

---

# **2015 Pohang Mathematics Workshop**

November 15 – 17, 2015  
Daemyung Resort, Geoje, Korea

---

**Program and Abstracts**



# 2015 Pohang Mathematics Workshop

Daemyung Resort, Geoje, Korea  
November 15 – 17, 2015

## Organizers

Byunghee An (IBS Center for Geometry and Physics)  
Jinseok Cho (Pohang Mathematics Institute)  
Sung Rak Choi (IBS Center for Geometry and Physics)  
Aeryeong Seo (Center for Geometry and its Applications)

## Sponsored by



**PMI**





# Contents

<b>Program of the Sessions</b>	<b>2</b>
<b>Abstracts</b>	<b>5</b>
<b>List of Participants</b>	<b>9</b>

## Program

### 16 November

---

Chair : Seonhwa Kim (IBS-CGP)

10:00–10:40 **Comparison of mirror functors of the elliptic curve via LG/CY correspondence**

*by* SANGWOOK LEE (IBS-CGP)

11:00–11:40 **Tautological rings of moduli spaces of curves**

*by* MEHDI TAVAKOL (IBS-CGP)

12:00–14:00                      Photo Session & Lunch

Chair : Hyowon Park (PMI)

14:00–14:40 **Equivariant surgery for circle actions**

*by* YUNHYUNG CHO (IBS-CGP)

14:50–15:30 **Liouville type theorems for the steady axially symmetric Navier-Stokes equations**

*by* SHANGKUN WENG (PMI)

15:30–16:00                      Coffee Break

**16 November**

---

Chair : Jeong Rye Park (POSTECH Math BK21+)

16:00–16:40 **Cohomology support loci and forms of degree one**

*by* YOUNGHO YOON (IBS-CGP)

16:50–17:30 **Restriction problem and some estimates**

*by* CHUHEE CHO (POSTECH Math BK21+)

18:00–            Banquet

## 17 November

---

Chair : Yoshikazu Nagata (SRC-GAIA)

10:00–10:40 **Defining functions for unbounded domains in almost complex manifolds**

*by* HARZ TOBIAS (SRC-GAIA)

11:00–11:40 **On combinatorics on spheres**

*by* HYONJU YU (PMI)

12:00–14:00

Lunch



## Abstracts

### **Comparison of mirror functors of the elliptic curve via LG/CY correspondence**

SANGWOOK LEE, *IBS Center for Geometry and Physics*

We review two different kinds of homological mirror symmetries of elliptic curves. One has been classically known since Polishchuk-Zaslow's work, which has B-model as a derived category, while the other due to Cho-Hong-Lau has the B-model as Landau-Ginzburg theory, namely the category of matrix factorizations. We investigate how they are related via Orlov's LG/CY correspondence theorem.

### **Tautological rings of moduli spaces of curves**

MEHDI TAVAKOL, *IBS Center for Geometry and Physics*

The study of intersection theory on moduli spaces of curves was started by Mumford. He established the foundational framework for understanding the geometry of spaces of curves. He also defined the notion of tautological classes on these spaces. Tautological classes have been studied extensively since then. In this talk I will discuss the development of methods for this study since Mumford.

**Equivariant surgery for circle actions**YUNHYUNG CHO, *IBS Center for Geometry and Physics*

Let  $M$  be a  $(2n + 1)$ -dimensional closed manifold equipped with a fixed point free circle action such that there are only finitely many exceptional orbits. In this paper, we present a way of constructing a new closed manifold  $\widetilde{M}$  with a free  $S^1$ -action from  $M$  via  $S^1$ -equivariant surgery technique. As consequences, firstly we presents a new method to obtain resolutions of isolated cyclic quotient singularities. Secondly, we prove that the Chern number  $N = \langle c_1(E)^n, [B] \rangle$  of the complex line orbi-bundle  $E$  associated to  $M$  satisfies  $l \cdot N \in \mathbb{Z}$  where  $B = M/S^1$  and  $l$  is the least common multiple of the orders of the isotropy groups of the element of  $M$ . Finally, we illustrate several applications of our results in symplectic topology. This is joint work with Byung Hee An.

**Liouville type theorems for the steady axially symmetric Navier-Stokes equations**SHANGKUN WENG, *Pohang Mathematics Institute*

In this talk, I will briefly introduce the physical background of the Navier-Stokes equations and also the main mathematical achievements in this field during the past 80 years. Then I will talk about my recent works on the steady axially symmetric Navier-Stokes equations. Some of my works are joint with Prof. Dongho Chae at Chung-Ang University.

**Cohomology support loci and forms of degree one**YOUNGHO YOON, *IBS Center for Geometry and Physics*

Cohomology support loci of rank one local systems of a smooth quasi-projective complex algebraic variety are finite unions of torsion-translated complex subtori of the character variety of the fundamental group. Tangent spaces of the character variety are (partially) represented by logarithmic 1-forms. We give a relation between cohomology support loci and the natural strata of 1-forms given by the dimension of the vanishing locus.

**Restriction problem and some estimates**CHUHEE CHO, *POSTECH Math BK21+*

In this talk we introduce the restriction problem and some known results. Also we show an improved restriction estimate for hyperbolic surfaces in  $\mathbb{R}^3$ .

## Defining functions for unbounded domains in almost complex manifolds

HARZ TOBIAS, *Center for Geometry and its Applications*

I will explain that every strictly pseudoconvex domain  $\Omega$  in an almost complex manifold  $(M, J)$  admits a  $J$ -plurisubharmonic defining function, which is defined on an open neighborhood of the closure  $\bar{\Omega}$ , and which is strictly  $J$ -plurisubharmonic near the boundary  $b\Omega$ . This is joint work with N. Shcherbina and G. Tomassini.

## On combinatorics on spheres

HYONJU YU, *Pohang Mathematics Institute*

In this talk, we discuss “good” finite subset on the unit sphere.

1. Coding theoretical viewpoint
  - Find a subset  $X$  of  $S^{n-1}$  in which the points are mutually separated as much as possible
    - 1.1 (Tammes problem) for given  $X$ , make the minimum distance of  $X$  as large as possible
    - 1.2 (Packing problem) for given  $d$ , make  $X$  as large as possible under the condition; minimum distance of  $X \geq d$
2. Design theoretical viewpoint
  - Find a finite subsets of  $S^{n-1}$  which approximates the whole space
  - ex) spherical design, ...

## **List of Participants**

Byunghee An, *IBS Center for Geometry and Physics*

Youngjin Bae, *IBS Center for Geometry and Physics*

Chuheo Cho, *POSTECH Math BK21 Plus Organization*

Junseok Cho, *Pohang Mathematics Institute*

Yunhyung Cho, *IBS Center for Geometry and Physics*

Sung Rak Choi, *IBS Center for Geometry and Physics*

Sun-Yong Choi, *POSTECH Math BK21 Plus Organization*

Dmitry Doryn, *IBS Center for Geometry and Physics*

Gabriel C. Drummond-Cole, *IBS Center for Geometry and  
Physics*

Tobias Harz, *Center for Geometry and its Applications*

Seonhwa Kim, *IBS Center for Geometry and Physics*

Juhyun Lee, *IBS Center for Geometry and Physics*

Sangwook Lee, *IBS Center for Geometry and Physics*

Changzheng Li, *IBS Center for Geometry and Physics*

Yoshikazu Nagata, *Center for Geometry and its Applications*

Yong-Geun Oh, *IBS Center for Geometry and Physics* &  
*POSTECH*

Hyo Won Park, *Pohang Mathematics Institute*

In Young Park, *Center for Geometry and its Applications*

Jae-Suk Park, *IBS Center for Geometry and Physics &  
POSTECH*

Jeong Rye Park, *POSTECH Math BK21 Plus Organization*

Dmitrijs Sakovics, *IBS Center for Geometry and Physics*

Aeryeong Seo, *Center for Geometry and its Applications*

Mehdi Tavakol, *IBS Center for Geometry and Physics*

Shangkun Weng, *Pohang Mathematics Institute*

Hwajong Yoo, *IBS Center for Geometry and Physics*

Youngho Yoon, *IBS Center for Geometry and Physics*

Hyonju Yu, *Pohang Mathematics Institute*