Homological Methods in Quantum Field Theory Workshop Talk Schedule

Events for:
Monday, September 29th - Friday, October 3rd

Monday, September 29th

8:30am **Registration/Breakfast - SCGP Lobby and Cafe**

9:30am **Owen Gwilliam - SCGP 102**

Title: TBA

Abstract: TBA

10:30am **Coffee Break - SCGP Cafe**

11:00am **Si Li - SCGP 102**

Title: Perturbative renormalization and supersymmetric localization

Abstract: Index theorems are "proved" in physics via the SUSY localization in QFT, generating a great beauty and simplicity conceptually together with a substantial difficulty rigorously. In this lecture, I will explain an analogue realization of such QFT idea within Costello's perturbative renormalization theory. In lecture I, I will describe a Chern-Simons type theory for the one dimensional sigma model with target a symplectic manifold. We establish an equivalence between the BV quantization of our model and Fedosov's deformation quantization. In lecture II, I will describe the trace map on quantum observables. We will show that a rescaling symmetry of Fedosov's deformation quantization leads to an exact computation of the trace via the semi-classical approximation. The homotopy of the rescaling plays the role of SUSY localization, giving rise to a simple proof of algebraic index theorem.

12:00pm **Lunch - SCGP Cafe**

1:15pm **Jae-Suk Park - SCGP 102**

Title: QFT Algebras and Quantum Correlation Functions

Abstract: TBA

2:15pm **Short Break**

2:30pm **Kevin Costello - SCGP 102**

Title: TBA

Abstract: TBA

3:30pm **Special Tea for Alexander Zamolodchikov - SCGP Lobby**

Tuesday, September 30th

8:30am **Breakfast - SCGP Cafe**

9:30am **Vasily Dolgushev - SCGP 102**

Title: Operads, homotopy algebras and all that jazz...

Abstract: The goal of this series of lectures is to give an answer to the question "What do homotopy algebras form?". My presentation will be based on recent papers arXiv:1406.1744 and arXiv:1406.1751. In the first lecture, I will recall the notions of operad, cooperad and cobar construction. I will define homotopy algebras, give several examples and formulate the homotopy transfer theorem. In the second lecture, I will introduce L-infinity algebras, the Deligne-Getzler-Hinich(DGH) infinity groupoid and talk about categories enriched "over L-infinity algebras". In the third lecture, I will show that homotopy algebras of a fixed type naturally form a category enriched "over L-infinity algebras". Finally, I will explain in what sense this enriched category stands behind the homotopy category of homotopy algebras of a fixed type.

10:30am **Coffee Break - SCGP Cafe**

11:00am **Kevin Costello - SCGP 102**

Title: TBA

Abstract: TBA

11:30am **AST-105 - SCGP 103**

12:00pm **Lunch - SCGP Cafe**

1:15pm **Ryan Grady - SCGP 102**

Title: Moduli/β-functions for BV theories

Abstract: TBA

2:15pm **Short Break**

2:30pm **Si Li - SCGP 102**

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3:30pm **Tea Time - SCGP Lobby**

4:00pm **Fall Simons Lecture by Steve Zelditch of Northwestern University - SCGP 103**

Title: Plankâ€™s constant, time and stationary states in quantum mechanics Quantum mechanics solved the problem of how a particle can move and be stationary at the same time. It did this by replacing geometry (classical mechanics) by linear algebra (eigenfunctions, eigenvalues and spectral theory). But intuition asks for a geometric picture of the time evolution of quantum states and the topography of eigenfunctions. As Planck's constant h approaches 0, quantum mechanical objects have asymptotic relations to classical mechanical objects and provide the best picture possible. My talks will concentrate on topography of eigenfunctions of the Laplacian on Riemannian manifolds (M,g): their sizes and shapes as measured by their zero sets, sup norms, and Lp norms. One theme is to describe the (M, g) possessing extremal eigenfunctions. Another is the real and complex geometry of zero sets. The methods come from microlocal analysis and complex geometry. No prior knowledge of quantum mechanics or PDE is assumed.

Wednesday, October 1st

8:30am **Breakfast - SCGP Cafe**

9:30am **Katarzyna Rejzner - SCGP 102**

Title: BV algebras in perturbative algebraic quantum field theory

Abstract: Perturbative algebraic quantum field theory (pAQFT) is a rigorous formulation of perturbative QFT, based on the seminal work of Epstein and Glaser from 1973. In the 90's this approach got significantly more attention, since it got successfully applied to study QFT on a very general class of Lorentzian manifolds. Recently, also gauge theories got incorporated into the framework of pAQFT, with the use of the so called BV formalism. In this talk, based on my recent results, I will show how the Gerstenhaber algebras and the BV algebras arise naturally in the pAQFT framework and how this structure can be utilized in quantization of gauge theories.

10:30am **Coffee Break - SCGP Cafe**

11:00am **Mikhail Movshev - SCGP 102**

Title: On the Hilbert space of a \beta\gamma-system on pure spinors

Abstract: Berkovits string theory is well known for a heavy use of homological algebra. Construction of the Hilbert space in the theory is still an outstanding problem despite of serious attempts to define it. The problem is unlikely to be solved without a use of homological methods. In the talk I will present my approach by explaining the construction and by showing that the space has many nice properties conjectured by physicists.

12:00pm **Lunch - SCGP Cafe**

1:15pm **Maxim Zabzine - SCGP 102**

Title: Localization for 5D Yang-Mills theory

Abstract: TBA

2:00pm **Hold for Nikita's Student Seminars - SCGP-313**

2:15pm **Short Break**

2:30pm **Vasily Dolgushev - SCGP 102**

Title: L-infinity algebras and categories enriched "over L-infinity algebras".

Abstract: The goal of this series of lectures is to give an answer to the question "What do homotopy algebras form?". My presentation will be based on recent papers arXiv:1406.1744 and arXiv:1406.1751. In the first lecture, I will recall the notions of operad, cooperad and cobar construction. I will define homotopy algebras, give several examples and formulate the homotopy transfer theorem. In the second lecture, I will introduce L-infinity algebras, the Deligne-Getzler-Hinich(DGH) infinity groupoid and talk about categories enriched "over L-infinity algebras". In the third lecture, I will show that homotopy algebras of a fixed type naturally form a category enriched "over L-infinity algebras". Finally, I will explain in what sense this enriched category stands behind the homotopy category of homotopy algebras of a fixed type.

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5:00pm **Tim Nguyen - SCGP 102**

Title: A differential geometer explains BV quantization of the nonlinear sigma model

6:00pm **Workshop Banquet - SCGP Cafe**

Thursday, October 2nd

8:30am **Breakfast - SCGP Cafe**

9:30am **Vasily Dolgushev - SCGP 102**

Title: What do homotopy algebras form?

Abstract: The goal of this series of lectures is to give an answer to the question "What do homotopy algebras form?". My presentation will be based on recent papers arXiv:1406.1744 and arXiv:1406.1751. In the first lecture, I will recall the notions of operad, cooperad and cobar construction. I will define homotopy algebras, give several examples and formulate the homotopy transfer theorem. In the second lecture, I will introduce L-infinity algebras, the Deligne-Getzler-Hinich(DGH) infinity groupoid and talk about categories enriched "over L-infinity algebras". In the third lecture, I will show that homotopy algebras of a fixed type naturally form a category enriched "over L-infinity algebras". Finally, I will explain in what sense this enriched category stands behind the homotopy category of homotopy algebras of a fixed type.

10:30am **Coffee Break - SCGP Cafe**

11:00am **Claudia Scheimbauer - SCGP 102**

Title: Factorization homology as a fully extended TFT

Abstract: (Homotopy) algebras and (pointed) bimodules over them can be viewed as factorization algebras on the real line R which are locally constant with respect to a certain stratification. Moreover, Lurie proved that E_n-algebras are equivalent to locally constant factorization algebras on R^n. Starting from these two facts I will explain how to model the Morita category of E_n-algebras as an (\infty, n)-category. Every object in this category, i.e. any E_n-algebra A, is "fully dualizable" and thus gives rise to a fully extended TFT by the cobordism hypothesis of Baez-Dolan-Lurie. I will explain how this TFT can be explicitly constructed by (essentially) taking factorization homology with coefficients in the E_n-algebra A.

11:30am **AST-105 - SCGP 103**

12:00pm **Lunch - SCGP Cafe**

1:15pm **Vasily Pestun - SCGP 102**

Title: Supersymmetric localization and equivariant cohomology of quantum field theories

Abstract: TBA

2:15pm **Short Break**

2:30pm **Chris Elliott - SCGP 102**

Title: Nonperturbative Descriptions for Twists of Classical Field Theories

Abstract: The procedure of "twisting" allows one to produce classical or quantum field theories with desirable symmetry properties (like translation or conformal invariance) from the action of a certain supergroup. I'll explain how to define and compute these twists for classical theories both perturbatively and non-perturbatively, i.e. on the level of the derived critical locus of the action. This procedure recovers moduli spaces of interest for geometric representation theory, related to moduli stacks of holomorphic or flat G-bundles, from N=4 supersymmetric gauge theory.

3:30pm **Tea Time - SCGP Lobby**

4:00pm **Fall Simons Lecture by Steve Zelditch of Northwestern University - SCGP 102**

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Friday, October 3rd

8:30am **Breakfast - SCGP Cafe**

9:30am **Qin Li - SCGP 102**

Title: Perturbative Rozansky-Witten theory

Abstract: TBA

10:30am **Coffee Break - SCGP Cafe**

11:00am **Theo Johnson-Freyd - SCGP 102**

Title: Poisson AKSZ theories

Abstract: I will describe a version of the AKSZ construction that applies to possibly-open source manifolds and to possibly-infinite-dimensional Poisson (as opposed to symplectic) target manifolds (the cost being that the target must be infinitesimal). Quantization of such theories has to do with the relationship between dioperads and properads, and to the fact (due to Merkulov and Vallette) that formality in one world does not imply formality in the other. In particular, universal quantization of AKSZ theories on R^d is equivalent to the formality of a certain properad which is formal as a dioperad. I will conjecture that it is also equivalent to formality of the E_d operad.

12:00pm **Lunch - SCGP Cafe**

1:15pm **Pavel Mnev - SCGP 102**

Title: An example of a cellular topological quantum field theory in BV-BFV formalism, with Segal-like gluing.

Abstract: TBA

2:15pm **Short Break**

2:30pm **Bruno Vallette - SCGP 102**

Title: Givental action and trivialization of circle action

Abstract: In this talk, I will show that the Givental group action on genus zero cohomological field theories, also known as formal Frobenius manifolds or hypercommutative algebras, naturally arises in the deformation theory of Batalin--Vilkovisky algebras. This implies that the Givental action is equal to an action of the trivialisations of the trivial circle action. This result relies on the equality of two Lie algebra actions coming from two apparently remote domains: geometry and homotopical algebra. (Joint work with Sergei Shadrin and Vladimir Dotsenko)

3:30pm **Tea Time - SCGP Lobby**