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Western hemisphere virtual symplectic seminar (Spring 2020)

Organizers: Mohammed Abouzaid (Columbia), Nate Bottman (USC), Catherine Cannizzo (Simons Center), Sheel Ganatra (USC), Kyler Siegel (Columbia)
Location: Zoom: https://usc.zoom.us/j/471010220 (first talk, **NOTE NEW LINK**), https://columbiauniversity.zoom.us/j/110276868 (second talk), full invite
Usual day/time: Fridays at (A) 4 pm GMT (9-10am PT, 12-1pm ET, 6-7 pm CEST) and (B) 7 pm GMT (12-1pm PT, 3-4pm ET, 9-10 pm CEST). Zoom meetings will open 15 minutes before the talk begins.
Notes: PDFs, OneNote (real-time) - if that link does not work on your browser, please email organizers to be added to the Web view, Videos
Survey: https://forms.gle/CEZJb1fgfSvDJzjr8

Spring 2020 Calendar (scroll further down for abstracts):

Date	Time/Location notes	Speaker	Institution	Title
3/27	9am PDT / 12 pm EDT	Paul Seidel	MIT	Quantum Steenrod operations
3/27	12pm PDT / 3 pm EDT	Laura Starkston	UC Davis	Weinstein Trisections
4/03	9am PDT / 12 pm EDT	Michael Sullivan	UMass Amherst	The persistence of the Legendrian contact homology algebra
4/03	12pm PDT / 3 pm EDT	Ezra Getzler	Northwestern	New results on Batalin-Vilkovisky geometry
4/10	9am PDT / 12 pm EDT	Chris Wendl	Humboldt-Universität zu Berlin	Equivariant transversality, super-rigidity and all that
4/10	12pm PDT / 3pm EDT	Hang Yuan	Stony Brook University	Family Floer program and non-archimedean SYZ mirror construction
4/17	9am PDT / 12 pm EDT	Hiro Lee Tanaka	Texas State University	Formalisms of gluing Fukaya categories
4/17	12pm PDT / 3pm EDT	Andrew Hanlon	Simons Center	On Fukaya-Seidel categories mirror to toric varieties
4/24	9am PDT / 12 pm EDT	Abigail Ward	Harvard University	Homological mirror symmetry for elliptic Hopf surfaces
4/24	12pm PDT / 3pm EDT	Yu Pan	MIT	Augmentations and exact Lagrangian surfaces
5/1	9am PDT / 12 pm EDT	Tim Large	MIT	Floer K-theory and exotic Liouville manifolds
5/1	12pm PDT / 3pm EDT	Jo Nelson & Morgan Weiler	Rice	ECH of prequantization bundles and lens spaces
5/8	9am PDT / 12 pm EDT	Semon Rezchikov	Columbia University	Generalizations of Hodge-de-Rham degeneration for Fukaya categories
5/8	12pm PDT / 3pm EDT	Melissa Zhang	University of Georgia	An annular filtration on Sarkar-Seed-Szabó's spectral sequence
5/15--				Future talks posted here

Titles/Abstracts

Paul Seidel
Title: Quantum Steenrod operations
Abstract: Quantum Steenrod operations play a role in both Hamiltonian dynamics and mirror symmetry. I will explain a bit about their structure, give a sample dynamical application, and then tell you what we know about their mirror-symmetric meaning. Part of this is joint work with Nicholas Wilkins.

Laura Starkston
Title: Weinstein Trisections
Abstract: Gay and Kirby proved that every smooth 4-manifold admits a trisection--a decomposition into three pieces, each of which is a 1-handlebody. A Weinstein trisection is a trisection which is nicely compatible with a symplectic structure on the

4-manifold. We will explain this structure and show that every symplectic 4-manifold admits a Weinstein trisection. This is joint work with Peter Lambert-Cole and Jeffrey Meier.

Michael Sullivan
Title: The persistence of the Legendrian contact homology algebra
Abstract: The well-studied displacement energy of a Lagrangian submanifold is the minimum Hamiltonian oscillation needed so that the Lagrangian does not intersect its image under the Hamiltonian isotopy. For dimension reasons, the analogous Legendrian displacement energy definition requires the contact Hamiltonian image of the Legendrian to not intersect the Reeb flow of the original Legendrian. In this contact setting, I will discuss how to apply the persistent homology barcodes of a filtered Legendrian contact (Chekanov-Eliashberg) algebra to get lower bounds on the number of such intersections. The numerical bounds vary with the size of the Hamiltonian oscillation and hold when a Legendrian has a large loose chart, in contrast to a Legendrian with a small loose chart which sometimes has a small displacement energy. I will also discuss a related Legendrian non-squeezing result. This is joint work with Georgios Dimitroglou Rizell.

Ezra Getzler
Title: New results on Batalin-Vilkovisky geometry
Abstract: In the theory of supermanifolds, there is an odd analogue of symplectic geometry, where the parity of the symplectic form is fermionic. Liouville's theorem breaks down in this case: there is no canonical integral. The replacement for this is Batalin-Vilkovisky geometry, which has been brought into its modern form by Khudaverdian. The replacements for integrals are pairs made up of a half-density on the odd symplectic supermanifold satisfying a certain second-order linear differential equation and a Lagrangian submanifold. In this talk, I will describe recent work with Sean Pohorence (see https://arxiv.org/abs/1911.11269), in which we generalize this formalism to allow distinct Lagrangians on different charts, joined by isotopies on the intersections of charts, which are themselves joined by isotopies of isotopies in higher dimensions, and so on. This formalism has proved useful in understanding some situations in quantum field theory where there is no global choice of gauge (the Gribov ambiguity).

In this talk, I will focus on the mathematical side of the story, leaving the quantum field theory for another day.

Chris Wendl
Title: Equivariant transversality, super-rigidity and all that
Abstract: As everyone knows, you can't have transversality and symmetry at the same time. If you could, then multiply covered holomorphic curves would not be such a headache, and many popular symplectic invariants would be much easier to define. My goal in this talk is to clarify precisely what obstructs equivariant transversality, and just how happy you should be when those obstructions vanish. I will sketch applications in three distinct settings: (1) Generic functions on a finite-dimensional orbifold are Morse; (2) Generic 1-parameter deformations of geodesible line fields undergo only birth-death and period-doubling bifurcations; (3) Generic almost complex structures on a symplectic Calabi-Yau 3-fold make the Cauchy-Riemann operator intersect the zero-section cleanly (i.e. all holomorphic curves are "super-rigid"). I will also try to explain what technical lemmas need to be proved (e.g. "Petri's condition") in order for this machinery to work in any given setting, though I will probably not explain how to prove them.

Hang Yuan
Title: Family Floer program and non-archimedean SYZ mirror construction
Abstract: Given a Lagrangian fibration, we construct a mirror Landau-Ginzburg model consisting of a rigid analytic space and a global potential, based on Fukaya's family Floer theory and non-archimedean tropical geometry. This may be thought of as a symplectic version of Gross-Seibert's program.

Locally, the potential is given by counting Maslov-two disks. A local chart is the zero locus of weak Maurer-Cartan equations of an A_∞ algebra in the non-archimedean torus fibration.

We will explain how an A_∞ homomorphism gives us a wall-crossing formula, which leads to a transition map between two local charts. If time allows, I will explain why the transition map only depends on the homotopy class of this A_∞ homomorphism.

Hiro Lee Tanaka
Title: Formalisms of gluing Fukaya categories
Abstract: In the Weinstein setting, we know that wrapped Fukaya categories glue, so it behooves us to understand a general framework that captures the properties of this gluing. After explaining a few approaches of how to formalize gluing procedures in the 2-dimensional setting, we'll explain why we think a framework inspired by factorization homology seems most promising to capture the general behavior of local-to-global invariants of Weinstein sectors. Setting up this formalism sheds insights into things like the following: (a) We can classify all local-to-global invariants of 2-dimensional Liouville sectors. (b) We see that the Floer theory of Lagrangian cobordisms in R^oo recovers the higher K theory of the integers. (We have been unable to compute this higher K theory for decades, and a computation would yield powerful results in arithmetic.) (c) Wrapped Floer theory can shed insight into higher homotopy groups of Liouville embedding spaces.

Andrew Hanlon
Title: On Fukaya-Seidel categories mirror to toric varieties
Abstract: We will discuss one way of defining a Fukaya-Seidel category mirror to a toric variety and use it to understand homological mirror symmetry in this setting. Along the way, we will see how this Fukaya-Seidel category relates to more traditional definitions. This is partly based on joint work in progress with Jeff Hicks.

Abigail Ward
Title: Homological mirror symmetry for elliptic Hopf surfaces
Abstract: One can produce non-Kähler complex surfaces by performing logarithmic transformations on projective elliptic surfaces; for example,

elliptic Hopf surfaces (including the classical Hopf surface S^1 x S^3) can be obtained by performing such operations to the product of the projective plane with an elliptic curve. In situations where the original surface has a mirror symplectic space, one can ask if there is a "mirror operation" to the logarithmic transformation, i.e. a way of producing a mirror to the logarithmically transformed surface from the original mirror space. We will discuss an answer to this question in the case of elliptic Hopf surfaces. For each such surface S, we will produce a mirror "non-algebraic Landau-Ginzburg model" with an associated Fukaya category. We will relate objects of this Fukaya category to coherent analytic sheaves on S.

Yu Pan
Title: Augmentations and exact Lagrangian surfaces
Abstract: Augmentations are some algebraic invariants of Legendrians that are tightly related to both embedded and immersed exact Lagrangian fillings. We will talk about various relations between embedded and immersed exact Lagrangian surfaces using tools related to augmentations.

Tim Large
Title: Floer K-theory and exotic Liouville manifolds
Abstract: In this talk, we will explain how to construct Liouville manifolds which have vanishing symplectic cohomology but non-vanishing symplectic K-theory. In particular, we construct an exotic symplectic structure on Euclidean space which is not distinguished by traditional Floer homology invariants. Instead, it is detected by a module spectrum for complex K-theory, built as a variant of Cohen-Jones-Segal's Floer homotopy type. The proof involves passage through (wrapped) Fukaya categories with coefficients in a ring spectrum, rather than an ordinary ring; we will outline the construction of such "spectral Fukaya categories" in the setting of exact symplectic manifolds.

Jo Nelson & Morgan Weiler
Title: ECH of prequantization bundles and lens spaces
Abstract: In 2011, Farris provided an expected dictionary between counts of pseudoholomorphic cylinders and Z_2-graded embedded contact homology (ECH) of prequantization bundles over Riemann surfaces. We upgrade to a full Z-grading, and in combination with the domain dependent methods introduced by Farris in his thesis, make use of the direct limits for filtered ECH established in Hutchings-Taubes proof of the Arnold-Chord conjecture to extend the Morse-Bott methods for prequantization bundles to the realm of ECH. In particular, we establish that the ECH of a prequantization bundle over a Riemann surface is isomorphic to the exterior algebra of the homology of this base. We comment on future work, which relates the U map in ECH to Gromov-Witten invariants of the base, permitting computations of the associated ECH capacities and an expected stabilization result purely in the context of ECH.

Semon Rezchikov
Title: Generalizations of Hodge-de-Rham degeneration for Fukaya categories
Abstract: Hodge theory shows that the Hodge-de-Rham spectral sequence associated to a compact Kahler manifold degenerates. Kaledin showed that the non-commutative Hodge-de-Rham spectral sequence associated to a smooth proper dg-category over a field of characteristic zero degenerates as well. When the category is just smooth or just proper, Kontsevich conjectured that certain weaker statements, which are true for smooth or proper varieties, should continue to hold in the categorical setting. Recently, counterexamples to Kontsevich's conjectures were found by Efimov. I will discuss the background to this story, and then I will explain why the conjectures of Kontsevich do hold, for analytic reasons, when the category is a Fukaya category. The argument suggests interesting directions to explore regarding the homological algebra of PROPs of surfaces.

Melissa Zhang
Title: An annular filtration on Sarkar-Seed-Szabó's spectral sequence
Abstract: Khovanov homology is a combinatorial invariant of links in the three-sphere borne from structures in representation theory. Nevertheless, there are many spectral sequences relating Khovanov homology to geometrically-defined invariants, such as Ozsváth-Szabó's Heegaard Floer homology. Seidel-Smith defined its geometric counterpart, symplectic Khovanov homology, which Abouzaid-Smith showed is indeed isomorphic to combinatorial Khovanov homology over characteristic 0. Inspired by symplectic Khovanov homology's O(2) action, Sarkar-Seed-Szabó extended Szabó's geometric spectral sequence, which is a combinatorial spectral sequence conjectured to be isomorphic to Ozsváth-Szabó's spectral sequence (from the Khovanov homology of a knot to the Heegaard Floer homology of the branched double cover of its mirror knot). A bifiltered version of this complex admits a family of Rasmussen-type link invariants.

In joint work with Linh Truong, we show that for links in a solid torus (i.e. annular links), Sarkar-Seed-Szabó's complex admits third filtration. This annular filtration allows us to define a 2-parameter family of annular concordance invariants s_{r,t} analogous to Grigsby-Licata-Wehrli's annular Rasmussen invariants d_t (from annular Khovanov-Lee theory). The two families share many properties, including applications to 3D contact geometry and smooth knot concordance.