MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

T a g u n g s b e r i c h t 37/1999

Topologie

12.09. – 18.09.1999

The conference was organized by Robion Kirby (Berkeley), Wolfgang Lück (Münster) and Elmer Rees (Edinburgh), and was attended by about 40 participants. Within 18 talks various new developments and new results in topology have been presented. A certain emphasis was put on results in low dimensional topology and geometric group theory. Seven of the 18 talks were devoted to this area. However, there were also talks on classical subjects as for example stable homotopy theory.
Special attention went to results of Bob Edwards on a generalization of the Hilbert-Smith Conjecture, and to results of Cochran and Teichner, who found new powerful knot invariants. Both topics were presented in a series of two lectures. As topology can be used in various branches of mathematics the talks covered a wide range of results. For example, there was a talk on the Lichtenbaum-Quillen Conjecture. Another talk covered the solution of the conjugacy problem for automorphisms of free groups.
During the whole week there was a good, stimulating atmosphere, and the schedule allowed to have plenty of discussion. The latter has extensively been used, and everybody profited a lot from his stay at Oberwolfach.

Arthur Bartels
Link homotopy and singular concordance

Link homotopy was introduced by Milnor in 1954 to study links $S^1 \amalg \cdots \amalg S^1 \hookrightarrow S^3$. A link homotopy is a motion that keeps different components disjoint (but allows selfintersection). Examples of links not link homotopic to trivial links are given by the Hopf link and the Borromean rings. In higher dimensions the situaton is different:

Theorem. *For $n \geq 2$ every (embedded) link $L : S^n \amalg \cdots \amalg S^n \hookrightarrow S^{n+2}$ is link homotopically trivial.*

The proof uses surgery to construct the complement of singular slice disks for L in D^{n+3}. As an important step we construct a nilpotent model space from certain singular slice disks for the trivial link.

Stefan Bauer
Seiberg-Witten theory and stable homotopy theory

Let X be an oriented closed Riemannian 4-manifold with a fixed $spin^c$ structure. The monopole map Ψ_X is a compact perturbation of an S^1-equivariant linear Fredholm map, extending continuously to the one-point completions of certain Hilbert spaces. One can associate to this monopole map an element of an equivariant stable cohomotopy group

$$[\Psi_X] \in \pi^b_{S^1}(Pic^0(X); ind(D)),$$

which via the Hurewicz-map relates to the integer valued Seiberg-Witten invariant. A connected sum theorem states that the stable cohomotopy invariant of a connected sum is the smash product of the respective stable cohomotopy invariants of the summands. Using this theorem, one can distinguish 4-manifolds which could not be distinguished via Seiberg-Witten or Donaldson invariants.

The second part of the talk gave a general picture for the stable cohomotopy invariant: Let G denote the automorphism group of the $spin^c$ structure. This locally convex Lie group acts properly on the configuration space consisting of metrics, $spin^c$ connections and harmonic one-forms on X. This configuration space actually is a classifying space for proper actions of the group G. Consider the monopole map as a G-equivariant map between Hilbert space bundles over the configuration space. This monopole map can be viewed as an element of a suitably defined proper G-equivariant stable cohomotopy ring $\pi_G(Conf)$. The latter can be viewed as some sort of generalized Burnside ring associated to G.

Michel Boileau

Geometrization of 3-orbifolds with infinite fundamental group

Work in progress with B. Leeb and J. Porti: we are writing a complete proof of the following theorem:

Theorem. *Let $\mathcal{O}$ be a compact, connected, orientable, irreducible, 3-orbifold with non empty singular locus. Assume that $\mathcal{O}$ has either a non-empty boundary or an infinite fundamental group. If $\mathcal{O}$ is topologically atoroidal, then $\mathcal{O}$ admits either a hyperbolic, a Euclidean or a Seifert fibered structure.*

This is part of a Theorem announced by Thurston in 1982. A different proof of this theorem is also announced by D. Cooper, G. Hodgson and S. Kerckhoff. An orientable compact irreducible 3-orbifold $\mathcal{O}$ is *Haken* if it can be decomposed into discal 3-orbifolds or $\{\text{turnovers}\}\times[0,1]$ by repeated cutting along 2-sided properly embedded essential 2-suborbifolds. It is *small* if it is not Haken. An extension to Haken 3-orbifolds of Thurston's hyperbolization Theorem for Haken 3-manifolds allows to reduce the proof of Theorem 1 to the small case. Let $\mathcal{O}$ be a compact connected orientable small 3-orbifold with a non empty singular locus Σ. Let $\Sigma^{(o)}$ be the set of vertices and $\Sigma^{(1)}$ the set of edges of Σ. We set $M = \mathcal{O} - \{\Sigma^{(1)} \cap \mathcal{N}(\Sigma^{(o)})\}$. Using Thurston's hyperbolization theorem we reduce the proof to the case where M admits a complete hyperbolic structure with finite volume and totally geodesic boundary. For $t \in [0,1]$, let $C(t\alpha)$ denote a hyperbolic cone 3-manifold having topological type $(|\mathcal{O}|, \Sigma)$ and cone angles $t\alpha = \left(\frac{2t\pi}{m_1}, \dots, \frac{2t\pi}{m_q}\right)$ (where $m_1, \dots, m_q$ are the ramification indices). $C(0)$ denotes the complete hyperbolic structure of finite volume on M. Let

$$\mathcal{J} := \{t \in [0,1], \text{such that } C(t\alpha) \text{is a hyperbolic cone 3-manifold }\},$$

then the first step of the proof is:

Openess Theorem. *$\mathcal{J}$ is open.*

Since $\mathcal{J} \neq \emptyset$, it reduces the proof to the following propositions:

Proposition 1. *If $\sup \mathcal{J} < 1$, then $\mathcal{O}$ has a finite fundamental group.*

Proposition 2. *If $\mathcal{J} = [0,1[$, then $\mathcal{O}$ is either Euclidean or Seifert fibered.*

A key ingredient in the proofs of Propositions 2 and 3 is:

Thickness Theorem. *Given $0 < \omega < \pi$, there is a uniform constant $\delta(\omega) > 0$ such that every closed hyperbolic cone 3-manifold C with diam$(C) \geq 1 > 0$ and cone angles $\leq \omega < \pi$ contains a point x with injectivity radius inj$(x) \geq \delta(\omega)$.*

Martin Bridson

The complexity of navigating in discrete groups

Let Γ be a group with finite generating set A. We seek to understand Γ via the structure of the normal forms that it admits, i.e. set-theoretic sections $\sigma : \Gamma \to A^*$ of the natural projection (word evaluation) $A^* \to \Gamma$ from the free monoid on A. One views the words σ_g as edge-paths in the Cayley graph of Γ.

Geometric Constraints: A group is said to be combable if it admits a normal form (combing) σ for which there is a constant $K > 0$ such that $d(\sigma_g(t), \sigma_{ga}(t)) \leq K$ for all $t \in \mathbb{N}$, where w_t denotes the prefix of length t in w. One also considers a weaker condition — asynchronous combability, where monotone reparametrization of paths is allowed before comparing them — and a stronger condition, bicombability.

Grammatical Constraints: One attempts to minimize the grammatical complexity of the language $\sigma(\Gamma) \subset A^*$ and locate it within the standard hierarchy of formal languages:

$$\text{Reg} \subset \text{CF} \subset \text{Ind} \subset \text{CS},$$

regular, context-free, indexed and context-sensitive languages.

There is an obvious tension in trying to minimize the geometric and grammatical complexity of σ simultaneously.

Motivation:

Theorem. *If X is a compact non-positively curved space, then $\pi_1 X$ is bicombable.*

Theorem [Cannon-Gromov]. *If X is negatively curved then one can require the bicombing of $\pi_1 X$ to be a regular language.*

This second theorem was the starting point for automatic group theory in the early eighties. This area of geometry/group theory has been marred by a lack of examples to distinguish between the different classes of groups obtained by imposing the geometric and grammatical constraints listed above. The situation for asynchronous combings was largely resolved by analysing the fundamental groups of 3-manifolds (Bridson-Gilman, Epstein-Thurston) Comm. Math. Helv. **71** (1996), 525–555. We now prove:

Theorem 1. *There exist compact aspherical 2-complexes X such that $\pi_1 X$ is combable but not bicombable.*

Theorem 2. *There exist complexes X as in Theorem 1 such that the optimal isoperimetric inequality for X is cubic.*

Corollary. *There exist combable groups that are not automatic.*

Theorem 3. *There exist* Ind-*combable groups that are not* Ind-*combable (i.e. automatic).*

Bestvina-Brady give a very different proof of the above Corollary.

Viktor M. Buchstaber
Torus actions and combinatorics of polytopes

In our research we develop the study of the relationship between the algebraic topology of manifolds and the combinatorics of polytopes. Originally, this research was inspired by results of toric variety theory. In our joint paper with N.Ray we developed relations between toric varietes and cobordism theory. One of the main results proved there is that each complex cobordism class contains a smooth quasitoric manifold. The main object of our present study are smooth manifolds defined by the combinatorial structure of simple polytopes. The study of such manifolds was undertaken in our joint paper with T.Panov. The main topics of my talk are:

1. Simple polytopes and their face rings.
2. Topological spaces defined by simple polytopes and arrangement of planes in Euclidean space.
3. Bigraded (moment - angle) cellular complexes and bigraded cohomology rings.
4. Bigraded cohomology rings of manifolds defined by polytopes and combinatorial results.
5. Multioriented quasitoric manifolds and complex cobordisms.
6. Combinatorial formulae for the Hirzebruch genera of multioriented quasitoric manifolds.

Tim Cochran & Peter Teichner
Knot concordance and L^2-signatures

We construct many examples of non-slice knots in 3-space that cannot be distinguished from slice knots by previously known invariants. Using Whitney towers in place of embedded disks, we define a geometric filtration of the 3-dimensional topological knot concordance group. As special cases of Whitney towers of height less than four, the bottom part of the filtration exhibits all classical concordance invariants, including the Casson-Gordon invariants. Considering our entire filtration could lead to a 4-dimensional homology surgery theory. As a first step, we construct an infinite sequence of new obstructions that vanish on slice knots. These take values in the L-theory of skew fields associated to certain rationally universal solvable groups. Finally, we use the dimension theory of von Neumann algebras to detect the first unknown step in our obstruction theory by an L^2-signature, providing infinitely many examples of non-slice knots with vanishing Casson-Gordon invariants.

Robert Edwards

Cantor groups, their classifying spaces, and the Hilbert-Smith Conjecture

A *cantor group* is a topological group which is homeomorphic to the cantor set (i.e., is an infinite second-countable profinite group, if you wish). Basic examples are 1) any countably-infinite direct product of nontrivial finite groups, and 2) the p-adic integers, for your favorite prime p. It is a beautiful classical theorem (attributable to Peter-Weyl-von Neumann) that a (second countable) compact topological group is either a Lie group, or else contains a cantor subgroup, and furthermore both properties cannot hold simultaneously.

A fundamental open problem concerning how cantor groups can act on nice spaces is the

Free-Set Z-Set (FSZS) Conjecture. *Given any action by a cantor group on an ENR (= euclidean neighborhood retract), the free set of the action is a homology Z-set (in the ENR).*

A homology Z-set is one whose removal does not change the homology of any open subset of the ENR. The FSZS Conjecture can be regarded as a sort of Super Hilbert-Smith Conjecture, the HSC being the case where the ENR is a manifold. Our talk discussed the (natural) classifying space approach to the FSZS Conjecture, and my solution of the key free-action, finite-dimensional-quotient case. The main theorem can be paraphrased as follows: Although it is well known that the classical (principal action) cohomological dimension of the p-adic integers is finite (either 1 or 2, depending on your flavor), the free-action cohomological dimension is *infinite*.

Hans-Werner Henn

Euler characteristics of orthogonal groups over $\mathbb{Z}[1/2]$

In this talk we describe joint work in progress with Jean Lannes. We compute the virtual Euler characteristic of the orthogonal groups over the ring $\mathbb{Z}[1/2]$ for quadratic forms which are positive definite when considered over the real numbers. We express the Euler characteristic in terms of values of zeta functions resp. L-functions. These computations complement results of Harder and Serre from the early 70's. They had found similar expressions for the Euler characteristic of many classes of S-arithmetic groups. However, they worked with certain assumptions which do not hold in our case.
The main ingredients in the computation are Minkowski-Siegel mass formulae for (uni)modular lattices together with a combinatorial analysis of a suitable contractible complex (a kind

of building) on which these orthogonal groups act.

Lars Hesselholt
Algebraic K-theory of local fields

This is joint work with Ib Madsen. In one formulation, the Lichtenbaum-Quillen conjecture states that for any field K and any prime p, the natural map

$$K_*(K, \mathbb{Z}/p\mathbb{Z}) \to \beta^{-1} K_*(K, \mathbb{Z}/p\mathbb{Z})$$

is an isomorphism in degrees $\geq \mathrm{cd}_p(K)$. Here $\beta \in K_{2p-2}(\mathbb{Z}, \mathbb{Z}/p\mathbb{Z})$ is the Bott element defined as tranfer image of the canonical generator of the subgroup $\mu_p^{\otimes(p-1)}$ of $K_{2p-2}(\mathbb{Z}(\mu_p), \mathbb{Z}/p\mathbb{Z})$. We prove this conjecture when K is the fraction field of a complete discrete valuation ring A of characteristic 0 with perfect residue field k of characteristic $p > 2$. If k is finite, or equivalently, if K is a finite extension of $\mathbb{Q}_p$, the affirmed conjecture implies that

$$K(K)^{\wedge}_p \simeq (F\Psi^{g^{p^{a-1}d}} \times BF\Psi^{g^{p^{a-1}d}} \times U^{|K:\mathbb{Q}_p|})^{\wedge}_p,$$

where $F\Psi^r$ is the homotopy fiber of $\Psi^r - 1\colon \mathbb{Z} \times BU \to BU$, $g \in \mathbb{Z}_p^{\times}$ is a topological generator, d is $p-1$ divided by $|K(\mu_p) : K|$, and a is maximal with $\mu_{p^a} \subset K(\mu_p)$.

It is known that for the fields in question, the cyclotomic trace

$$K_*(K, \mathbb{Z}/p\mathbb{Z}) \to \pi_*(\mathrm{TC}(A|K;p), \mathbb{Z}/p\mathbb{Z})$$

is an isomorphism in degrees ≥ 1, and it is the right hand side we evaluate. We define $T(A|K)$ to be the mapping cone of the transfer map $T(k) \to T(A)$ in topological Hochschild homology. There is a circle action on $T(A|K)$ and we define $\mathrm{TR}^n(A|K;p)$ to be the fixed set by the cyclic group of order p^{n-1}. The homotopy groups $\pi_* \mathrm{TR}^{\cdot}(A|K;p)$ have a rich algebraic structure of which the de Rham-Witt pro-complex $W.\omega^*_{(A,M)}$ is the universal example. The main theorem is that when $\mu_p \subset K$, the canonical map

$$W.\omega^*_{(A,M)} \otimes S_{\mathbb{F}_p}(\mu_p) \xrightarrow{\sim} \pi_*(\mathrm{TR}^{\cdot}(A|K;p); \mathbb{Z}/p\mathbb{Z})$$

is a pro-isomorphism. The Lichtenbaum-Quillen conjecture for K is an immediate consequence of this result and the definition of $\mathrm{TC}(A|K;p)$.

Marc Lackenby
Word hyperbolic Dehn surgery

Thurston's geometrisation conjecture proposes that every compact orientable irreducible atoroidal 3-manifold is either Seifert fibred or hyperbolic. (A manifold is hyperbolic if its interior is homeomorphic to the quotient of hyperbolic space by a discrete group of fixed-point free isometries.) Thurston proved this conjecture in the case where M has non-empty boundary (and, more generally, when M is 'Haken'). To what extent can this result be used to explore the unsolved case when M is closed? One possible approach to this problem is via Dehn surgery. Thurston proved that, if M is a hyperbolic manifold with a single toral boundary component (other than the solid torus), then all but finitely many manifolds obtained by Dehn surgery on M admit a hyperbolic structure. But how many 'exceptional surgeries' can there be? In my talk, I explained the proof of the following theorem, which goes some way to answering this question.

Theorem. *For all but at most 12 slopes on the boundary of M, the manifold obtained by Dehn filling along this slope is irreducible, atoroidal and not Seifert fibred, and has infinite, word hyperbolic fundamental group.*

Martin Lustig

The conjugacy problem for automorphisms of free groups

The conjugacy problem in $Aut(F_n)$ and in $Out(F_n)$ was a well known open problem since the work of Nielsen in the 20's on non-abelian free groups F_n of finite rank n. In a sequence of papers, starting from his habilitation thesis 1992, and culminating in a detailed preprint [1] from last year, the author has solved this problem. This solution combines combinatorial aspects (introducing an improved version of Bestvina-Handel's train tracks) with geometric ones ($\mathbf{R}$-trees) to define structural invariants for any automorphism of F_n which are computable. In the talk this work and some of its consequences has been presented.

[1] Martin Lustig, *Structure and conjugacy for automorphisms of free groups*, preprint 1999, http://homepage.ruhr-uni-bochum.de/Martin.Lustig/

Wolfgang Metzler

Low-dimensional homotopy theory

The Andrews–Curtis Conjecture claims that a finite CW–complex with $K^2 \simeq *$ fulfills $K^2 \overset{3}{\nearrow\!\!\searrow} *$. More generally, Wall asked whether a simple homotopy equivalence between K^2 and L^2, fixing a common subcomplex K_0, can be turned into a 3–deformation $K^2 \overset{3}{\nearrow\!\!\searrow} L^2$, which also fixes K_0. Unlike in the contractible case, (1) there is a "systematic" way to construct potential counterexamples. (2) An invariant to establish these would be obtained if certain infinite families of perfect groups could be shown to contain only nontrivial members. (3) Recently we detected representations into iterated semidirect products of locally indicable groups where (2) can be shown for a big subfamily. At present we are optimistic that this method carries through in general.

The talk also discusses related problems (e.g. the question whether there are 2–dimensional extensions of complexes with nontrivial Whitehead torsion and the question of the (non–)existence of groups with a finite relator gap); they all concern commutators of defining relations; and it looks as if a modification of the above technique will also contribute to their solution.

Dietrich Notbohm
Spaces with polynomial mod-p cohomology

In the early seventies Steenrod posed the question which polynomial algebras over the finite field $\mathbb{F}_p$ of p elements can be realized as the mod-p cohomology of a topological space. For odd primes, based on work of Adams and Wilkerson and Dwyer, Miller and Wilkerson we gave a complete answer in terms of pseudo reflection groups acting on a p-adic lattice; i.e. we characterized the realizable polynomial algebras in these purely algebraic terms and we achieved a complete classification of all homotopy types of p-complete spaces with polynomial mod-p cohomology.

Such spaces are constructed as the homotopy colimit of a certain diagram, where all involved spaces are given by classifying spaces of compact connected Lie groups and where the underlying diagram is given by a full subcategory of the orbit category of a pseudo reflection group.

The technical key lemma compares higher derived limits defined on full subcategories of the orbit category of finite group. This lemma has several application in the homotopy theory of classifying spaces; e.g we constructed (sharp) homology decompositions for classifying spaces of finite groups associated to modular representations.

Robert Oliver
Equivalences between completed classifying spaces

We consider the question, for given finite groups G and G' and a prime p, of whether the completed classifying spaces $BG^\wedge_p$ and $BG'^\wedge_p$ are homotopy equivalent. Martino and Priddy tried to show that this is the case if and only if there is a "fusion preserving" isomorphism between Sylow p-subgroups $S \subseteq G$ and $S' \subseteq G'$ — an isomorphism $\alpha : S \to S'$ such that an isomorphism $f : P \to Q$ between subgroups of S is given by conjugation in G iff the corresponding isomorphism $f' : P' \to Q'$ between subgroups of S' is given by conjugation in G'. However, their argument was incomplete, and it is still unknown whether or not this condition is sufficient to imply the homotopy equivalence.

In joint work with Carles Broto and Ran Levi, we found an alternative criterion for showing that $BG^\wedge_p \simeq BG'^\wedge_p$. We define a category $\tilde{\mathcal{X}}^c_p(G)$, whose objects are the p-centric subgroups of G — the p-subgroups $P \subseteq G$ such that $C_G(P) = Z(P) \times C'(P)$ for some $C'(P)$ of order prime to p — and whose morphisms are given by

$$\mathrm{Mor}_{\tilde{\mathcal{X}}(G)}(P,Q) = C'(P)\backslash\{g \in G \mid g^{-1}Pg \subseteq Q\}.$$

We then show that $BG^{\wedge}_p \simeq BG'^{\wedge}_p$ if and only if the categories $\bar{\mathcal{X}}^c_p(G)$ and $\bar{\mathcal{X}}^c_p(G')$ are equivalent.

Given a fusion preserving isomorphism $\alpha : S \to S'$ between Sylow p-subgroups of G and G', the obstruction to the existence of a homotopy equivalence $BG^{\wedge}_p \simeq BG'^{\wedge}_p$ lies in $\varprojlim^2(Z)$, where Z is the function on the p-subgroup orbit category of G which sends G/P to $Z(P)$ if P is p-centric and to 0 otherwise. We do not know yet whether this group can ever be nonzero, much less whether the obstruction can be nonzero. The best partial result we have so far is that $\varprojlim^2(Z) = 0$ if $\mathrm{rk}_p(G) < p^2$, and thus that the Martino-Priddy conjecture holds in this case.

Eric Pedersen

The Baum-Connes conjecture and the assembly map

We talked about joint work with Gunnar Carlson and John Roe. Given a discrete group Γ, $\mathcal{E}\Gamma$ denotes the universal space for proper Γ-actions, e.g. Γ-actions where all isotropy groups are finite. The universality means that given a $\Gamma - CW$ complex E with finite isotropy, there is a unique homotopy class of equivariant maps $E \to \mathcal{E}\Gamma$. The Baum-Connes conjecture in the case of discrete groups states that a certain index map

$$KK^{\Gamma}_i(C_0(\mathcal{E}\Gamma), \mathbb{C}) \to K_i(C^*_r\Gamma)$$

is an isomorphism. Strictly speaking we should have assumed that the action of Γ on $\mathcal{E}\Gamma$ is cocompact, or rather replace the lefthand side by the direct limit over the Γ-invariant Γ-compact subsets.

In case Γ is torsionfree $\mathcal{E}\Gamma = E\Gamma$ and the left side may be identified with $KK_i(C_0(B\Gamma), \mathbb{C})$ which in turn may be identified as the homology theory dual to complex topological K-theory applied to $B\Gamma$. This of course makes the Baum-Connes map look a lot like an assembly map in the sense of topology, and we shall see this is essentially true.

The main aim of this paper is to construct a functor $\mathbf{K}$ from Γ-spaces to spectra with Γ-action (spectra in the sense of topology) such that the induced map on fixed sets

$$\mathbf{K}^{\Gamma}(\mathcal{E}\Gamma) \to \mathbf{K}^{\Gamma}(*)$$

induces the Baum-Connes map on homotopy groups, in other words to "spacify" the Baum-Connes map. Such a spacification has been provided by Davis and Lück but it is important for our purposes that it is obtained as a fixed set.

Andrew Ranicki

Circle-valued Morse theory and chain complexes

Given a circle-valued Morse function $f : M \to S^1$ let $c_i(f)$ be the number of critical points of index i. An *R-coefficient Novikov complex* $C^{Nov}(M, f; R)$ is a based f.g. free R-module chain complex, for some ring morphism $\mathbb{Z}[\pi_1(M)] \to R$, such that

(i) $C^{Nov}(M, f; R) = R^{c_i(f)}$

(ii) $C^{Nov}(M, f; R)$ is chain equivalent to $R \otimes_{\mathbb{Z}[\pi_1(M)]} C(\widetilde{M})$ with $C(\widetilde{M})$ a cellular chain complex of the universal cover $\widetilde{M}$ of M.

Novikov (for $\pi_1(M) \cong \pi_1(S^1)$) and Pazhitnov (for arbitrary $\pi_1(M)$) constructed an R-coefficient Novikov complex geometrically, using the gradient flow, with $R = \mathbb{Z}\widehat{[\pi_1(M)]}$ a certain completion of $\mathbb{Z}[\pi_1(M)]$.

The talk described the algebraic construction in [1] and [2] of an R-coefficient Novikov complex, with $R = \Sigma^{-1}\mathbb{Z}[\pi_1(M)]$ a certain noncommutative localization of $\mathbb{Z}[\pi_1(M)]$.

[1] (with M.Farber) *The Morse-Novikov theory of circle-valued functions and noncommutative localization*, e-print dg-ga/9812122, to appear in Proc. 1998 Moscow Conference for S.P.Novikov's 60th Birthday.

[2] *The algebraic construction of the Novikov complex of a circle-valued Morse function*, e-print at/9903090 (1999)

Berichterstatter: Michael Joachim

e-mail addresses:

Alexandro Adem	adem@math.wisc.edu
Arthur Bartels	bartelsa@math.uni-muenster.de
Michel Boileau	boileau@picard.ups-tlse.fr
Stefan Bauer	bauer@mathematik.uni-bielefeld.de
Carl-Friedrich Bödigheimer	cfb@math.uni-bonn.de
Martin Bridson	bridson@maths.ox.ac.uk
Viktor Buchstaber	vmb@maths.ed.ac.uk
Tim Cochran	cochran@math.rice.edu
Anand Dessai	desssai@mathpool.uni-augsburg.de
Tammo tomDieck	tammo@uni-math.gwdg.de
Robert D. Edwards	rde@math.ucla.edu
Ian Hambleton	hamblton@mcmaster.ca
Hans-Werner Henn	henn@math.u-strasbg.fr
Lars Hesselholt	larsh@mi.aau.dk
Juliane Jänich	janich@math.uni-muenster.de
Michael Joachim	joachim@math.uni-muenster.de
Klaus Johannson	johann@math.utk.edu
Robion Kirby	kirby@math.berkeley.edu
Stephan Klaus	klaus@mfo.de
Karlheinz Knapp	knapp@math.uni-wuppertal.de
Matthias Kreck	kreck@topologie.mathematik.uni-mainz.de
Marc Lackenby	M.Lackenby@dpmms.cam.ac.uk
Gerd Laures	laures@topologie.mathematik.uni-mainz.de
Wolfgang Lück	lueck@math.uni-muenster.de
Martin Lustig	martin.lustig@rz.ruhr-uni-bochum.de
Wolfgang Metzler	hog-angeloni.metzler@mathematik.uni-frankfurt.dbp.de
Dietrich Notbohm	notbohm@mpim-bonn.mpg.de
Robert Oliver	bob@math.univ-paris13.fr
Erich Ossa	ossa@math.uni-wuppertal.de
Eric Kjaer Pedersen	erik@math.binghamton.edu
Volker Puppe	mapuppe@dknkurz1.bitnet
Andrew Ranicki	aar@maths.ed.ac.uk
Elmer Rees	elmer@maths.ed.ac.uk
Holger Reich	reichh@math.uni-muenster.de
Justin Roberts	justin@maths.ed.ac.uk
Roman Sauer	sauerr@math.uni-muenster.de
Thomas Schick	schick@math.psu.edu
Björn Schuster	schuster@math.uni-wuppertal.de
Wilhelm Singhof	singhof@cs.uni-duesseldorf.de
Peter Teichner	teichner@math.ucsd.edu
Elmar Vogt	vogt@math.fu-berlin.de

Rainer Vogt Rainer.Vogt@mathematik.uni-osnabrueck.de

Tagungsteilnehmer

Prof.Dr. Alejandro Adem
Department of Mathematics
University of Wisconsin-Madison
480 Lincoln Drive

Madison WI, 53706-1388
USA

Arthur Bartels
Mathematisches Institut
Universität Münster
Einsteinstr. 62

48149 Münster

Prof.Dr. Stefan Alois Bauer
Fakultät für Mathematik
Universität Bielefeld
Postfach 100131

33501 Bielefeld

Prof.Dr. Carl-Friedrich Bödigheimer
Mathematisches Institut
Universität Bonn
Beringstr. 1

53115 Bonn

Prof.Dr. Michel Boileau
Mathematiques
Laboratoire Topologie et Geometrie
Universite Paul Sabatier
118 route de Narbonne

F-31062 Toulouse Cedex

Prof.Dr. Martin R. Bridson
Mathematical Institute
Oxford University
24 - 29, St. Giles

GB-Oxford OX1 3LB

Prof.Dr. Victor I. Buchstaber
c/o Professor M. M. Postnikov
Steklov Mathematical Institute
Academy of Sciences
ul. Vavilova 42

Moscow 117 966 GSP-1
RUSSIA

Prof.Dr. Tim D. Cochran
Dept. of Mathematics
Rice University
P.O. Box 1892

Houston , TX 77251
USA

Dr. Anand Dessai
Institut für Mathematik
Universität Augsburg

86135 Augsburg

Prof.Dr. Tammo tom Dieck
Mathematisches Institut
Universität Göttingen
Bunsenstr. 3-5

37073 Göttingen

Prof.Dr. Robert D. Edwards
Dept. of Mathematics
University of California
405 Hilgard Avenue

Los Angeles , CA 90095-1555
USA

Prof.Dr. Cameron M. Gordon
Dept. of Mathematics
University of Texas at Austin
RLM 8.100

Austin , TX 78712-1082
USA

Prof.Dr. Ian Hambleton
Department of Mathematics and Statistics
Mc Master University
1280 Main Street West

Hamilton , Ont. L8S 4K1
CANADA

Prof.Dr. Hans-Werner Henn
U.F.R. de Mathematique et d'Informatique
Universite Louis Pasteur
7, rue Rene Descartes

F-67084 Strasbourg Cedex

Dr. Lars Hesselholt
Department of Mathematics
MIT
Room 2-269

Cambridge , MA 02139 4307
USA

Juliane Jänich
Mathematisches Institut
Universität Münster
Einsteinstr. 62

48149 Münster

Dr. Michael Joachim
Mathematisches Institut
Universität Münster
Einsteinstr. 62

48149 Münster

Prof.Dr. Klaus Johannson
Dept. of Mathematics
University of Tennessee at Knoxville
121 Ayres Hall

Knoxville , TN 37996-1300
USA

Prof.Dr. Robion C. Kirby
Department of Mathematics
University of California
at Berkeley
815 Evans Hall

Berkeley , CA 94720-3840
USA

Dr. Stephan Klaus
Mathematisches Forschungsinstitut Oberwolfach
Lorenzenhof

77709 Oberwolfach

Prof.Dr. Karlheinz Knapp
Fachbereich 7: Mathematik
U-GHS Wuppertal

42097 Wuppertal

Prof.Dr. Matthias Kreck
Mathematisches Institut
Universität Heidelberg
Im Neuenheimer Feld 288

69120 Heidelberg

Prof.Dr. Mark Lackenby
Trinity College

GB-Cambridge CB2 1TQ

Dr. Gerd Laures
Fachbereich Mathematik
Universität Mainz
Saarstr. 21

55122 Mainz

Prof.Dr. John Lott
Dept. of Mathematics
The University of Michigan
525 East University Avenue

Ann Arbor , MI 48109-1109
USA

Prof.Dr. Wolfgang Lück
Mathematisches Institut
Universität Münster
Einsteinstr. 62

48149 Münster

Dr. Martin Lustig
Institut f. Mathematik
Ruhr-Universität Bochum
Gebäude NA

44780 Bochum

Prof.Dr. Wolfgang Metzler
Fachbereich Mathematik
Universität Frankfurt
Postfach 111932

60054 Frankfurt

Dr. Dietrich Notbohm
Mathematisches Institut
Universität Göttingen
Bunsenstr. 3-5

37073 Göttingen

Prof.Dr. Robert Oliver
Departement de Mathematiques
Institut Galilee
Universite Paris XIII
Av. J.-B. Clement

F-93430 Villetaneuse

Prof.Dr. Erich Ossa
Fachbereich 7: Mathematik
U-GHS Wuppertal

42097 Wuppertal

Prof.Dr. Erik Kjaer Pedersen
Dept. of Mathematical Sciences
State University of New York
at Binghamton

Binghamton , NY 13902-6000
USA

Prof.Dr. Volker Puppe
Fakultät für Mathematik
Universität Konstanz
D 201
Postfach 5560

78434 Konstanz

Prof.Dr. Andrew A. Ranicki
Dept. of Mathematics & Statistics
University of Edinburgh
James Clerk Maxwell Bldg.
King's Building, Mayfield Road

GB-Edinburgh , EH9 3JZ

Prof.Dr. Elmer G. Rees
Dept. of Mathematics & Statistics
University of Edinburgh
James Clerk Maxwell Bldg.
King's Building, Mayfield Road

GB-Edinburgh , EH9 3JZ

Dr. Holger Reich
Mathematisches Institut
Universität Göttingen
Bunsenstr. 3-5

37073 Göttingen

Prof.Dr. Justin Roberts
Dept. of Mathematics & Statistics
University of Edinburgh
James Clerk Maxwell Bldg.
King's Building, Mayfield Road

GB-Edinburgh , EH9 3JZ

Roman Sauer
Mathematisches Institut
Universität Münster
Einsteinstr. 62

48149 Münster

Thomas Schick
Dept. of Mathematicsik
Penn State University
218 McAllister Building

University Park , PA 16802
USA

Björn Schuster
Fachbereich 7: Mathematik
U-GHS Wuppertal
Gaußstr. 20

42119 Wuppertal

Prof.Dr. Wilhelm Singhof
Mathematisches Institut
Heinrich-Heine-Universität
Gebäude 25.22
Universitätsstraße 1

40225 Düsseldorf

Prof.Dr. Peter Teichner
Dept. of Mathematics
University of California, San Diego
9500 Gilman Drive

La Jolla , CA 92093-0112
USA

Prof.Dr. Rainer Vogt
Fachbereich Mathematik/Informatik
Universität Osnabrück

49069 Osnabrück

Prof.Dr. Elmar Vogt
Institut für Mathematik II (WE2)
Freie Universität Berlin
Arnimallee 3

14195 Berlin