# SYZ and Homological Mirror Symmetry
# Workshop Program

## Monday, November 28

### 10:30-11:30am Hiro Lee Tanaka, Harvard University
**Title: "Floer theory through spectra"**

**Abstract**: Cohen and Cohen-Jones-Segal have written about how to lift Floer-type invariants to spectra in the sense of stable homotopy theory. We'll talk about new and conjectural ways to lift Floer-type invariants to spectra.

**1130-1:00pm Lunch**

### 1:00-2:30pm Fabian Haiden, Harvard University
**Title: "Categorical Kahler Geometry"**

**Abstract:** The title refers to a long term project, developed in collaboration with Katzarkov, Kontsevich, and Pandit, to find a good notion of Kahler metric on an A-infinity or DG category, such that the corresponding notion of Kahler class is a stability structure in the sense of Bridgeland. The motivation comes from the problem of constructing stability structures on Fukaya categories with coefficients, as well as a number of examples in geometry and algebra, which share a wealth of common features, such as a notion of metrized object, complex-valued Kahler potentials, mass functionals, minimizing flow, and harmonic representatives of polystable objects. The general picture which is emerging has already led to a several results of independent interest, such as isometries of quiver varieties under mutation and a canonical balanced refinement of the Harder-Narasimhan filtration.

**2:30-2:45pm Break**

### 2:45-4:15pm Fabian Haiden, Harvard University
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**4:15-4:30pm Break**

## 4:30-5:15PM GARRET ALSTON, UNIVERSITY OF OKLAHOMA

**Title: "Potential Functions of Non-exact fillings"**

**Abstract**: The paper "Topological strings, D-model and knot contact homology" by Aganagic, Ekholm, Ng and Vafa describes some interesting relationships between knot contact homology and the open Gromov-Witten theory of non-exact fillings. I will describe a Floer theory formulation of these ideas. In particular, I will explain how the open Gromov-Witten potential function of the non-exact filling can be written down using the A-infinity structure of the filling. Also, I will explain how contact homology of a Legendrian is related to the immersed Floer theory of the Legendrian, and show that the potential function of the filling is a generating function for the moduli space of bounding cochains of the boundary Legendrian.

# TUESDAY, NOVEMBER 29

## 10:30-11:30AM CONAN LEUNG, CHINESE UNIVERSITY OF HONG KONG

**Title: "Remarks on SYZ"**

**11:30am-1:00pm Lunch**

## 1:00-2:30PM JINGYU ZHAO, COLUMBIA UNIVERSITY

**Title: "Homological mirror symmetry for open manifolds and Hodge theoretic invariants"**

**Abstract:** Mirror symmetry was first studied for a pair of Calabi-Yau 3-folds. It predicted the genus zero Gromov-Witten invariants on the quintic 3-fold from the variations of Hodge structures on the mirror family. Following Barannikov and Katzarkov-Kontsevich-Pantev, the recent work of Ganatra-Sheridan-Perutz showed that the Hodge theoretic invariants can be recovered from the homological mirror symmetry conjecture for Calabi-Yau 3-folds.

In these talks, I will describe some work in progress of how to implement this idea for open manifolds. For an open symplectic manifold, the homological mirror symmetry conjecture says that there is a derived equivalence between the wrapped Fukaya category and the category of singularities of the mirror Landau-Ginzburg model. We will recall these categories and define various Hodge theoretic invariants associated to such a category using noncommutative geometry.

**2:30-2:45pm Break**

## 2:45-4:15PM HIRO LEE TANAKA, HARVARD UNIVERSITY

**Title: "Floer theory through spectra"**

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**4:15-4:30pm Break**

## 4:30-5:15PM HANSOL HONG, HARVARD CMSA/BRANDEIS

**Title: "Mirror symmetry for punctured Riemann surfaces and gluing construction"**

**Abstract**: Bocklandt constructed a mirror LG model of a punctured Riemann surface using the combinatorial data of a given polygonal decomposition of the surface. I will briefly explain how to interpret this construction as a formal deformation of a certain immersed Lagrangian, which is uniquely determined from the polygonal decomposition. When a punctured Riemann surface is obtained as a gluing of pairs of pants, we will see there is a corresponding gluing construction for the mirror LG model.

# WEDNESDAY, NOVEMBER 30

## 10:30-11:30AM JUNWU TU, UNIVERSITY OF MISSOURI

**Title: "Homotopy L-infinity spaces and mirror symmetry"**

**Abstract**: In the first lecture, I introduce the notion of homotopy L-infinity spaces. This is an algebraic structure that appears usually on moduli spaces.

In the second lecture, I will explain why this algebraic structure is useful to understand the mirror symmetry conjecture.

### 11:30am-1:00pm Lunch

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### 2:30-2:45pm Break

## 2:45-4:15PM DAVID TREUMANN, BOSTON COLLEGE

**Title: "Invariants of Lagrangians via microlocal sheaf theory"**

**Abstract:** I will explain some of the microlocal theory of sheaves, developed by Kashiwara and Schapira a long time ago. Over the past ten years it has emerged that it can be used to give the same kinds of results in symplectic geometry as Lagrangian Floer theory, without the use of pseudoholomorphic curves. In the second lecture I will present some of my recent work with Linhui Shen and Eric Zaslow, where we study a family of Lagrangian handlebodies in R^6.

# THURSDAY, DECEMBER 1

## 10:30-11:30AM DAVID TREUMANN, BOSTON COLLEGE

**Title: "Some examples in three dimensions"**

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## 2:45-4:15PM NATANEL BLAIER, BRANDEIS UNIVERSITY/HARVARD CMSA

**Title: "The quantum Johnson homomorphism, and the symplectic mapping class group of 3-folds"**

**Abstract:** This talk is about the symplectic isotopy problem: investigating the kernel of the forgetful map $$\pi_0 Symp(M,\omega) \to \pi_0 Diff^+(M)$$ when $(M,\omega)$ is a symplectic manifold. While many results are known for some time for $dim=4$, very little has been discovered in higher dimensions. Fukaya categories are a great way to organize the entire Floer theory of a manifold into one algebraic gadget, but they are not the ideal tool for every mission. We use a parametrized version of quantum Massey products and some $A_\infty$-deformation theory to introduce a quantum analogue of the Johnson homomorphism (familiar to low-dimensional topologists from the study of the Torelli group).

This invariant attaches a "characteristic class" in Hochschild cohomology to every suitable automorphism. Moreover, in good cases, this class be evaluated by studying the interaction of rational homotopy with Moduli spaces of holomorphic spheres. As a sample application, we consider $X = BL_C \mathbb{P}^3$, the blowup of projective space at a genus four curve. Using ideas from the birational geometry, we construct a symplectomorphism $\phi : X \to X$ with an explicit factorization as a product of six-dimensional Dehn twists. Even though each of the Dehn twists has infinite order in the symplectic mapping class group, we prove that $\phi$ is exotic.