

# Second BICMR & IBS-CGP Joint Symplectic Geometry Workshop

Time: September 18-22, 2017

Venue: Lecture Hall, Jiayibing Building, Jingchunyuan 82, BICMR, Peking University

## Lecture Series

KENJI FUKAYA (Simons Center for Geometry and Physics)

*Relative and/or equivariant Lagrangian Floer theory*

In these talks I will explain generalizations of Lagrangian Floer theory in two directions.

One is the equivariant theory in case there is an action of a compact Lie group on the target space. The other is the case where there is a (normal crossing divisor) in the target space and the holomorphic curve we consider goes to the complement of the divisor.

My original motivation to do these generalizations is application to gauge theory which I will explain in the first talk, together with other possible applications.

In the other 3 talks I will explain various problems to generalize the story in those cases and will sketch the way to resolve them.

## Research Talks

YOUNGJIN BAE (IBS-CGP)

*Periodic orbits in virtually contact structures*

We prove that certain non-exact magnetic Hamiltonian systems on products of closed hyperbolic surfaces and with a potential function of large oscillation admit nonconstant contractible periodic solutions of energy below the Mane critical value. For that we develop a theory of holomorphic curves in symplectization of non-compact contact manifolds that arise as the covering space of a virtually contact structure whose contact form is bounded with all derivatives up to order three. This is a joint work with Kevin Wiegand, and Kai Zehmisch.

CHEOL-HYUN CHO (Seoul National University)

*Gluing localized mirror functors*

Using formal deformation theory of a reference Lagrangian submanifold  $L$ , we can define a localized mirror functor from Fukaya category to the matrix factorization category of the potential function of  $L$ . It is called localized since the functor is non-trivial only for Lagrangians having non-trivial Floer homology with the chosen reference  $L$ . Given two different reference Lagrangian submanifolds, we explain how to glue two localized mirror functors to obtain a global

functor. As an example, we discuss the case of punctured Riemann surfaces. This is a joint work in progress with Hansol Hong and Siu-Cheong Lau.

YUNHYUNG CHO (Sungkyunkwan University)

*Lagrangian fibers of Gelfand-Cetlin systems I*

This talk will survey some recent joint works with Yoosik Kim and Yong-Geun Oh on Gelfand-Cetlin (or shortly GC-) systems. We observe that a GC-system is very similar to a toric moment map in the sense that every GC-fiber over a  $k$ -dimensional face of a GC-polytope is an isotropic submanifold and has a  $k$ -dimensional torus factor. However, their main difference is that there always exist non-torus Lagrangian fibers unless our space is a projective space. We classify all Lagrangian GC-fibers in a purely combinatorial way. Furthermore, we find all monotone Lagrangian fibers by using some Maslov index formula for Hamiltonian circle actions.

BOHAN FANG (BICMR, Peking University)

*Oscillatory integrals on  $T$ -dual branes*

I will describe how to compute the oscillatory integrals on the  $T$ -dual Lagrangians in the mirror LG model of a complete toric variety, which involves Iritani's Gamma classes. I will also discuss the relation between this computation and the Gamma II conjecture.

JIANXUN HU (Sun Yat-Sen University)

*Symplectic geometry of del Pezzo manifold*

In this talk, I will first review binational symplectic program. Then I will talk about how to use Gromov-Witten invariants to study symplectically rationally connectedness of del Pezzo manifolds. This is a joint work with Huangzhong Ke in progress.

MORIMICHI KAWASAKI (IBS-CGP)

*Partial symplectic quasi-states constructed by Lagrangian Floer theory*

Entov and Polterovich give a concept of (super)heaviness for subsets of symplectic manifolds. To define them, they used the Oh-Schwarz spectral invariants defined in terms of the Hamiltonian Floer theory. In this talk, we give a concept of (super)heaviness in terms of the Lagrangian Floer theory. We also give its application to non-displaceability, existence of Hamiltonian chord between two disjoint subsets, Lagrangian version of energy capacity inequality, *etc.*

CHANGZHENG LI (Sun Yat-Sen University)

*Gamma conjecture I for del Pezzo surfaces*

Conjecture  $\textcircled{C}$  and the underlying Gamma conjectures I and II for Fano manifolds were proposed by Galkin, Golyshev and Iritani recently. In this talk, we will discuss conjecture  $\textcircled{C}$  and Gamma conjecture I in the special case of del Pezzo surfaces  $X$ , the former of which is concerned with eigenvalues of an operator on the quantum cohomology of  $X$  induced by the quantum multiplication by the first Chern class of  $X$ , and the latter of which relates Givental's  $J$ -function with the Gamma class of  $X$ . This is my joint work with Huazhong Ke, Jianxun Hu and Tuo Yang.

YONG-GEUN OH (IBS-CGP, POSTECH)

*Lagrangian fibers of Gelfand-Cetlin systems II*

This talk is a continuation of the talk of Yunhyung Cho on the recent joint work, a study of Lagrangian fibers of the Gelfand-Cetlin systems and their nondisplaceability which generalizes Fukaya-Oh-Ohta-Ono's study of toric cases to the complex partial flag manifolds. This also extends the previous study of Nishino-Nohara-Ueda and Nohara-Ueda. I will particularly explain our construction of a continuum family of nondisplaceable Lagrangian tori degenerating to the Lagrangian fiber of the type the three-sphere in the full flag manifold  $F(1, 2, 3)$ . This in particular proves the limiting Lagrangian sphere is nondisplaceable, which answers to the question on the nondisplaceability of the sphere whose Floer homology Nohara-Ueda computed is zero.

HIROSHI OHTA (Nagoya University)

*TBA*

KAORU ONO (RIMS, Kyoto University)

*Twisted sectors in Lagrangian Floer theory*

I will speak on a notion of twisted sectors in Lagrangian Floer theory in an appropriate setting. I also discuss it in some typical example and necessary ingredients to construct a theory. It is based on a joint work (in progress) with Bohui Chen and Bai-Ling Wang.

JAKE SOLOMON (Hebrew University)

*Graded Riemann surfaces and descendent integrals*

I will discuss the notion of a graded Riemann surface and how it gives rise to open descendent integrals at arbitrary genus. This is joint work with Ran Tessler.

PING XU (Penn State University)

*Shifted derived Poisson manifolds*

We will discuss shifted derived Poisson manifolds in the  $C^\infty$ -context. As a main example, we prove that to any foliation  $F$ , there exists a  $(-1)$ -shifted derived Poisson manifold, canonical up

to isomorphisms, whose algebra of functions can be considered as polyvector fields normal to the foliation. This is a joint work with R. Bandiera, Z. Chen and M. Stienon.

QIZHENG YIN (BICMR, Peking University)

*Chow groups and derived categories of K3 surfaces*

We introduce an interesting filtration on the bounded derived category of coherent sheaves on a  $K3$  surface. The filtration has its origin in the study of algebraic cycles on the  $K3$  surface. We also discuss some consequences on the algebro-geometric side, as well as speculations inspired by (homological) mirror symmetry. Joint work with Junliang Shen and Xiaolei Zhao.

YOUJIN ZHANG (Tsinghua University)

*TBA*

ZHENGYU ZONG (YMSC, Tsinghua University)

*Gromov-Witten/Donaldson-Thomas correspondence for local gerby curves*

In 2004 and 2005, the work of Bryan-Pandharipande and Okounkov-Pandharipande build the Gromov-Witten/Donaldson-Thomas correspondence for local curves. In this talk, I will discuss an ongoing project on the Gromov-Witten/Donaldson-Thomas correspondence for local gerby curves, which is an orbifold generalization of the above work. More concretely, we will consider a  $Z_{n+1}$ -gerbe  $C$  over a smooth genus  $g$  curve. Let  $L_1$  and  $L_2$  be two orbifold line bundles over  $C$  such that the isotropy group  $Z_{n+1}$  acts on them via fiberwisely multiplication by  $\exp(2\pi i/n + 1)$  and  $\exp(-2\pi i/n + 1)$  respectively. We will study the Gromov-Witten/Donaldson-Thomas correspondence for the total space of  $X := L_1 \oplus L_2$ . The strategy of the proof is to apply degeneration formula to  $X$  to reduce the problem to the case of cap, cylinder, and pair of pants. This work is joint with Zijun Zhou.