

MATHEMATISCHES FORSCHUNGSIINSTITUT OBERWOLFACH

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T O P O L O G I E

7.9. bis 13.9.1980

Die Tagung fand unter der Leitung von Herrn L. Siebenmann (Orsay), Herrn Ch. Thomas (Cambridge) und Herrn F. Waldhausen (Bielefeld) statt. Das Schwergewicht der Tagung lag auf geometrischer Topologie (insbesondere Topologie der Mannigfaltigkeiten und Knotentheorie), weniger auf Homotopietheorie, in Hinblick auf die nachfolgende Spezialtagung zu diesem Thema.

Vortragsauszüge

M. AUDIN:

Classe de cobordisme de la singularité d'un morphisme de fibrés vectoriels complexes

Soit $\varphi : \xi^n \rightarrow \eta^{n+i}$ un morphisme générique de fibrés vectoriels complexes sur une variété lisse X . Soit $\tilde{\Sigma}^1(\varphi)$ la désingularisation de l'ensemble de singularité $\Sigma^1(\varphi)$ définie par:

$$\tilde{\Sigma}^1(\varphi) = \{(x, 1) \in P(\xi) \mid 1 \subset \ker \varphi_x\}$$

où $P(\xi)$ est le projectifé de ξ . $\tilde{\Sigma}^1(\varphi)$, muni de la restriction de $\pi : P(\xi) \rightarrow X$ porte une classe de cobordisme complexe.

Soit γ^* le dual du fibré en droite canonique sur $\mathbb{C}\mathbb{P}^k$, et sa classe d'Euler en cobordisme; pour ζ un fibré de rang complexe m sur X . Définissons, des classes caractéristiques, α^j par

$$e(\gamma^* \otimes \zeta) = \sum \beta^k \times \alpha^{m-k}(\zeta).$$

Th. $[\tilde{\Sigma}^1(\varphi), \Pi|\tilde{\Sigma}^1(\varphi)] = \sum_{k \geq 0} \alpha^{i+k}(n-\zeta)[\mathbb{C}\mathbb{P}^k].$

Applications: Calcul de $\pi_* : U^*(P\xi) \rightarrow U^*(X)$;

Calcul de la classe de cobordisme d'une désingularisation des points doubles d'une application analytique.

E. BAYER:

Class numbers of simple fibred $(4q+1)$ -knots having an irreducible minimal polynomial

Let $\Sigma^{4q+1} \subset S^{4q+3}$ be a simple fibred knot, $q \geq 1$, and let λ be the minimal polynomial of the monodromy of Σ^{4q+1} . Assume that λ is irreducible. The Alexander polynomial of Σ^{4q+1} is then of the form $\pm \lambda^n$. λ and n are invariants of the isotopy class of Σ^{4q+1} . Let $K = \mathbb{Q}[x]/(\lambda) = \mathbb{Q}(\tau)$, and let F be the fixed field of the

involution of K which sends τ to τ^{-1} . Assume that $\mathbb{Z}[x]_{/\langle \lambda \rangle}$ is integrally closed.

Proposition: If $n = 1$, or if $n \geq 1$ and no infinite prime of F ramifies in K , (for instance if λ has only real roots) then the number of isotopy classes of simple fibred $(4q+1)$ -knots, $q \geq 1$, with invariants λ and n is

$$\frac{2^i h_K}{h_F} \cdot \# \left[\mathbb{U}_0 /_{N_{K/F}(U)} \right]$$

where h_K, h_F are the class numbers; U, U_0 the groups of units of K resp. F . $i = 0$ if K/F is ramified and $i = 1$ if K/F is totally unramified.

F. BONAHON

Cobordism of diffeomorphisms of surfaces

Two pairs (F_1^n, f_1) and (F_2^n, f_2) , where f_i is a diffeomorphism of the oriented closed n -manifold F_i^n ($i=1, 2$), are cobordant if there exists a diffeomorphism \hat{f} of a compact oriented manifold M^{n+1} such that $\partial M = F_1 \sqcup (-F_2)$ and $\hat{f}|_{\partial M} = f_1 \sqcup f_2$. The corresponding cobordism group Δ_n has been computed for $n \geq 3$ by M. Kreck.

When $n = 2$, Kreck's invariants are still defined, but it has been proven (A. Casson, K. Johannson - D. Johnson) that they are unsufficient to compute Δ_2 . We show that

$$\Delta_2 \cong \mathbb{Z}^\infty \oplus (\mathbb{Z}/2)^\infty.$$

The proof provides some more information on the structure of Δ_2 . For instance, the periodic cobordism group Δ_2^P , which consists of periodic cobordism (= cobordism by periodic diffeomorphisms of 3-manifolds), is a direct summand of Δ_2 .

The methods are geometric and deal with 3-manifold theory.

T. TOM DIECK

Homotopy representations of compact Lie groups

Let G be a compact Lie group. A homotopy representation for G is a finite-dimensional G -CW-complex X of finite orbit type such that each fixed point set X^H is homotopy-equivalent to a sphere $S^{n(H)-1}$; it is called finite if the complex is finite. The join $X * Y$ of h.r. X, Y is again a h.r. with composition law induced by join. ($V(G)$ Grothendieck group of finite h.r.). I reported about some aspects of computation of $V^\infty(G)$ and $V(G)$, in particular about torus actions and finiteness obstructions.

Theorem: Let $RO(T)$ be the real representation ring of a torus T . Let $l : RO(T) \rightarrow V^\infty(T)$, $V \mapsto S(V)$, be the canonical homomorphism. Then l is an isomorphism.

Theorem: There is a canonical exact sequence

$$0 \rightarrow V(G) \rightarrow V^\infty(G) \xrightarrow{\sigma} \prod_{(H)} \widetilde{K}_0(\mathbb{Z}(WH/WH_0)) \text{ where } (H) \text{ runs}$$

through the conjugacy classes of closed subgroups,
 $WH = NH/H$, WH_0 component of 1 in WH . The map σ is a suitable modified and generalized finiteness obstruction as introduced for free actions by Swan and Wall.

J. DUPONT

Scissors congruence and homology of Lie groups

Let $X = \mathbb{R}^n$, S^n or H^n , i.e. Euclidean, spherical or hyperbolic n -space and let G be a group of isometries of X . Define the polytope group (or "scissors congruence group") $P(X, G)$ to be the free abelian group on all proper polytopes P in X modulo the relations:

- 1) $[P] = [P'] + [P'']$, $P = P' \cup P''$, $\dim P' \cap P'' < n$
- 2) $[P] = [gP]$, $g \in G$

For G the whole isometry group we write $P(X, G) = P(X)$. We study the relation between this group and certain homology groups of G considered as a discrete group. In particular

Theorem: There are exact sequences

$$0 \rightarrow A \rightarrow H_3(SU(2), \mathbb{Z}) \rightarrow P(S^3)/\mathbb{Z} \xrightarrow{D} \mathbb{R} \otimes \mathbb{R}/\mathbb{Z} \rightarrow H_2(SU(2), \mathbb{Z}) \rightarrow 0$$
$$0 \rightarrow B \rightarrow H_3(SL(2, \mathbb{C}), \mathbb{Z})^- \rightarrow P(H^3) \xrightarrow{D} \mathbb{R} \otimes \mathbb{R}/\mathbb{Z} \rightarrow H_2(SL(2, \mathbb{C})\mathbb{Z})^- \rightarrow 0$$

Here A and B are annihilated by some 2-power and D denotes the Dehn invariants.

We also comment on the relation with the Cheeger-Simons invariants for flat bundles.

N. HABEGGER

Embedding the homotopy type of a complex in a manifold

Let $f : X^n \rightarrow V^m$ be a map from a finite C.W. complex to a manifold V . We say a submanifold $N \subset V$ is an induced thickening of X via f if

1) $\pi_1(N) = \pi_1(\partial N)$

- 2) There is a (simple) homotopy equivalence from X to N such that

$$\begin{array}{ccc} X & \xrightarrow{f} & V \\ \approx & \diagup \searrow & \\ & N & \end{array}$$

commutes up to homotopy.

Theorem (Wall)

Suppose $m-n \geq 3$ and f is $2n-m+1$ connected. Then f induces a thickening. If f is $2n-m+2$ connected the thickening is unique up to isotopy.

This leads to the question, what if the connectivity condition is relaxed? For simplicity we state the following theorem in the simply connected case.

Theorem: Suppose $m-n \geq 3$, $2n-m \geq 2$, $\pi_1(X) = \pi_1(V) = 0$, f $2n-m$ connected.

- 1) There is an element

$$\sigma(f) \in \frac{H^{2n}(X \times X; H_{2n-m+1}(f))}{I - T}$$

(where T is the map induced by switching factors and multiplication by ± 1 depending on the parity of $m-n$) such that $\sigma(f) = 0$ if and only if f induces a thickening.

2) If f is $2n-m+1$ connected, isotopy classes of thickenings induced by f are in bijection with this group.

Now in the special case $V = \mathbb{R}^m$ it can be shown that

$$\sigma \in \frac{\ker I+T}{I-T} \simeq \begin{cases} H^n(X; H_{2n-m}(X)) \otimes \mathbb{Z}_2, & m-n \text{ even} \\ H^n(X; H_{2n-m}(X)) * \mathbb{Z}_2, & m-n \text{ odd} \end{cases}$$

and evaluation of σ on homology classes gives homomorphisms which can be identified with the Thom operations. Thus:

Theorem: Let X^n be $2n-m+1$ connected. Then X thickens in \mathbb{R}^m if and only if the Thom operations θ_{m-n} are zero on $H_n(X)$ (all coefficients).

J.-C. HAUSMANN

On the homotopy of nilpotent spaces

In contrast with the classical results giving relations between the homotopy and the homology of a nilpotent space, we prove the following statement:

Theorem: Let P_i ($i \geq 2$) and Q_j ($j \geq 1$) be two arbitrary graded abelian groups. Then, there exists a 2-cosimple space X such that $\pi_i(X) \cong P_i$ and $H_j(X) \cong Q_j$ for all $i \geq 2$ and $j \geq 1$.

(A space X is 2-cosimple if $\pi_1(X)$ acts trivially on $\pi_i(X)$ for all $i \geq 2$). This theorem is obtained by

studying the possibles coverings of acyclic spaces.

K. IGUSA

Higher singularities are unnecessary

Let $f : M^n \rightarrow \mathbb{R}$ be a C^∞ function on a compact C^∞ manifold M^n . We define:

- (1) $\Sigma f = \{c \in M \mid Df(c) = 0\} = \text{singular set of } f$.
- (2) $A_k(f) = \{c \in \Sigma f \mid \text{there is a } C^\infty \text{ embedding } \varphi : U \rightarrow M \text{ where } U \text{ is a neighborhood of } 0 \text{ in } \mathbb{R}^n \text{ such that } \varphi(0) = c \text{ and } \forall x \in U \quad f\varphi(x) = \pm x_1^{k+1} + \sum_{i=2}^n x_i^2 + f(c)\}$
- (3) $P(M) = \{g : M \times I \rightarrow M \times I \text{ diffeomorphisms} \mid g \text{ is the identity map near } M \times 0 \cup \partial M \times I\}$
- (4) $F(M) = \{C^\infty \text{ maps } f : M \times I \rightarrow I \mid f = \text{proj}_I \text{ near } \partial(M \times I)\}$
- (5) $E(M) = \{f \in F(M) \mid \Sigma f = \emptyset\}$
- (6) $F_1(M) = \{f \in F(M) \mid \Sigma f = A_1(f) \cup A_2(f)\}$

All function spaces (3,4,5,6) have the Whitney C^∞ topology.

$$\underline{\text{Theorem}} \text{ (Cerf)} \quad \pi_k(F(M), E(M)) \cong \pi_{k-1} P(M)$$

My Theorem: If $\dim M > k$ then the inclusion

$F_1(M) \subset F(M)$ includes a split epimorphism

$$\pi_k(F_1(M), E(M)) \longrightarrow \pi_k(F(M), E(M)) \cong \pi_{k-1} P(M).$$

C. KEARTON

Factorisation of knots

An n -knot is a locally flat PL pair (S^{n+2}, S^n) . It is a classical result of H. Schubert that for $n=1$, every knot k factorizes uniquely as a sum $k = k_1 + \dots + k_m$ of irreducible knots k_i .

It is shown that if k is a fibered simple $(2q-1)$ -knot ($q \geq 3$) for which the associated quadratic form is definite, then k factorises uniquely into irreducibles. E. Bayer and J.A. Hillman have shown that neither of the hypotheses "fibered" or "definite" can be dropped. E. Bayer also has examples of simple $2q$ -knots ($q \geq 4$) which factorize into irreducibles in more than one way.

J. LANNES

Immersions and the Hurewicz map

Let X^n be a manifold of dimension n . Let $\alpha: Y^n \xrightarrow{\sim} \mathbb{R}^p \times X$ be an immersion with Y a compact manifold of dimension n ; one supposes that the normal bundle of α is trivialized: $v_\alpha \simeq \epsilon^p$. The cobordism group of such immersions is isomorphic to $[\hat{X}, QS^0]$, \hat{X} denoting the one point compactification of X and QS^0 the direct limit $\varinjlim_q \Omega^q S^q$.

We define on the group $[\hat{X}, QS^0]$ two kinds of maps.

I) The maps θ

Let Z be \mathbb{Z} equipped with the signature action of G_m .

Let G be an abelian group and u be a class in

$H^q(G_m; \mathbb{Z}^{P_X} \otimes G)$, we denote

$$\theta(p, m, u) : [\hat{X}, QS^0] \rightarrow H_c^{(m-1)p+q}(X; G)$$

the map such that

$$\theta(p, m, u)(\alpha) = \alpha_m^* c_m^* u$$

$\alpha_m : Y_m \xrightarrow{\sim} \mathbb{R}^p \times X$ denoting the m -fold immersion of α

and $c_m : Y_m \rightarrow BG_m$ the canonical covering of Y_m .

II) The maps h (h for Hurewicz)

one has a canonical isomorphism $H^*(QS^0; G) \simeq H^*(G; G)$,

so $H^*(QS^0; G) \simeq (H^*(G; G))^{\mathbb{Z}}$; we denote

$\Delta : H^*(G; G) \rightarrow H^*(QS^0; G)$ the diagonal embedding. Let v

be a class in $H^r(G; G)$ then

$$h(v) : [\hat{X}, QS^0] \rightarrow H_c^r(X; G)$$

is the map such that

$$h(v)(a) = a^* \Delta v.$$

For explicit the connection between the maps of type θ

and h we need some notations. Let N_m be the kernel of

the restriction $H^*(G_m; G) \rightarrow H^*(G_{m-1}; G)$ and

$$\bigoplus_{m=2}^{\infty} N_m : \bigoplus_{m=2}^{\infty} N_m \longrightarrow \tilde{H}^*(G; G)$$

be the Nakaoka decomposition of the cohomology of the

infinite symmetric group.

Let e_m be in $H^{m-1}(G_m; \mathbb{Z})$ the Euler class of the representation of G_m by permutation on the hyperplane $\sum_{i=1}^m x_i = 0$ of \mathbb{R}^m .

Theorem: $\theta(p, m, u) = h(\tau_m(e_m^p \cup u))$

This theory, for example, gives the following statements.

Proposition: Let X^n be an oriented manifold and $\alpha : Y^n \rightarrow \mathbb{R} \times X^n$ be a generic immersion with Y compact and oriented. If $n \neq 1, 3$ then the number of $(n+1)$ -fold points of α is even (it is a generalization of the recent result of P.J. Ecles for $X = \mathbb{R}^n$).

Proposition: Let $\theta : \pi_3^S \rightarrow \mathbb{Z}/3$ be a nontrivial homomorphism. Let a be an element of π_3^S represented by a generic immersion $\alpha : Y^3 \rightarrow \mathbb{R}^4$ with Y compact and oriented. It is possible to assign, in a canonical way, to each triple circle C of α a number $n(C)$ in $\mathbb{Z}/3$ such that

$$\theta(a) = \sum_C n(C)$$

Also the theory leads to generalizations of the Borsuk-Ulam theorem.

D. LEHMANN

Residues of connections with singularities and characteristic classes

We provide a "Chern-Weil theory" for those connections on a C^∞ bundle which are defined only over a neighborhood of the $(2k-1)$ skeleton of a differentiable triangulation of the bases, describing the real characteristic classes up to the dimension $2k$ by mean of the curvature of such a

connection ($k =$ any positiv integer).

This description covers simultaneously the classical Chern-Weil theory (generalizing Gauss-Bonnet) and the obstruction theory for the prolongation of a section (generalizing the Hopf theorem for index of section with isolated singularities)- Riemann-Hurwitz formulas for branched coverings can also appear as a particular case of the above theory.

A. MARIN

De nouvelles preuves des congruences dans le 16^e probleme de Hilbert

Soit $C \subset \mathbb{RP}^2$ une courbe algébrique de degré pair $2k$. Chacune de ses composantes coupe \mathbb{RP}^2 en un disque et une bande de Möbius; une composante est pair si elle est contenue dans un nombre pair de disques, impair sinon, on note p et n les nombres des composantes paires et impaires et \mathbb{RP}_+ celle des deux régions dicoupées par C qui est orientable.

Le quotient de C par la conjugaison complexe σ est une surface à bord D qui vit dans une sphère S^4 , le quotient de \mathbb{RP}^2 par σ . La surface $F = D \cup \mathbb{RP}_+$, non orientable en général, vérifie $F.F = 2(k^2 - (p-n))$.

On construit une forme quadratique q :

$$H_1(F, \mathbb{Z}/2) \rightarrow \mathbb{Z}/4 \text{ et montre que } \frac{\text{sign}(S^4) - F.F}{2} = \text{l'invariant}$$

de Brown $\alpha(q) \in \mathbb{Z}/8$: Une généralisation aux surfaces caractéristiques non orientables du Théorème de Rohlin sur la signature.

Ceci permet de retrouver la congruence de Rohlin $p-n \equiv k^2 \pmod{8}$ pour une M courbe, ainsi que toute les congruences que l'école Russe a produites en utilisant le théorème d'Atiyah Singer qui leur donne des congruences en toutes dimensions. Rohlin avait tout abord donné une preuve de "dimension quatre". Nous donnons un contre-exemple à cette preuve qui souligne l'opportunité de la généralisation aux surfaces caractéristiques non orientables du théorème de Rohlin.

C. ROGER

Sur la cohomologie de certaines algèbres de Lie de dimension infinie

Nous considérons les algèbres de Lie de dimension infinie que l'on rencontre naturellement en géométrie différentielle, et plus particulièrement les quatre algèbres suivantes:

- (1) $A(M)$ l'algèbre des champs tangents à une variété
- (2) $Sp(M)$ l'algèbre des champs symplectiques
- (3) $Vol(M)$ l'algèbre des champs de forme volume
- (4) $C(M)$ l'algèbre des champs de contact.

On cherche à calculer la cohomologie (au sens de Gelfand et Fuks) de ces algèbres de Lie, avec des coefficients triviaux ou non (les exemples les plus fréquents de tels coeffi-

cients seront l'algèbre elle même, soit $F(M)$ l'anneau des fonctions C^∞ sur M , où les champs de vecteurs opèrent par dérivations). Le problème est alors de décider de la finitude de ces cohomologies. Après le calcul de $H^*(A(M), \mathbb{R})$ dû à Haefliger et Segal, le cas des coefficients non triviaux a été résolu par Tsujishita (1977) qui a calculé $H^*(A(M), F(M))$ et donné des résultats très explicités pour $M = S^1$. On déduit également de ses résultats que $H^*(A(M), A(M)) \cong 0$.

Les cas autres que celui de l'algèbre de tous les champs sont encore assez mystérieux.

L'auteur a obtenu des résultats de finitude et de connexité sur $H^*(C(n))$ où $C(n)$ est algèbre de Lie des champs contact formels. On a en particulier le résultat suivant: $H^i(C(n)) = 0$ pour $i \leq 2n + 2$.

R. SEYMORE

Spaces of homogeneous polynomials and stable Adams Conjecture phenomena

The complex stable Adams conjecture (= S.A.C.) is the assertion that the diagram:

$$\begin{array}{ccc} BU_{1/q} & \xrightarrow{\psi^q} & BU_{1/q} \\ J \searrow & & \downarrow J \\ & BSG_{1/q} & \end{array}$$

commutes as a diagram of infinite loop maps. This has been proved by Friedlander by a very complicated argument. The real S.A.C. is known to be false (Madsen).

We show that the S.A.C. follows from the following "algebraic S.A.C."

Let $P_q(n)$ be the space of proper homogeneous polynomial maps of degree q from \mathbb{C}^n to \mathbb{C}^n , with base point $\sigma_q^n : (x_1, \dots, x_n) \rightarrow (x_1^q, \dots, x_n^q)$. Define $l, r : GL(n) \rightarrow P_q(n)$ by $l(A) = A \circ \sigma_q^n$ and $r(A) = \sigma_q^n \circ A$. The limit space $P_q(\infty)$ is an infinite loop space and l, r define infinite loop maps. The "algebraic S.A.C." asserts that the p -completion (p a prime not dividing q) of the following diagram commutes as a diagram of infinite loop maps:

$$\begin{array}{ccc} BGL(\infty) & \xrightarrow{\psi^q} & BGL(\infty) \\ l \searrow & & \swarrow r \\ & P_q(\infty) & \end{array}$$

This can be shown modulo a conjecture in étale homotopy theory. Namely: $P_q(n)$ is a complex variety defined by a single equation with integer coefficients. The equation therefore defines a scheme over \mathbb{Z} . If $k = \overline{\mathbb{F}}_q$ (q prime), $W =$ Witt ring of k and $j : W \rightarrow \mathbb{C}$ an embedding then we require that $X_k \xrightarrow{i} X_W \xleftarrow{j} X_{\mathbb{C}}$ should induce isomorphisms in étale cohomology for X a finite product of $P_q(n)$'s.

The corresponding algebraic diagram in the real case exists and can be shown to deloop once. This implies the usual real A.C. Both the real and complex results follow from

the "algebraic A.C." and a "proto-S.A.C.", which has the following form:

There are infinite loop spaces and maps (over \mathbb{C} and \mathbb{R}) .

$X_q, \mu_q : X_q \rightarrow X_q, \lambda_q : X_q \rightarrow X_q$ such that the following diagram commutes as a diagram of infinite loop maps

$$\begin{array}{ccc} (X_q)_{1/q} & \xrightarrow{\mu_q} & (X_q)_{1/q} \\ \downarrow \lambda & & \downarrow \lambda \\ BGL(\infty) & \xrightarrow{J} & BGL(\infty) \\ & \searrow J & \swarrow J \\ & (BSG)_{1/q} & \end{array}$$

L. SIEBENMANN (with F. BONAHON)

New splittings of classical knots

Consider a knot (S^3, K^1) consisting of a smooth closed 1-submanifold K^1 in S^3 (possibly not connected). We are interesting in classification of such knots up to deg+1 diffeomorphism of pairs.

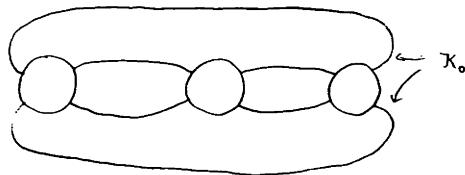
By classical splitting results due to H. Kneser and H. Schubert

(and others) there is no loss of generality in restricting attention to knots (S^3, K) such that $S^3 - K$ is irreducible and atoroidal (equivalently (S^3, K) is not a split link and has no companion knots).

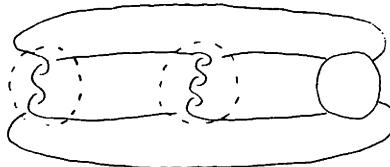
Such a knot is called simple for Schubert.

In a knot that is simple for Schubert, we study 2-spheres $S^2 \subset S^3$ that meet K in 4-points transversally. They are called Conway

spheres. Let $F = F_1 \sqcup \dots \sqcup F_k$ be a family of disjoint Conway spheres so that each $F_i - K$ is incompressible in $S^3 - K$ (i.e. π_1 injects). We choose F (say by a process of Haken) to be maximal for property that no (closed up) component N of $S^3 - F$ gives a parallelism of two components of F , i.e. $(N, K \cap N) \cong (S^2, 4\text{-points}) \times [0, 1]$. A closed-up component N of $S^3 - F$ is called elementary of the pair $(N, K \cap N)$ can be built as follows. Start with the 'hollow' pair (N_o, K_o) .



where N_o is S^3 minus three 3-balls and K_o is 6 segments as illustrated, then plug 0, 1, 2, or 3 of these holes with a pair consisting of a 3-ball and two linear segments, any gluing map is allowed to fit the plug in (respecting strings). An example of an elementary pair is



Let $A^3 \subset S^3$ be the union of all the closed-up components of $S^3 - F$ that are elementary.

Theorem

- I) A^3 is well defined up to isotopy of S^3 respecting K (although F^2 in general is not) Further up to $\deg 1$ pairisomorphisms the pair $(A^3, K \cap A^3)$ is classified by certain almost canonical integrally weighted planar trees (one per component of A^3). This classification is so natural that the $\deg + 1$ automorphisms of $(A^3, K \cap A^3)$ finite on ∂A^3 are classified up to pairwise isotopy by the group of automorphisms of this almost canonical weighted planar tree as to a central extension thereof by $\mathbb{Z}/2$. This classification suffers a few exceptions when $A^3 = S^3$. Namely the Borromean rings and rational knots, for which the automorphismgroups are known. Our methods do not apply to knots (S^3, K) that are elementary, but M. Bodeau has proved the results in almost all such cases.
- II) Let $A^* = \overline{S^3 - A^3}$, then the surface $F \cap A^*$ is well-defined up to isotopy respecting K . Using Thurston's hyperbolisation theorem (and some auxiliary results) one can show that the pair $(A^* - F, K \cap (A^* - F))$ has a complets Π -hyperbolic structure of finite volume; this corresponds to a hyperbolic structure on the 2-fold branched cyclic covering for which the covering involution is an isometry.

T.L. THICKSTUN

Open acyclic 3-manifolds, a loop theorem and the Poincaré conjecture

The classical Poincaré conjecture (hereafter denoted P.C.) is equivalent to a conjecture concerning the class of open, irreducible

acyclic 3-manifolds. Here a space, X , is acyclic iff $H_1(X, \mathbb{Z}) = 0$ and a 3-manifold, M^3 , is irreducible iff every 2-sphere P.L. embedded in M^3 bounds a ball. A map is proper iff preimages of compacta are compacta.

Theorem: P.C. iff every open, irreducible, acyclic 3-manifold, which is the degree one proper image of an open 3-manifold embeddable in S^3 , is also embeddable in S^3 .

Indication of proof

If: This is an easy consequence of results found in "Open 3-manifolds an the Poincaré conjecture" by D.R.McMillan Jr. and T.L. Thickstem (Topology 1980).

Only if: Given a degree one, proper map

$$f : V^3 \rightarrow U^3 \quad \text{with} \quad V^3 \subset S^3$$

and U^3 acyclic there is a procedure for compactifying U^3 so as to obtain a space which, modulo P.C., is S^3 (but which, if P.C. is false, can even fail to be a manifold).

This compactification procedure makes repeated use of the following lemma, which is an analogue of the classical loop theorem of Stallings. First define a virtual disk to be the 2-disk with some compact subset (usually non polyhedral) deleted from its interior.

Let $f : (\overset{\vee}{D}, \partial \overset{\vee}{D}) \rightarrow (W^3, \partial W^3)$ be a proper map of a virtual disk into a non-compact 3-manifold, W^3 , which is acyclic at ∞ . Let A be a normal subgroup of $\pi_1(\partial W^3)$ such that $[f|_{\partial \overset{\vee}{D}}] \notin A$. Then there exists a proper embedding of a virtual disk, $g : (\overset{\vee}{E}, \partial \overset{\vee}{E}) \rightarrow (W^3, \partial W^3)$, such that $[g|_{\partial \overset{\vee}{E}}] \notin A$.

E. VOGT

A condition for local stability of compact foliations

Let F be a compact foliation (i.e. all leaves are compact) on a manifold M . Let M_0 be union of leaves without holonomy. M_0 is open and dense in M and the leaves in M_0 are called the typical leaves. Let M_1 be the union of leaves with finite holonomy. If $M_1 = M$, then F is called locally stable. The reason for this terminology is the fact that every leaf of a locally stable compact foliation has a basis of neighborhoods with are union of leaves, i.e. the foliation is stable near each leaf with respect to variation of initial conditions. A locally stable C^1 -foloation has by a result of Ehresmann and D.B.A. Epstein a very explicit description near each leaf as a (generalized) Seifert fibration. The talk was concerned with the relationship between $H^1(\text{Leaf}; \mathbb{R})$ and the local stability behaviour of the foliation (a question raised by D.B.A. Epstein and H. Rosenberg).

Proposition 1: For each closed analytic manifold F there is a C^ω -foliation of codimension 2 with all leaves compact and F as typical leaf which is not locally stable.
(Thus $H^1(\text{typical leaf}; \mathbb{R})$ has nothing to do with local stability).

Proposition 2: Let F be a compact C^1 -foloation on a manifold M which is not locally stable. Let either
a) $\dim M - M_1 \geq \dim M - 2$ or

- b) codim $F \leq 3$ or
c) codim $F \leq 4$ and M be compact, then there is an open dense saturated $U \subset M - M_1$ s.t. every leaf in U has a finite cover \tilde{F} with $H^1(\tilde{F}, \mathbb{R}) \neq 0$.

Proposition 3: Let F be as in Prop. 2. Then for every leaf $F \subset M - M_1$, there is an action of $\pi_1 F$ on $\xi_k = \text{germs}$ of real functions on \mathbb{R}^k , $k = \text{codim } F$, s.t. $H^1(F, \xi_k) \neq 0$.

C. WEBER

Fibered Casson-Gordon knots

Theorem: Let $K \subset S^3$ be a rational (= two bridged) fibered knot, which is algebraically slice. If g denotes the genus of K , then $m = 2g+1$ has the following property:

(D) For all prime divisors l/m the order of 2 in the multiplicative group $(\mathbb{Z}_{/l})^*$ is odd.

The $g < 50$ satisfying condition (D) are: 3, 11, 15, 23, 24, 35, 36, 39, 44.

For $g = 3$ there are 20 rational fibered knots, among which 5 are algebraically slice. They are indeed ribbon.

For $g = 11$ there are 1'049'600 rational fibered knots among which 22 are algebraically slice (Found with the help of a computer). The simplest of them has $L(12'321; 7'550)$ for double cover and its Conway notation is 2 171 171 121 12.

For this knot everything written so far has been checked by hand computation.

Computation of signatures with a computer has given one Casson-Gordon invariant equal to 3. If this last computation is correct, this is the simplest rational fibered Casson-Gordon knot (27 crossings)

This is a report of a joint work with Daniel Lines.

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