GEOMETRIC TOPOLOGY SEMINAR (FALL 2018)

Where: Math Department of the Higher School of Economics, Room 212

When: Mondays from 15:30 to 18:20 (in practice, we usually finish earlier).

What: We invite research talks in Mathematics (on research by the speaker) and expository talks (on classical or recent results) in Geometric Topology. A list of suggested sources and a definition of Geometric Topology are provided below.

For students: The seminar is affiliated with the Scientific Education Center (SEC = НОЦ) of the Steklov Math Institute and students who give a talk will earn credit at the SEC. Math Department of the HSE recognizes SEC's credits.

For non-HSE participants: To pass the security please name the Geometric Topology Seminar and show your passport or another photo ID. In case of problems with the security please call Ash Lightfoot (+7 925 8897129).

For all: Tea and refreshments will be provided after the talk or during a break.

Contacts: Please feel free to contact Ash Lightfoot (Room 309, HSE Math. Dept.; alightfoot@hse.ru) or Sergey Melikhov (melikhov@mi-ras.ru) to be included in the mailing list, to submit an abstract of talk or for any other queries.

A bit of history: The Geometric Topology Seminar has been meeting since the 1950s at the Steklov Math. Institute. Until the early 70s it was led by L. V. Keldysh, and the participants included A. B. Sossinsky, A. V. Chernavsky and M. A. Shtan'ko (more details: Russ. Math. Surv. 60 (2005), 589–614). In the late 70s the seminar was resumed under E. V. Shchepin; active participants included A. Chigogidze, A. Dranishnikov, M. Zarichnyi in the 80s, P. Akhmetiev, N. Brodsky, P. Semyonov, A. Skopenkov in the 90s, and P. Akhmetiev, A. Chernavsky, O. Frolkina, E. Kudryavtseva, S. Melikhov, M. Skopenkov in the 00s. From 2011, abstracts of talks are posted at mathnet.ru.

What is Geometric Topology? It is a state of mind that can be roughly characterized by a set of positive and negative symptoms.

- The patient is obsessed with mental images of topological objects, particularly manifolds and cell complexes. Patients in severe condition may be frequented by more bizarre subspaces of Euclidean spaces or even the Hilbert cube.
- Some patients endlessly knot and unknot circles or other things, or link and unlink them with each other. Others mentally deform spaces to construct homeomorphisms or embeddings, or to see that they do not exist. Often they do so either combinatorially (sticking to triangulations) or smoothly (avoiding sharp angles). Still others look at maps with self-intersections (link maps, immersions, submersions, etc.) and sometimes even with certain singularities (cusps, folds, umbrellas, swallowtails, etc.). Patients in severe condition may even indulge in multi-parameter families and moduli spaces of all those kinds of stuff.

- The patient may enjoy doing metric geometry (i.e., measurement of distances, angles, areas, etc.) but only insofar as it helps understanding something about topologically invariant properties. Patients who find themselves immersed in doing geometry per se usually have a different condition (Discrete Geometry, Riemannian Geometry, Symplectic Topology, Geometric Group Theory, etc.).
- The patient may enjoy computing and analyzing algebraic invariants of topological objects but only insofar as it helps proving something about those objects themselves. Patients who find themselves immersed in doing algebraic computations per se usually have a different condition (Algebraic Topology, K-Theory, Representation Theory, etc.)

Suggested sources for expository talks:

1) Knots, links and their ramifications

• T. Cochran, K. Orr, P. Teichner, *Knot concordance, Whitney towers and L^2-signatures,* Ann. of Math., 157 (2003), 433–519 (arxiv) and followup work

• R. Schneiderman, P. Teichner, *The group of disjoint 2-spheres in 4-space*, 2017 (arxiv)

• R. Koytcheff, I. Volic, *Milnor invariants of string links, trivalent trees, and configuration space integrals,* 2017 (arxiv)

• S. Chmutov, M. Polyak, *Elementary combinatorics of the HOMFLYPT polynomial,* Int. Math. Res. Notices (2009) (arxiv) and M. Brandenbursky, *Link invariants via counting surfaces,* Geom. Dedicata 173 (2014), 243–270 (arxiv)

• O. Viro, *Quantum relatives of the Alexander polynomial,* Алгебра и анализ 18 (2006), 63–157 (arxiv) and Y. Bao, Z. Wu, *The Alexander polynomial for a balanced bipartite graph and its MOY-type relations,* 2017 (arxiv)

• P. Kirk, C. Livingston, Z. Wang, *The Gassner representation for string links,* Comm. Cont. Math. 3 (2001), 87–136 (arxiv) and T. Tsukamoto, A. Yasuhara, *A factorization of the Conway polynomial and covering linkage invariants,* J. Knot Theory Ram. 16 (2007), 631–640 (arxiv)

• A. B. Merkov, *Vassiliev invariants classify plane curves and doodles,* Матем. сб., 194:9 (2003), 31–62 (link)

2) The Andrews–Curtis conjecture and related topics

• *Two-Dimensional Homotopy and Combinatorial Group Theory,* Cambridge U. Press, 1993

• *Advances in Two-Dimensional Homotopy and Combinatorial Group Theory,* Cambridge U. Press, 2018

3) Algebraic K-theory of spaces and related topics

• A. Hatcher, *Higher simple homotopy theory,* Ann. of Math. 102 (1975), 101–137 (link) and M. Steinberger, *The classification of PL fibrations,* Michigan Math J., 33 (1986), 11–26 (link)

• F. Waldhausen, B. Jahren, J. Rognes, *Spaces of PL Manifolds and Categories of Simple Maps,* Princeton U. Press, 2013 (link)

4) Higher-dimensional algebra

• J.-L. Loday, *Homotopical syzygies,* Contemp. Math. 265 (2000), 99–127 (link)

• R. A. Brown, *Generalized group presentation and formal deformations of CW complexes,* Trans. Amer. Math. Soc. 334 (1992), 519–549 (link) and A. Mutlu, T. Porter, *Free crossed resolutions from simplicial resolutions with given CW-basis,* Cahiers Topol. Geom. Diff. Categ. 40 (1999), 261–283 (link)