Algebraic Topology
Topologie algébrique
(Org: **Alejandro Adem** (UBC) and/et **Bob Oliver** (Paris XIII))

KAI BEHREND, UBC

RYAN BUDNEY, Mathematics and Statistics, University of Victoria, Victoria, BC, Canada V8W 3P4
The space of embeddings of S^1 in S^3 and related topics

I will provide a status-update on what is known about the homotopy-type of the space of embeddings of the circle in the 3-sphere, $\mathrm{Emb}(S^1, S^3)$. $\mathrm{Emb}(S^1, S^3)$ fibers over a Stiefel manifold with fiber the space of "long knots" $\mathrm{Emb}(R, R^3)$, these are the smooth embeddings of R in R^3 which agree with a fixed linear inclusion $R \to R^3$ outside of a ball.

By the work of Allen Hatcher, the components of $\mathrm{Emb}(R, R^3)$ are $K(\pi, 1)$ spaces (components are precisely isotopy-classes of knots). I worked out a procedure to compute the fundamental groups of these components, but the answer requires

(1) knowledge of the JSJ-decomposition of the knot complement,

(2) knowledge of the geometric structures on the complement split along its JSJ-decomposition, and

(3) knowledge of a certain signed-symmetric representation of the isometry groups of certain "almost Brunnian" hyperbolic link complements (these are the hyperbolic link complements that arise in the JSJ-decompositions of knots).

My overriding motivation is that I believe it is possible to have a "closed form" description of the homotopy type of the spaces $\mathrm{Emb}(S^1, S^3)$ and $\mathrm{Emb}(R, R^3)$, where "closed form" in this context means "$\mathrm{Emb}(R, R^3)$ has the homotopy type of a collection of connected spaces X, where X is generated from the 1-point space via 3 simple bundle operations, where the base spaces are S^1, $S^1 \times S^1$, or coloured configuration spaces in R^2, and the fibers are products of previous spaces in the collection X, and the monodromy is given explicitly from an elementary table of monodromies." In principle this should give a description of $H_*(\mathrm{Emb}(R, R^3))$ as a certain "mangled" bar construction, for lack of a better word.

JOSE MARIA CANTARERO, University of British Columbia, Room 121, 1984 Mathematics Road, Vancouver, BC, Canada V6T 1Z2
Equivariant K-theory, groupoids and proper actions

Equivariant K-theory for actions of Lie groupoids can be defined using a subset of equivariant bundles. For a Bredon-compatible Lie groupoid, this defines a periodic cohomology theory on the category of finite equivariant CW-complexes. A particular instance is equivariant K-theory for proper actions of non-compact Lie groups. Some important examples and an analogue of the completion theorem of Atiyah and Segal will be provided.

VINCENT FRANJOU, Université de Nantes
Finite generation of invariants

A classic problem in invariant theory, often referred to as Hilbert's 14th problem, asks, when a group acts on a finitely generated algebra by algebra automorphism, whether the ring of invariants is still finitely generated. I shall discuss joint work with W. van der Kallen treating the problem for a Chevalley group over an arbitrary base. I shall also present progress by A. Touzé, on the corresponding conjecture of van der Kallen for rational cohomology over a field, that uses functor cohomology as an essential tool.

GREGORY GINOT, UPMC Paris 6, 4, place Jussieu, 75252 Paris, France
Gerbes, principal 2-group bundles and characteristic classes

It is well known that a principal G-bundle P over a manifold M determines a homotopy class of maps f from M to the classifying space BG of the group G. Pulling back the generators of $H^*(BG)$ through f, one obtains characteristic classes of the principal bundle P over M. It is a classical theorem that these characteristic classes coincide with those obtained from the Chern–Weil construction using connections and curvatures.

Gerbes are higher analogue of principal bundles. We will discuss an analogue of Chern's theorem for Gerbes. The idea is to relate Gerbes with 2-group principal bundles, and to study characteristic classes of these principal 2-group bundles.

VERONIQUE GODIN, Harvard University
A coproduct is string topology and knots

I'll discuss how a string coproduct on the homology of certain path spaces sees knots. And potential consequences.

PIERRE GUILLOT, IRMA, 7 rue Rene Descartes, 67000 Strasbourg, France
The computation of Stiefel–Whitney classes

Research in finite group cohomology has acquired a new flavour in recent years, thanks to the availability of numerous explicit calculations by Jon Carlon and David Green, using computers. Concrete examples have been produced en masse.

If you look at these computations and compare them with the sort of results which would be presented by a mathematician, a major difference is that most of us would try to present the *Stiefel–Whitney classes* in the cohomology ring. These classes are associated with real representations of the group, and have thus a geometric meaning. Moreover, it is more satisfying to explain an algebraic relation in the cohomology ring in terms of a representation-theoretic fact (for example involving tensor products or exterior powers).

Another piece of information which one would like to add to the computer calculation is the effect of *Steenrod operations* on the ring. These give a much richer structure.

At first sight it seems difficult to use any of the available definitions in order to teach a computer to deal with this. In this talk I will explain, however, how one can use a simple trick to perform the calculations in most cases. You can see the results on my webpage: `http://www-irma.u-strasbg.fr/~guillot/research/cohomology_of_groups/index.html`

RICK JARDINE, University of Western Ontario, London, Ontario, Canada N6A 5B7
Algebraic K-theory presheaf of spectra

The published versions of the construction of the algebraic K-theory presheaf of spectra predate recent developments in stable homotopy theory, and are quite awkward from a modern point of view.

Waldhausen's methods can be used to produce symmetric spectrum models for K-theory spectra, as well as smash product pairings for biexact pairings such as tensor product. This construction can be promoted to give an algebraic K-theory presheaf of symmetric spectra on the big site for a scheme S. The usual coherence problems are solved by using big site vector bundles in place of ordinary vector bundles to define the spectra. This construction is a foundation for all Grothendieck topological versions of algebraic K-theory, such as etale K-theory and motivic K-theory.

SADOK KALLEL, University of Lille
Homology of Finite Subset Spaces

We introduce the tools of homological algebra into the study of the homology of finite subset spaces X_n, $n \geq 1$. After reviewing and expanding on some known and less well-known results about the finite subset spaces of a simplicial complex X, we introduce a spectral sequence for "generalized double mapping cylinders" which in the case of finite subset spaces reduces to a spectral sequence first investigated by Ross Biro in his Stanford thesis. This spectral sequence which is made out from the symmetric products of X and its suspension provides a powerful tool for calculations; an assertion we illustrate by working out the rational and mod-2 homology of finite subset spaces of spheres.

This is joint work with Denis Sjerve (Vancouver).

MURIEL LIVERNET, Université Paris 13, Avenue JB Clement, 93439 Villetaneuse
Left modules and algebras over a Hopf operad

In this talk I will explain why left modules are the right notion to deal with algebras over an operad, especially in the context of Hopf operads where one can recover Lie theory or combinatorial Hopf algebras.

ANDREW NICAS, McMaster University
Hochschild homology relative to a family of groups

We define the Hochschild homology groups of a group ring ZG relative to a family of subgroups F of G. These groups are the homology groups of a space which can be described as a homotopy colimit, or as a configuration space, or, in the case F is the family of finite subgroups of G, as a space constructed from stratum preserving paths.

This is joint work with David Rosenthal (St. John's University, Jamaica, NY).

JEFF SMITH, UBC

BRUNO VALLETTE, Université de Nice Sophia-Antipolis
Deformation theory of algebraic structures

The purpose of this talk is to define and study the deformation theory of universal algebras based on the recent use of higher algebraic objects, operads and props, that model these categories.

Many categories of algebras like associative algebras, Lie algebras, Gerstenhaber algebras, BV-algebras, Lie bialgebras or associative bialgebras, for instance, are governed by one algebraic object called an operad or more generally a prop. Any construction performed on the level of operads or props give universal results to any algebras encoded by this operad or prop. We will define the deformation theory of morphisms of prop/operads à la Quillen. For instace, we recover Hochschild (co)homology for associative algebras, Chevalley–Eilenberg (co)homology for Lie algebras or Gerstenhaber–Shack (co)homology for associative bialgebras.

Using operadic homological algebra (twisting morphisms, bar and cobar constructions), we will make this cohomology theories explicit. This will allow to prove that these deformation theories are always governed by a homotopy Lie algebra, thus verifying Deligne's statement that "any deformation theory should be governed by a differential graded Lie algebra". For instance, this shows that Gerstenhaber–Shack bicomplex is endowed with a natural structure of homotopy Lie algebra.

Any realization of these chain complexes is based on a cofibrant resolution of the associated prop. Koszul duality theory gives an efficient method to make explicit such resolutions. Unfortunately, many props fail to be Koszul, so we will present other methods to get cofibrant resolutions of props.

CHRISTINE VESPA, Université Louis Pasteur (IRMA) Strasbourg
Stable homology of groups by functor homology

In 1999, Betley and Suslin prove independently a powerful theorem which relates homological computations in the category of functors between vector spaces and stable homology of general linear groups. It is natural and interesting to obtain generalizations of this result for other families of groups, notably the orthogonal groups. In this talk I will explain the steps of the proof given by Suslin and present the situation and the difficulties for orthogonal groups.