Benjamin Matthias Ruppik

Curriculum Vitae

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Personal Information

Name	Benjamin Matthias Ruppik
Date of birth	1994-06-30
Place of birth	Aachen, Germany
Nationality	German

Education

October 2018 – Present	**PhD student, member of the Bonn International Graduate School of Mathematics (BIGS); funded by the the International Max Planck Research School on Moduli Spaces (IMPRS)** , *Max-Planck-Institute for Mathematics, Vivatsgasse 7, 53111 Bonn*, Expected graduation: Beginning of 2022.
July 2016 – August 2018	**Master of Science in Mathematics**, *University of Bonn*, .
October 2013 – June 2016	**Bachelor of Science in Mathematics**, *University of Bonn*, .
2004 – July 2013	**Abitur**, *Gymnasium Haus Overbach*, Jülich-Barmen, .

Preprints

Daniel Kasprowski, Johnny Nicholson, Benjamin Ruppik: Homotopy classification of 4-manifolds whose fundamental group is dihedral (arXiv:2011.03520)
Abstract: We show that the homotopy type of an oriented Poincaré 4-complex is determined by its quadratic 2-type provided its fundamental group is finite and has a dihedral Sylow 2-subgroup. This applies in the case of smooth oriented 4-manifolds whose fundamental group is a finite subgroup of SO(3), examples of which are elliptic surfaces with finite fundamental group.

Michael Klug, Benjamin Ruppik: Deep and shallow slice knots in 4-manifolds (arXiv:2009.03053)
Abstract: We consider slice disks for knots in the boundary of a smooth compact 4-manifold X^4. We call a knot $K \subset \partial X$ deep slice in X if there is a smooth properly embedded 2-disk in X with boundary K, but K is not concordant to the unknot in a collar neighborhood $\partial X \times [0,1]$ of the boundary. We point out how this concept relates to various well-known conjectures and give some criteria for the nonexistence of such deep slice knots. Then we show, using the Wall self-intersection invariant and a result of Rohlin, that every 4-manifold consisting of just one 0- and a nonzero number of 2-handles always has a deep slice knot in the boundary. We end by considering 4-manifolds where every knot in the boundary bounds an embedded disk in the interior. A generalization of the Murasugi-Tristram inequality is used to show that there does not exist a compact, oriented 4-manifold V with spherical boundary such that every knot $K \subset S^3 = \partial V$ is slice in V via a null-homologous disk.

Jason Joseph, Michael Klug, Benjamin Ruppik, Hannah Schwartz: Unknotting numbers of 2-spheres in the 4-sphere (arXiv:2007.13244)
Abstract: We compare two naturally arising notions of "unknotting number" for 2-spheres in the 4-sphere: namely, the minimal number of 1-handle stabilizations needed to obtain an unknotted surface, and the minimal number of Whitney moves required in a regular homotopy to the unknotted 2-sphere. We refer to these invariants as the stabilization number and the Casson-Whitney number of the sphere, respectively. Using both algebraic and geometric techniques, we show that the stabilization number is bounded above by one more than the Casson-Whitney number. We also provide explicit families of spheres for which these invariants are equal, as well as families for which they are distinct. Furthermore, we give additional bounds for both invariants, concrete examples of their non-additivity, and applications to classical unknotting number of 1-knots.'

Daniel Kasprowski, Mark Powell, Benjamin Ruppik: Homotopy classification of 4-manifolds with finite abelian 2-generator fundamental groups (arXiv:2005.00274)
Abstract: We show that for an oriented 4-dimensional Poincaré complex with finite fundamental group, whose 2-Sylow subgroup is abelian with at most 2 generators, the homotopy type is determined by its quadratic 2-type.

Talks

Research

2020-11-05 'Casson-Whitney unknotting numbers of knotted 2-spheres in the 4-sphere', in the Iowa Topology Seminar (virtual)

2020-04-02 'Deeply slice knots', in the virtual Geometric Topology Grad and Postdoc Seminar (GT GAPS)

2019-06-14 'Stable classification of 4-manifolds', reporting on my master thesis in the LKS-Seminar (organized by Stefan Friedl and Clara Löh) at the university of Regensburg.

Expository

2020-11 'Introduction to the Adams Spectral Sequence', IMPRS seminar at MPIM Bonn.

2020-11-09 'Some of Freedman's results on topological 4-manifolds', Exotic 4-manifolds learning seminar.

2020-05-03 'Rasmussen's s-invariant and the local Thom conjecture', IMPRS seminar at MPIM Bonn.

2019-11-21 'Fulton MacPherson compactifications' with David Gay in the Seminar on configuration spaces and diffeomorphisms at MPIM Bonn.

2019-04 Co-organized (with Danica Kosanović) a Study group on Milnor invariants.

2019-04-24 'Homology of the little disks operad', IMPRS seminar at MPIM Bonn.

2018-10-31 'The trefoil and figure-eight are not slice - An introduction to knot concordance', IMPRS seminar at MPIM Bonn.

Posters

2019-07 'Ribbon concordances and doubly slice knots', Poster for the BIGS exhibition at the Mathematical institute in Bonn.

Conferences & Travel

2020-06 Summer Virtual Trisectors Workshop, online, June 22 - 25, 2020.

2020-06 Nearly Carbon Neutral Geometric Topology Conference, online, June 1 - 14, 2020.

2020-02 Winter Braids X, Pisa, February 17 - 21, 2020.

2019-10 Low-dimensional topology workshop, Regensburg, October 21 - 23, 2019.

2019-09 Workshop on 4-manifolds, Bonn, September 16 - 20, 2019; contributed slide 'Resolving Ribbon Singularities' to the picture show.

2019-07 Swiss Knots, Zurich, July 16 - 19, 2019.

2019-06 Knot concordance and low-dimensional manifolds, Le Croisic, June 17 - 21, 2019.

2019-05 Knots and Braids in Norway, Trondheim, May 2019; 5 minute gong show talk 'Doubly slice knots and satellites'.

Theses

Master Thesis — Equivariant intersection forms of 4-manifolds, University Bonn, 2018, supervised by Dr. Daniel Kasprowski & Prof. Dr. Peter Teichner

Bachelor Thesis — Torsion in $\Gamma(\pi_2 K)/\pi_1 K$, University Bonn, 2016, supervised by Dr. Daniel Kasprowski & Prof. Dr. Peter Teichner. Development of a SageMath module in Python to calculate an invariant of specific 2-complexes.

Experience

Vocational

August 2013 – Present — **Organist**, Kirchengemeindeverband Aldenhoven-Linnich, Linnich.
Employed at Kirchengemeindeverband Aldenhoven-Linnich (Pfarrer-Reiff-Str. 15, 52441 Linnich-Welz) as organ player.

October 2014 – September 2020 — **Student associate**, Mathematical Institute of the University of Bonn, Bonn.
Employed as tutor for the lectures *Analysis I, II*, *Linear Algebra I, II*, *Introduction to Algebra*, *Introduction to Geometry and Topology*, *Topology I, II*, *Algebraic Topology I, II*.

April 2018 – September 2018 — **Student associate**, Institute of Computer Science III, Bonn.
Semantic segmentation of RGB-images and point clouds captured by a Velodyne LiDAR.

Miscellaneous

July 2017 – June 2018 — **Treasurer for the Debating team at the University of Bonn**.

July 2010 – January 2011 — **Stay abroad**, Escondido, CA 92026, USA.
First half of Junior Year at Calvin Christian School (2000 N Broadway, Escondido, CA).

Computer skills

Programming languages — C/C++, Python, Go, OpenCV, SageMath, haskell, Prolog, LaTeX

Machine learning frameworks — TensorFlow, PyTorch

Languages

German — Mothertongue

English — Fluent

Latin — Basic

Interests

- Piano, Organ

Bonn, November 9, 2020 Benjamin Ruppik

Benjamin Ruppik