Math 80430 Fall 2017

Topics in Topology

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The topic of this course is **Factorization Algebras**. This is a very flexible language which can capture mathematical structures that at first sight might not have much to do with each other, including:

- Algebras, modules, their (derived) tensor product, Hochschild homology;
- algebras over the little disk operad E_n;
- vertex algebras;
- observables of field theories (classical and quantum).

The aim of this course is to define factorization algebras, to discuss examples, and to explain how they are related to the topics mentioned above. If time permits, I will explain how a factorization algebra gives rise to a field theory in the sense of Atiyah-Segal (or rather a "derived" version), which is based on joint work with Bill Dwyer and Peter Teichner.

The course will draw from the following sources:

- The two volumes of the book entitled *Factorization algebras in quantum field theory* by Kevin Costello and Owen Gwilliam, available at people.mpim-bonn.mpg.de/gwilliam/vol1may8.pdf and people.mpim-bonn.mpg.de/gwilliam/vol2may8.pdf.
- Owen Gwilliam's 2012 thesis, entitled *Factorization algebras and free field theories*, which is available at http://people.mpim-bonn.mpg.de/gwilliam/thesis.pdf.
- My notes *Functorial field theories and factorization algebras* based on the topics course I taught in the Spring of 2014, available at https://www3.nd.edu/~stolz/Math80440(S2014)/Fact_algs.pdf.

The only prerequisite for the course is standard first year graduate material (in particular, manifolds, vector bundles, differential forms, chain complexes, homology and categories) and a willingness to learn new stuff. Necessary background material will be covered as needed.