

**Courses and Topics**  
**Workshop on Topological Field Theories**  
**May 18-22, 2009**

**David Ben-Zvi:** Topological Field Theory, Loop Spaces and Representation Theory

1. 2-dimensional gauge theory: Mass formula for numbers of characters, Class functions as the center and abelianization of the group algebra. Hecke algebras. Hochschild (co)homology, trace maps and central actions. Categorification and dimensional reduction.

2. Hochschild (co)homology and loop spaces. Algebra of local operators and  $E_n$  structure; de Rham cohomology and D-modules. Cyclic cohomology and its categorification.

3. 3-dimensional gauge theory: Drinfeld centers and abelianizations. Character sheaves. The twisted Springer correspondence. Morita equivalence for Hecke categories. Categories of D-modules in representation theory.

4. The geometric Langlands program and 4-dimensional gauge theory: geometric Satake and local operators. Diagonalization problem. Local version and deformation.

**Jacob Lurie:** Topological Quantum Field Theories

1. Introduction to TQFTs, ending with a formulation of the cobordism hypothesis

2. Introduction to higher category theory, complete Segal spaces, and presentation of bordism categories as complete Segal spaces

3. Finiteness conditions and a more precise/general formulation of the cobordism hypothesis

4. Some applications (relationship with the Mumford conjecture, string topology, ...)

**Bertrand Toën:** Secondary K-theory

1. Review of dg-categories: Dg-categories, dg-modules, Morita theory, the 2-category of dg-categories, smooth and proper dg-categories, first definition and properties of secondary K-theory.

2. Higher categorical aspects: Segal categories, localisation, monoidal structures, the monoidal Segal category of dg-categories, the secondary K-theory ring spectrum.

3. Derived algebraic geometry: The Segal category of simplicial rings, the Segal category of derived stacks, derived loop spaces and relation with de Rham theory.

4. Families of dg-categories: The chern character for a derived stack in rigid monoidal Segal categories, applications to families of dg-categories, the secondary Chern character map, interpretation in terms of field theories.