

Ten papers published by Geometry & Topology Monographs

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Geometry and Topology Publications is pleased to announce commencement of publication of G&T Monograph number 13:

Groups, homotopy and configuration spaces (Tokyo 2005)

Editors: Norio Iwase, Toshitake Kohno, Ran Levi, Dai Tamaki and Jie Wu

This volume is the proceedings of the conference "Groups, Homotopy and Configuration Spaces" held at the University of Tokyo, July 5–11, 2005, in honor of the 60th birthday of Fred Cohen. The emphasis of the conference was on cohomology of groups, classical and modern homotopy theory, geometry and topology of configuration spaces and related topics. However, the conference was intended to have a broad scope, with talks on a variety of topics of current interests in topology. The organizing committee consisted of Norio Iwase, Toshitake Kohno, Ran Levi, Dai Tamaki and Jie Wu. The conference was supported by the COE program of the Graduate School of Mathematical Sciences, The University of Tokyo.

The proceedings will consist of twenty–three papers, of which the first ten have now been published:

(1) Geometry & Topology Monographs 13 (2008) 1–10
String topology of Poincare duality groups
by Hossein Abbaspour, Ralph Cohen and Kate Gruher
URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p001.xhtml>
DOI: 10.2140/gtm.2008.13.1

(2) Geometry & Topology Monographs 13 (2008) 11–40
Computation of the homotopy of the spectrum tmf
by Tilman Bauer
URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p002.xhtml>
DOI: 10.2140/gtm.2008.13.11

(3) Geometry & Topology Monographs 13 (2008) 41–83

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A family of embedding spaces

by Ryan Budney

URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p003.xhtml>

DOI: 10.2140/gtm.2008.13.41

(4) Geometry & Topology Monographs 13 (2008) 85–104

Cohomology of Artin groups of type \tilde{A}_n , B_n and applications

by Filippo Callegaro, Davide Moroni and Mario Salvetti

URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p004.xhtml>

DOI: 10.2140/gtm.2008.13.85

(5) Geometry & Topology Monographs 13 (2008) 105–146

The boundary manifold of a complex line arrangement

by Daniel C Cohen and Alexander I Suci

URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p005.xhtml>

DOI: 10.2140/gtm.2008.13.105

(6) Geometry & Topology Monographs 13 (2008) 147–168

Basis–conjugating automorphisms of a free group
and associated Lie algebras

by F R Cohen, J Pakianathan, V V Vershinin and J Wu

URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p006.xhtml>

DOI: 10.2140/gtm.2008.13.147

(7) Geometry & Topology Monographs 13 (2008) 169–193

On braid groups and homotopy groups

by F R Cohen and J Wu

URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p007.xhtml>

DOI: 10.2140/gtm.2008.13.169

(8) Geometry & Topology Monographs 13 (2008) 195–201

Odd–primary homotopy exponents of compact simple Lie groups

by Donald M Davis and Stephen D Theriault

URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p008.xhtml>

DOI: 10.2140/gtm.2008.13.195

(9) Geometry & Topology Monographs 13 (2008) 203–227

Filtering the fiber of the pinch map

by Brayton Gray

URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p009.xhtml>

DOI: 10.2140/gtm.2008.13.203

(10) Geometry & Topology Monographs 13 (2008) 229–259

Homotopy algebra of open–closed strings

by Hiroshige Kajiura and Jim Stasheff

URL: <http://www.msp.warwick.ac.uk/gtm/2008/13/p010.xhtml>

DOI: 10.2140/gtm.2008.13.229

Abstracts follow

(1) String topology of Poincaré duality groups

by Hossein Abbaspour, Ralph Cohen and Kate Gruher

Let G be a Poincaré duality group of dimension n . For a given element g in G , let C_g denote its centralizer subgroup. Let L_G be the graded abelian group defined by $(L_G)_p = \sum_{[g]} H_{p+n}(C_g)$ where the sum is taken over conjugacy classes of elements in G . In this paper we construct a multiplication on L_G directly in terms of intersection products on the centralizers. This multiplication makes L_G a graded, associative, commutative algebra. When G is the fundamental group of an aspherical, closed oriented n -manifold M , then $(L_G)_* = H_{*+n}(LM)$, where LM is the free loop space of M . We show that the product on L_G corresponds to the string topology loop product on $H_*(LM)$ defined by Chas and Sullivan.

(2) Computation of the homotopy of the spectrum tmf
by Tilman Bauer

This paper contains a complete computation of the homotopy ring of the spectrum of topological modular forms constructed by Hopkins and Miller. The computation is done away from 6, and at the (interesting) primes 2 and 3 separately, and in each of the latter two cases, a sequence of algebraic Bockstein spectral sequences is used to compute the E_2 term of the elliptic Adams–Novikov spectral sequence from the elliptic curve Hopf algebroid. In a further step, all the differentials in the latter spectral sequence are determined. The result of this computation is originally due to Hopkins and Mahowald (unpublished).

(3) A family of embedding spaces
by Ryan Budney

Let $\text{Emb}(S^j, S^n)$ denote the space of C^∞ -smooth embeddings of the j -sphere in the n -sphere. This paper considers homotopy-theoretic properties of the family of spaces $\text{Emb}(S^j, S^n)$ for $n \geq j > 0$. There is a homotopy-equivalence of $\text{Emb}(S^j, S^n)$ with $SO_{n+1} \times_{SO_{n-j}} K_{n,j}$ where $K_{n,j}$ is the space of embeddings of R^j in R^n which are standard outside of a ball. The main results of this paper are that $K_{n,j}$ is $(2n-3j-4)$ -connected, the computation of $\pi_{2n-3j-3}(K_{n,j})$ together with a geometric interpretation of the generators. A graphing construction $\Omega K_{n-1,j-1} \rightarrow K_{n,j}$ is shown to induce an epimorphism on homotopy groups up to dimension $2n-2j-5$. This gives a new proof of Haefliger's theorem that $\pi_0(\text{Emb}(S^j, S^n))$ is a group for $n-j > 2$. The proof given is analogous to the proof that the braid group has inverses. Relationship between the graphing construction and actions of operads of cubes on embedding spaces are developed. The paper ends with a brief survey of what is known about the spaces $K_{n,j}$, focusing on issues related to iterated loop-space structures.

(4) Cohomology of Artin groups of type \tilde{A}_n, B_n and applications

by Filippo Callegaro, Davide Moroni and Mario Salvetti

We consider two natural embeddings between Artin groups: the group $G_{\tilde{A}_{n-1}}$ of type \tilde{A}_{n-1} embeds into the group $1G_{B_n}$ of type B_n ; G_{B_n} in turn embeds into the classical braid group $Br_{n+1} := G_{A_n}$ of type A_n . The cohomologies of these groups are related, by standard results, in a precise way. By using techniques developed in previous papers, we give precise formulas (sketching the proofs) for the cohomology of G_{B_n} with coefficients over the module $Q[q^{\pm 1}, t^{\pm 1}]$, where the action is $(-q)$ -multiplication for the standard generators associated to the first $n-1$ nodes of the Dynkin diagram, while is $(-t)$ -multiplication for the generator associated to the last node.

As a corollary we obtain the rational cohomology for $G_{\tilde{A}_n}$ as well as the cohomology of Br_{n+1} with coefficients in the $(n+1)$ -dimensional representation obtained by Tong, Yang and Ma.

We stress the topological significance, recalling some constructions of explicit finite CW-complexes for orbit spaces of Artin groups. In case of groups of infinite type, we indicate the (few) variations to be done with respect to the finite type case. For affine groups, some of these orbit spaces are known to be $K(\pi, 1)$ spaces (in particular, for type \tilde{A}_n).

We point out that the above cohomology of G_{B_n} gives (as a module over the monodromy operator) the rational cohomology of the fibre (analog to a Milnor fibre) of the natural fibration of $K(G_{B_n}, 1)$ onto the 2-torus.

(5) The boundary manifold of a complex line arrangement
by Daniel C Cohen and Alexander I Suciu

We study the topology of the boundary manifold of a line arrangement in CP^2 , with emphasis on the fundamental group G and associated invariants. We determine the Alexander polynomial $\Delta(G)$, and more generally, the twisted Alexander polynomial associated to the abelianization of G and an arbitrary complex representation. We give an explicit description of the unit ball in the Alexander norm, and use it to analyze certain Bieri-Neumann-Strebel invariants of G . From the Alexander polynomial, we also obtain a complete description of the first characteristic variety of G . Comparing this with the corresponding resonance variety of the cohomology ring of G enables us to characterize those arrangements for which the boundary manifold is formal.

(6) Basis-conjugating automorphisms of a free group
and associated Lie algebras
by F R Cohen, J Pakianathan, V V Vershinin and J Wu

Let $F_n = \langle x_1, \dots, x_n \rangle$ denote the free group with generators

$\{x_1, \dots, x_n\}$. Nielsen and Magnus described generators for the kernel of the canonical epimorphism from the automorphism group of F_n to the general linear group over the integers. In particular among them are the automorphisms $\chi_{\{k,i\}}$ which conjugate the generator x_k by the generator x_i leaving the x_j fixed for $j \neq k$. A computation of the cohomology ring as well as the Lie algebra obtained from the descending central series of the group generated by $\chi_{\{k,i\}}$ for $i < k$ is given here. Partial results are obtained for the group generated by all $\chi_{\{k,i\}}$.

(7) On braid groups and homotopy groups
by F R Cohen and J Wu

This article is an exposition of certain connections between the braid groups, classical homotopy groups of the 2-sphere, as well as Lie algebras attached to the descending central series of pure braid groups arising as Vassiliev invariants of pure braids. Natural related questions are posed at the end of this article.

(8) Odd-primary homotopy exponents of compact simple Lie groups
by Donald M Davis and Stephen D Theriault

We note that a recent result of the second author yields upper bounds for odd-primary homotopy exponents of compact simple Lie groups which are often quite close to the lower bounds obtained from v_1 -periodic homotopy theory.

(9) Filtering the fiber of the pinch map
by Brayton Gray

A new type of Hopf invariant is described for the fiber of the pinch map:

$$F \rightarrow X \cup CA \rightarrow SA$$

and this is used to study the boundary map in the fibration sequence of Cohen, Moore and Neisendorfer:

$$\Omega^2 S^{2n+1} \rightarrow \Omega F_n \rightarrow \Omega P^{2n+1} \rightarrow \Omega S^{2n+1}$$

The boundary map is shown to be compatible with the Hopf invariant and a filtration of the splitting is obtained.

(10) Homotopy algebra of open-closed strings
by Hiroshige Kajiura and Jim Stasheff

This paper is a survey of our previous works on open-closed homotopy algebras, together with geometrical background, especially in terms of compactifications of configuration spaces (one of Fred's specialities) of Riemann surfaces, structures on loop spaces, etc. We newly present Merkulov's geometric A_∞ -structure [Internat. Math. Res. Notices

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(1999) 153—164] as a special example of an OCHA. We also recall the relation of open–closed homotopy algebras to various aspects of deformation theory.

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