Vorträge
Tenure Track „ALGEBRAISCHE TOPOLOGIE"

Dienstag, 5. März 2019, Seminarraum 11

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Nils Carqueville
(Universität Wien)

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9:00 Uhr – 9:20 Uhr: Didaktischer Vortrag
„The fundamental groupoid of a topological space"

Constructing algebraic invariants of topological spaces is an important aspect of algebraic topology. Since homotopy groups are relatively easily defined and accessible to intuition, they make for a good first example of functorial invariants in an introductory course. With this in mind I will introduce fundamental groups and fundamental groupoids. (I imagine this taking place in a course whose first chapter covered basic constructions with topological spaces (products, quotients, pullbacks, pushouts, CW complexes) as well as the language of categories and functors, and whose second chapter recently started with the notion of homotopy between two continuous maps.)

9:50 Uhr – 10:35 Uhr: Wissenschaftlicher Vortrag
„Representations of bordisms and their orbifolds"

Topological quantum field theory is about structure-preserving maps from bordism categories to algebraic categories, e.g. of vector spaces. This has produced important topological invariants of manifolds and knots, and it has inspired productive interactions and applications in algebra, geometry, topology, and theoretical physics.
I will introduce the subject and outline the research programme I have been pushing for several years. One basic idea is to construct new invariants from triangulations of bordisms that are decorated with combinatorial data; triangulation invariance imposes conditions on such data, giving rise to a tower of algebraic structures and their representation theory. I will describe how this theory has found surprising applications in singularity theory, and recent work that has paved the way for new topological invariants from non-semisimple tensor categories, as well as new candidates for topological quantum computation.

Dienstag, 5. März 2019, Seminarraum 13

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Vera Vertesi
(University of Strasbourg)

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15:00 Uhr – 15:20 Uhr: Didaktischer Vortrag
„Coverings and the fundamental group"

In this lecture I present the beautiful Galois-like connection between subgroups of the fundamental group of a space and its coverings. This would be part of a class, where the immediately preceding lectures included the topics:
paths, loops, homotopies, the fundamental group, covering spaces, path lifting lemma, fundamental group of the circle, Brower fixed-point theorem, the fundamental theorem of algebra, hedgehog theorem, Van Kampen theorem, fundamental group of product, fundamental group of CW-complexes.

15:50 Uhr – 16:35 Uhr: Wissenschaftlicher Vortrag
„Contact Heegaard decompositions"
In 1898 Heegaard proved that any (smooth, closed, connected, oriented) 3-manifold splits up as the union of two handlebodies. These simple building blocks, handlebodies, are balls with some number of handles attached to them. The number of handles are called the genus. The Heegaard genus of a 3-manifold is the the minimum of the genera of its possible Heegaard splittings. This is a good measurement of complexity of 3-manifolds. A corollary of Haken's Lemma from 1968 is that the Heegaard genus of 3-manifolds is additive under connected sum. In this lecture I explain the generalisation of this result for contact 3-manifolds.

Mittwoch, 6. März 2019, Seminarraum 05 **Paul Wedrich**
(Australian National University)

9:00 Uhr – 9:20 Uhr: Didaktischer Vortrag
„Die Fundamentalgruppe"
Ein Ausschnitt aus der Vorlesung „Algebraische Topologie".

9:50 Uhr – 10:35: Wissenschaftlicher Vortrag
„On coloured link homologies"
Link homology theories are powerful generalisations of knot polynomials. Besides being better at distinguishing links, these theories are often functorial under link cobordisms and detect additional topological information. I will start by introducing Khovanov homology, a paradigmatic example of a link homology theory. I will then survey how Khovanov homology fits into the family of coloured gl(N) link homologies, how these invariants extract interesting topological information, and why they appear in many parts of mathematics. At the end, I will outline the next steps towards one of the most pressing problems in low-dimensional topology: the construction of categorified quantum invariants of 3- and 4-manifolds.

Donnerstag, 7. März 2019, Seminarraum 13 **Matthias Nagel**
(Oxford University)

9:00 Uhr – 9:20 Uhr: Didaktischer Vortrag
„Invarianten von Knotenaußenräumen"
Wir betrachten Außenräume von Knoten in der 3-Sphäre und ihre Homologie.

9:50 Uhr – 10:35 Uhr: Wissenschaftlicher Vortrag
„Links between dimensions three and four"
Knot theory investigates the many ways of embedding a circle into the three-dimensional sphere. The study of these embeddings is not only important for understanding three-dimensional manifolds, but is also intimately related to many new and surprising phenomena appearing in dimension four. I will describe and motivate an equivalence relation on knots, called "concordance", which takes the fourth dimension into account. Concordance is connected with many problems at the heart of the topology of four-manifolds, such as the difference between the smooth and the topological category and I will discuss results that illuminate these relations.

Freitag, 8. März 2019, Seminarraum 05   **Dmitry Tonkonog**
                                                (University of California, Berkeley)

9:00 Uhr – 9:20 Uhr: Didaktischer Vortrag
„Introduction to homology"
The setting: I am teaching an algebraic topology course and have covered the first major topic, the fundamental group. I assume that the notions of homotopy, homotopy equivalence, fundamental groups have been covered. (In addition, I assume that point-set topology and basic abstract algebra are prerequisites for the course.) I am about to start the next topic, homology. In this 20-minute piece, I will present an informal introduction to homology, focusing on motivations and ideas. (I would move on towards the precise definitions in an actual class, but not within this 20-minute piece.)

9:50 Uhr – 10:35: Wissenschaftlicher Vortrag
„Lagrangian enumerative geometry and mirror symmetry"
Symplectic topology provides a bridge between classical algebraic topology, and algebraic geometry. I will discuss this by looking at Lagrangian tori, which play a crucial role in Hamiltonian dynamics and mirror symmetry. I will present an approach towards proving classical mirror symmetry predictions for Fano manifolds using Lagrangian enumerative geometry. The main example will be the period integral formula for computing quantum periods of Fano manifolds.

Freitag, 8. März 2019, Seminarraum 05   **Goncalo Tabuada**
                                           (Massachusetts Institute of Technology)

14:00 Uhr – 14:20 Uhr: Didaktischer Vortrag
„The fundamental group and its applications"
I will start by defining the fundamental group of a topological space. Then, I will compute it in the case of the circle. Finally, I will explain how the (famous) Brouwer fixed point in dimension 2 follows from this latter computation.

14:50 Uhr – 15:35 Uhr: Wissenschaftlicher Vortrag
„A noncommutative/topological approach to some celebrated conjectures of Grothendieck, Tate and Weil"
The Grothendieck standard conjectures, the Tate conjecture(s), and the Weil conjecture, play a central role in geometry. Notwithstanding the effort of several generations of mathematicians, the proof of these celebrated conjectures remains elusive (the Weil conjecture was proved by Deligne). The aim of this talk is to give an overview of a recent noncommutative/topological approach which led to the proof of the aforementioned important conjectures in several new cases (and to an alternative proof of the Weil conjecture).