

Workshop Schedule

Events for:

Monday, February 10th - Friday, February 14th

Monday, February 10th

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

Title: Breakfast

9:30am **Workshop: Albrecht Klemm - SCGP 102**

Title: Symplectic Invariants on Calabi-Yau 3 folds, Modularity and Stability

Abstract: We discuss techniques to calculate symplectic invariants on CY 3-folds M , namely Gromov-Witten (GW) invariants, Pandharipande-Thomas (PT) invariants, and Donaldson-Thomas (DT) invariants. Physically the latter are closely related to BPS brane bound states in type IIA string compactifications on M . We focus on the rank $r_{\bar{6}}=1$ DT invariants that count $\bar{D}6$ - $D2$ - $D0$ brane bound states related to PT- and high genus GW invariants, which are calculable by mirror symmetry and topological string B-model methods modulo certain boundary conditions, and the rank zero DT invariants that count rank $r_4=1$ $D4$ - $D2$ - $D0$ brane bound states. It has been conjectured by Maldacena, Strominger, Witten and Yin that the latter are governed by an index that has modularity properties to due S - T duality in string theory and extends to a mock modularity index of higher depth for $r_4 > 1$. Again the modularity allows to fix the at least the $r_4=1$ index up to boundary conditions fixing their polar terms. Using Wall crossing formulas obtained by Feyzbakhsh certain PT invariants close to the Castenouvo bound can be related to the $r_4=1,2$ $D4$ - $D2$ - $D0$ invariants. This provides further boundary conditions for topological string B-model approach as well as for the $D4$ - $D2$ - $D0$ brane indices. The approach allows to prove the Castenouvo bound and calculate the $r_{\bar{6}}=1$ DT- invariants or the GW invariants to higher genus than hitherto possible.

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

Title: Coffee Break

11:00am **Workshop: Murad Alim - SCGP 102**

Title: From Gromov-Witten to Donaldson-Thomas invariants via Resurgence

Abstract: Enumerative invariants of Calabi-Yau manifolds are most naturally organized in terms of partition functions of physical theories. Higher genus Gromov-Witten invariants of CY threefolds correspond to the expansion coefficients of a series in a formal parameter which corresponds to the topological string coupling. This series is however only asymptotic. I will show how the analysis of finite difference equations and Borel summation reveals the piecewise analytic structure behind the asymptotic expansion. The resulting Stokes jumps of the piecewise analytic structure encode another set of enumerative invariants of the threefold, namely Donaldson-Thomas invariants.

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

Title: Lunch

2:30pm **Workshop: Thorsten Schimannek - SCGP 102**

Title: Topological strings on nodal Calabi-Yau with topologically non-trivial B-fields

Abstract: "I will review a recent proposal for the interpretation of the A-model topological string partition function on nodal Calabi-Yau threefolds that carry a flat but topologically non-trivial B-field.

From an enumerative perspective, this is conjectured to encode a refinement of the usual Gopakumar-Vafa invariants with respect to a torsion curve class that only exists in small resolutions that have a trivial canonical class but are not Kaehler. After illustrating the phenomenon in some examples, my focus will be on the relation under mirror symmetry to variations of Hodge structure that have an atypical integral structure.

I will explain how this integral structure can be interpreted in terms of the singular geometries and the B-field and discuss interesting open question"

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

4:00pm **Workshop: Sheldon Katz - SCGP 102**

Title: Enumerative invariants via Wilson loops

Abstract: A compact Calabi-Yau threefold X can be considered to approach a local Calabi-Yau threefold Y in certain limits of Kahler moduli. The enumerative geometry of Y is simpler and physical tools of 5-dimensional gauge theory apply, particularly the use of Wilson loops. Roughly speaking, refined Wilson loop amplitudes are refined BPS numbers of blowups of Y at generic points of the compact surface contained in Y . A general proposal is made for the structure of the refined BPS numbers of X in terms of refined Wilson loops. Using low degree geometric computation and a refined holomorphic anomaly equation for the Wilson loop partition function, refined BPS numbers of elliptically fibered X are computed for many examples, with $h^{1,1}(X)$ as large as 5. In particular, the unrefined limit produces higher genus BPS invariants of X . This talk is based on joint work with Minxin Huang, Albrecht Klemm, and Xin Wang.

Tuesday, February 11th

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

Title: Breakfast

9:30am **Workshop: Johannes Schmitt - SCGP 102**

Title: Logarithmic tautological rings

Abstract: "Many moduli spaces arising in enumerative geometry (of smooth curves, abelian varieties, ...) are a priori non-compact. To define enumerative invariants, it is natural to construct a compactification with normal crossings boundary and to study its intersection theory. However, often there are different choices for such compactifications, with some more convenient than others depending on the geometric problem at hand. In this talk, I introduce the logarithmic Chow ring $\log\text{CH}^*$, which encodes the intersection theory of all such (suitably chosen) compactifications simultaneously. We will see how natural cycle classes in this ring can be constructed from purely combinatorial/convex geometric data. I discuss applications to double Hurwitz numbers and explicit calculations of $\log\text{CH}^*$ of moduli spaces of rational curves. Finally, I present some recent joint work with Pandharipande, Ranganathan and Spelier, which combines these convex geometric inputs with the intersection theory of strata on our moduli space, and allows to define an additive generating set of $\log\text{CH}^*$ modelled on the tautological classes of the moduli space of stable curves."

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

Title: Coffee Break

11:00am **Workshop: Georg Oberdieck - SCGP 102**

Title: Gromov-Witten theory of Enriques surfaces and quasi-modular forms

Abstract: "It is well-known that the descendent Gromov-Witten potentials of an elliptic curve are quasi-modular forms. In this talk, we present a conjecture that descendent Gromov-Witten potentials of an Enriques surface are quasi-modular forms for the orthogonal group of the Enriques lattice. Orthogonal quasi-modular forms here is a new notion that we introduce. The stated conjectures fit into the larger question regarding the modular interpretation of relative Gromov-Witten potentials of K3 and abelian surface fibrations. The talk is based on joint work with Brandon Williams."

12:00pm **Workshop: Group Photo - SCGP Lobby**

Title: Group Photo

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

Title: Lunch

1:00pm **Workshop: Aaron Pixton - SCGP 102**

Title: Double ramification cycles, admissible covers, and the top degree part

Abstract: The double ramification (DR) cycle parametrizes curves admitting maps to the projective line with specified ramification profiles over two points. I will begin by discussing joint work with Q. Zhao giving a new formula for the DR cycle in degree one as well as a new conjectural formula in higher degree. This higher degree formula writes the DR cycle as the corresponding admissible covers cycle plus additional error terms coming from contracted components. This can be viewed as motivation for believing an older conjecture, that DR cycles and admissible covers cycles have the same asymptotic growth as the degree and ramification profiles are scaled up. I will conclude by defining the top degree part of the DR cycle and giving some identities that it satisfies, presenting joint work with Y. Bae and S. Molcho.

2:15pm **Workshop: Break - SCGP Cafe**

Title: Break

2:30pm **Workshop: Zhiyu Liu - SCGP 102**

Title: Castelnuovo bound conjecture and curve-counting invariants

Abstract: The Castelnuovo bound conjecture, which is proposed by physicists, predicts an effective vanishing result for Gopakumar-Vafa invariants of Calabi-Yau 3-folds of Picard number one. In this talk, I will introduce recent advances toward solving this conjecture and discuss relevant results about the bounds of genus of curves in projective threefolds.

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

4:00pm **Workshop: Junliang Shen - SCGP 102**

Title: Perverse filtrations and refined Gopakumar-Vafa invariants for local surfaces

Abstract: I will discuss some roles played by perverse filtrations in enumerative geometry of local surfaces. In physics, this connection was essentially pointed out by Gopakumar-Vafa (via quite different language). It was mathematically formulated by Hosono-Saito-Takahashi, Kiem-Li, Maulik-Toda, etc. I will discuss 3 particular cases (1) local curves T^*C (2) K3 surfaces, and (3) del Pezzo surfaces, where the Gopakumar-Vafa theory is tightly connected to geometry and topology of (1) character varieties of surface groups, (2) Lagrangian fibrations of compact hyper-Kaehler manifolds, and (3) Le Potier's moduli spaces for CP^2 . Open questions in each case will be discussed.

Wednesday, February 12th

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

Title: Breakfast

9:30am **Workshop: Pierrick Bousseau - SCGP 102**

Title: Modular forms from Betti numbers

Abstract: Modular forms are complex analytic functions with striking symmetries, which play a fundamental role in number theory. In the last few decades, there have been a series of astonishing predictions from theoretical physics that various basic mathematical numbers when put in a generating series, end up being modular forms when there is no known mathematical reason for such hidden structure. In this talk, we will first provide a gentle introduction to modular forms. We will then focus on spaces parametrizing complex plane algebraic curves with line bundles, and prove that generating series of their Betti numbers are modular forms. This verifies physical predictions, using various tools of modern enumerative algebraic geometry. Part of this is joint work with Honglu Fan, Shuai Guo, and Longting Wu.

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

Title: Coffee Break

11:00am **Workshop: Amanda Hirschi - SCGP 102**

Title: Global Kuranishi charts for symplectic Gromov-Witten theory

Abstract: In 2021, Abouzaid, McLean and Smith constructed a presentation of the moduli space of pseudo-holomorphic stable rational curves in symplectic manifold that dramatically simplifies the construction of a virtual fundamental class. I will describe a generalisation of their construction to higher genus and some applications to symplectic Gromov-Witten theory. This is partially joint work with Mohan Swaminathan.

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

Title: Lunch

1:00pm **Workshop: Renzo Cavalieri - SCGP 102**

Title: Tropical psi classes and tropicalizations of psi classes

Abstract: The general rule for the interactions between tropical geometry and moduli spaces of course is the following: everything you may wish is going to work like a charm in genus zero, and break down horribly in higher genus. This is the case for the tautological intersection theory of psi classes, a class of fundamental objects in the geometry of moduli spaces of curves: the generating function of their intersection numbers has made waves, pun intended, when it was noticed that it is a tau function for the KdV hierarchy. Back to tropical geometry: in genus zero tropical psi classes have been first defined by Mikhalkin in the early 2000's, then through the work of Kerber-Markwig and Katz it was shown that intersection numbers of tropical psi classes agree with their algebraic counterparts. In work with A.Gross and H.Markwig (2021), we were able to make sense of tropical psi classes in higher genus, by making the tropical moduli space of curves into a stack for families of tropical curves with an affine structure. This is a combinatorial theory that recovers the algebraic intersection numbers, but can also produce results that do not have a counter part in algebraic geometry. To this end, in recent work with A.Gross we answer the question of when we can show that tropical psi classes are tropicalizations. In order to even make sense of the statement, we had to introduce a notion of tropicalization for families of curves based on the Picard theory of the base. "

2:15pm **Workshop: Break - SCGP Cafe**

Title: Break

2:30pm **Workshop: Hülya Argüz - SCGP 102**

Title: Gromov-Witten theory of complete intersections

Abstract: I will explain an algorithm for calculating all genus Gromov-Witten invariants of complete intersections in projective spaces. While the focus of previous work has been primarily on invariants with insertions pulled back from the ambient projective space, we study invariants with arbitrary insertions, in particular with "primitive insertions" that are not pulled back from the ambient space. I will describe several techniques we developed to achieve this, utilizing monodromy, degeneration, and nodal relative geometry. This is joint work with Pierrick Bousseau, Rahul Pandharipande, and Dimitri Zvonkine.

4:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

5:00pm **Mirrors of Sound: A Musical Odyssey. Piano Performance by Liya Nigmati - 103**

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

Thursday, February 13th

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

Title: Breakfast

9:30am **Workshop: Hsian-Hua Tseng - SCGP 102**

Title: Genus 1 Gromov-Witten invariants of Hilbert scheme of points on the affine plane

Abstract: We discuss some results on genus 1 Gromov-Witten invariants of Hilbert scheme of points on the affine plane, including a determination of multi-point series in terms of one-point series and a close formula for an one-point series.

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

Title: Coffee Break

11:00am **Workshop: Sheel Ganatra - SCGP 102**

Title: Homological mirror symmetry for Batyrev mirror pairs

Abstract: I will give an overview of my recent proof (joint with Hanlon, Hicks, Pomerleano, and Sheridan) of Kontsevich's homological mirror symmetry conjecture for a large class of mirror pairs of compact Calabi–Yau hypersurfaces in toric varieties. These mirror pairs were first constructed by Batyrev from dual reflexive polytopes, and our result holds in characteristic zero and in all but finitely many positive characteristics. I will also say a few words about how our result (along with conjectural structural expectations in open-closed Floer theory) might imply all-genus mirror symmetry for such pairs.

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

Title: Lunch

1:00pm **Workshop: Guangbo Xu - SCGP 102**

Title: Integer-valued Gromov-Witten invariants

Abstract: (joint work with Shaoyun Bai) Moduli spaces in Gromov-Witten theory have two somewhat unsatisfying features: 1. it is hard to separate the contributions of simple curves and those of multiple covers; 2. the symmetry of curves leads to rational but not integral invariants. Following a proposal of Fukaya-Ono, we developed a new method to define counts of pseudoholomorphic curves with prescribed symmetry types, by turning on a specific kind of single-valued perturbations. In particular, this technology (which is purely topological) leads to integer-valued curve counting invariants (for all symplectic manifolds in all genera), which can be interpreted as the counts of curves with trivial automorphism group. Additionally, there are evidences suggesting that these integers agree with Gopakumar-Vafa invariants for Calabi-Yau threefolds. In this talk I will explain the idea underlying this new technology and the structures of these new invariants.

2:15pm **Workshop: Break - SCGP Cafe**

Title: Break

2:30pm **Workshop: Andrei Okounkov - SCGP 102**

Title: Local and global in enumerative geometry

Abstract: For a restricted class of targets X , I will talk about some examples and general expectations connecting local computations (equivariant counts of maps to X from P^1 or a formal disk) to counts of maps to X from a complete curve, that may be fixed or move in moduli.

3:30pm **Workshop: Tea Time - SCGP Cafe**

Title: Tea Time

4:00pm **Workshop: Mohammed Abouzaid - SCGP 102**

Title: Bordism valued GW invariants

Abstract: The geometric input of Gromov-Witten theory are moduli spaces of (pseudo)-holomorphic curves with target a (closed) symplectic manifold. It has long been known that these are not in general manifolds, because of the presence of symmetries, and that they are not in general orbifolds either, since symmetries can obstruct transversality. One model for the structure they carry is that of derived orbifolds. This motivates the study of the bordism groups of stably complex derived orbifolds as a universal receptacle for Gromov-Witten invariants in symplectic topology. I will describe joint work with Shaoyun Bai, which uses the functoriality of the resolution of singularities algorithm for complex algebraic varieties, together with refinements of Fukaya and Ono's old idea of normally complex perturbations, to split the inclusion of the bordism group of stably complex manifolds (unitary bordism) into this mysterious group, and thus proving the existence of well-defined GW invariants valued in complex cobordism groups.

Friday, February 14th

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

Title: Breakfast

9:30am **Workshop: Hyeonjun Park - SCGP 102**

Title: Symplectic pushforwards and DT theory

Abstract: I will introduce how to pushforward shifted symplectic fibrations along base changes. This yields an étale local structure theorem for shifted symplectic derived Artin stacks via Hamiltonian reduction. One application is a construction of cohomological Hall algebras for Calabi-Yau 3-folds, which is joint work with Tasuki Kinjo and Pavel Safronov. Another application is deformation invariance of Donaldson-Thomas invariants for Calabi-Yau 4-folds.

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

Title: Coffee Break

11:00am **Workshop: Yefeng Shen - SCGP 102**

Title: The quantum spectrum and Gamma structure for standard flips

Abstract: In this talk, we investigate the quantum spectrum and Gamma structure for projective bundles, blow-ups, and standard flips in a particular setup. By restricting the quantum cohomology to a fiber curve direction, both quantum spectrum and asymptotic behavior become computable. Using a sequence of reductions and asymptotic expansions of Meijer G-functions, we obtain a decomposition of the cohomology of standard flips into asymptotic Gamma classes. This decomposition is compatible with the semi-orthogonal decomposition for standard flips constructed in the work of Bondal-Orlov and Belmans-Fu-Raedschelders. The talk is based on work joint with Mark Shoemaker.

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

Title: Lunch