Zhengwei (Beijing), McRae, Robert H. (Nashville), Mori, Michiya (Paris), Morrison, Scott (Acton), Nelson, Brent (East Lansing), Neshveyev, Sergey (Oslo), Ogata, Yoshiko (Tokyo), Oikawa, Mizuki (Tokyo), Osborne, Tobias J. (Hannover), Penneys, David (Columbus), Plavnik, Julia (Bloomington), Ren, Yunxiang (Cambridge), Reutter, David (Bonn), Runkel, Ingo (Hamburg), Ruth, Lauren (Nashville), Schopieray, Andrew (Kensington), Schweigert, Christoph (Hamburg), Snyder, Noah (Bloomington), Tanimoto, Yoh (Roma), Tener, James (Acton), Teschner, Jörg (Hamburg), Tomatsu, Reiji (Sapporo), Valvekens, Matthias (Leuven), Wang, Zhenghan (Santa Barbara), Weiner, Mihaly (Budapest), Wenzl, Hans (La Jolla), Woike, Lukas J. (Hamburg), Wolf, Ramona (Hannover), Wood, Simon (Cardiff), Yamashita, Makoto (Oslo), Yamashita, Mayuko (Kyoto), Yang, Yang (Hamburg)

## Workshop 1945



**03.11. - 09.11.2019**

Organizers:

### **Analytic Number Theory**

Jörg Brüdern, Göttingen

Kaisa Matomäki, Turku

Robert C. Vaughan, University Park

Trevor D. Wooley, West Lafayette

### **Abstract**

Analytic number theory is a subject which is central to modern mathematics. There are many important unsolved problems which have stimulated a large amount of activity by many talented researchers. At least two of the Millennium Problems can be considered to be in this area. Moreover in recent years there has been very substantial progress on a number of these questions.

### **Participants**

Bettin, Sandro (Genova), Bhargava, Manjul (Princeton), Biggs, Kirsti (Bristol), Blomer, Valentin (Bonn), Bloom, Thomas Frederick (Cambridge), Bober, Jonathan (Bristol), Brandes, Julia (Göteborg), Browning, Timothy D. (Klosterneuburg), Brüdern, Jörg (Göttingen), Chow, Sam (Coventry), Conrey, Brian (San Jose), de la Bretèche, Régis (Paris), Dietmann, Rainer (Egham), Florea, Alexandra (New York), Fouvry, Etienne (Orsay), Frei, Christopher (Manchester), Friedlander, John B. (Toronto), Gafni, Ayla (University), Ghidelli, Luca (Ottawa), Green, Ben J. (Oxford), Grimmelt, Lasse P. (Utrecht), Hanson, Brandon (Athens), Heath-Brown, Roger (Oxford), Helfgott, Harald A. (Göttingen), Iwaniec, Henryk (Piscataway), Kaczorowski, Jerzy (Poznań), Klurman, Oleksiy (Stockholm), Koukoulopoulos, Dimitris (Montreal), Lamzouri, Youness (Vandoeuvre-lès-Nancy), Liu, Yu-Ru (Waterloo), Matomäki, Kaisa (University of Turku), Maynard, James A. (Oxford), Milinovich, Micah B. (University), Montgomery, Hugh L. (Ann Arbor), Myerson, Simon (Göttingen), Pathak, Siddhi (University Park), Peluse, Sarah (Oxford), Perelli, Alberto (Genova), Pierce, Lillian Beatrix (Durham), Pollack, Paul (Athens), Radziwiłł, Maksym (Pasadena), Rodgers, Brad (Kingston), Salberger, Per (Göteborg), Sawin, Will (New York), Schindler, Damaris (Utrecht), Shakan, George (Oxford), Soundararajan, Kannan (Stanford), Teräväinen, Joni P. (Oxford), Thompson, Lola (Oberlin), Turnage-Butterbaugh, Caroline (Northfield), Vaughan, Robert C. (University Park), Wooley, Trevor D. (West Lafayette), Zhao, Lilu (Shandong)





**17.11. - 23.11.2019**

**Heat Kernels, Stochastic Processes and Functional Inequalities**

Organizers:

Masha Gordina, Storrs  
Takashi Kumagai, Kyoto  
Laurent Saloff-Coste, Ithaca  
Karl-Theodor Sturm, Bonn

**Abstract**

The aims of the 2019 workshop Heat Kernels, Stochastic Processes and Functional Inequalities were: (a) to provide a forum to review recent progresses in a wide array of areas of analysis (elliptic, subelliptic and parabolic differential equations, transport, functional inequalities), geometry (Riemannian and sub-Riemannian geometries, metric measure spaces, geometric analysis and curvature), and probability (Brownian motion, Dirichlet spaces, stochastic calculus and random media) that have natural common interests, and (b) to foster, encourage and develop further interactions and cross-fertilization between these different directions of research.

**Participants**

Alonso Ruiz, Patricia (College Station), Andres, Sebastian (Cambridge), Baudoin, Fabrice (Storrs), Berger, Noam (Garching bei München), Biskup, Marek (Los Angeles), Bosnic, Filip (Bielefeld), Brue, Elia (Pisa), Chen, Li (Storrs), Chen, Zhen-Qing (Seattle), Cipriani, Fabio (Milano), Croydon, David (Kyoto), Dello Schiavo, Lorenzo (Bonn), Deuschel, Jean Dominique (Berlin), Eldredge, Nathaniel (Greeley), Erbar, Matthias (Bonn), Faggionato, Alessandra (Roma), Gantert, Nina (Garching bei München), Gordina, Masha (Storrs), Gwynne, Ewain (Cambridge), Habermann, Karen (Paris), Haslhofer, Robert (Toronto), Herry, Ronan (Bonn), Hornshaw, David (Bonn), Kajino, Naotaka (Kobe), Kaßmann, Moritz (Bielefeld), Kigami, Jun (Kyoto), Kopfer, Eva (Bonn), Kumagai, Takashi (Kyoto), Le Gall, Jean-Francois (Orsay), Maas, Jan (Klosterneuburg), Mathieu, Pierre (Marseille), Melcher, Tai (Charlottesville), Miermont, Grégory (Lyon), Milman, Emanuel (Haifa), Murugan, Mathav (Vancouver), Norris, James R. (Cambridge), Rigoni, Chiara (Bonn), Rothhardt, Annika (Berlin), Saloff-Coste, Laurent (Ithaca), Shiraishi, Daisuke (Kyoto), Sikora, Adam B. (NSW), Slowik, Martin (Berlin), Smart, Charles K. (Chicago), Sokol, Anna-Lisa (Berlin), Sturm, Karl-Theodor (Bonn), Suzuki, Kohei (Pisa), Thalmaier, Anton (Esch-sur-Alzette), Wang, Jian (Fuzhou), Weidner, Marvin (Bielefeld), Winter, Anita (Essen)





**01.12. - 07.12.2019**

Organizers:

**Groups, Dynamics, and Approximation**

Emmanuel Breuillard, Cambridge

Alex Furman, Chicago

Nicolas Monod, Lausanne

Andreas Thom, Dresden

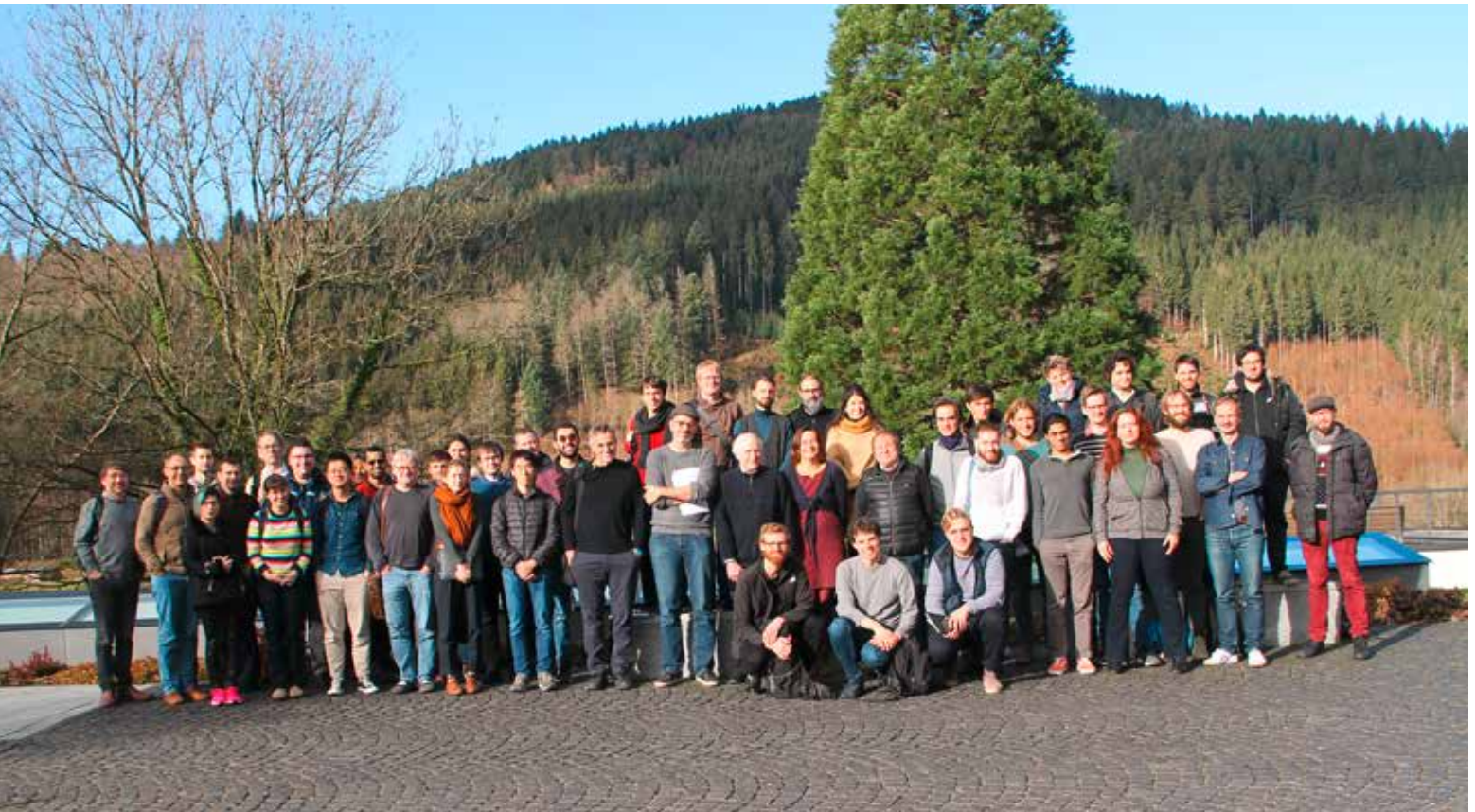
**Abstract**

The workshop brought together leading mathematicians working at the interface between geometric group theory, ergodic theory and operator algebras. Meant as a continuation of the workshops Group Theory, Measure, and Asymptotic Invariants (2013) and Measured Group Theory (2016) this "transversal workshop" covered a wide range of topics, this time putting more emphasis on Geometric Group Theory, Ergodic Theory and links with Functional Analysis on the one hand and Mathematical Logic on the other. The topics of the talks included: sofic groups and approximation properties of infinite groups, word maps on finite or compact groups, lattices and approximate lattices in Lie groups, Benjamini-Schramm convergence, invariant random subgroups and orbit equivalence, ergodic theory of group actions, von Neumann algebras and measure equivalence, representation theory of in finite groups.

**Participants**

Abert, Miklos (Budapest), Arzhantseva, Goulmara N. (Wien), Avni, Nir (Evanston), Becker, Oren (Cambridge), Björklund, Michael (Göteborg), Boutonnet, Rémi (Talence), Breuillard, Emmanuel (Cambridge), Caprace, Pierre-Emmanuel (Louvain-la-Neuve), Carderi, Alessandro (Karlsruhe), de Cornulier, Yves (Villeurbanne), de la Salle, Mikael (Lyon), Eberhard, Sean (Cambridge), Erschler, Anna G. (Paris), Fish, Alexander (Sydney), Fujiwara, Koji (Kyoto), Gaboriau, Damien (Lyon), Gerasimova, Maria (Ramat-Gan), Glasner, Eli (Ramat Aviv, Tel Aviv), Glebsky, Lev (San Luis Potosí), Hartnick, Tobias (Karlsruhe), Hochman, Michael (Jerusalem), Hutchcroft, Thomas (Cambridge), Kassabov, Martin (Ithaca), Kun, Gabor (Budapest), Le Boudec, Adrien (Lyon), Li, Hanfeng (Buffalo), Löh, Clara (Regensburg), Lubotzky, Alex (Jerusalem), Machado, Simon (Cambridge), Mann, Kathryn P. (Ithaca), Matte Bon, Nicolás (Zürich), Melleray, Julien (Villeurbanne), Monod, Nicolas (Lausanne), Mozes, Shahar (Jerusalem), Nekrashevych, Volodymyr V. (College Station), Ozawa, Narutaka (Kyoto), Peterson, Jesse D. (Nashville), Popa, Sorin (Los Angeles), Puder, Doron (Ramat Aviv, Tel Aviv), Quint, Jean-Francois (Talence), Rangarajan, Bharatram (Jerusalem), Rosendal, Christian (Alexandria), Sauer, Roman (Karlsruhe), Schick, Thomas (Göttingen), Schneider, Jakob (Dresden), Shusterman, Mark (Madison), Tent, Katrin (Münster), Tessera, Romain A. (Paris), Thom, Andreas B. (Dresden), Tsankov, Todor (Villeurbanne)





**08.12. - 14.12.2019**

Organizers:

**Random Matrices**

László Erdős, Klosterneuburg

Friedrich Götze, Bielefeld

Alice Guionnet, Lyon

**Abstract**

This workshop brought together outstanding researchers from a variety of mathematical backgrounds whose areas of research are linked to random matrices. While there are strong links between their motivations, the techniques used by these researchers span a large swath of mathematics, ranging from purely algebraic techniques to stochastic analysis, classical probability theory, operator algebra, supersymmetry, orthogonal polynomials, etc.

**Participants**

Aggarwal, Amol (Cambridge), Akemann, Gernot (Bielefeld), Alt, Johannes (Genève), Anantharaman, Nalini (Strasbourg), Augeri, Fanny (Rehovot), Bailey, Emma (Bristol), Banna, Marwa (Saarbrücken), Bao, Zhigang (Kowloon), Bauerschmidt, Roland (Cambridge), Benigni, Lucas (Chicago), Bufetov, Alexey (Bonn), Capitaine, Mireille (Toulouse), Chafai, Djalil (Paris), Cipolloni, Giorgio (Klosterneuburg), Cook, Nicholas (Stanford), Disertori, Margherita (Bonn), Dörnemann, Nina (Bochum), Ducatez, Raphael (Genève), Dumitriu, Ioana (San Diego), Erdős, Laszlo (Klosterneuburg), Fyodorov, Yan V. (London), Götze, Friedrich (Bielefeld), Guionnet, Alice (Lyon), He, Yukun (Zürich), Husson, Jonathan (Lyon), Jalowy, Jonas (Bielefeld), Knowles, Antti (Genève), Kösters, Holger (Rostock), Krüger, Torben (Bonn), Lodhia, Asad (Ann Arbor), Mai, Tobias (Saarbrücken), Najim, Jamal (Marne-la-Vallée), Najnudel, Joseph (Bristol), Naumov, Alexey (Moscow), Nemish, Yuriy (La Jolla), Neuschel, Thorsten (Bielefeld), Parraud, Félix (Lyon), Renfrew, David (Binghamton), Rider, Brian (Philadelphia), Schnell, Kevin (Stockholm), Schröder, Dominik (Zürich), Shamis, Mira (London), Shcherbina, Tatyana (Princeton), Speicher, Roland (Saarbrücken), Tikhomirov, Alexander (Syktyvkar), Venker, Martin (Bielefeld), Virag, Balint (Toronto), Vogel, Martin (Strasbourg), Youssef, Pierre (Paris), Zeitouni, Ofer (Rehovot)





**15.12. - 21.12.2019**

Organizers:

**Modular Forms**

Jan Hendrik Bruinier, Darmstadt

Atsushi Ichino, Kyoto

Tamotsu Ikeda, Kyoto

Özlem Imamoglu, Zürich

**Abstract**

The theory of Modular Forms has been central in mathematics with a rich history and connections to many other areas of mathematics. The workshop explored recent developments and future directions with a particular focus on connections to the theory of periods. It consisted of 14 one-hour long lectures and 8 half-hour long lectures. Beyond the talks, the participants enjoyed ample time for discussions and collaborative research activities.

**Participants**

Alfes-Neumann, Claudia (Paderborn), Andreatta, Fabrizio (Milano), Atobe, Hiraku (Sapporo), Bengoechea, Paloma (Zürich), Beuzart-Plessis, Raphaël (Marseille), Blomer, Valentin (Bonn), Böcherer, Siegfried (Mannheim), Bringmann, Kathrin (Köln), Bruinier, Jan Hendrik (Darmstadt), Cai, Yuanqing (Kyoto), Chen, Shih-Yu (Taipei), Chenevier, Gaëtan (Orsay), Cho, Sungmun (Korea), Choie, Young Ju (Pohang City), Darmon, Henri René (Montreal), Ehlen, Stephan (Köln), Funke, Jens (Durham), Furusawa, Masaaki (Osaka), Gan, Wee Teck (Singapore), Hiraga, Kaoru (Kyoto), Hironaka, Yumiko (Tokyo), Ibukiyama, Tomoyoshi (Osaka), Ichino, Atsushi (Kyoto), Ikeda, Tamotsu (Kyoto), Imamoglu, Özlem (Zürich), Katsurada, Hidenori (Muroran), Kiefer, Paul (Darmstadt), Kohnen, Winfried (Heidelberg), Kramer, Jürg (Berlin), Kudla, Stephen S. (Toronto), Lägeler, Alessandro (Zürich), Li, Chao (New York), Li, Yingkun (Darmstadt), Morimoto, Kazuki (Kobe), Nelson, Paul (Zürich), Neururer, Michalis (Darmstadt), Ochiai, Tādashi (Osaka), Pollack, Aaron (Durham), Prasanna, Kartik (Ann Arbor), Purkait, Soma (Tokyo), Raum, Martin (Göteborg), Rotger, Victor (Barcelona, Catalonia), Sankaran, Siddarth (Winnipeg), Schwagenscheidt, Markus (Köln), Su, Ren-He (Chengdu, Sichuan), Toth, Arpad (Budapest), van der Geer, Gerard (Amsterdam), von Pippich, Anna (Darmstadt), Wachter, Seraina R. (Zürich), Wakatsuki, Satoshi (Kanazawa), Wan, Xiaolei (Singapore), Yamana, Shunsuke (Osaka), Yamauchi, Takuya (Sendai), Yang, Tonghai (Madison), Zagier, Don B. (Bonn)



## 2.4. Miniworkshops

### Miniworkshop 1910a



**03.03. - 09.03.2019**

### **Mathematical Aspects of Nonlinear Wave Propagation in Solid Mechanics**

Organizers:

Giuseppe Saccomandi, Perugia  
Yasemin Sengül, Istanbul  
Luigi Vergori, Perugia

#### **Abstract**

Nonlinear elastodynamics sets a plethora of challenging mathematical problems such as those concerning wave propagation in solids. Elastic vibrations and acoustic waves have been widely studied because of their applications in nondestructive tests of materials and structures, and, in recent times, several novel aspects of the theory of wave propagation in solids have blossomed thanks to the introduction of metamaterials and new technological devices. The goal of this workshop was to bring together researchers with different backgrounds to discuss recent advances, and to stimulate future work.

#### **Participants**

Balbi, Valentina (Galway), Buliček, Miroslav (Praha), Ciambella, Jacopo (Roma), Destrade, Michel (Galway), Erbay, Hüsnü A. (Cekmeköy 34794 / Istanbul), Fu, Yibin (Keele, Newcastle, Staffs), Grunert, Katrin (Trondheim), Krushynska, Anastasiia (Wageningen), Nobili, Andrea (Modena), Peshkov, Ilya M. (Toulouse), Pinton, Gianmarco (Chapel Hill), Saccomandi, Giuseppe (Perugia), Sengül Tezel, Yasemin (Tuzla/Istanbul), Tzavaras, Athanasios E. (Thuwal), Vergori, Luigi (Perugia)





**03.03. - 09.03.2019**

Organizers:

**Lorentz Gas Dynamics: particle systems and scaling limits**

Alessia Nota, Bonn

Chiara Saffirio, Zürich

Juan Velázquez, Bonn

### **Abstract**

This workshop had the aim to bring together leading experts from different fields, i.e. interacting particle systems, dynamical systems and kinetic theory, to consider questions related to the dynamics of the Lorentz gas and to promote the exchange of information concerning the techniques that have been developed in different contexts and communities.

### **Participants**

Ayi, Nathalie (Paris), Basile, Giada (Roma), Basti, Giulia (Zürich), Carlen, Eric A. (Piscataway), Carvalho, Maria C. (Piscataway), Desvillettes, Laurent (Paris), Golse, Francois (Palaiseau), Griffin, Jory (Kingston), Gubinelli, Massimiliano (Bonn), Leopold, Nikolai (Klosterneuburg), Lutsko, Christopher (Bristol), Nota, Alessia (Bonn), Pulvirenti, Mario (Roma), Saffirio, Chiara (Zürich), Simonella, Sergio (Lyon), Velazquez, Juan J. L. (Bonn), Wennberg, Bernt (Göteborg), Winter, Raphael (Bonn)





**03.03. - 09.03.2019**

Organizers:

**Cohomology of Hopf Algebras and Tensor Categories**

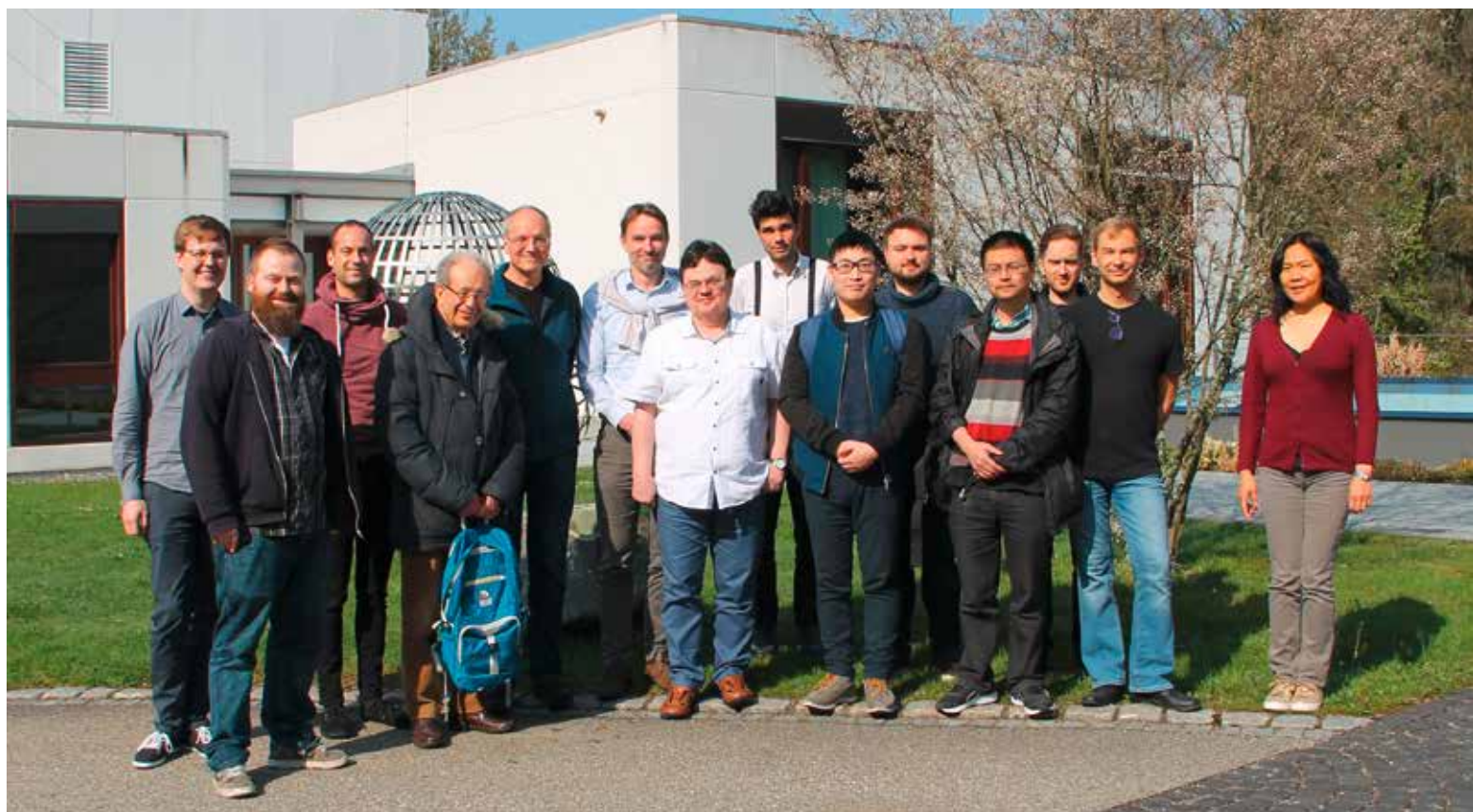
Henning Krause, Bielefeld  
Sarah Witherspoon, College Station  
James Zhang, Seattle

**Abstract**

The mini-workshop featured some open questions about the cohomology of Hopf algebras and tensor categories. Questions included whether the cohomology ring of a finite dimensional Hopf algebra or a finite tensor category is finitely generated, questions about corresponding geometric methods in representation theory, and questions about noetherian Hopf algebras. The workshop brought together mathematicians currently working on these and other open problems.

**Participants**

Andruskiewitsch, Nicolás (Córdoba), Benson, David J. (Aberdeen), Bergh, Petter A. (Trondheim), Brown, Ken A. (Glasgow), Drupieski, Christopher (Chicago), Erdmann, Karin (Oxford), Herscovich, Estanislao (Gières), Krause, Henning (Bielefeld), Negron, Cris (Cambridge), Nguyen, Van C. (Frederick), Pevtsova, Julia (Seattle), Rognerud, Baptiste (Bielefeld), Solberg, Oeyvind (Trondheim), Touzé, Antoine (Villeneuve d'Ascq), Wang, Xingting (Washington), Witherspoon, Sarah (College Station), Zhang, James (Seattle)



**07.04. - 13.04.2019**

**Recent Progress in Path Integration on Graphs and Manifolds**

Organizers:

Batu Güneysu, Berlin  
Matthias Keller, Potsdam  
Kazumasa Kuwada, Sendai  
Anton Thalmaier, Luxembourg

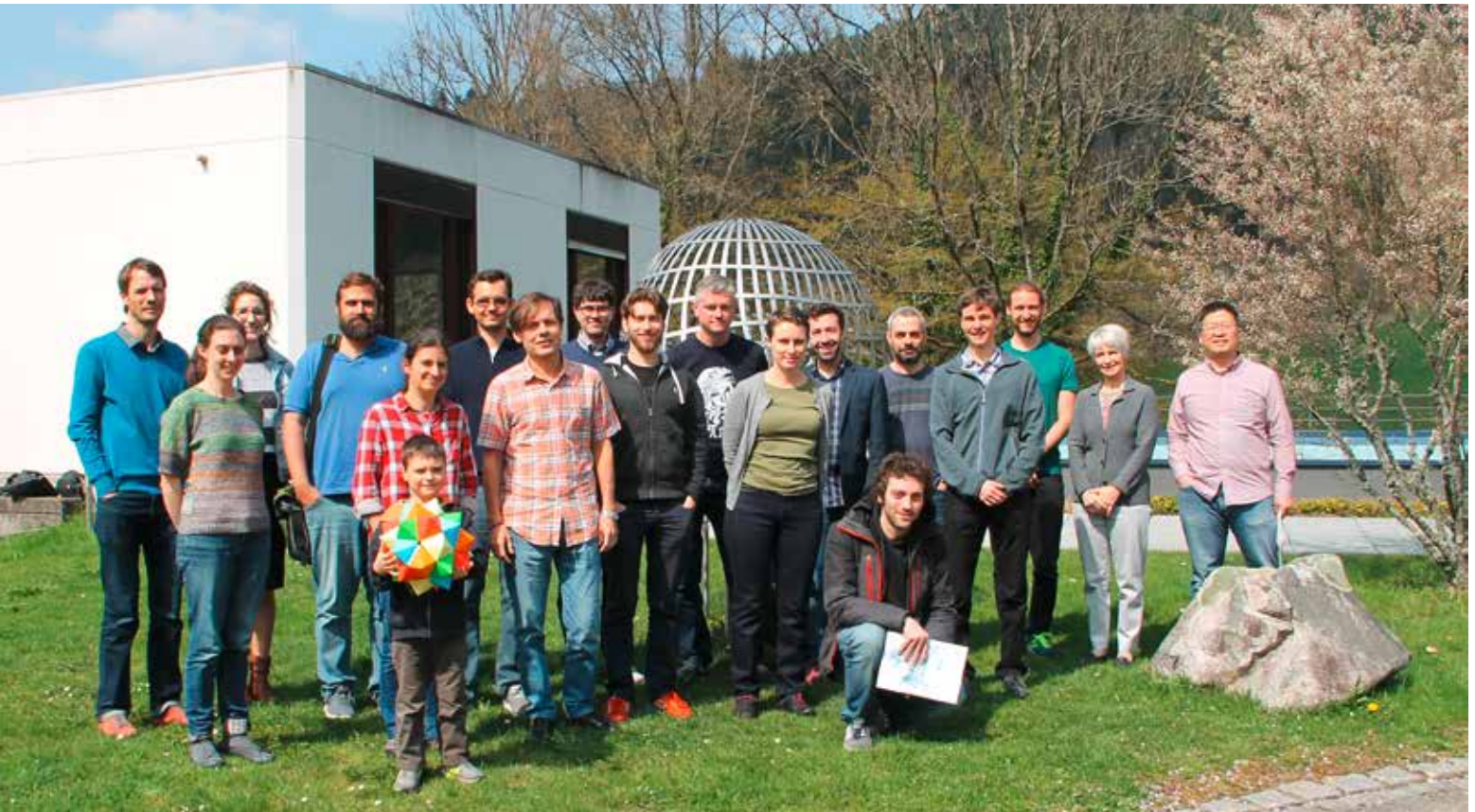
**Abstract**

Ever since Richard Feynman's PhD thesis, path integrals have played a decisive role in mathematical physics. While it is well-known that such formulae can hold only formally, it was Mark Kac who realized that by replacing the unitary group by the heat semigroup, one obtains well-defined and rigorous formulae. Following this pioneering work, Feynman-Kac path integral formulae have been adapted to several situations and generalized into several directions providing the central focus of this workshop.

**Participants**

Bär, Christian (Potsdam), Baumgarth, Robert (Esch-sur-Alzette), Bismut, Jean-Michel (Orsay), Güneysu, Batu (Bonn), Keller, Matthias (Potsdam), Li, Xue-Mei (London), Liu, Bingxiao (Bonn), Ludwig, Matthias (Adelaide), Schilling, René (Dresden), Schmidt, Marcel (Jena), Shen, Shu (Paris), Thalmaier, Anton (Belvaux), Thompson, James (Esch-sur-Alzette), von Renesse, Max (Leipzig)





**07.04. - 13.04.2019**

Organizers:

**Reflection Groups in Negative Curvature**

Mikhail Belolipetsky, Rio de Janeiro

Vincent Emery, Bern

Ruth Kellerhals, Fribourg

**Abstract**

Discrete groups generated by reflections constitute an important source of examples of lattices in simple Lie groups of real rank 1 (whose associated symmetric spaces are negatively curved). Yet a classification for them is far from being achieved, even in the case of hyperbolic geometry. The goal of this mini-workshop was to stimulate the research by bringing together specialists of different aspects of the theory.

**Participants**

Bär, Ruben (Bern), Belolipetsky, Mikhail (Rio de Janeiro), Deraux, Martin (Gières), Dotti, Edoardo (Fribourg), Emery, Vincent (Bern), Everitt, Brent (Heslington, York), Felikson, Anna (Durham), Haensch, Anna (Pittsburgh), Kellerhals, Ruth (Fribourg), Kolpakov, Alexander (Neuchâtel), Komori, Yohei (Tokyo), Linowitz, Benjamin (Oberlin), Mark, Alice (Piscataway), Meyer, Jeffrey S. (San Bernadino), Slavich, Leone (Pisa), Stover, Matthew (Philadelphia), Thomas, Anne (Sydney), Tumarkin, Pavel (Durham)





**07.04. - 13.04.2019**

Organizers:

**Mathematics of Crystallisation**

Stefan Adams, Warwick

Michael Baake, Bielefeld

Markus Heydenreich, München

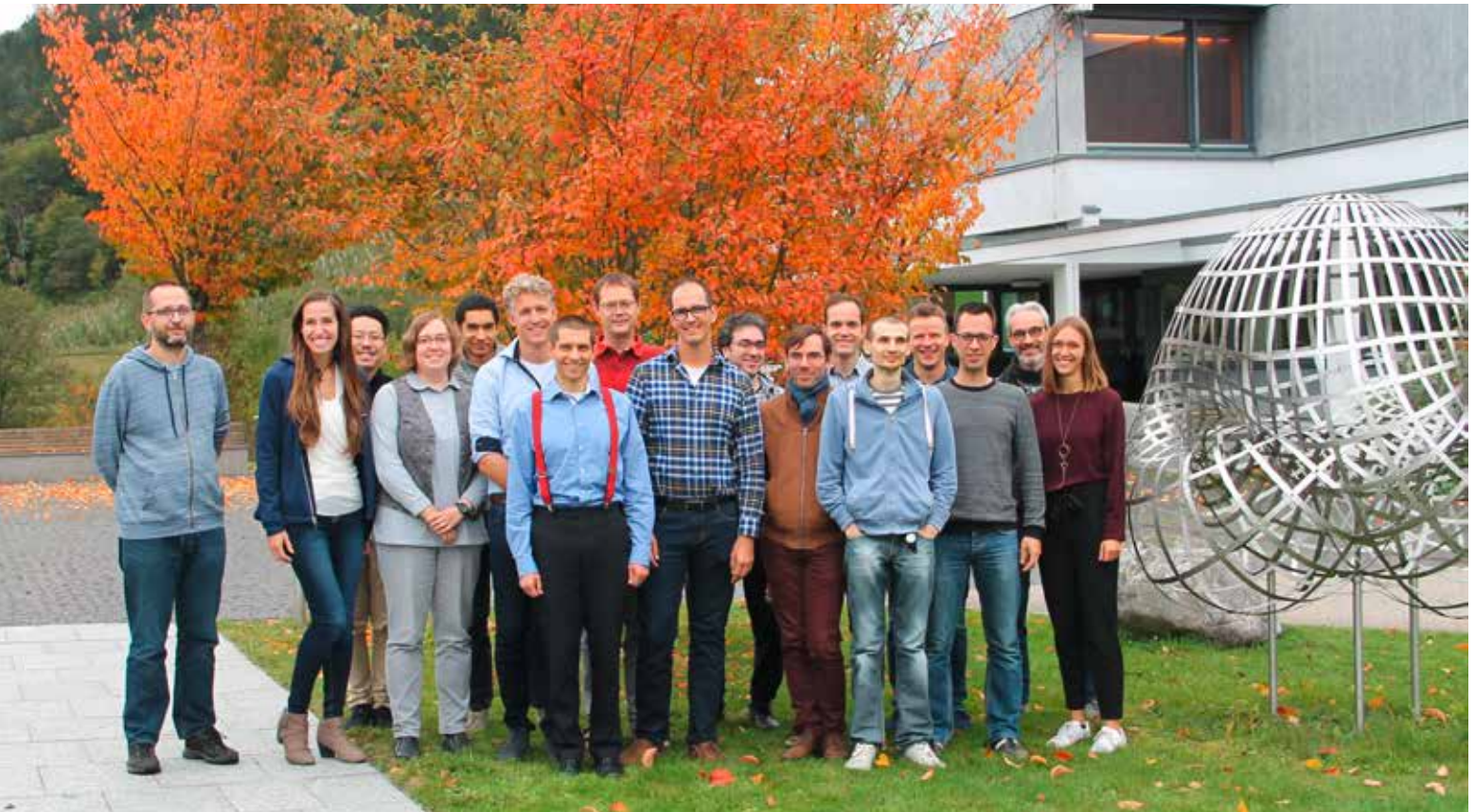
**Abstract**

Crystallisation, by which we mean the formation of solids precipitating from a solution, is the central theme of the present mini-workshop. Participants discussed different approaches towards a rigorous mathematical understanding of crystallisation as well as detecting, modelling and establishing properties of crystalline and quasicrystalline structures.

**Participants**

Adams, Stefan (Coventry), Baake, Michael (Bielefeld), Bétermin, Laurent (København), Conache, Diana (Garching bei München), Gähler, Franz (Bielefeld), Giuliani, Alessandro (Roma), Grimm, Uwe (Milton Keynes), Heydenreich, Markus (München), Jansen, Sabine (München), Kösters, Holger (Rostock), Magazinov, Alexander (Moscow), Merkl, Franz (München), Pulvirenti, Elena (Bonn), Rucklidge, Alastair (Leeds), Scardia, Lucia (Edinburgh), Schmidt, Bernd (Augsburg), Theil, Florian (Coventry)





**06.10. - 12.10.2019**

Organizers:

**Operator Algebraic Quantum Groups**

Michael Brannan, College Station

Martijn Caspers, Delft

Moritz Weber, Saarbrücken

Anna Wysoczanska-Kula, Wroclaw

**Abstract**

This mini-workshop brought together a rich and varied cross-section of young and active researchers working on operator algebraic aspects of quantum group theory. The primary goals of this meeting were to highlight the state-of-the-art results on the subject and to trigger new research by advertising some of the main open directions in operator algebraic quantum group theory: classification problems for  $C^*$ - and von Neumann algebras, relations to free/non-commutative probability, applications in quantum information theory, and the creation of new quantum groups and potential classification results for subclasses of quantum groups.

**Participants**

Arano, Yuki (Kyoto), Baraquin, Isabelle (Besançon), Brannan, Michael (College Station), Caspers, Martijn (Delft), Chirvasitu, Alexandru (Buffalo), Eifler, Kari (College Station), Franz, Uwe (Besançon), Freslon, Amaury (Orsay), Kalantar, Mehrdad (Houston), Maassen, Laura (Aachen), Raum, Sven (Stockholm), Skalski, Adam (Warszawa), Sołtan, Piotr (Warszawa), Tarrago, Pierre (Paris), Vergnioux, Roland (Berlin), Voigt, Christian (Glasgow), Weber, Moritz (Saarbrücken)



**06.10. - 12.10.2019**

Organizers:

**Degeneration Techniques in Representation Theory**

Evgeny Feigin, Moscow  
Ghislain Fourier, Aachen  
Martina Lanini, Rome

**Abstract**

Modern Representation Theory has numerous applications in many mathematical areas such as algebraic geometry, combinatorics, convex geometry, mathematical physics, probability. Many of the object and problems of interest show up in a family. Degeneration techniques allow to study the properties of the whole family instead of concentrating on a single member. This idea has many incarnations in modern mathematics, including Newton-Okounkov bodies, tropical geometry, PBW degenerations, Hessenberg varieties. During the mini-workshop Degeneration Techniques in Representation Theory various sides of the existing applications of the degenerations techniques were discussed and several new possible directions were reported.

**Participants**

Bossinger, Lara (Oaxaca de Juárez), Dumanski, Ilya (Moscow), Fang, Xin (Köln), Feigin, Evgeny (Moscow), Flake, Johannes (Aachen), Fourier, Ghislain (Aachen), Fujita, Naoki (Tokyo), Kato, Syu (Kyoto), Kiritchenko, Valentina (Moscow), Lanini, Martina (Roma), Littelmann, Peter (Köln), Makhlin, Igor (Moscow), Manon, Christopher (Lexington), Precup, Martha (St. Louis), Rajchgot, Jenna (Saskatoon), Reineke, Markus (Bochum), Tymoczko, Julianna (Northampton)





**06.10. - 12.10.2019**

Organizers:

**Self-adjoint Extensions in New Settings**

Ugo Boscain, Paris

Aleksey Kostenko, Wien

Konstantin Pankrashkin, Orsay

**Abstract**

The main focus of the workshop is on the analysis of boundary value problems for differential and difference operators in some non-classical geometric settings, such as fractal graphs, sub-Riemannian manifolds or nonelliptic transmission problems. Taking into account their importance in modern mathematical analysis, we aim at developing suitable tools in the operator theory to deal with the new problem settings.

**Participants**

Boscain, Ugo (Paris), Franceschi, Valentina (Paris), Kachanovska, Maryna (Palaiseau), Keller, Matthias (Potsdam), Kostenko, Aleksey (Wien), Lenz, Daniel (Jena), Malamud, Mark (Moscow), Neel, Robert (Bethlehem), Nicolussi, Noema (Wien), Pankrashkin, Konstantin (Orsay), Prandi, Dario (Gif-sur-Yvette), Rizzi, Luca (Gières), Semin, Adrien (Darmstadt), Sheipak, Igor (Moscow), Thalmaier, Anton (Esch-sur-Alzette), Woess, Wolfgang (Graz)



**10.11. - 16.11.2019**

Organizers:

**Algebraic Tools for Solving the Yang–Baxter Equation**

Eric Jespers, Brussels

Victoria Lebed, Caen

Wolfgang Rump, Stuttgart

Leandro Vendramin, Buenos Aires

**Abstract**

The workshop was focused on three facets of the interplay between set-theoretic solutions to the Yang-Baxter equation and classical algebraic structures (groups, monoids, algebras, lattices, racks etc.): structures used to construct new solutions; structures as invariants of solutions; and YBE as a source of structures with interesting properties.

**Participants**

Ballester-Bolinches, Adolfo (Burdjassot), Brzezinski, Tomasz (Swansea), Byott, Nigel P. (Exeter), Catino, Francesco (Lecce), Cedó, Ferran (Bellaterra), Chouraqui, Fabienne (Kiryat Tivon), Dietzel, Carsten (Stuttgart), Eisermann, Michael (Stuttgart), Gateva-Ivanova, Tatiana (Blagoevgrad), Jespers, Eric F. (Bruxelles), Kubat, Lukasz (Bruxelles), Lebed, Victoria (Caen), Okninski, Jan (Warszawa), van Antwerpen, Arne (Bruxelles), Vendramin, Leandro (Buenos Aires), Verwimp, Charlotte (Bruxelles), Wiertel, Magdalena (Warszawa)





**10.11. - 16.11.2019**

Organizers:

**Rank One Groups and Exceptional Algebraic Groups**

Tom De Medts, Gent

Bernhard Mühlherr, Gießen

Anastasia Stavrova, St. Petersburg

**Abstract**

Rank one groups are a class of doubly transitive groups that are natural generalizations of the groups  $SL_2(k)$ . The most interesting examples arise from exceptional algebraic groups of relative rank one. This class of groups is, in turn, intimately related to structurable algebras. The goal of the mini-workshop was to bring together experts on these topics in order to make progress towards a better understanding of the structure of rank one groups.

**Participants**

Chernousov, Vladimir (Edmonton), De Medts, Tom (Gent), Gille, Philippe (Villeurbanne), Grüninger, Matthias (Gießen), Jansen, Paulien (Gent), Meulewaeter, Jeroen (Gent), Mühlherr, Bernhard M. (Gießen), Petrov, Victor A. (St. Petersburg), Rigby, Simon (Gent), Segev, Yoav (Beer-Sheva), Smirnov, Oleg N. (Charleston), Stavrova, Anastasia (St. Petersburg), Van Maldeghem, Hendrik (Gent), Weiss, Richard M. (Medford), Wiedemann, Torben (Gießen)



**10.11. - 16.11.2019**

Organizers:

**Seshadri Constants**

Thomas Bauer, Marburg

Lucja Farnik, Krakow

Krishna Hanumanthu, Kelambakkam

Jack Huizenga, University Park

### **Abstract**

Seshadri constants were defined by Demailly around 30 years ago using the ampleness criterion of Seshadri. Demailly was interested in studying problems related to separation of jets of line bundles on projective varieties, specifically in the context of the well-known Fujita Conjecture. However, Seshadri constants turned out to be objects of fundamental importance in the study of positivity of linear series and many other areas. Consequently, in the past three decades, they have become a central object of study in numerous directions in algebraic geometry and commutative algebra. In this mini-workshop, we studied some of the most interesting current research problems concerning Seshadri constants. We expect that this exploration will help focus research on some of the most important questions in this area in the years to come.

### **Participants**

Bauer, Thomas (Marburg), Dumnicki, Marcin (Kraków), Farnik, Lucja (Kraków), Fulger, A. Mihai (Storrs), Hanumanthu, Krishna (Tamil Nadu), Harbourne, Brian (Lincoln), Huizenga, Jack (University Park), Küronya, Alex (Frankfurt am Main), Murayama, Takumi (Ann Arbor), Roé, Joaquim (Bellaterra), Rollenske, Sönke (Marburg), Roy, Praveen Kumar (Mumbai), Schmitz, David (Bayreuth), Seceleanu, Alexandra (Lincoln), Szemberg, Tomasz (Kraków), Szpond, Justyna (Kraków), Tutaj-Gasińska, Halszka (Kraków)



## 2.5. Simons Visiting Professors

Die folgenden Forscherinnen und Forscher kombinierten einen Aufenthalt in Oberwolfach mit einem Aufenthalt an einer europäischen Universität, unterstützt durch die Simons Foundation.

### **Kostochka, Alexandr V. (Urbana, USA)**

Workshop: 1902 Graph Theory  
Host: Stiebitz, Michael (Ilmenau, Germany)

### **Liebenau, Anita (Sydney, Australia)**

Workshop: 1902 Graph Theory  
Host 1: Krivelevich, Michael (Tel Aviv, Israel)  
Host 2: Samotij, Wojciech (Tel Aviv, Israel)

### **Seymour, Paul (Princeton, USA)**

Workshop: 1902 Graph Theory  
Host: Scott, Alexander (Oxford, UK)

### **Shin, Sug Woo (Berkeley, USA)**

Workshop: 1903 Arithmetic of Shimura Varieties  
Host: Kret, Arno (Amsterdam, Netherlands)

### **Polini, Claudia (Notre Dame, USA)**

Workshop: 1907 Singularities and Homological Aspects of Commutative Algebra  
Host: Rossi, Maria Evelina (Genova, Italy)

### **Mukhjopadhyay, Parthasarathi (Pune, India)**

Workshop: 1908 Moist Processes in the Atmosphere  
Host: Stevens, Bjorn (Hamburg, Germany)

### **Liu, Yifeng (New Haven, USA)**

Workshop: 1909 Non-Archimedean Geometry and Applications  
Host: Gubler, Walter (Regensburg, Germany)

### **Kelley, Christine A. (Lincoln, USA)**

Workshop: 1912 Contemporary Coding Theory  
Host: Hollanti, Camilla (Aalto, Finland)

### **Manganiello, Felice (Clemson, USA)**

Workshop: 1912 Contemporary Coding Theory  
Host: Rosenthal, Joachim (Zürich, Switzerland)

### **Gluesing-Luerssen, Heide (Lexington, USA)**

Workshop: 1912 Contemporary Coding Theory  
Host: Horlemann-Trautmann, Anna-Lena (St. Gallen, Switzerland)

### **Carlson, Jon F. (Athens, USA)**

Workshop: 1913 Representations of Finite Groups  
Host: Krause, Henning (Bielefeld, Germany)

### **Cavaliere, Renzo (Fort Collins, USA)**

Workshop: 1918 Tropical Geometry: new directions  
Host: Markwig, Hannah (Tübingen, Germany)

## 2.5. Simons Visiting Professors

The following researchers combined their stay in Oberwolfach with a research visit to a European University, supported by the Simons Foundation.

### **Behr, Merle (Berkeley, USA)**

Workshop: 1919 Statistical and Computational Aspects of Learning with Complex Structure  
Host: Munk, Axel (Göttingen, Germany)

### **Li, Qionglin (Tianjin, China)**

Workshop: 1920 Geometry and Physics of Higgs Bundles  
Host: Alessandrini, Daniele (Heidelberg, Germany)

### **Maloni, Sara (Charlottesville, USA)**

Workshop: 1920 Geometry and Physics of Higgs Bundles  
Host 1: Alessandrini, Daniele (Heidelberg, Germany)  
Host 2: Pozzetti, Maria Beatrice (Bonn, Germany)

### **Shen, Wen (University Park, USA)**

Workshop: 1921 Nonlinear Hyperbolic Problems: modeling, analysis, and numerics  
Host: Guerra, Graziano (Milano, Italy)

### **Yang, Fan (Stanford, USA)**

Workshop: 1922 Foundations and New Horizons for Causal Inference  
Host: Meinshausen, Nicolai (Zürich, Switzerland)

### **Zhang, Kun (Pittsburgh, USA)**

Workshop: 1922 Foundations and New Horizons for Causal Inference  
Host: Schölkopf, Bernhard (Tübingen, Germany)

### **Nannicini, Giacomo (Yorktown Heights, USA)**

Workshop: 1923 Mixed-integer Nonlinear Optimization: a hatchery for modern mathematics  
Host: Traversi, Emiliano (Paris, France)

### **Wise, Jonathan (Boulder, USA)**

Workshop: 1925a Logarithmic Enumerative Geometry and Mirror Symmetry  
Host: Gross, Mark (Cambridge, UK)

### **Turner, Katharine (Acton, Australia)**

Workshop: 1925b Statistical Methodology and Theory for Functional and Topological Data  
Host: Skraba, Primoz (London, UK)

### **Ginzburg, Viktor L. (Santa Cruz, USA)**

Workshop: 1928 Dynamische Systeme  
Host: Abbondandolo, Alberto (Bochum, Germany)

### **Hur, Vera Mikyoung (Urbana, USA)**

Workshop: 1929a Mathematical Theory of Water Waves  
Host: Vanden-Broeck, Jean-Marc (London, UK)

**Evans, John A. (Boulder, USA)**

Workshop: 1929b Mathematical Foundations of Isogeometric Analysis

Host: Jüttler, Bert (Linz, Austria)

**Zhang, Yongjie Jessica (Pittsburgh, USA)**

Workshop: 1929b Mathematical Foundations of Isogeometric Analysis

Host: Manni, Carla (Roma, Italy)

**Brenner, Susanne C. (Baton Rouge, USA)**

Workshop: 1931 Computational Multiscale Methods

Host 1: Peterseim, D. (Augsburg, Germany)

Host 2: Gedicke, Joscha (Wien, Austria)

**Kennedy, Matthew (Waterloo, Canada)**

Workshop: 1933 C\*-Algebras

Host: Raum, Sven (Stockholm, Sweden)

**Peterson, Jesse D. (Nashville, USA)**

Workshop: 1933 C\*-Algebras

Host: Thom, Andreas B. (Dresden, Germany)

**Gillaspy, Elizabeth (Missoula, USA)**

Workshop: 1933 C\*-Algebras

Host 1: Arici, Francesca (Nijmegen, Netherlands)

Host 2: Werner, Wend (Münster, Germany)

**Babson, Eric (Davis, USA)**

Workshop: 1935 Geometric, Algebraic, and Topological Combinatorics

Host: Welker, Volkmar (Marburg, Germany)

**Nachtergaele, Bruno (Davis, USA)**

Workshop: 1937 Many-Body Quantum Systems

Host: Warzel, Simone (Garching, Germany)

**Basu, Riddhipratim (Bengaluru, India)**

Workshop: 1938 Large Scale Stochastic Dynamics

Host: Goswami, Subhaji (Bures-sur-Yvette, France)

**Ogata, Yoshiko (Tokyo, Japan)**

Workshop: 1944 Subfactors and Applications

Host: Schweigert, Christoph (Hamburg, Germany)

**Choie, Young Ju (Pohang City, South Korea)**

Workshop: 1951 Modular Forms

Host: Imamoglu, Özlem (Zürich, Switzerland)

**Yang, Tonghai (Madison, USA)**

Workshop: 1951 Modular Forms

Host: Bruinier, Jan (Darmstadt, Germany)



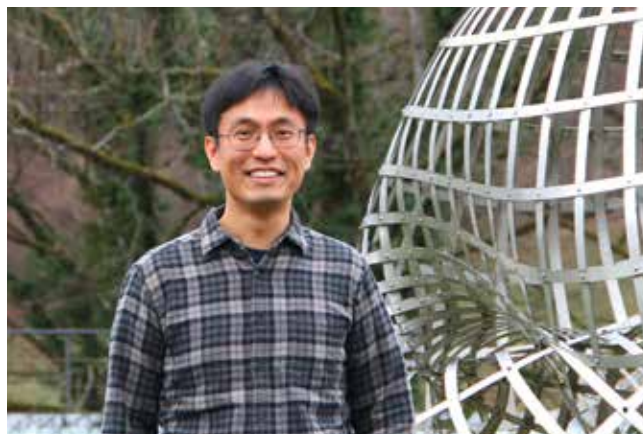
*A. V. Kostochka*



*A. Liebenau*



*P. Seymour*

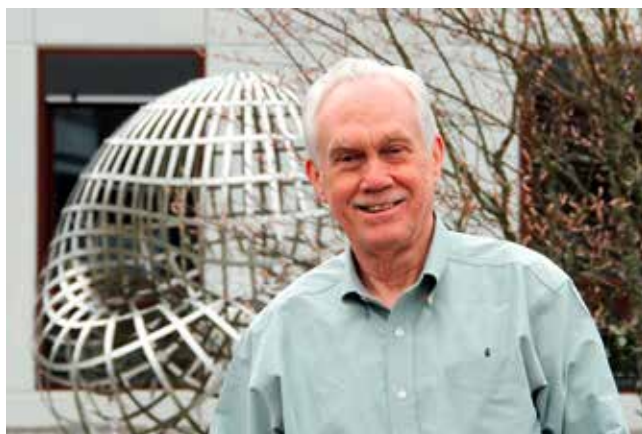


*S. W. Shin*





*C. Polini*



*J. F. Carlson*



*P. Mukhjopadhyay*



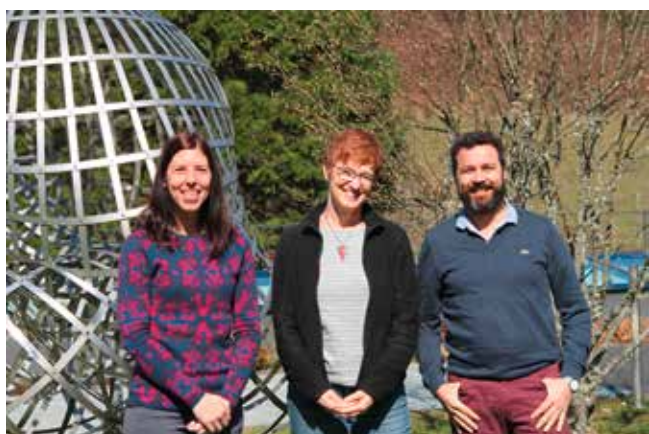
*R. Cavalieri*



*Y. Liu*



*M. Behr*



*C. Kelley, H. Gluesing-Luerssen, F. Manganiello*



*Q. Li*

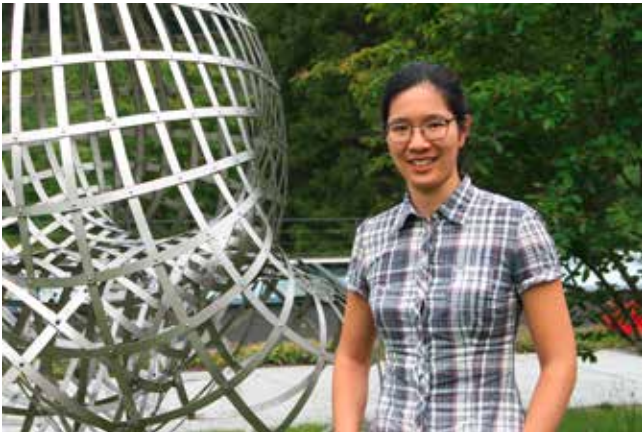




*S. Maloni*



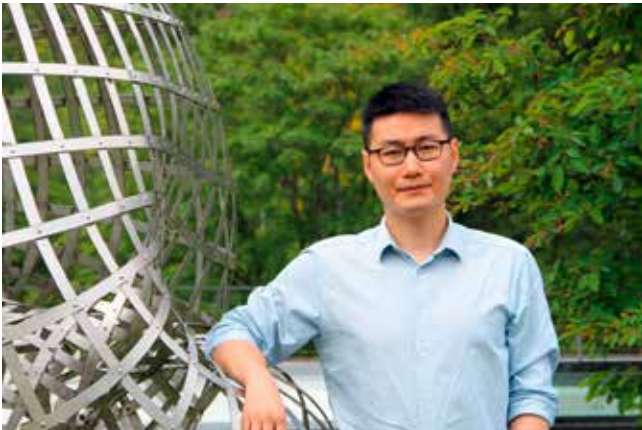
*J. Wise*



*F. Yang*



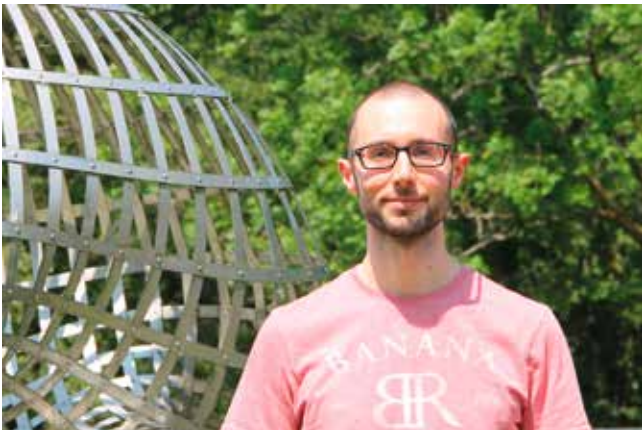
*K. Turner*



*K. Zhang*



*V. L. Ginzburg*



*G. Nannicini*



*V. M. Hur*





*J. A. Evans*



*E. Gillaspy*



*Y. J. Zhang*



*E. Babson*



*M. Kennedy*



*B. Nachtergaele*



*J. D. Peterson*



*R. Basu*





*Y. Ogata*



*T. Yang*



*Y. J. Choie*



## 2.6. Arbeitsgemeinschaften

### Arbeitsgemeinschaft 1914



**31.03. - 06.04.2019**

Organizers:

#### **Elliptic Cohomology according to Lurie**

Paul Goerss, Evanston

Jacob Lurie, Cambridge MA

Thomas Nikolaus, Münster

#### **Abstract**

The Arbeitsgemeinschaft gave an overview of Jacob Lurie's construction of elliptic cohomology and Lubin Tate theory. As opposed to the original construction by Goerss–Hopkins–Miller, which uses heavy obstruction theory, Lurie constructs these objects by a moduli problem in spectral algebraic geometry. A major part of the meeting was devoted to the foundations and background in higher algebra needed to set up this moduli problem (in the case of Lubin Tate theory) and prove that it is representable.

#### **Participants**

Anschütz, Johannes (Paris), Ariotta, Stefano (Münster), Arnold, Bertram (Bonn), Baker, Andrew J. (Glasgow), Barucco, Matteo (Coventry), Berwick-Evans, Daniel (Urbana), Bobkova, Irina (Princeton), Bohmann, Anna Marie (Nashville), Brantner, Lukas B. (Oxford), Bunke, Ulrich (Regensburg), Chatham, Hood (Cambridge), Culver, Dominic (Urbana), Davies, Jack Morgan (Utrecht), Dotto, Emanuele (Bonn), Faltings, Gerd (Bonn), Gepner, David J. (West Lafayette), Goerss, Paul G. (Evanston), Hahn, Jeremy (Cambridge), Heard, Drew K. (Regensburg), Hebestreit, Fabian (Bonn), Hedenlund, Alice (Oslo), Hendrian, Leon (Münster), Henn, Hans-Werner (Strasbourg), Heuts, Gijs (Utrecht), Kedziorek, Magdalena (Utrecht), Krause, Achim (Münster), Lawson, Tyler (Minneapolis), Li, Guchuan (Evanston), Lurie, Jacob (Cambridge), McCandless, Jonas (København), Meier, Lennart (Utrecht), Naumann, Niko (Regensburg), Nikolaus, Thomas (Münster), Ozornova, Viktoriya (Bochum), Patchkoria, Irakli (Aberdeen), Patrikis, Stefan (Salt Lake City), Pham, Viet-Cuong (Strasbourg), Pstragowski, Piotr (Evanston), Quigley, James D. (Notre Dame), Raksit, Arpon (Stanford), Ray, Catherine (Evanston), Rezk, Charles (Urbana), Rognes, John (Oslo), Sala Fernandez, Guillem (København), Schlank, Tomer (Jerusalem), Schrade, Christoph (Münster), Senger, Andrew (Cambridge), Stojanoska, Vesna (Urbana), VanKoughnett, Paul (West Lafayette), Wilson, Dylan (Chicago), Wimmer, Christian (Hamburg), Yakerson, Maria (Essen), Yanovski, Lior (Jerusalem), Yuan, Allen (Cambridge)



**13.10. - 18.10.2019**

Organizers:

**Zimmer's Conjecture**

Aaron Brown, Chicago

David Fisher, Bloomington

Sebastian Hurtado-Salazar, Chicago

**Abstract**

The aim of this Arbeitsgemeinschaft was to understand the recent progress on Zimmer's conjecture, which involves many novel ideas and contributions from various areas of mathematics. The main sources of techniques and ideas are: (1) rigidity theory, (2) smooth dynamics, particularly hyperbolic dynamics, (3) homogeneous dynamics, particularly the study of invariant measures, (4) operator algebras, particularly Lafforgue's strong property ( $T$ ). The lectures were organized to introduce participants to the elements of this wide variety of topics. One third of the participants were PhD students, one third were PostDoc and the last third were mathematicians with a permanent position. Many of the participants were working on a topic related to the conference.

**Participants**

Bajpai, Jitendra (Göttingen), Blayac, Pierre-Louis (Orsay), Brown, Aaron W. (Chicago), Chow, Michael (New Haven), Chung, Ping Ngai (Chicago), Corso, Emilio (Zürich), Dang, Nguyen Thi (Rennes), De La Cruz Mengual, Carlos A. (Zürich), Deninger, Christopher (Münster), Dinamarca, Leonardo (Santiago Centro, RM), Dodds, Samuel (Chicago), Finkelshtein, Vladimir (Göttingen), Fisher, David (Bloomington), Flaminio, Livio (Villeneuve d'Ascq), Gal, Swiatoslaw R. (Wrocław), Gastineau, Stella Sue (Chestnut Hill), Guan, Lifan (Göttingen), Hurder, Steve (Chicago), Hurtado-Salazar, Sebastian (Chicago), Kalinin, Boris (University Park), Kedra, Jarek (Aberdeen), Kim, Sang-hyun (Seoul), Kuessner, Thilo (Augsburg), Lee, Homin (Bloomington), Lee, Min Ju (New Haven), Leibtag, Elyashev (Rehovot), Luethi, Manuel (Zürich), Mallahi-Karai, Keivan (Bremen), Masbaum, Gregor (Paris), Mondal, Arghya (Mumbai), Navas Flores, Andrés Ignacio (Santiago Centro, RM), Nguyen, Thang Quang (Ann Arbor), Pecastaing, Vincent (Esch-sur-Alzette), Rühr, Rene (Ramat Aviv, Tel Aviv), Sanchez, Anthony (Seattle), Sarkar, Pratyush (New Haven), Schaffhauser, Florent (Strasbourg), Scott, Isabella (Chicago), Sedano Mendoza, Manuel (Morelia), Sert, Cagri (Zürich), Shchetka, Ekaterina (St. Petersburg), Skenderi, Mishel (Waltham), Spatzier, Ralf J. (Ann Arbor), Triestino, Michele (Dijon), Trost, Alexander (Aberdeen), Vigdorovich, Itamar (Rehovot), Vigolo, Federico (Rehovot), Wang, Shi (Bonn), Xu, Hui (Suzhou), Yang, Pengyu (Zürich), Zeghib, Ghani (Lyon)



## 2.7. Oberwolfach Seminare

### Oberwolfach Seminar 1924a



**09.06. - 15.06.2019**

Organizers:

#### **Anisotropic Spaces and their Applications to Hyperbolic and Parabolic Systems**

Viviane Baladi, Paris  
Mark Demers, Fairfield  
Giovanni Forni, College Park  
Sébastien Gouëzel, Nantes

#### **Abstract**

The general topic of this Oberwolfach Seminar was how Ruelle resonances, i.e. the spectral data of a dynamical system (which describe its correlation asymptotics), appear and can be studied in various settings: the hyperbolic case (with singularities) of dispersive billiards, the parabolic case of horocycle flows in negative curvature, and the elliptic case (with singularities) of translation flows. The unifying theme was the use of a fairly new tool: anisotropic Banach spaces, on which the eigenvalues of suitable Ruelle transfer operators furnish the Ruelle resonances. There were four minicourses, which all started at a basic level, building up to very recent results: (1) Resonances and Sinai billiards, (2) resonances and averages of horocycle flows, (3) Ruelle resonances for pseudo-Anosov systems, (4) from cohomological equations to Ruelle resonances.

#### **Participants**

Akurugodage, Buddhima Kasun Fernando (Toronto), Baladi, Viviane (Paris), Butterley, Oliver James (Nova Gorica), Demers, Mark (Fairfield), Doll, Moritz (Bremen), Filip, Simion (Princeton), Forni, Giovanni (College Park), Giulietti, Paolo (Pisa), Gouezel, Sebastien (Nantes), Jézéquel, Malo (Paris), Kim, Minsung (College Park), Lee, Jungwon (Ulsan), Lefeuvre, Thibault (Orsay), Sedro, Julien (Orsay), Selley, Fanni (Budapest), Sewell, Benedict (Coventry), Simonelli, Lucia (Trieste), Slipantschuk, Julia (London), Spilioti, Polyxeni (Tübingen), Tanzi, Matteo (Victoria), Thomine, Damien (Orsay), Vytnova, Polina (Coventry), Wabnitz, Paul (Bremen), Wolf, Lasse Lennart (Paderborn), Zhang, Jinhua (Orsay)





**09.06. - 15.06.2019**

Organizers:

**Beyond Numerical Homogenization**

Daniel Peterseim, Augsburg

Houman Owhadi, Pasadena

### **Abstract**

The program of this seminar comprised the following topics: Numerical homogenization: Identification of accurate and localized basis functions for approximating the solution space of elliptic operators (including prototypical PDEs with arbitrary rough coefficients without periodicity and scale separation). Interpretations in the following fields and their interplay/connections: homogenization theory, variational multiscale analysis, theory of finite elements, domain decomposition methods, optimal recovery, polyharmonic splines, Bayesian/probabilistic numerics, Gaussian process regression, game/decision theory. Beyond: Multiresolution analysis: operator adapted wavelets, fast direct multilevel solvers. Kernels/computational statistics: compression, inversion and approximate PCA of dense kernel matrices, sparse and rank revealing representations of inverse operators and Gaussian processes, screening effect. Uncertainty quantification: sparse compression of expected solution operators, statistical numerical approximation. Eigenvalue problems: Anderson localization, Wannier functions, multilevel methods. Inverse Problems/Learning: de-noising, learning kernels.

### **Participants**

Baumgarten, Niklas (Karlsruhe), Chen, Yifan (Pasadena), Freese, Jan Philip (Karlsruhe), Garay, José C. (Baton Rouge), Gorynina, Olga (Marne-la-Vallée), Habrich, Oliver (Darmstadt), Keil, Tim (Münster), Kröpfl, Fabian (Augsburg), Li, Sijing (Hong Kong), Liu, Xinliang (Shanghai Shi), Ma, Chupeng (Heidelberg), Maier, Roland (Augsburg), Owhadi, Houman (Pasadena), Parker-Lamptey, George (Kumasi), Peterseim, Daniel (Augsburg), Pun, Sai-Mang (Shatin, N.T., Hong Kong), Schäfer, Florian (Pasadena), Strehlow, Arne (Heidelberg), Varga, Mario (Dresden), Wang, Lihan (Durham), Wang, Yixuan (Beijing), Yesypenko, Anna (Austin), Yoo, Gene R. (Pasadena), Zhang, Ziyun (Pasadena)





**20.10. - 26.10.2019**

Organizers:

**Growth in Finite and Infinite Groups**

Laurent Bartholdi, Göttingen/Lyon

Harald Helfgott, Göttingen

Matthew Tointon, Cambridge

**Abstract**

How many numbers can one obtain by hitting  $n$  keys on a calculator? Or, to be more general, group-oriented and genteel: say we are given a group  $G$  and a finite subset  $A$ ; write  $A^r = \{x_1 x_2 \dots x_r : x_i \in A\}$ . How much larger are  $A^2$  or  $A^3$  than  $A$ ? How does  $A^r$  grow as a function of  $r$ ? The seminar was devoted to such questions. The target audience were PhD students or post-doctoral researchers wishing to be quickly immersed in a modern, active research area.

**Participants**

Alpeev, Andrey (St. Petersburg), Bartholdi, Laurent (Göttingen), Becker, Oren (Cambridge), Bensaïd, Oussama (Paris), Bishop, Alexander (Sydney), Deré, Jonas (Kortrijk), Eberhard, Sean (Cambridge), Escalier, Amandine (Paris), Evetts, Alexander (Edinburgh), Francoeur, Dominik (Lyon), Goffer, Gil (Rehovot), Guan, Lifan (Göttingen), Helfgott, Harald A. (Göttingen), Janssens, Geoffrey (Bruxelles), Jezernik, Urban (Budapest), Kerr, Alice (Oxford), Melnikov, Igor (Moscow), Morales López, Ismael (Madrid), Murphy, Brendan (Bristol), Sabatini, Luca (Firenze), Slutsky, Raz (Rehovot), Spiegel, Christoph (Barcelona, Catalonia), Thilmany, Francois (Bruxelles), Tointon, Matthew (Cambridge), Wötzel, Maximilian (Barcelona, Catalonia)



**20.10. - 26.10.2019**

Organizers:

**Topological Cyclic Homology and Arithmetic**

Dustin Clausen, Bonn

Lars Hesselholt, Copenhagen

Akhil Mathew, Chicago

**Abstract**

The purpose of the seminar was to introduce the higher algebra refinements of determinant and trace, namely, algebraic  $K$ -theory and topological cyclic homology, along with their budding applications in arithmetic geometry and number theory. In particular, we used these ingredients to build Clausen's Artin map from  $K$ -theory of locally compact topological  $R$ -modules to the dual of his Selmer  $K$ -theory of  $R$ , and explain that for  $R$  a finite, local, or global field, this implies the classical Artin reciprocity.

**Participants**

Andriopoulos, Faidon (Chicago), Anschütz, Johannes (Bonn), Azouri, Ran (Essen), Bosco, Guido (Orsay), Bräunling, Oliver (Freiburg i. Br.), Clausen, Dustin (Bonn), Darrell, Micah (Chicago), Gilles, Sally (Lyon), Guo, Haoyang (Ann Arbor), Hansen, David (Bonn), Hebestreit, Fabian (Bonn), Hedenlund, Alice (Oslo), Hesselholt, Lars (Nagoya), Iwasa, Ryomei (København), Konovalov, Andrei (Moscow), Krause, Achim (Münster), Land, Markus (København), Le Bras, Arthur-César (Villetaneuse), Lueders, Morten (Paris), Mathew, Akhil (Chicago), Moulinos, Tasos (Toulouse), Nikolaus, Thomas (Münster), Raksit, Arpon (Stanford), Yang, Lucy (Cambridge), Yuan, Allen (Cambridge)





**24.11. - 30.11.2019**

**Structure-preserving Methods for Nonlinear Hyperbolic Problems**

Organizers:

Alina Chertok, Raleigh  
Philippe G. LeFloch, Paris  
Giovanni Russo, Catania

**Abstract**

Many problems in the physical sciences are modeled by nonlinear hyperbolic systems of partial differential equations. Often, such systems and their solutions enjoy certain structural properties that are of key importance in applications. In consequence, numerical methods should be designed in order to enjoy at the discrete level of approximation the same structural properties. The development of structure-preserving schemes is based on many interrelated methodologies. This includes time-asymptotic preserving methods for hyperbolic systems containing linear, as well as nonlinear, relaxation terms, and based on implicit-explicit Runge-Kutta discretizations. The proposed schemes do not require the drastic restriction on the time step which should normally be imposed by the stiff source terms. Another important example is provided by the theory of small-scale dependent shock waves, generated by diffusive-dispersive terms or associated with hyperbolic equations in a nonconservative form; the notion of schemes with controlled dissipation was introduced for such problems. This Oberwolfach Seminar presented the foundations of the subject and overviewed the most recent developments on numerical methods adapted to these problems.

**Participants**

Altmann, Robert (Augsburg), Astuto, Clarissa (Catania), Birke, Claudius (Würzburg), Boulos Al Makary, Nelly (Villetaneuse), Cao, Yangyang (Paris), Chertock, Alina (Raleigh), Gomez Bueno, Irene (Malaga), Joshi, Hrishikesh (Darmstadt), Knapp, Tyler (Raleigh), LeFloch, Philippe G. (Paris), Leonard, Christopher (Raleigh), Liu, Yongle (Shenzhen), Macca, Emanuele (Catania), Mantri, Yogiraj (Aachen), Matern, Christoph (Magdeburg), Ostrowski, Lukas (Stuttgart), Parisot, Martin (Talence), Pimentel Garcia, Ernesto (Malaga), Ranocha, Hendrik (Jeddah), Russo, Giovanni (Catania), Warnecke, Sandra (Würzburg), Wiebe, Bettina (Mainz), Yaghi, Hazem (Magdeburg)



**24.11. - 30.11.2019**

Organizers:

**Wave Phenomena: Analysis and Numerics**

Marlis Hochbruck, Karlsruhe  
Andreas Rieder, Karlsruhe  
Roland Schnaubelt, Karlsruhe  
Christian Wieners, Karlsruhe

### **Abstract**

The research on wave-type problems is a fascinating and emerging field in mathematical research with many challenging applications in sciences and engineering. Profound investigations on waves require a strong interaction of several mathematical disciplines including functional analysis, partial differential equations, mathematical modeling, mathematical physics, numerical analysis, and scientific computing. The goal of this seminar was to present a comprehensive introduction to the research on wave phenomena by a series of lectures, student projects and software experiments. Starting with basic models for acoustic, elastic, and electro-magnetic waves we considered the existence of solutions for linear and some nonlinear material laws, efficient discretizations and solution methods in space and time, and the application to inverse parameter identification problems. Our aim in this course was to intertwine analysis and numerical mathematics for wave-type problems which will enable students for cooperative research projects in this field.

### **Participants**

Bärnin, Johannes (Konstanz), Bentahar, Rajae (Tetuan), Hauser, Julia (Graz), Hilder, Bastian (Stuttgart), Hochbruck, Marlis (Karlsruhe), Ionescu-Tira, Mathias (Halle/Saale), Jawecki, Tobias (Wien), Klaus, Friedrich (Karlsruhe), Klumpp, Maximilian (Stuttgart), Köhler, Jonas (Karlsruhe), Mahlen, Ola (Trondheim), Muhr, Markus (Garching bei München), Nick, Jörg (Tübingen), Pellhammer, Valentin (Konstanz), Pieronek, Lukas (Jülich), Quaine, Kieran (Edinburgh), Rieder, Andreas (Karlsruhe), Schnaubelt, Roland (Karlsruhe), Siemer, Lars (Bremen), Stocker, Paul (Wien), Tietz, Daniel Paul (Halle/Saale), Torres, Céline (Zürich), Wess, Markus (Wien), Wieners, Christian (Karlsruhe), Xue, Jun (Trondheim)



## 2.8. Fortbildungsveranstaltungen/Training weeks

### Trainings- und Abschluss-Seminar für die Internationale Mathematik-Olympiade 1921a



**19.05. - 25.05.2019**

Organizer:

**Trainings- und Abschluss-Seminar für die Internationale Mathematik-Olympiade**

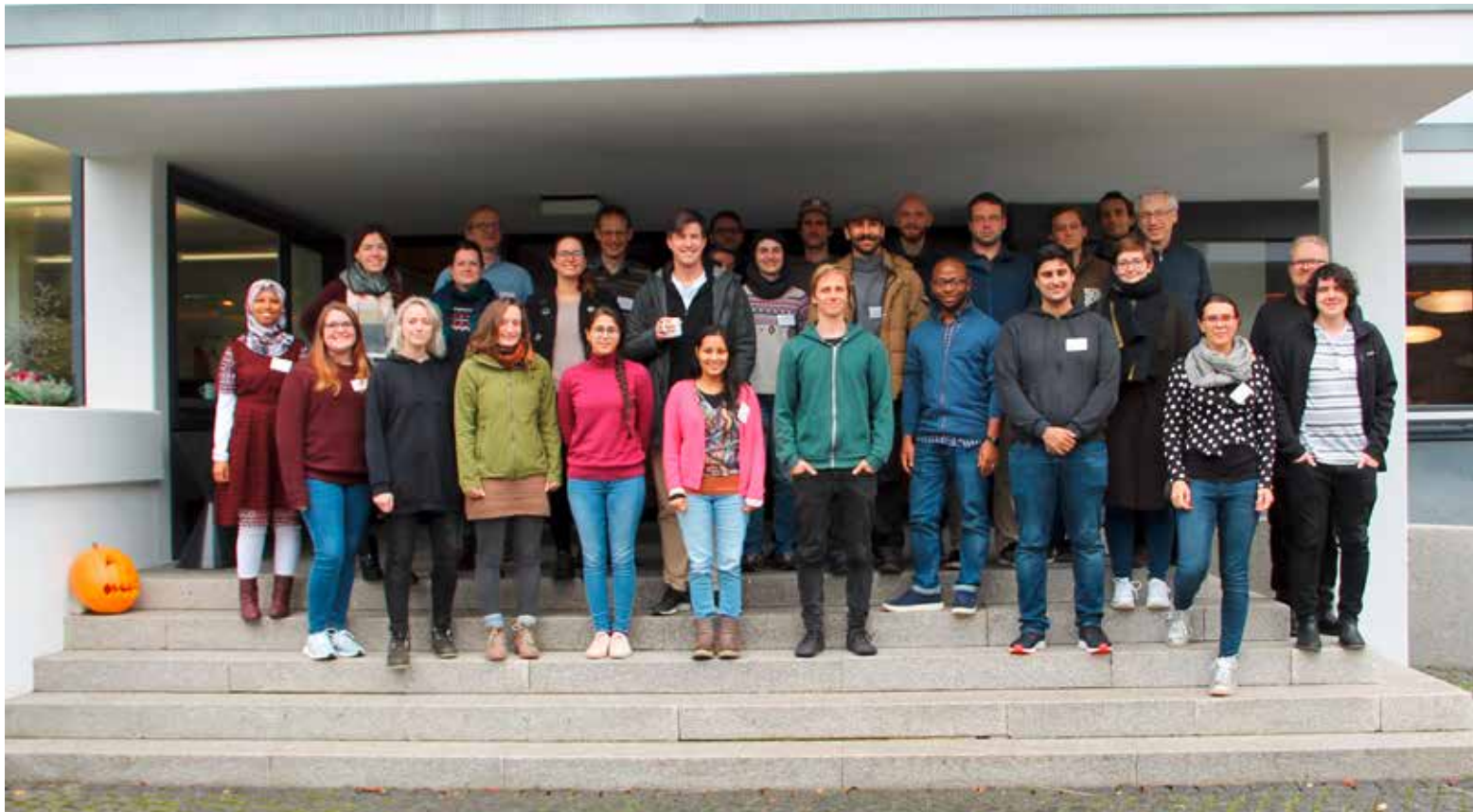
Jürgen Prestin, Lübeck

#### **Abstract**

The Institute hosted again the annual final training week for especially gifted German pupils to prepare for the International Mathematical Olympiad.

#### **Participants**

Bauer, Tobias; Dubischar, Simon; Göbel, Maximilian; Groß, Lukas Finn; Grotelüschen, Jonah Leon; Herbrich, Marcel; Keßler, Maximilian; McKeever, Philip; Müller, Paul; Perner, Edgar; Rimmelspacher, Esther; Schmitt, Paul; Thiel, Alexander; Walter, Jonas; Weiß, Melvin; Zotova, Sofia



**27.10. – 1.11.2019**

Organizers:

**MMS Summer School 2019: Modern Programming Languages for Science and Statistics - R and Julia**

Patricio Farrell (WIAS)  
Jürgen Fuhrmann (WIAS)  
Alexander Linke (WIAS)  
Jörg Polzehl (WIAS)  
Chris Rackauckas (JuliaLab/MIT)  
Karsten Tabelow (WIAS)

**Abstract**

The development and the application of software that relies on certain mathematical and statistical algorithms is widespread in institutes of all sections of the Leibniz Association. Applications are the statistical analysis of experimental and observational data, the simulation of complex models or the optimization of engineering devices. The second PhD Summer School of the Leibniz Network "Mathematical Modeling and Simulation" provided an introduction and an overview about two modern open source programming languages for science and statistics, namely R and Julia, which offer powerful tools for scientists.

**Participants**

Anvari, Mehrnaz (Potsdam), Bauer, Tobias (Leipzig), Campbell, Amy (Berlin), Dar, Asim Hassan (Magdeburg), Deane, Katrina (Magdeburg), Grossi Bovi Karatay, Grazielle (Potsdam), Hajizadeh, Aida (Magdeburg), Holm, Alexander (Leipzig), Ilin, Ekaterina (Potsdam), Leonhardt, Franziska (Dresden), Lezhnina, Olga (Hannover), Lindner, Michael (Potsdam), Marzban, Nader (Potsdam), Musa, Abdulraheem (Dummersdorf), Ouatahar, Latifa (Potsdam), Pasteris, Andrea Marina (Potsdam), Plietzsch, Anton (Potsdam), Ramachandran, Kesava Prasad (Kühlungsborn), Reimann, Maja (Borstel), Rug, Levin (Leipzig), Smith, Krister (Frankfurt a.M.), Strenge, Lia (Potsdam), Vaidya, Shrijana (Müncheberg), Vogel, Denise (Leipzig), Wilharm, Nils (Leipzig), Willenbücher, Katharina (Potsdam)





Image credits: Banach Center

**17.11. - 23.11.2019**

Organizers:

**Mathematics of Deep Learning**

Gitta Kutyniok, Berlin

Philipp Grohs, Wien

### Abstract

Despite the outstanding success of deep learning in real-world applications, most of the related research is empirically driven and a mathematical foundation is almost completely missing. At the same time, those methods have already shown their impressive potential in mathematical research areas such as imaging sciences, inverse problems, or numerical analysis of partial differential equations. Recently, theoretical research aiming to derive a fundamental understanding of different aspects of deep learning such as expressibility, generalization, identifiability, and learning as well as improving current methodologies has been intensified. Summarizing, deep learning is a rich research area, touching various areas of mathematics and posing an exciting challenge to mathematicians. This seminar was intended to provide an introduction to the current state-of-the-art in the mathematical analysis of deep learning algorithms. We discussed current main theoretical results, and also include practical sessions. The seminar also included problem sessions which are intended to initiate collaborations on particular projects, as well as preparing the participants to conduct their own research in this area.

### Participants

Abdeljawad, Ahmed (Linz), Ansari, Jonathan (Freiburg i. Br.), Aronsson, Jimmy (Göteborg), Aziznejad, Shayan (Lausanne), Balwani, Aishwarya H. (Atlanta), Banerjee, Pradeep Kumar (Leipzig), Bartel, Felix (Chemnitz), Baumgarten, Niklas (Karlsruhe), Berner, Julius (Wien), Bobenko, Nikolai (Berlin), Borys, Clemens (København), Brandoni, Domitilla (Bologna), Burrows, Liam (Liverpool), Cascarano, Pasquale (Bologna), Corallo, Daniele (Karlsruhe), Daws, Jr., Joseph (Knoxville), Facciola, Chiara (Milano), Fakhoury, Daniele (Roma), Gailus, Siragan (Boston), Gazdag, Luca Eva (Oslo), Geuenich, Jan (Bielefeld), Grohs, Philipp (Wien), Gundert, Anna (Köln), Guth, Philipp (Mannheim), Horak, Verena (Graz), Khatib, Rajaei (Haifa), Kircheis, Melanie (Chemnitz), Koliander, Günther (Wien), Koppensteiner, Sarah (Wien), Kröpfl, Fabian (Augsburg), Kunczik, Leonhard (Neubiberg), Kunsch, Robert (Aachen), Kutyniok, Gitta (Berlin), Laschos, Vaios (Berlin), Maly, Johannes (Aachen), Meyer, Joseph Theo (Heidelberg), Müller, David (Linz), Müller, Johannes (Stadtbergen), Pichler, Georg (Wien), Piotrowski, Bartosz (Warszawa), Rajkovic, Marko (Bonn), Richter, Lorenz (Berlin), Schmischke, Michael (Chemnitz), Schnoor, Ekkehard (Aachen), Simon, Frieder (Wolfgraben), Sokolowski, Jan (Trier), Tafo, Pavel (Marburg), Volkmer, Toni (Chemnitz), Yousefzadeh, Roozbeh (College Park), Zellinger, Werner (Linz), Zerafa, Christopher (Msida)

## 2.9. Research in Pairs

Die folgenden Forscherinnen und Forscher nahmen 2019 am Research in Pairs Programm teil:

The following researchers attended the Research in Pairs program in 2019:

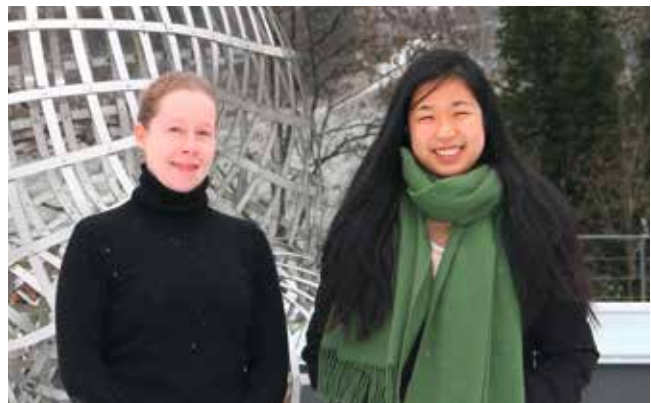
Farshid Hajir, Amherst Christian Maire, Besancon Ravi K. Ramakrishna, Ithaca	06.01. - 19.01.2019	Stefanos Aivazidis, Piraeus Thomas Müller, London	31.03. - 20.04.2019
Adrien Boyer, Rehovot Jean-Claude Picaud, Tours	06.01. - 19.01.2019	Márton Naszódi, Budapest Konrad Swanepoel, London	31.03. - 13.04.2019
Eveliina Peltola, Genève Yilin Wang, Zürich	13.01. - 26.01.2019	Berry Groisman, Cambridge Michael McGettrick, Galway Mehdi Mhalla, Grenoble Marcin Pawlowski, Gdansk	07.04. - 20.04.2019
Jim Geelen, Waterloo Rose McCarty, Waterloo Paul Wollan, Rome	13.01. - 19.01.2019	Winfried Bruns, Osnabrück Sebastian Gutsche, Siegen Matthias Köppe, Davis Jean-Philippe Labbé, Berlin	21.04. - 04.05.2019
Daniel Le, Toronto Bao Viet Le Hung, Chicago Brandon W. Levin, Tucson Stefano Morra, Montpellier	20.01. - 09.02.2019	David Brander, Lyngby Farid Tari, Sao Paulo	21.04. - 04.05.2019
Jussi Behrndt, Graz Henk de Snoo, Groningen	20.01. - 02.02.2019	Luca Battistella, Bonn Navid Nabijou, Glasgow	21.04. - 04.05.2019
Yves André, Paris Francesco Baldassarri, Padova Maurizio Cailotto, Padova	27.01. - 09.02.2019	Vaclav Kucera, Praha Maria Lukacova Medvidova, Mainz Sebastian Noelle, Aachen Jochen Schütz, Diepenbeek	05.05. - 18.05.2019
Karl Heinrich Hofmann, Darmstadt Linus Kramer, Münster	03.02. - 23.02.2019	Robert Laister, Bristol Mikolaj Sierzega, Warszawa	05.05. - 18.05.2019
Elena Berdysheva, Gießen Nira Dyn, Tel Aviv Elza Farkhi, Tel Aviv Alona Mokhov, Tel Aviv	10.02. - 23.02.2019	Sergey Finashin, Ankara Viatcheslav Kharlamov, Strasbourg	05.05. - 11.05.2019
Angélica Benito, Madrid Heisuke Hironaka, Cambridge MA Bernd Schober, Hannover Bernard Teissier, Paris	17.02. - 23.02.2019	David Colton, Newark Rainer Kress, Göttingen	12.05. - 25.05.2019
Lorenzo Taggi, Bath Niccolò Torri, Créteil	17.02. - 02.03.2019	Thomas Baumgarte, Brunswick Carsten Gundlach, Southampton David Hilditch, Lisboa	19.05. - 01.06.2019
Daniele Bartoli, Perugia Herivelto M. Borges Filho, Sao Paulo Luciane Quoos, Rio de Janeiro	24.02. - 09.03.2019	Peter Boyvalenkov, Sofia Peter Dragnev, Fort Wayne Edward B. Saff, Nashville Maya Stoyanova, Sofia	26.05. - 08.06.2019
András Frank, Budapest Kazuo Murota, Tokyo	24.02. - 09.03.2019	David J. Benson, Aberdeen Srikanth Iyengar, Salt Lake City Henning Krause, Bielefeld	02.06. - 15.06.2019
Kay Schwieger, Gerlingen Stefan Wagner, Karlskrona	03.03. - 16.03.2019	Henry Adams, Fort Collins Florian Frick, Pittsburgh Ziga Virk, Ljubljana	02.06. - 15.06.2019
Hakima Bessaih, Laramie Annie Millet, Paris	03.03. - 23.03.2019	Laura Costa Farras, Barcelona Rosa Maria Miró-Roig, Barcelona Juan Francisco Pons Llopis, L'Aquila	09.06. - 22.06.2019
Pauline Baillet, Hannover Benoît Guerville-Ballé, Sao Carlos Anatoly Libgober, Chicago Simona Settepanella, Sapporo	03.03. - 16.03.2019	Viatcheslav Kharlamov, Strasbourg Rares Rasdeaconu, Nashville	16.06. - 29.06.2019
Ulrich Kohlenbach, Darmstadt Genaro López Acedo, Sevilla Adriana Maria Nicolae, Sevilla	10.03. - 23.03.2019	Peter Latham, London Monica Nevins, Ottawa	16.06. - 29.06.2019
Nicolò Drago, Pavia Simone Murro, Freiburg	17.03. - 30.03.2019	Lutz Dümbgen, Bern Jon Wellner, Seattle	23.06. - 06.07.2019
Gerhard Knieper, Bochum Norbert Peyerimhoff, Durham	24.03. - 13.04.2019	Jürgen Klüners, Paderborn Jiuya Wang, Durham	07.07. - 20.07.2019



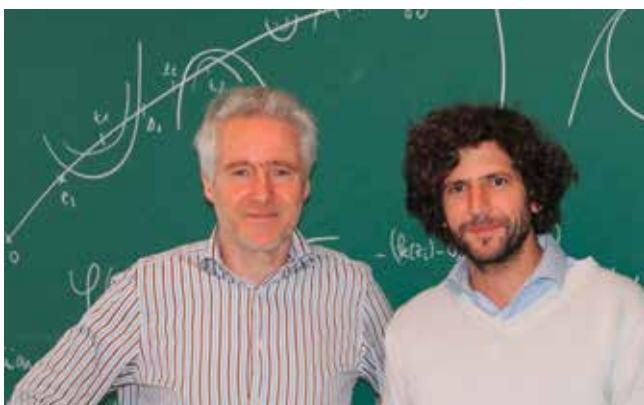
Michael Shapiro, East Lansing Alek Vainshtein, Haifa	07.07. - 20.07.2019	Claudia Polini, Notre Dame Bernd Ulrich, West Lafayette	01.09. - 21.09.2019
Tom Lyche, Oslo Carla Manni, Roma Hendrik Speleers, Roma	07.07. - 13.07.2019	Anne Lonjou, Basel Christian Urech, London Susanna M. Zimmerman, Angers	01.09. - 14.09.2019
Andrew S. Obus, New York Padmavathi Srinivasan, Atlanta	14.07. - 27.07.2019	Gabriel R. Barrenechea, Glasgow Volker John, Berlin Petr Knobloch, Praha	08.09. - 21.09.2019
Chao-Nien Chen, Hsinchu (Taiwan) Yung-Sze Choi, Storrs Matthias Winter, Uxbridge	21.07. - 10.08.2019	Kenji Iohara, Lyon Kyoji Saito, Tokio	15.09. - 05.10.2019
Henk P. Barendregt, Nijmegen Giulio Manzonetto, Villetaneuse	21.07. - 03.08.2019	Pietro Belotti, Birmingham Sven Leyffer, Argonne IL	22.09. - 05.10.2019
Cleonice F. Bracciali, Sao Jose do Rio Preto Teresa E. Pérez Fernández, Granada	21.07. - 03.08.2019	Dusko Jojic, Banja Luka Gaiane Panina, St Petersburg Rade T. Zivaljevic, Belgrade	13.10. - 26.10.2019
Toshiyuki Kobayashi, Tokyo Birgit Speh, Ithaca	04.08. - 17.08.2019	Ya'acov Peterzil, Haifa Sergei S. Starchenko, Notre Dame	13.10. - 26.10.2019
Nursel Erey, Gebze Jürgen Herzog, Essen Takayuki Hibi, Osaka Sara Saedi Madani, Tehran	18.08. - 07.09.2019	Zur Izhakian, Aberdeen Glenn Merlet, Marseille	27.10. - 09.11.2019
Anne Theresia Franzen, Lisboa Yafet Erasmo Sanchez Sanchez, Bonn	25.08. - 07.09.2019	Evgeniy Lokharu, Lund Miles H. Wheeler, Wien	03.11. - 16.11.2019
Nicola Oswald, Wuppertal Jörn Steuding, Würzburg	01.09. - 14.09.2019	Reinhard Diestel, Hamburg Joshua P. Erde, Graz Rudi Pendavingh, Eindhoven Geoffrey Whittle, Wellington	10.11. - 23.11.2019



*R. K. Ramakrishna, F. Hajir, C. Maire*



*E. Peltola, Y. Wang*

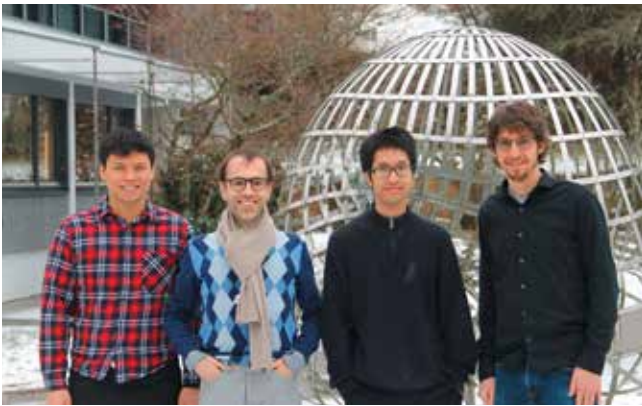


*J.-C. Picaud, A. Boyer*



*P. Wollan, R. McCarty, J. Geelen*





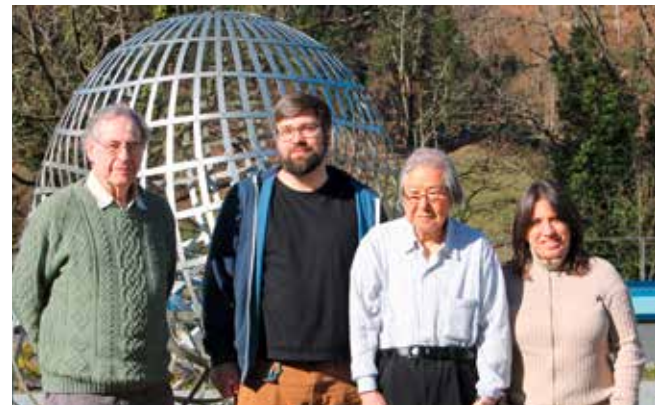
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*E. Berdysheva, N. Dyn, A. Mokhov, E. Farkhi*



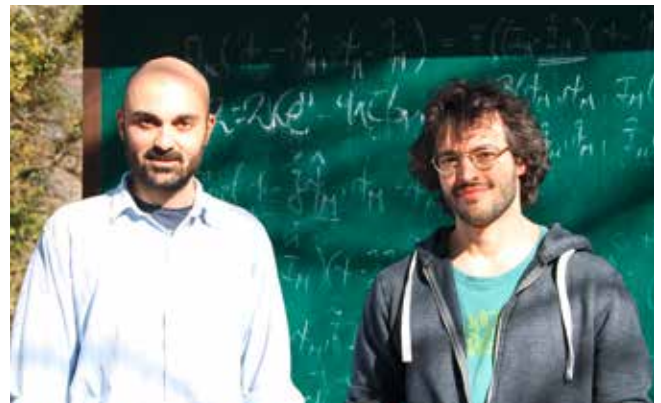
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*B. Teissier, B. Schober, H. Hironaka, A. Benito*



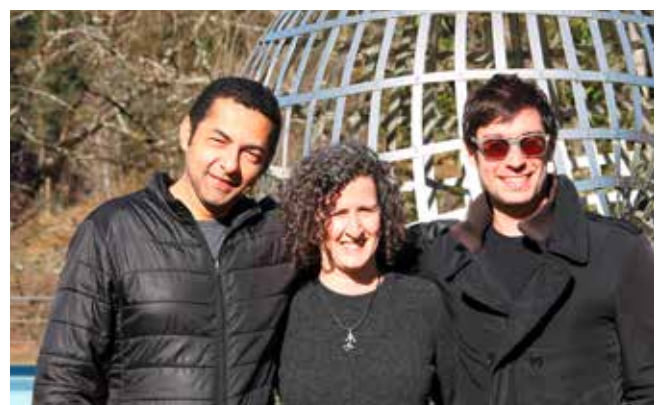
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*L. Taggi, N. Torri*

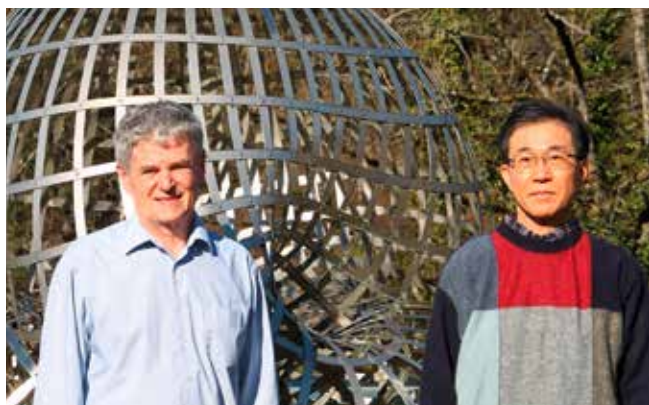


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*H. M. Borges Filho, L. Quoos, D. Bartoli*





*A. Frank, K. Murota*



*G. López Acedo, A.M. Nicolae, U. Kohlenbach*



*S. Wagner, K. Schwieger*



*S. Murro, N. Drago*



*H. Bessaih, A. Millet*



*G. Knieper, N. Peyrerimhoff*



*A. Libgober, S. Settepanella, B. Guerville-Ballé, P. Baillet*

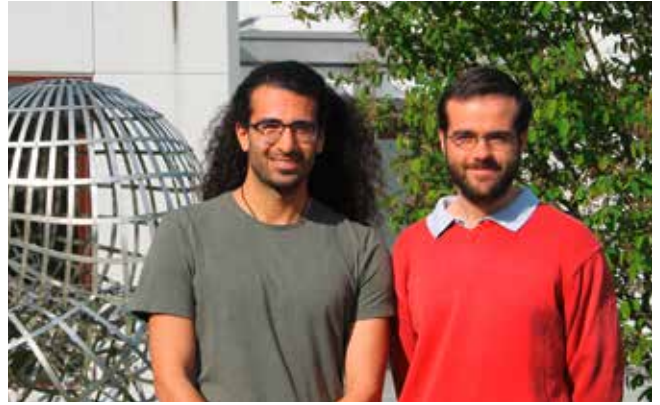


*T. Müller, S. Aivazidis*

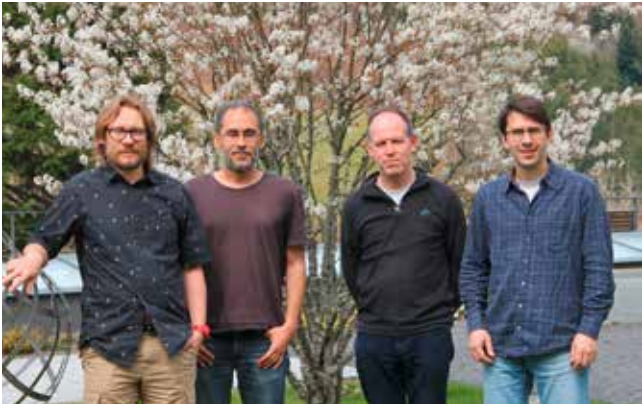




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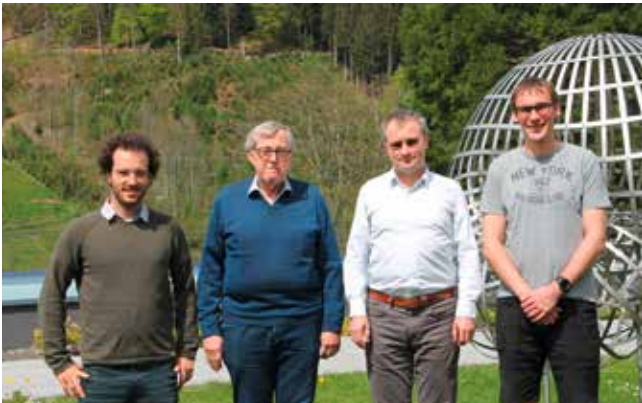
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*M. Pawlowski, M. Mhalla, M. McGettrick, B. Groisman*



*J. Schütz, M. Lukacova Medvidova, S. Noelle, V. Kucera*



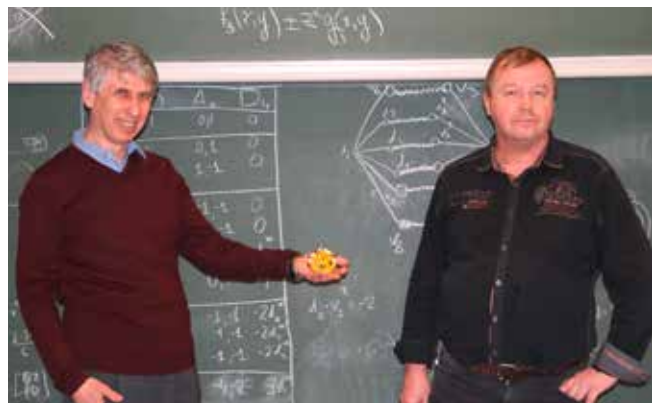
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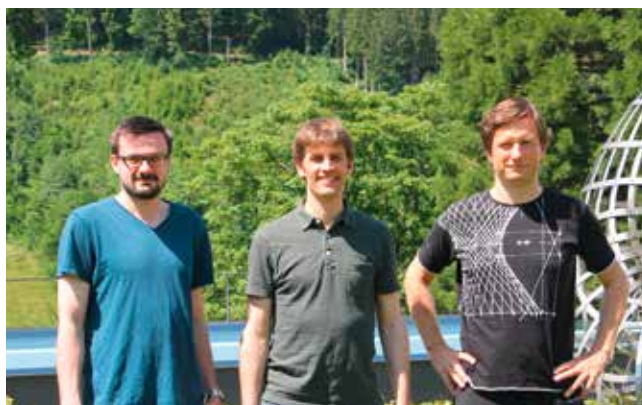


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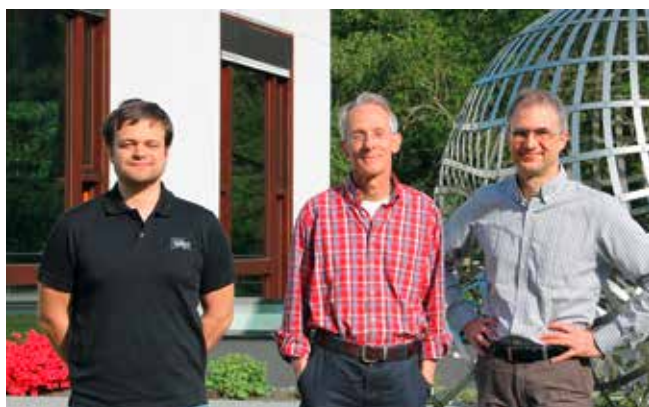




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*F. Frick, H. Adams, Z. Virk*



*D. Hilditch, C. Gundlach, T. Baumgarte*



*J. F. Pons Llopis, R. M. Miró-Roig, L. Costa Farras*



*P. Boyvalenkov, E. B. Saff, M. Stoyanova, P. Dragnev*



*V. Kharlamov, R. Rasdeaconu*



*H. Krause, D. J. Benson, S. Iyengar*



*M. Nevins, P. Latham*

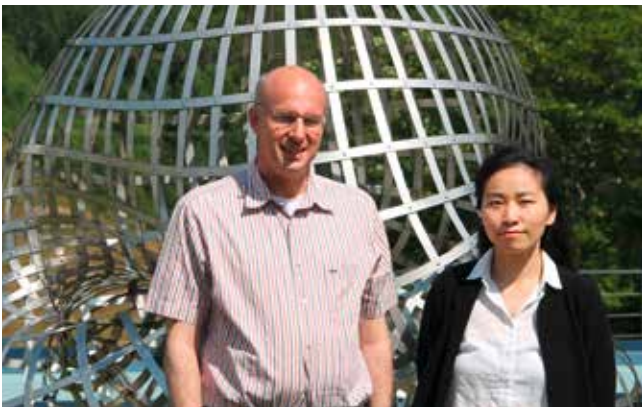




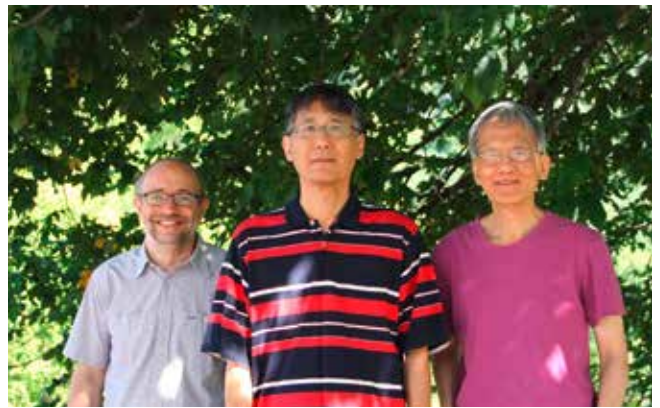
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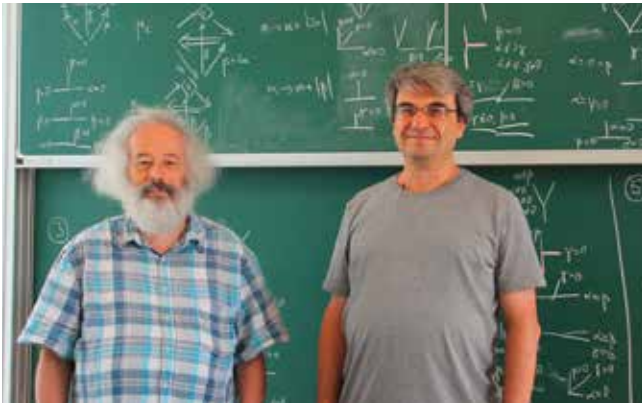
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*J. Klüners, J. Wang*



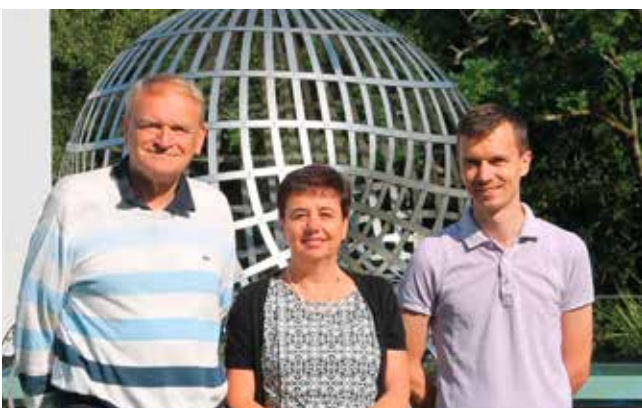
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*A. Vainshtein, M. Shapiro*



*G. Manzonetto, H. P. Barendregt*



*T. Lyche, C. Manni, H. Speleers*



*C. F. Bracciali, T. E. Pérez Fernández*

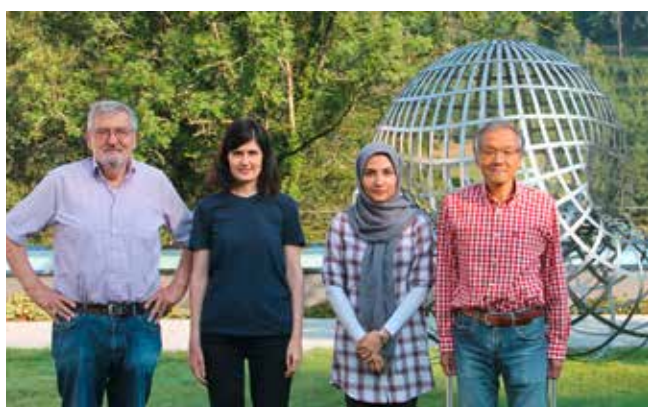




*T. Kobayashi, B. Speh*



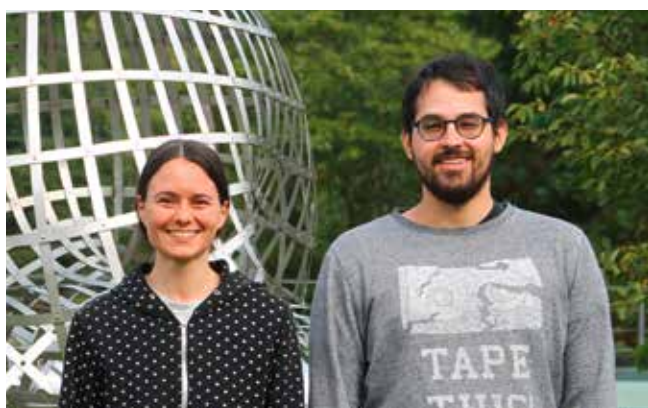
*B. Ulrich, C. Polini*



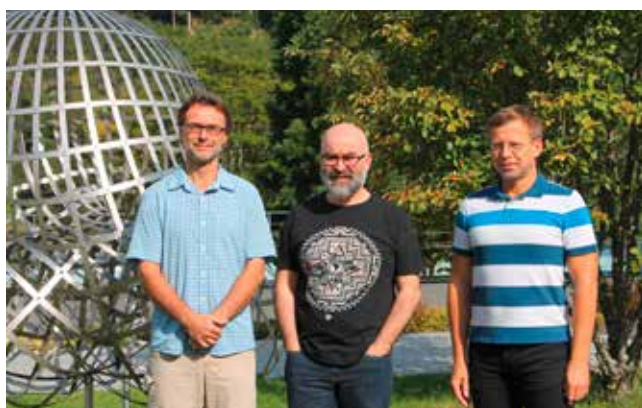
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*A. Lonjou, S. M. Zimmermann, C. Urech*



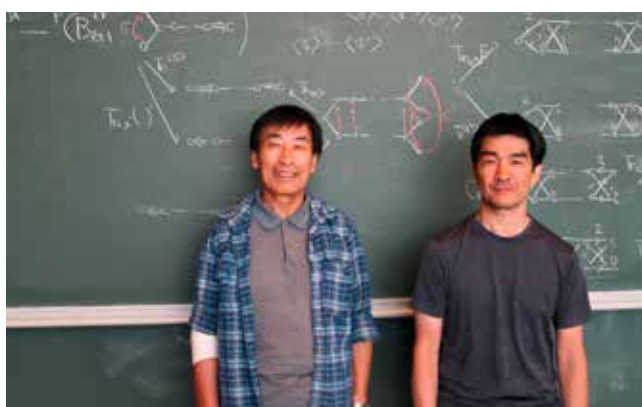
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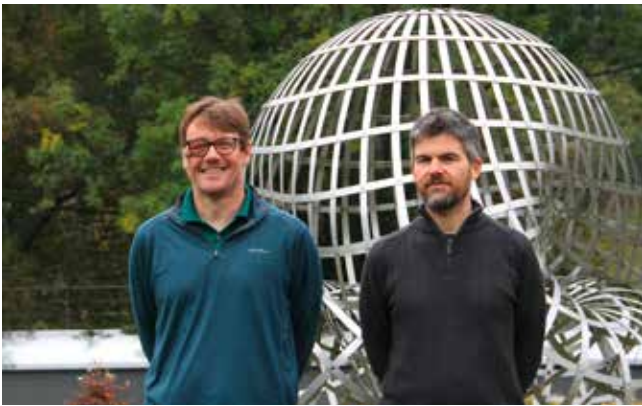


*J. Steuding, N. Oswald*

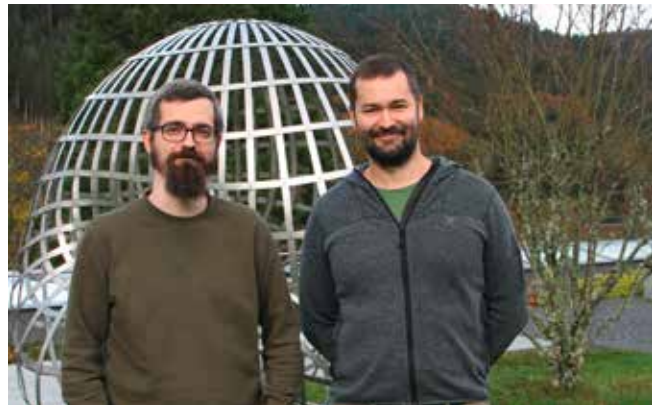


*K. Saito, K. Iohara*





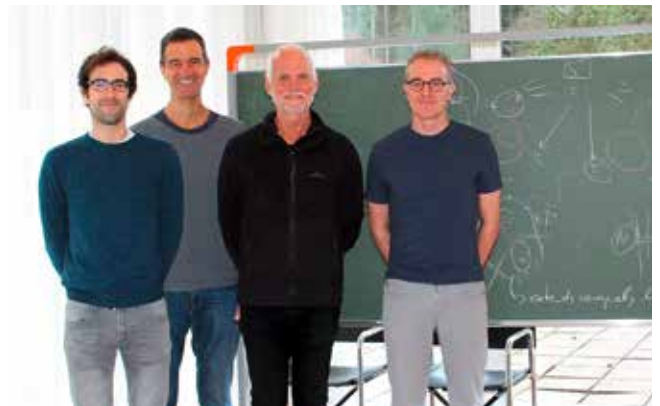
*S. Leyffer, P. Belotti*



*E. Lokharu, M. H. Wheeler*



*R. T. Zivaljevic, G. Panina, D. Jojic*



*J. P. Erde, R. Diestel, G. Whittle, R. Pendavingh*



*S. S. Starchenko, Y. Peterzil*



## 2.10. Oberwolfach Leibniz Fellows

Im Rahmen des Nachwuchsförderprogramms Oberwolfach Leibniz Fellows verbrachten die folgenden Personen im Jahr 2019 einen Forschungsaufenthalt in Oberwolfach:

Within the program for junior researchers, Oberwolfach Leibniz Fellows, the following persons spent a research stay in Oberwolfach in the year 2019:

**Proietti, Valerio (Copenhagen)** **06.01.-23.02.2019**  
external guest researcher:  
Nishikawa, Shintaro (University Park) 31.01.-02.02.2019

**So, Tse Leung (Southampton)** **03.02.-27.04.2019**

**Biswas, Arindam (Wien)** **05.05.-27.07.2019**  
external guest researcher:  
Saha, Jyoti Prakash (Bhopal) 30.06.-27.07.2019

**de Freitas Pessoa, Leandro (Teresina)** **02.06.-31.07.2019**  
external guest researcher:  
Setti, Alberto G. (Como) 18.06.-20.06.2019

**Grinberg, Darij (Minneapolis)** **14.07.-31.08.2019**

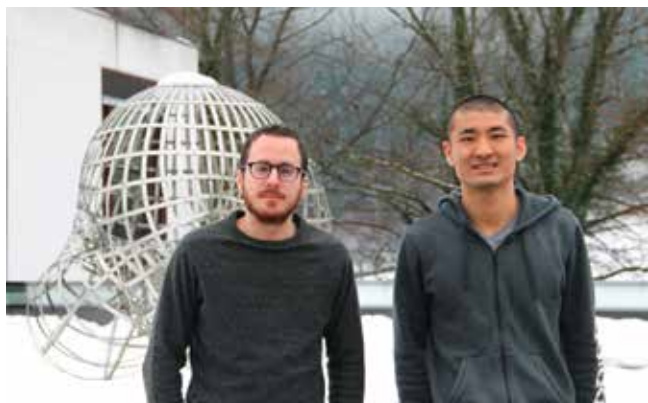
**Boos, Magdalena (Bochum)** **28.07.-23.08.2019**  
**Franzen, Hans (Bochum)** **28.07.-23.08.2019**  
external guest researcher:  
Brecan, Ana-Maria (Bayreuth) 15.08.-23.08.2019

**Gügümcü, Neslihan (Izmir)** **25.08.-21.09.2019**

**Acu, Bahar (Evanston)** **22.09.-23.11.2019**  
external guest researchers:  
Niederkrueger, Klaus (Villeurbanne) 29.09.-05.10.2019  
Gironella, Fabio (Budapest) 03.11.-09.11.2019  
Moreno, Agustin (Augsburg) 03.11.-09.11.2019  
Marinkovic, Aleksandra (Belgrade) 17.11.-22.11.2019

**Palvannan, Bharathwaj (Taipei)** **22.09.-02.11.2019**  
external guest researchers:  
Lee, Jungwon (Ulsan) 22.09.-28.09.2019  
Masdeu, Marc (Bellaterra) 27.10.-02.11.2019  
Williams, Christopher D. (London) 27.10.-02.11.2019

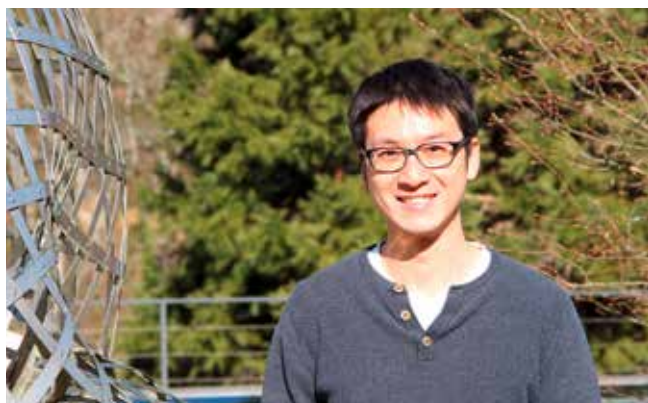
**Mahatab, Kamalakshya (Trondheim)** **03.11.-21.12.2019**



*V. Proietti, S. Nishikawa*



*J. P. Saha, A. Biswas*



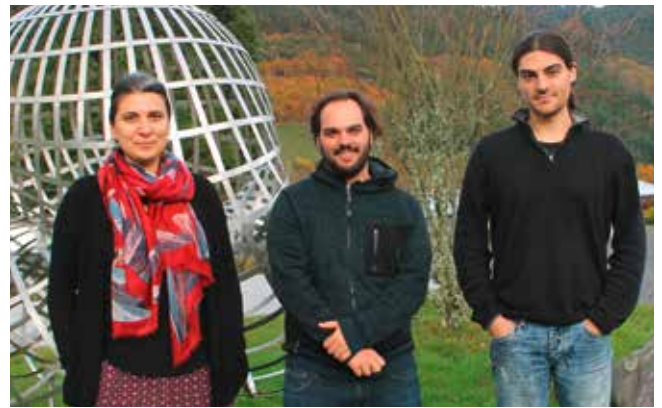
*T. L. So*



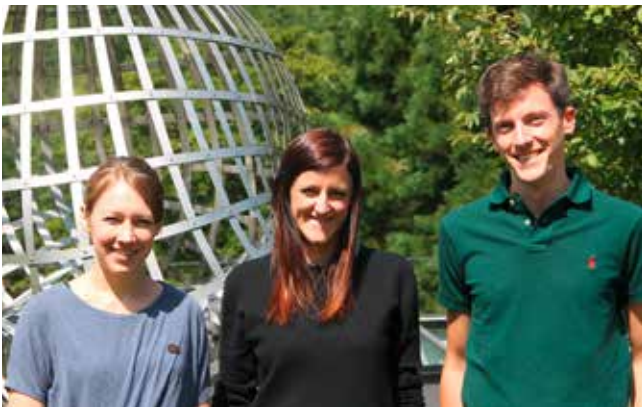
*L. de Freitas Pessoa, A. G. Setti*



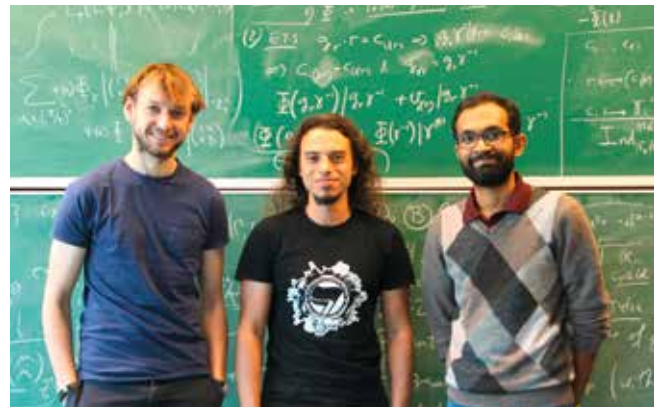
*D. Grinberg*



*B. Acu, A. Moreno, F. Gironella*



*M. Boos, A.-M. Breca, H. Franzen*



*C. D. Williams, M. Masdeu, B. Palvannan*



*N. Ggmcu*



*K. Mahatab*



## 2.11. Publikationen 2019

Das MFO unterstützt die Idee von Open Access. Daher sind alle Publikationen auf der Webseite [www.mfo.de](http://www.mfo.de) elektronisch frei verfügbar (mit Ausnahme der Buchreihe Oberwolfach Seminars bei Springer Nature).

### Oberwolfach Reports (OWR)

OWR wird in Zusammenarbeit mit dem Publishing House der EMS veröffentlicht und enthält die Ergebnisse der Workshops, Miniworkshops und Arbeitsgemeinschaften in Form von erweiterten Abstracts der Vorträge. 2019 sind die Bände OWR 16.1 bis 16.4 mit mehr als 3.600 Seiten erschienen.



## 2.11. Publications 2019

The MFO supports the idea of open access. Hence, all publications are freely available on the website [www.mfo.de](http://www.mfo.de) (with the exception of the book series Oberwolfach Seminars from Springer Nature).

### Oberwolfach Reports (OWR)

OWR is published in cooperation with the EMS publishing house and contains extended abstracts of the talks in the Workshops, Mini-Workshops, and Arbeitsgemeinschaften. In 2019, the issues OWR 16.1 to 16.4 were published with more than 3,600 pages in total.



### Oberwolfach Preprints (OWP)

In OWP werden Resultate von längerfristigen Forschungsaufenthalten (RiP und OWLF) publiziert, aber auch von mathematischen Vorträgen am MFO im Rahmen von besonderen Veranstaltungen, z.B. der Oberwolfach Vorlesung. 2019 sind die folgenden Preprints erschienen:

- Cataland: Why the Fuß?  
(OWP-2019-01) Stump, Christian; Thomas, Hugh; Williams, Nathan
- A Function Algebra Providing New Mergelyan Type Theorems in Several Complex Variables  
(OWP-2019-02) Falcó, Javier; Gauthier, Paul Montpetit; Manolaki, Myrto; Nestoridis, Vassili
- Time Discretization Schemes for Hyperbolic Systems on Networks by  $\varepsilon$ -Expansion  
(OWP-2019-03) Altmann, Robert; Zimmer, Christoph
- Applications of BV Type Spaces  
(OWP-2019-04) Appell, Jürgen; Bugajewska, Daria; Kasprzak, Piotr; Merentes, Nelson; Reinwand, Simon; Sánchez, José Luis
- Hölder Continuity of the Spectra for Aperiodic Hamiltonians  
(OWP-2019-05) Beckus, Siegfried; Bellissard, Jean; Cornean, Horia
- Group Algebras of Compact Groups. A New Way of Producing Group Hopf Algebras over Real and Complex Fields: Weakly Complete Topological Vector Spaces  
(OWP-2019-06) Hofmann, Karl Heinrich; Kramer, Linus

### Oberwolfach Preprints (OWP)

OWP mainly contains research results related to a longer stay in Oberwolfach (RiP and OWLF), but this can also include an Oberwolfach Lecture, for example. The following Preprints were published in 2019:

- Weighted Surface Algebras: General Version  
(OWP-2019-07) Erdmann, Karin; Skowroński, Andrzej
- On a Group Functor Describing Invariants of Algebraic Surfaces  
(OWP-2019-08) Dietrich, Heiko; Moravec, Primož
- The First Hochschild Cohomology as a Lie Algebra  
(OWP-2019-09) Rubio y Degrassi, Leonard; Schroll, Sibylle; Solotar, Andrea
- On the Lie Algebra Structure of  $HH^1(A)$  of a Finite-Dimensional Algebra  $A$   
(OWP-2019-10) Linckelmann, Markus; Rubio y Degrassi, Leonard
- Minimal Codimension One Foliation of a Symmetric Space by Damek-Ricci Spaces  
(OWP-2019-11) Knieper, Gerhard; Parker, John R.; Peyerimhoff, Norbert
- The Fourier Transform on Harmonic Manifolds of Purely Exponential Volume Growth  
(OWP-2019-12) Biswas, Kingshook; Knieper, Gerhard; Peyerimhoff, Norbert
- The Becker-Gottlieb Transfer: a Geometric Description  
(OWP-2019-13) Wang, Yi-Sheng
- Chirality of Real Non-Singular Cubic Fourfolds and Their Pure Deformation Classification  
(OWP-2019-14) Finashin, Sergey; Kharlamov, Viatcheslav
- Experimenting with Symplectic Hypergeometric Monodromy Groups  
(OWP-2019-15) Detinko, Alla; Flannery, Dane; Hulpke, Alexander
- Congruences Associated with Families of Nilpotent Subgroups and a Theorem of Hirsch  
(OWP-2019-16) Aivazidis, Stefanos; Müller, Thomas
- On Residuals of Finite Groups  
(OWP-2019-17) Aivazidis, Stefanos; Müller, Thomas
- A Quantitative Analysis of the "Lion-Man" Game  
(OWP-2019-18) Kohlenbach, Ulrich; López-Acedo, Genaro; Nicolae, Adriana
- On Co-Minimal Pairs in Abelian Groups  
(OWP-2019-19) Biswas, Arindam; Saha, Jyoti Prakash
- On a Cheeger Type Inequality in Cayley Graphs of Finite Groups  
(OWP-2019-20) Biswas, Arindam
- A Cheeger Type Inequality in Finite Cayley Sum Graphs  
(OWP-2019-21) Biswas, Arindam; Saha, Jyoti Prakash
- Group-Graded Rings Satisfying the Strong Rank Condition  
(OWP-2019-22) Kropholler, Peter H.; Lorenzen, Karl
- Groups with Spanier-Whitehead Duality  
(OWP-2019-23) Nishikawa, Shintaro; Proietti, Valerio
- Reflective Prolate-Spheroidal Operators and the KP/KdV Equations  
(OWP-2019-24) Casper, W. Riley; Grünbaum, F. A.; Yakimov, Milen; Zurrián, Ignacio Nahuel
- Matchings and Squarefree Powers of Edge Ideals  
(OWP-2019-25) Erey, Nursel; Herzog, Jürgen; Hibi, Takayuki; Saeedi Madani, Sara
- Global Solutions to Stochastic Wave Equations with Superlinear Coefficients  
(OWP-2019-26) Millet, Annie; Sanz-Solé, Marta



## Schnappschüsse moderner Mathematik aus Oberwolfach

In den „Schnappschüssen moderner Mathematik aus Oberwolfach“ bereiten Teilnehmerinnen und Teilnehmer der wissenschaftlichen Programme des MFO einen besonders spannenden Aspekt ihrer Forschung für die interessierte Öffentlichkeit auf. Im Jahr 2019 sind insgesamt 21 Schnappschüsse aus unterschiedlichen mathematischen Gebieten erschienen:

- Snake graphs, perfect matchings and continued fractions (No. 1/2019)  
Schiffler, Ralf
- On radial basis functions (No. 2/2019)  
Buhmann, Martin; Jäger, Janin
- Diophantine equations and why they are hard (No. 3/2019)  
Pasten, Hector
- Positive Scalar Curvature and Applications (No. 4/2019)  
Rosenberg, Jonathan; Wraith, David
- Algebra, matrices, and computers (No. 5/2019)  
Detinko, Alla; Flannery, Dane; Hulpke, Alexander
- Counting self-avoiding walks on the hexagonal lattice (No. 6/2019)  
Duminil-Copin, Hugo
- Random permutations (No. 7/2019)  
Betz, Volker
- Nonlinear Acoustics (No. 8/2019)  
Kaltenbacher, Barbara; Brunnhuber, Rainer
- On Logic, Choices and Games (No. 9/2019)  
Oliva, Paulo
- Limits of graph sequences (No. 10/2019)  
Klimošová, Tereza
- Configuration spaces and braid groups (No. 11/2019)  
Jiménez Rolland, Rita; Xicoténcatl, Miguel A.
- Analogue mathematical instruments: Examples from the “theoretical dynamics” group (France, 1948–1964) (No. 12/2019)  
Petitgirard, Loïc
- Touching the transcendentals: tractional motion from the birth of calculus to future perspectives (No. 13/2019)  
Milici, Pietro
- Mixed-dimensional models for real-world applications (No. 14/2019)  
Nordbotten, Jan Martin
- Deep Learning and Inverse Problems (No. 15/2019)  
Arridge, Simon; de Hoop, Maarten; Maass, Peter; Öktem, Ozan; Schönlieb, Carola; Unser, Michael
- Expander graphs and where to find them (No. 16/2019)  
Khukhro, Ana
- Formation Control and Rigidity Theory (No. 17/2019)  
Zelazo, Daniel; Zhao, Shiyu

## Snapshots of modern mathematics from Oberwolfach

In the “snapshots of modern mathematics from Oberwolfach” participants of the scientific programs at the MFO explain an especially exciting aspect of their research to an interested public. 21 snapshots from distinct mathematical areas have been published in 2019:

- A surprising connection between quantum mechanics and shallow water waves (No. 18/2019)  
Fillman, Jake; VandenBoom, Tom
- The Mathematics of Fluids and Solids (No. 19/2019)  
Kaltenbacher, Barbara; Kukavica, Igor; Lasiecka, Irena; Triggiani, Roberto; Tuffaha, Amjad;  
Webster, Justin
- The Interaction of Curvature and Topology (No. 20/2019)  
Kordaß, Jan-Bernhard
- Is it possible to predict the far future before the near future is known accurately? (No. 21/2019)  
Gander, Martin J.



## 3. Infrastruktur und Finanzen

### 3.1. Übersicht der Bereiche

Die wissenschaftliche Arbeit der Forschungsgäste wird durch eine effiziente Infrastruktur ermöglicht.

Von besonderer Bedeutung ist die Bibliothek, die in der mathematischen Forschung eine ähnliche Rolle spielt wie das Labor in den Naturwissenschaften. Die Bibliothek des MFO zählt zu den weltweit besten Spezialbibliotheken in der Mathematik und steht den Gästen rund um die Uhr zur Verfügung.

Daneben spielt der Bereich der Informationstechnologie eine wichtige Rolle, sowohl direkt für die wissenschaftliche Arbeit (elektronische Publikationen, Datenbanken und mathematische Software), als auch für die weltweite Kommunikation der Forschenden untereinander (Email, Internet und Informationsdienste).

Zur Planung, Durchführung und Begleitung der wissenschaftlichen Programme waren am Institut etwa 23 Stellen in den Bereichen der wissenschaftlichen Verwaltung, Bibliothek, IT-Abteilung, Verwaltungsleitung, Öffentlichkeitsarbeit, Gästebetreuung und Hauswirtschaft besetzt. Für die effiziente, konzentrierte Arbeit der Gäste am MFO sind dabei die abgeschiedene Lage, die hervorragende wissenschaftliche Infrastruktur, und nicht zuletzt auch die ideale Betreuung einschließlich Unterbringung und Verpflegung im Gästehaus, direkt neben dem Tagungs- und Bibliotheksgebäude, wichtige Faktoren.

### 3.2 Bibliothek

Die Bibliothek des MFO ist für die Forschungsgäste in Oberwolfach das wichtigste Arbeitsmittel. Sie wird intensiv von Teilnehmenden aller Programme genutzt. Viele Mathematiker ziehen eine Einladung nach Oberwolfach anderen Einladungen vor, da sie am MFO Literatur vorfinden, die für sie sonst nicht zugänglich ist. Neben dem hohen internationalen Standard des wissenschaftlichen Programms und den exzellenten Rahmenbedingungen für den persönlichen Gedankenaustausch ist die Bibliothek ein wichtiger Grund für das hohe Ansehen des MFO weltweit.

Der hohe Stellenwert der Bibliothek wird auch deutlich in dem großen Engagement verschiedener Stiftungen wie der Klaus Tschira Stiftung gGmbH, der Marga und Kurt Möllgaard-Stiftung, der VolkswagenStiftung sowie der Carl Friedrich von Siemens Stiftung. So haben die Klaus Tschira

## 3. Facilities and Finances

### 3.1. Overview on the divisions

The MFO has set up an excellent infrastructure for scientific research activities.

The library represents a vital part of this infrastructure and plays an important role, similar to laboratories in experimental sciences. The MFO's library is one of the world's most excellent libraries in mathematics and can be used by the guest researchers 24 hours a day.

But also information technology is of great importance for assisting research activities (electronic publications, database and mathematical software), and also to ensure worldwide communication among the scientific community (email, internet, and information services).

For the planning and realization of the scientific program approximately 23 positions in various divisions, such as scientific and administration management, library, IT-service, outreach and media, guest service, and housekeeping are provided. Besides the excellent scientific infrastructure it is also the Institute's remote location, and the excellent service with board and lodging in our guest house close to the conference and library building, that guarantees efficient and concentrated working conditions for our guests.

### 3.2 Library

The library is the most important working tool for scientific research in Oberwolfach. It is used intensively by participants of all scientific programs. Many mathematicians prefer an invitation to Oberwolfach to other invitations because they find literature here that is otherwise unavailable for them. In addition to the high international standard of the scientific program and the excellent conditions for the face-to-face exchange of ideas, the library is an important factor for the high reputation of the MFO worldwide.

The high significance of the library is also reflected in the great commitment of various foundations, such as the Klaus Tschira Stiftung gGmbH, the Marga and Kurt Möllgaard-Foundation, the Volkswagen Foundation and the Carl Friedrich von Siemens Foundation. For example,

Stiftung und die VolkswagenStiftung zu gleichen Teilen den Erweiterungsbau der Oberwolfacher Bibliothek finanziert und damit Platz für etwa 20 weitere Jahre geschaffen. Die Carl Friedrich von Siemens Stiftung unterstützt die Oberwolfacher Bibliothek seit 1999 mit einem regelmäßigen Betrag für den Erwerb von Büchern. In 2015-2016 konnte durch Mittel der VolkswagenStiftung die Informations- und Kommunikations-Infrastruktur der Bibliothek modernisiert und eine Kompaktanlage für die gebundenen Zeitschriften eingerichtet werden. Darüber hinaus hat die Deutsche Forschungsgemeinschaft (DFG) seit 2004 zahlreiche Projekte im Rahmen des Förderprogramms „Wissenschaftliche Literaturversorgungs- und Informationssysteme“ finanziert.

### Bibliotheksprofil

Die Oberwolfacher Bibliothek hat die Aufgabe, die Fachliteratur aus allen Bereichen der Mathematik sowie aus angrenzenden Gebieten so vollständig wie möglich zu erwerben und bereit zu stellen. Im Fokus stehen dabei insbesondere mathematische Fachzeitschriften sowie Monographien und Kongressberichte der relevanten Fachverlage. Schwerpunktmäßig werden Bücher in gedruckter Form angeschafft, Zeitschriften hingegen bevorzugt elektronisch. Aber auch E-Books werden seit 2014 gezielt und in Ergänzung zum gedruckten Bestand erworben. Die relevante Literatur wird gekauft, im Tausch gegen institutseigene Publikationen erworben oder als Geschenk empfangen.

Die Bibliothek des MFO ist eine reine Präsenzbibliothek und für die Forschungsgäste rund um die Uhr geöffnet. Sämtliche Bestände stehen innerhalb der Bibliothek ohne Einschränkung zur Verfügung. Es findet keinerlei Ausleihe statt, auch Fernleihe ist nur in begründeten Einzelfällen möglich (z.B. bei Alleinbesitz).

Das MFO nimmt seit 1995 am Südwestdeutschen Bibliotheksverbund (SWB) teil. Die Arbeit im Verbund sowie die durch das Bibliotheksservice-Zentrum Baden-Württemberg (BSZ) als betreuende Institution bereitgestellte Software bedeuten für das Institut eine erhebliche Erleichterung bei der Verwaltung der Bibliotheksbestände.

### Bestand

Zum Bestand der Bibliothek gehörten in 2019 ca. 66.300 gedruckte Bücher, davon 44.600 Monographien und 8.700 Kongressberichte. Die Zahl der E-Books konnte auf über 24.000 gesteigert werden. Vor allem durch DFG-Nationallizenzen und weitere Allianzlizenzen stehen am

the Klaus Tschira Stiftung and the Volkswagen Foundation have funded the extension of the library building in equal parts, creating space for another 20 years. The Carl Friedrich von Siemens Foundation has supported the Oberwolfach library since 1999 with a regular amount for the purchase of books. In 2015-2016 the MFO received support from the Volkswagen Foundation to modernize the library infrastructure of information and communication and to install compact shelves for the bound journal volumes. In addition, since 2004, the Deutsche Forschungsgemeinschaft (German Research Foundation, DFG) has financed numerous projects within the funding program "Scientific Library Services and Information Systems".

### Library Profile

The task of the library in Oberwolfach is to acquire and to provide specialist literature from all fields of mathematics and its neighboring areas as complete as possible. In particular, the acquisition focuses on mathematical journals and monographs as well as on conference proceedings of the relevant academic publishers. Books are primarily acquired in printed form, while journals are preferred electronically. However, since 2014 e-books have also been systematically acquired in addition to the printed stock. The relevant literature is either purchased, acquired in exchange for publications of the Institute, or received as a gift.

The library of the MFO is a reference library and can be used by our research guests 24 hours a day. The complete collection is available within the library without restriction. There is no lending system, interlibrary lends are only possible in justified individual cases (e.g. in the case of exclusive possession).

Since 1995 the MFO has been a member of the Südwestdeutscher Bibliotheksverbund (SWB), which, together with the software provided by the Bibliotheksservice-Zentrum Baden-Württemberg (BSZ) as supporting institution, facilitates the cataloging of our library collection enormously.

### Inventory

In 2019, the stock of the library contained about 66,300 printed books, in particular 44,600 monographs and 8,700 conference proceedings. The number of e-books has increased to more than 24,000. Including the national and alliance licenses, the MFO can offer access to



MFO über 9.500 E-Journals zur Verfügung. Die Zahl der zusätzlich vom MFO abonnierten Zeitschriften in 2019 betrug ca. 950, die meisten davon wurden nur noch als E-Journal bezogen. In den Kompaktregalen befanden sich weiterhin ca. 32.000 gedruckte Zeitschriftenbände, nicht alles davon ist digital erhältlich. In Zukunft werden mehr und mehr Zeitschriften auf einen rein elektronischen Bezug umgestellt, während bei den Büchern die gedruckte Version weiterhin eine große Rolle spielen wird.

### DEAL-Wiley-Vertrag

Am 15. Januar 2019 wurde der Vertrag zwischen dem Verlag Wiley und der Projektgruppe DEAL unterzeichnet. Es war der erste Vertragsabschluss im Projekt DEAL. Durch den Vertrag können knapp 10.000 wissenschaftliche Fachartikel aus Deutschland pro Jahr in Wiley-Zeitschriften im Open Access verfügbar gemacht werden.

Das MFO ist diesem Vertrag am 18. April 2019 beigetreten. Damit haben auch die Nutzer am MFO uneingeschränkten Zugriff auf alle Zeitschriften, die Bestandteil des DEAL-Wiley-Vertrags sind.

### Buchausstellung

Die ständige Buchausstellung gibt interessierten wissenschaftlichen Verlagen die Möglichkeit, ihre Neuerscheinungen im Bereich Mathematik am MFO über einen längeren Zeitraum zu präsentieren. Die Bibliothek des MFO profitiert von dieser Kooperation, indem sie die kostenlos gelieferten Neuerscheinungen in ihren Bestand integrieren kann. 2019 gingen insgesamt 675 Bücher im Rahmen der Buchausstellung in den Bibliotheksbestand ein. Wir danken den folgenden Verlagen für ihre Unterstützung und ihr Mitwirken in unserem Buchausstellungsprogramm:

- American Mathematical Society (AMS)
- Atlantis Press (Co-publishing with Springer)
- Birkhäuser Science
- Cambridge University Press
- De Gruyter GmbH & Co. KG
- Edition am Gutenbergplatz Leipzig EAG.LE
- European Mathematical Society Publishing House
- International Press of Boston, Inc.
- Iwanami Shoten Publishers
- Mathematical Society of Japan

more than 9,500 e-journals, where the MFO has subscribed to about 950 additional journals in 2019, most of them in the e-only version. Additionally, the compact shelves of the library contain about 32,000 bound journal volumes, where not all of them are also electronically available. In the future, more and more journals will be subscribed electronically, whereas printed books will continue to play a major role.

### DEAL-Wiley-Agreement

On 15 January 2019, the agreement between Wiley and Projekt DEAL has been concluded. It is the first such contract concluded by Projekt DEAL. Through this agreement, nearly 10,000 research articles by German authors will now be published immediately open access.

The MFO has joined this agreement on 18 April 2019. This means that users at the MFO also have unrestricted access to all journals that are part of the DEAL-Wiley contract.

### Book exhibition

The permanent book exhibition enables academic publishers to present their new publications in the field of mathematics at the MFO for a certain period of time. The library of the MFO benefits from this cooperation, because all books from the exhibition can be included free of charge into the inventory of the library. In the year 2019 the library received a total of 675 books this way. We wish to thank the following publishers for taking part in our book exhibition program:

- Oxford University Press
- Presses polytechniques et universitaires romandes / EFPL Press
- Princeton University Press
- Société Mathématique de France (SMF)
- Society for Industrial and Applied Mathematics (SIAM)
- Springer Nature
- Springer Spektrum
- XYZ Press by AwesomeMath (distributed by AMS)

### Oberwolfach Photo Collection

Zum Bibliotheksbestand gehört eine umfangreiche Sammlung an Mathematiker-Porträts, zusammengetragen durch Herrn Prof. Dr. Konrad Jacobs, Erlangen. Diese Sammlung ist im Jahr 2004 mit Hilfe des Springer Verlags Heidelberg digitalisiert worden; sie steht im Internet mit verschiedenen Recherche-Funktionen frei zur Verfügung. Die zugrunde liegende Datenbank ist eine Eigenentwicklung des MFO. Die Sammlung wird laufend ergänzt durch institutseigene Aufnahmen sowie durch Beiträge von Mathematikern weltweit. Sie wird unter anderem für den Bereich Mathematik in der Wikipedia unter den Bedingungen der Creative Commons License Attribution-Share Alike 2.0 Germany sowie in zunehmendem Maße von Verlagen für deren Publikationen genutzt.

Ende 2019 waren ca. 21.400 Fotos in der Datenbank enthalten.

### Oberwolfach Digital Archive

Als Angebot für die mathematische Gemeinschaft und als weiterer Beitrag zur wissenschaftlichen Arbeit von Oberwolfach schuf das MFO das Oberwolfach Digital Archive (ODA). Das ODA umfasst digitalisierte Dokumente und Ergebnisse von Oberwolfach Workshops zurückgehend bis ins Jahr 1944.

Drei Arten von Dokumenten sind enthalten:

- Tagungsberichte: maschinengeschriebene Abstracts von gehaltenen Vorträgen am Institut
- Vortragsbücher: handgeschriebene Abstracts von gehaltenen Vorträgen am Institut
- Gästebücher: Teilnehmerlisten der Workshops mit Unterschriften

Das Oberwolfach Digital Archive wurde seit Beginn des Jahres 2010 vom Bibliothesservice-Zentrum Baden-Württemberg (BSZ) gehostet

### Oberwolfach Photo Collection

The inventory of the library includes a large collection of mathematician portraits, collected by Prof. Dr. Konrad Jacobs, Erlangen. This collection has been digitized in the year 2004 with support of the publisher Springer Heidelberg. It is freely available on the internet with a variety of search functions. The underlying database is an in-house development of the MFO. The collection is continuously supplemented by in-house photographs and contributions by mathematicians worldwide. Among other things, the collection is used for the field of mathematics in Wikipedia according to the conditions of the Creative Commons License Attribution-Share Alike 2.0 Germany. Increasingly, publishers use the collection as well for their publications.

By the end of 2019 the database contained approximately 21,400 photos.

### Oberwolfach Digital Archive

As a service to the mathematical community and a further contribution to the scientific work of Oberwolfach, the MFO created the Oberwolfach Digital Archive (ODA). The ODA comprises digitized documents and results of the Oberwolfach Workshops dating as far back as 1944.

Three types of documents are in this archive:

- Workshop Reports: containing machine written abstracts of given talks at the Institute
- Books of Abstracts: containing handwritten abstracts of given talks at the Institute
- Guest Books: containing lists of workshop participants with their signatures

Since its beginning in 2010, the Oberwolfach Digital Archive was hosted and operated by the Bibliothekservice-Zentrum Baden-Württemberg



und betrieben. 2018 stellte das BSZ diesen Dienst ein. Seit dem 1. April 2019 ist die neue ODA-Benutzeroberfläche, basierend auf der Software DSpace, unter [oda.mfo.de](http://oda.mfo.de) verfügbar.

Auf der neuen Plattform wurden auch neue Funktionen implementiert. Tagungsberichte werden nun zusammen mit dem zugehörigen Gästebucheintrag und dem zugehörigen Eintrag im Vortragsbuch auf einer kombinierten Seite angezeigt.

### 3.3. IT

Die IT-Abteilung des MFO stellt den Institutsangehörigen, den Gremien und den Gästen effiziente IT-Arbeitsumgebungen zur Verfügung. Sie unterstützt die Bibliothek und den Bereich der Öffentlichkeitsarbeit bei Diensten für die mathematische Community und die interessierte Öffentlichkeit.

#### Verwaltungsbereich

Die Verwaltung der Tagungen und der längeren Forschungsaufenthalte erfolgt mit der am MFO entwickelten Software „owconf“, die Anforderungen von wissenschaftlicher Begutachtung, Konferenzmanagement und Hotelsoftware in sich vereinigt. Im Jahr 2019 wurde die Software um die Möglichkeit einer elektronischen Anmeldung erweitert. Zukünftig können sich alle Forschungsgäste im Vorfeld ihres Aufenthalts online über eine Webmaske registrieren. Dies erleichtert insbesondere die Arbeit der Rezeption und Verwaltung. Die Einrichtung erfolgte in Abstimmung mit der Datenschutzbeauftragten des MFO entsprechend der Vorgaben der DSGVO.

Kommerzielle Software wird in den Bereichen Finanzbuchhaltung, Personalverwaltung sowie beim Bibliothekskatalog und der Literaturrecherche eingesetzt.

#### Gästebereich

Die Gäste erhalten persönliche Nutzerkonten, drahtlosen und kabelgebundenen Internetzugang, SMTP-Server-Zugang sowie Scan- und Druckmöglichkeiten. Die Terminal-Server-Arbeitsplätze bieten neben den üblichen Office-Anwendungen Zugriff auf einen Compute-Server mit Maple, Mathematica, Magma sowie einer Vielzahl freier mathematischer Software. Wegen der relativ kurzen Aufenthalte der Gäste sind die IT-Angebote so intuitiv wie möglich gestaltet.

(BSZ). In 2018, the BSZ decided to shut down this service. As of 1. April, 2019, the new ODA interface, based on the software DSpace, is available at [oda.mfo.de](http://oda.mfo.de).

With this new platform, we also implemented new functionalities. Workshop Reports are now presented together with the corresponding Guest Book entry as well as the corresponding Book of Abstracts entry on one combined page.

### 3.3. IT

The IT department of the MFO provides an efficient IT infrastructure for the employees of the Institute, the committees, and the visiting scientists. Furthermore, the IT department supports the library and the public relations of the MFO with regard to services for the mathematical community and the interested public.

#### Administrative sector

The databased software “owconf”, developed in-house, handles all tasks arising from scientific management, conference management and guesthouse administration. In 2019, the software was extended to include the possibility of electronic registration. In the future, all our guests will be able to register online with the aid of a web mask prior to their stay. This particularly facilitates the work of the reception and administration. The extension was set up in coordination with the MFO's data protection officer and in accordance with the requirements of the GDPR.

Commercial software is used for financial accounting and human resources, for the library catalog and the literature search portal.

#### Guests' working environments

Guest scientists are provided with personal accounts, wifi and cable-bound ethernet connection, SMTP server access as well as scan and print facilities. Terminal Server workplaces offer the usual office tools together with access to a compute server with Maple, Mathematica, Magma and a range of free mathematical software. Due to the relatively short stays of the guest scientists, the services are designed as easy to use as possible.

Alle Vortragsräume enthalten moderne Präsentationstechnik. Den Gästen steht außerdem ein Videokonferenzsystem zur Verfügung. Die IT-Abteilung unterstützt die Forscherinnen und Forscher in allen technischen Fragen.

### Webdienste

Die Webdienste für die Gäste und die weitere mathematische Community bieten Informationen über die Angebote des MFO, künftige und vergangene Forschungsprogramme und – in Zusammenarbeit mit der Bibliothek – freien Zugang zu Publikationen des Instituts. Die Webseite wurde 2019 aufwändig überarbeitet und insbesondere hinsichtlich Responsivität und Barrierefreiheit verbessert.

Die speziellen Webdienste Oberwolfach Photo Collection und Oberwolfach References on Mathematical Software sind Eigenentwicklungen des MFO.

### Unterstützung der Öffentlichkeitsarbeit

Die IT-Abteilung unterstützt die Öffentlichkeitsarbeit des MFO, insbesondere die „Schnappschüsse moderner Mathematik aus Oberwolfach“, für deren Produktion sie die Infrastruktur bereitstellt. Außerdem betreut die IT des MFO das Oberwolfacher Museum für Mineralien und Mathematik „MiMa“. Dieses wird von der Gemeinde Oberwolfach, dem Verein der Freunde von Mineralien und Bergbau Oberwolfach und dem MFO gemeinsam betrieben (s. Abschnitt 3.4.: Öffentlichkeitsarbeit).

Ausgewählte Exponate werden auch direkt am Institut den Forschungsgästen über einen Touchscreen bereitgestellt. Dieser wurde im Jahr 2019 in Zusammenarbeit mit IMAGINARY erneuert und die Software überarbeitet. Dabei wurden die angebotenen Programme u.a. um den „Snapshot-Slider“ erweitert, ein Programm, mit dem man alle verfügbaren Schnappschüsse durchsehen und lesen kann.

### Sicherheit und Datenschutz

Informationssicherheit und Datenschutz sind wichtige Aufgaben der IT, die bei allen Arbeiten mit bedacht werden.

Schwerpunkte in diesem Jahr waren die Aktualisierung der Windowsdomäne und der Austausch der Arbeitsplatz-PCs in der Verwaltung sowie die Modernisierung der aktiven Netzwerkkomponenten.

The IT section maintains modern presentation equipment in all lecture rooms, a video conference system and offers technical support to guest researchers on all technical issues.

### Web services

Web services for the guest scientists and the wider mathematical community include information about MFO facilities, future and past research programs at the MFO and open access to publications of the Institute in collaboration with the MFO library. The website was extensively revised in 2019 and improved in particular with regard to responsiveness and accessibility.

The special web services Oberwolfach Photo Collection and Oberwolfach References on Mathematical Software have been developed in-house.

### Support of outreach activities

The IT section also supports the outreach activities of the MFO, in particular it supplies the infrastructure for producing the “snapshots of modern mathematics from Oberwolfach”. Moreover, the IT section services the Museum for Minerals and Mathematics “MiMa”. It is run jointly by the local authority, the association of the Friends of Minerals and Mining and the MFO – all seated at Oberwolfach (see section 3.4.: Outreach and Media).

Selected exhibits are also provided to our research guests at the Institute on a touchscreen. In 2019 the touchscreen was replaced and the software was revised in cooperation with IMAGINARY. Among others the station was complemented by the “Snapshot Slider”, an application to browse through and read in all available snapshots.

### Security and data protection

Data security and data protection are important tasks, taken into account throughout.

The focus of this year was to update the Windows domain and to replace PCs in the administration as well as to modernize the network components.



### 3.4. Öffentlichkeitsarbeit

Das MFO richtet sich in seiner Öffentlichkeitsarbeit sowohl an wissenschaftliche als auch an nicht-wissenschaftliche Zielgruppen. Die wissenschaftliche Kernzielgruppe, bestehend aus Mathematikern und Mathematikerinnen sowie Forschenden in angrenzenden Gebieten, erhält regelmäßig Informationen über anstehende Veranstaltungen und wissenschaftliche Programme des MFO. Das MFO verschickt dazu einen halbjährlichen Rundbrief per Email. Außerdem sendet das Institut mehrmals im Jahr Poster und Flyer mit Informationen über Veranstaltungen und Programme an etwa 400 verschiedene Institutionen. Eine weitere wichtige Informationsquelle ist die Website des Instituts.

Zusätzlich zur wissenschaftlichen Kernzielgruppe richtet sich das MFO an im weiteren Sinne forschungsinteressierte Gruppen, insbesondere an Schülerinnen und Schüler, Studierende, Lehrkräfte und Wissenschaftsredaktionen, sowie an die breite Öffentlichkeit. Das Hauptziel bei diesen Zielgruppen ist es, das Verständnis für die Bedeutung der Mathematik und der modernen mathematischen Forschung zu fördern. Das MFO verfolgt dazu drei miteinander vernetzte Aktivitäten: Das Institut ist Mitbetreiber des Museums für Mineralien und Mathematik in Oberwolfach, es ist Herausgeber der Open-Source Schriftenreihe „Schnappschüsse moderner Mathematik aus Oberwolfach“ und es ist Teilhaber und Kooperationspartner der IMAGINARY gGmbH.

#### Mathematik im MiMa

Das Mathematische Forschungsinstitut Oberwolfach betreibt seit 2010 gemeinsam mit dem Verein der Freunde von Mineralien und Bergbau und der Gemeinde Oberwolfach das MiMa – Museum für Mineralien und Mathematik. Das Museum zeigt eine einzigartige Sammlung an Mineralien aus dem gesamten Schwarzwald und erklärt ihre kristallinen Formen und Symmetrien in interaktiven mathematischen Installationen.

Der mathematische Teil der Ausstellung bietet kunstvolle Einblicke in die Mathematik und lädt dazu ein, mathematische Phänomene spielerisch zu erforschen. Sowohl Konzepte der angewandten als auch der reinen Mathematik werden in interaktiven Programmen, Hands-on-Exponaten und Bildern dargestellt. Ein deutlicher Schwerpunkt liegt auf den mathematischen Grundlagen der Kristallografie. Durch diese Verknüpfung von Mathematik und Mineralogie bietet das Museum einen interdisziplinären Zugang zu beiden Wissenschaften und vereint zwei Besonderheiten der Region unter einem Dach.

### 3.4. Outreach and Media

In its outreach the MFO addresses both academic and non-academic target groups. The core academic target group, consisting of mathematicians and researchers in adjacent areas, regularly receives information on forthcoming events and scientific programs of the MFO. The MFO sends a biannual newsletter via email. In addition, several times a year, the MFO sends posters and flyers with information on events and programs to around 400 institutions around the world. A further important source of information is the website of the Institute.

In addition to the core academic target group, the MFO addresses groups interested in research in a broader sense, in particular pupils, students, teachers and science journalists, as well as the general public. The main objective with regard to these audiences is to promote the understanding of the importance of mathematics and modern mathematical research. The MFO pursues three interlinked activities: The Institute is co-operator of the Museum of Minerals and Mathematics in Oberwolfach, it is the publisher of the open-source publication “snapshots of modern mathematics from Oberwolfach” and it is shareholder and cooperation partner of the IMAGINARY gGmbH.

#### Mathematics at the MiMa

Since 2010 the Mathematisches Forschungsinstitut Oberwolfach engages in the MiMa – Museum for Minerals and Mathematics, together with the association of the Friends of Minerals and Mining in Oberwolfach and the municipality Oberwolfach. The museum shows a one-of-a-kind collection of minerals from all over the Black Forest and explains their forms and symmetries with interactive mathematical applications.

The maths exhibition delivers aesthetic insights into mathematics and enables visitors to playfully explore mathematical phenomena. Interactive programs, hands-on exhibits, and images depict concepts of both applied and pure mathematics. A clear focus is put on the mathematical foundations of crystallography. Through this combination of mathematics and mineralogy, the museum offers an interdisciplinary approach to both sciences and presents two unique features of the region in one single spot.



"Crystal Flight" (Image credits: Wolber Kommunikation)

Die Ausstellung richtet sich an ein breites Publikum. Ein besonderer Schwerpunkt liegt auf den Schulen der Region, für die spezielle Führungen angeboten werden.

Im Jahr 2019 kamen fast 6000 Besucherinnen und Besucher ins MiMa.

### Schnappschüsse moderner Mathematik

Das Ziel der „Schnappschüsse moderner Mathematik aus Oberwolfach“ ist es, mathematische Ideen und Probleme in verständlicher Art und Weise einem breiten Publikum zu vermitteln. Sie sollen spannende Einblicke in die aktuelle mathematische Forschung bieten. Die Schnappschüsse werden von Teilnehmenden des wissenschaftlichen Programms am MFO geschrieben. Ein Team aus Editorinnen und Editoren unterstützt sie bei der Aufbereitung der komplizierten Sachverhalte für ein breites Publikum. Das MFO veröffentlicht die Schnappschüsse frei verfügbar unter einer Creative Commons Lizenz.

Das Schnappschuss-Projekt hat zum Ziel, Verständnis und Wertschätzung für moderne Mathematik und mathematische Forschung in der interessierten Öffentlichkeit weltweit zu fördern. Die angestrebte Leserschaft besteht aus Mathematiklehrkräften, Wissenschaftsjournalistinnen und -journalisten, Studierenden sowie fortgeschrittenen Schülerinnen und Schülern.

Das Projekt wird von Prof. Dr. Carla Cederbaum und Dr. Sophia Jahns koordiniert. Sie sind als Chefreditorinnen für das Editieren der Texte verantwortlich. 2019 haben Dr. David Edward Bruschi, Dr. Moritz Firsching, Dr. Sophia Jahns, Dr. Martin Kalck, Dr. Jan Kohlrus, Daniel Kronberg, Dr. Sara Munday, Dr. Johannes Niediek, Dr. Anja Randecker und Lara Skuppin Schnappschüsse editiert. Im Laufe des Jahres wurden 21 Schnappschüsse publiziert (s. Abschnitt 2.11.: Publikationen).



"Surfer" (Image credits: Wolber Kommunikation)

The exhibition is aimed at a broad audience. A special focus is on the schools of the region, for which special tours are offered.

In 2019 almost 6000 people visited the MiMa.

### Snapshots of modern mathematics

The aim of the "snapshots of modern mathematics from Oberwolfach" is to explain mathematical problems and ideas in an understandable way to a broad audience. They shall provide exiting insights into current mathematical research. The snapshots are written by participants of the scientific program at the MFO. A team of editors assists them in communicating complicated matters to a broad audience. The MFO publishes the snapshots for free download under a Creative Commons license.

The snapshot project is designed to promote the understanding and appreciation of modern mathematics and mathematical research in the interested public world-wide. The targeted readership consists of mathematics teachers, science journalists, undergraduate and advanced high school students.

The project is coordinated by Prof. Dr. Carla Cederbaum and Dr. Sophia Jahns. As senior editors they are responsible for the editing process of the snapshots. In 2019 Dr. David Edward Bruschi, Dr. Moritz Firsching, Dr. Sophia Jahns, Dr. Martin Kalck, Dr. Jan Kohlrus, Daniel Kronberg, Dr. Sara Munday, Dr. Johannes Niediek, Dr. Anja Randecker and Lara Skuppin worked as junior editors. 21 snapshots were published in this year (see section 2.11.: Publications).



## Zusammenarbeit mit IMAGINARY

IMAGINARY startete am MFO anlässlich des Wissenschaftsjahres der Mathematik 2008 als interaktive Wanderausstellung und entwickelte sich über die Jahre zu einer Online-Plattform für interaktive Mathematik-Vermittlung. Seit 2016 ist IMAGINARY eine selbständige gemeinnützige GmbH mit einem breiten Spektrum an Dienstleistungen in der Mathematikkommunikation. Das MFO ist Teilhaber der gGmbH und kooperiert mit IMAGINARY im Bereich seiner Öffentlichkeitsarbeit, insbesondere bei den Schnappschüssen und dem MiMa. Beide Projekte gingen als Teilprojekte aus IMAGINARY hervor und sind heute noch am MFO angesiedelt. Im MiMa unterstützt IMAGINARY das MFO bei der Auswahl und Implementierung neuer Exponate. Die Schnappschüsse werden maßgeblich über die IMAGINARY-Plattform verbreitet sowie auf vielen IMAGINARY-Ausstellungen in der interaktiven Station „Snapshot-Slider“ gezeigt und zum Ausdrucken oder Verschicken angeboten.

## 3.5. Verwaltung und Hauswirtschaft

Aufgrund der Beschlüsse der Gemeinsamen Wissenschaftskonferenz (GWK) erstellt das MFO als Mitglied der Leibniz-Gemeinschaft seit dem Haushaltsjahr 2006 ein Programmbudget als Grundlage für die gemeinsame Finanzierung durch Bund und Länder.

Das Tagungsgebäude liegt dem Gästehaus direkt gegenüber und wurde 1975 mit Mitteln der VolkswagenStiftung erbaut. Es bietet den Forschungsgästen exzellente Arbeitsmöglichkeiten und umfasst die Bibliothek, mehrere Vortragsräume sowie Computerarbeitsplätze. Ferner ist die wissenschaftliche Verwaltung dort untergebracht. Im Mai 2007 konnte der Erweiterungsbau der Bibliothek, finanziert von der Klaus Tschira Stiftung und der VolkswagenStiftung, feierlich eingeweiht werden. Die Nähe von Tagungsgebäude und Gästehaus erweist sich als sehr effizient, bietet sie den Gästen doch rund um die Uhr die Möglichkeit zu kreativer Arbeit, was intensiv genutzt wird. Im Frühjahr 2010 wurde die Sanierung des Gästehauses abgeschlossen.

Der Verwaltungsbereich umfasst derzeit 10,64 besetzte Stellen für die wissenschaftliche Verwaltung (Organisation der Workshops, Öffentlichkeitsarbeit, Drittmittelprojekte), die Bibliothek, die IT sowie für die allgemeine Verwaltung (Finanzverwaltung, Beschaffungswesen, Personal-

## Cooperation with IMAGINARY

IMAGINARY started at the MFO on the occasion of the science year of mathematics in 2008 as an interactive traveling exhibition and developed over the years to an online platform for interactive mathematics communication. In 2016 IMAGINARY became an independent non-profit company offering a wide range of services in mathematics communication. The MFO is a shareholder of the company and cooperates with it within the scope of outreach and media – in particular, with regard to the snapshots and the MiMa. Both projects were once founded as subprojects of IMAGINARY and are continued by the MFO. With regard to the MiMa, IMAGINARY supports the MFO in the selection and implementation of new exhibits. The snapshots are largely distributed via the IMAGINARY platform. They are also presented at many IMAGINARY exhibitions in the interactive “Snapshot-Slider” and offered for printing or mailing.

## 3.5. Administration and housekeeping

According to the resolution of the Joint Science Conference (Gemeinsame Wissenschaftskonferenz GWK), the MFO as a member of the Leibniz Association, has established a budget-plan since 2006 as a basis for the common financing by the federation of Germany and the federal states.

The library building is located immediately opposite the guest house and was built with funds from the Volkswagen Foundation in 1975. Hosting the library, several lecture halls and numerous computer stations it offers excellent working conditions for scientific research. The offices of the scientific administration are also part of this building. The extension of the library, funded by the Klaus Tschira Stiftung and the Volkswagen Foundation was ceremonially inaugurated in May 2007. The short distance between the guest house and the library building has proved very convenient as it offers scientists the possibility to work at any time, which is used extensively. Since spring 2010 the renovation measures in the guest house have been terminated.

The administration encompasses at the moment 10.64 positions, covering scientific administration (planning and organization of the scientific program, public relations, third-party projects), library, IT-services and general administration (financial management, purchasing, personnel

sachbearbeitung, Vertragswesen, usw.) und die Gästebetreuung.

Der Hauswirtschaftsbereich des Instituts unterstützt die Durchführung der wissenschaftlichen Programme, indem die Forschungsgäste im Gästehaus des Instituts Unterkunft und Verpflegung erhalten. Das Gästehaus wurde mit Mitteln der VolkswagenStiftung erbaut und 1967 eingeweiht. Die Wissenschaftler sind überwiegend in Einzelzimmern untergebracht, jedoch gibt es auch acht größere Appartements sowie fünf Bungalows. Dadurch sind auch längere Aufenthalte im Rahmen des RiP-Programms und des Oberwolfach-Leibniz-Fellows-Programms möglich. Der Hauswirtschaftsbereich umfasst insgesamt 13 Stellen für Küche und Zimmerservice sowie für die Pflege von Gebäuden und Grundstück (davon waren 2019 12,89 Stellen besetzt).

administration, contracts, renovation measures etc.) as well as guest liaison and support.

Since board and lodging is provided by the Institute, housekeeping is also an important part of the realization of the scientific program at the MFO. The guest house was built with funds from the Volkswagen Foundation and inaugurated in 1967. Accommodation of the scientists is mainly provided in single rooms. In addition to that, eight apartments and five bungalows enable a longer stay at the MFO within the Research in Pairs program and the Oberwolfach Leibniz Fellows program. The housekeeping department comprises 13 positions for kitchen and room service as well as for the maintenance of the buildings and premises (12.89 positions staffed in 2019).

### 3.6. Finanzielle Übersicht

### 3.6. Financial overview

#### Erlöse 2019

(gerundet auf 1.000 €)

Zuwendung Bund/Länder  
Selbstbewirtschaftungsmittel aus 2018  
Drittmittel  
Spenden  
Sonstige Einnahmen  
Zweckgebundene Reste aus 2018

#### Summe Erlöse

#### Revenues 2019

(rounded to 1,000 €)

Benefits from the federation/federal states 3.246.000  
Benefits from 2018 126.000  
Third party funds 472.000  
Donations 105.000  
Other income 97.000  
Earmarked surpluses 204.000

#### Total revenues:

**4.250.000**

#### Aufwendungen 2019

(gerundet auf 1.000 €)

Personalausgaben  
Materialaufwand  
Aufwand für bezogene Leistungen  
Abschreibungen  
Sonstige Aufwendungen (inklusive Sachausgaben Bibliothek)  
Rückstellungen für zweckgebundene Reste

Investitionen

#### Summe Aufwendungen

#### Expenses 2019

(rounded to 1,000 €)

Personnel department 1.700.000  
Purchases 385.000  
Expenses for drawn benefits 197.000  
Consumption of fixed capital 151.000  
Other expenses (with material expenses for the library) 1.179.000  
Provisions for earmarked surpluses 517.000

Investments 121.000

#### Total expenses:

**4.250.000**



## Erläuterungen

Der Anteil von Drittmitteln, Spenden und sonstigen Einnahmen bezogen auf die Gesamtsumme der Erlöse liegt im Haushaltsjahr 2019 bei 17,2%. Die zweckgebundenen Reste aus 2018 sind dabei nicht berücksichtigt.

## Öffentliche Mittel

Das MFO erhielt im Haushaltsjahr 2019 insgesamt 3,246 Mio. Euro Zuwendung von Bund und Ländern.

## Drittmittel

Die projektbezogenen Drittmittel rekrutierten sich im Haushaltsjahr 2019 insbesondere aus Mitteln der National Science Foundation (NSF), der Simons Foundation und der Carl Friedrich von Siemens Stiftung.

## Förderverein und Oberwolfach Stiftung

Zweckgebundene Spenden erhielt das MFO auch im Haushaltsjahr 2019 vom Förderverein und der Oberwolfach Stiftung. Die Gelder wurden für Reisekostenzuschüsse in besonderen Fällen, für die Unterstützung von Kinderbetreuungskosten, die Beschaffung von Büchern in der Bibliothek und als Zuschuss zu Baumaßnahmen verwendet.

## 3.7. Dank

Ein besonders herzliches Dankeschön gilt den Zuwendungsgebern (Bund und Länder). Weiter gilt unser Dank allen Drittmittelgebern wie der Carl Friedrich von Siemens Stiftung, der National Science Foundation (NSF), der Simons Foundation und der VolkswagenStiftung. Ein besonderes Dankeschön gilt natürlich auch dem Förderverein und der Oberwolfach Stiftung für die großzügige Unterstützung des MFO.

## Explanations

The proportion of private resources (own income, third-party-funds and donations) of the total sum of revenues is 17.2%. Funds carried forward from 2018 are disregarded here.

## Public funding

In the fiscal year 2019 the MFO received 3.246 million Euro funding from the federation and the federal states.

## Third-party funds

Earmarked third party funds in the fiscal year 2019 are mainly composed of the grants from the National Science Foundation (NSF), the Simons Foundation, and the Carl Friedrich von Siemens Foundation.

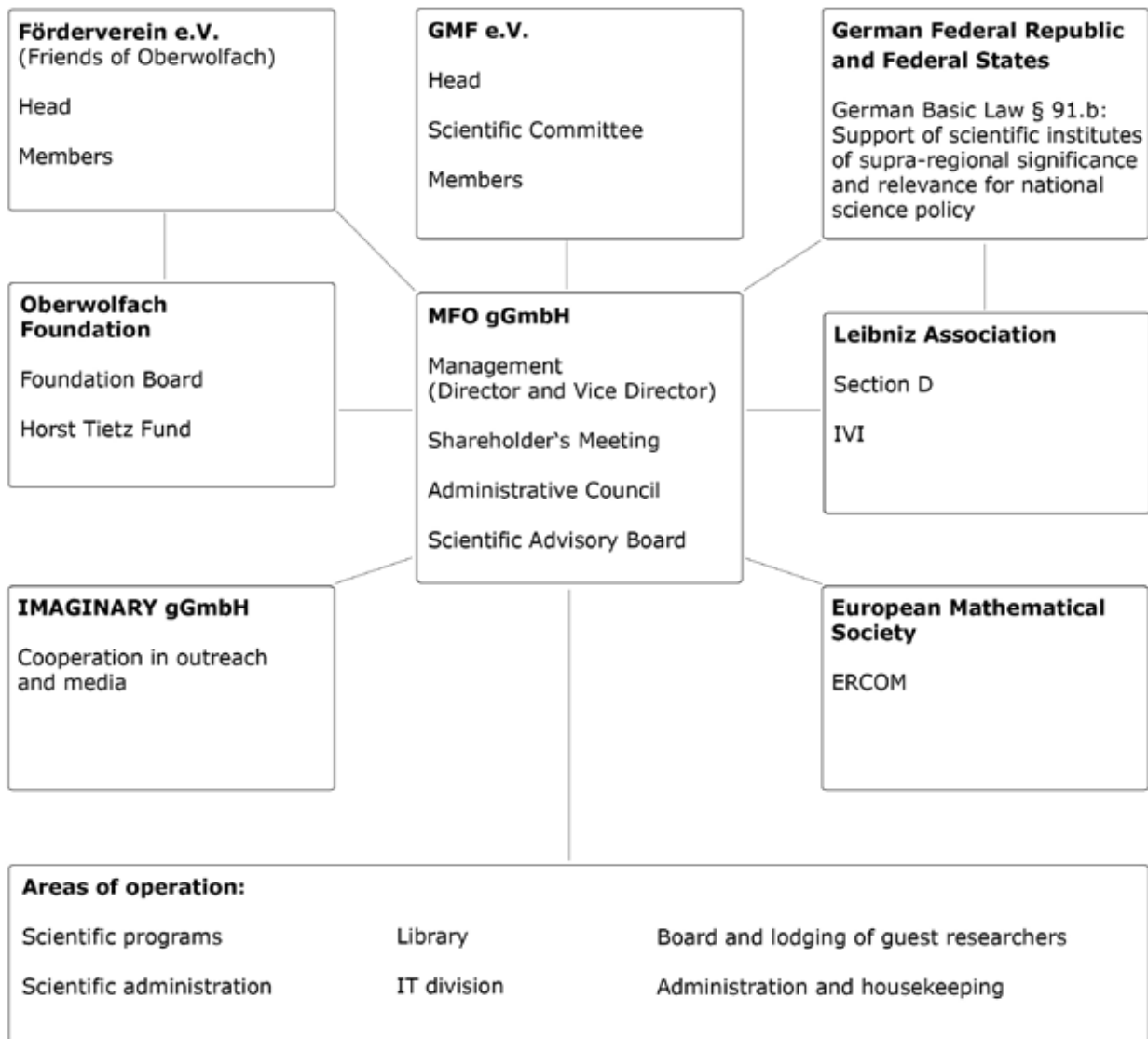
## Förderverein and Oberwolfach Foundation

Earmarked donations have been received by the Förderverein and the Oberwolfach Foundation. These funds have been used to support travel costs for scientists in special cases, for child support, for special literature, and as additional support for building measures.

## 3.7. Acknowledgement

A particular thank-you goes to the federation and the federal states for their financial support. We would also like to thank for the third-party funds received from the Carl Friedrich von Siemens Foundation, the National Science Foundation (NSF), the Simons Foundation and the Volkswagen Foundation. Our special thank-you also goes to the Förderverein and the Oberwolfach Foundation for their important support of the MFO.

### 3.8. Organigramm



#### Erläuterungen

Das Mathematische Forschungsinstitut Oberwolfach (MFO) ist seit April 2005 eine gemeinnützige GmbH. Die Geschäftsführung des MFO besteht aus Direktor und stellvertretendem Direktor. Alleinigere Gesellschafter des MFO ist die Gesellschaft für Mathematische Forschung e.V. (GMF), die durch ihren Vorstand vertreten wird. Das MFO wird von der Bundesrepublik Deutschland und den Bundesländern im Rahmen der Forschungsförderung nach Artikel 91b des Grundgesetzes gemeinschaftlich finanziert, wobei das Sitzland Baden-Württemberg eine besondere Rolle einnimmt. Dabei ist die Mitgliedschaft des MFO in der Leibniz-Gemeinschaft Bestandteil der gemeinschaftlichen Finanzierung. Die Zuwendungsgeber sind im Verwaltungsrat des MFO vertreten, der als wichtigstes Aufsichtsgremium

#### Explanations

Since April 2005 the Mathematisches Forschungsinstitut Oberwolfach has been registered as a non-profit corporation (gemeinnützige GmbH). The MFO is headed by a Director supported by a Vice Director. The sole associate of the MFO is the Gesellschaft für Mathematische Forschung e.V. (GMF), represented by its board. Financing of the MFO is shared by the Federal Republic of Germany and the Federal States according to article 91b (research financing) of the Basic Law of the Federal Republic of Germany with emphasis on the local state of Baden-Württemberg. Being a member of the Leibniz Association is a prerequisite for the common financing. The financial partners are represented in the Administrative Council of the MFO, which in its function as most important supervisory panel decides on



über die mittel- und langfristige Finanz- und Budgetplanung entscheidet. Institut und Verwaltungsrat werden dabei vom Wissenschaftlichen Beirat des MFO beraten, dem 6 bis 8 international angesehene Mathematiker angehören. Ferner ist das MFO Mitglied in ERCOM (European Research Centres on Mathematics), einem Komitee der European Mathematical Society.

Die Gesellschaft für Mathematische Forschung e.V. (GMF) hat ca. 80 Mitglieder, darunter die vier institutionellen Mitglieder DMV (Deutsche Mathematiker-Vereinigung), GAMM (Gesellschaft für angewandte Mathematik und Mechanik), EMS (European Mathematical Society) und Förderverein. Die GMF ist Eigentümer des Grundstücks und der Institutsgebäude des MFO. Der Vorstand der GMF besteht aus dem Vorstandsvorsitzenden, dem Schatzmeister und dem Vorsitzenden der Wissenschaftlichen Kommission. Die Wissenschaftliche Kommission der GMF besteht aus ca. 20-25 international angesehenen Mathematikern und ist in Abstimmung mit der Geschäftsführung des MFO zuständig für die Forschungs- und Entwicklungsplanung sowie die aktuelle wissenschaftliche Arbeitsplanung des MFO.

Der Verein zur Förderung des Mathematischen Forschungsinstituts Oberwolfach e.V. (Förderverein) hat etwa 600 Mitglieder, die das MFO durch Mitgliedsbeiträge zusätzlich finanziell unterstützen. Die Oberwolfach Stiftung, die im Förderverein als nicht rechtsfähige Stiftung gegründet wurde, sammelt Stiftungskapital aus dem wirtschaftlichen und dem privaten Bereich. Dabei spielt der Horst Tietz Fund als Sondervermögen innerhalb der Oberwolfach Stiftung eine besondere Rolle.

Das Institut ist außerdem Gesellschafter der IMAGINARY gGmbH und kooperiert mit dieser im Bereich der Öffentlichkeitsarbeit. IMAGINARY begann als Projekt des MFO im Jahr 2008 und wurde 2016 als selbständiger Dienstleister im Bereich der Mathematik-Kommunikation gegründet.

the medium- and long-term finance- and budget planning. The Institute and the Administrative Council are supported by the Scientific Advisory Board which is composed of 6 to 8 internationally renowned mathematicians. Moreover, the MFO is a member of ERCOM (European Research Centres on Mathematics), a committee of the European Mathematical Society.

The Gesellschaft für Mathematische Forschung e.V. (GMF) consists of about 80 members, including four institutional members, namely DMV (Deutsche Mathematiker-Vereinigung), GAMM (Gesellschaft für angewandte Mathematik und Mechanik), EMS (European Mathematical Society) and the Förderverein. The GMF is the legal owner of the site and of the buildings of the MFO. The head of the society is formed by the chairman, the treasurer, and the chairman of the Scientific Committee. The Scientific Committee of the GMF is composed of about 20 to 25 internationally renowned mathematicians and is responsible for the research and development planning, as well as for running decisions on scientific proposals, in agreement with the head of the MFO.

The Verein zur Förderung des Mathematischen Forschungsinstituts Oberwolfach e.V. (Förderverein) has about 600 members and provides additional financial support for the MFO by its membership fees. The Oberwolfach Foundation, a foundation of public utility within the Förderverein, provides further financial support by economic and private means. Within the Oberwolfach Foundation the Horst Tietz Fund plays an important role by providing special funds.

Furthermore the Institute is a shareholder of the IMAGINARY gGmbH and cooperates with the company in the field of public relations. IMAGINARY started in 2008 as a project of the MFO. Since 2016 it is an independent service provider in the field of mathematics communication.

**Wissenschaftliche Verwaltung**

Direktor  
Stellvertretender Direktor  
Wissenschaftlicher Administrator  
Wissenschaftliche Mitarbeiterin  
Sekretärinnen für Workshops, RiP  
und Seminare

**Scientific Administration**

Director  
Vice Director  
Scientific Administrator  
Scientific Assistant  
Secretaries for Workshops,  
RiP and Seminars

Prof. Dr. Gerhard Huisken  
Prof. Dr. Dietmar Kröner  
apl. Prof. Dr. Stephan Klaus  
Dr. Tatjana Ruf  
Silke Okon,  
Andrea Schillinger

**Verwaltung**

Verwaltungsleitung  
Sekretärinnen im Gästebüro

**Administration**

Head of Administration  
Secretaries in the guest  
services office  
Librarian  
Library Assistant

Susanne Riester  
Annette Disch, Petra Lein,  
Katrin Schmid  
Verena Franke  
Jennifer Hinneburg

Bibliothekarin  
Fachangestellte für Medien- und  
Informationsdienste (FaMI)  
Auszubildender FaMI  
IT

Trainee in the library  
IT

Jannes Wörner  
Gerold Glöde  
Helmut Kastenholz,  
Christoph Weber

**Hauswirtschaft**

Hauswirtschaftsleiterin  
Hausmeister

**Housekeeping**

Housekeeping Manager  
Caretaker

Charlotte Endres  
Helmut Breithaupt,  
Anton Herrmann

Auszubildende Hauswirtschafterin  
Weitere Beschäftigte

Housekeeping trainee  
Further housekeeping staff

Rebecca Schmid  
ca. 10 full time equivalent

**Verwaltungsrat des MFO/Administrative Council of the MFO**

(Mitglieder/Members 2019)

Tania Bolius

Ministerium für Wissenschaft, Forschung und Kunst, Stuttgart,  
(Vorsitzende/Chair)

Jan Neitzke

Bundesministerium für Bildung und Forschung, Bonn,  
(stellvertretender Vorsitzender/Vice Chair)

Prof. Dr. Jean-Pierre Bourguignon

President of the European Research Council

Prof. Dr. Friedrich Götze

Fakultät für Mathematik, Universität Bielefeld

Dr. Henrike Hartmann

VolkswagenStiftung, Hannover

Prof. Dr. Wolfgang Lück

Director of HIM (Hausdorff Institute for Mathematics),  
Mathematisches Institut, Universität Bonn

Christian Mees

Staatskanzlei des Saarlandes

Prof. Dr. Felix Otto

Direktor des Max-Planck-Instituts für Mathematik in den  
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