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## PMI workshop for women in PDEs and related topics: DAY 1

| Time          | Speaker(Affiliation) | Title   |
|---------------|----------------------|---|
| 1:50pm-2:00pm | <b>Opening</b>       |   |
| 2:00pm-2:40pm | 채명주 (한경대)            | Stability of the Hamiltonian system in high sobolev spaces  |
| 2:55pm-3:35pm | 임미경 (KAIST)          | Asymptotics and computation of the solution to the conductivity equation in the presence of adjacent inclusions with extreme conductivities |
| 3:35pm-4:00pm | <b>LUNCH</b>         |   |
| 4:00pm-4:40pm | 홍성금 (조선대)            | $L^p$ -SOBOLEV REGULARITY FOR INTEGRAL OPERATORS OVER CERTAIN HYPERSURFACES   |
| 4:55pm-5:35pm | 이은경 (부산대)            | Positive Solutions for Classes of Infinite Semipositone Problems  |
| 5:40pm-       | <b>Banquet</b>       |   |

## PMI workshop for women in PDEs and related topics: DAY 2

| Time            | Speaker(Affiliation) | Title  |
|-----------------|----------------------|--|
| 10:00am-11:00am | 김인원(UCLA)            | Quasi-static evolution and congested crowd motion                  |
| 11:15am-11:55am | 노재욱(한림대)             | SPATIAL STABILITY OF 3D EXTERIOR STATIONARY<br>NAVIER-STOKES FLOWS |
| 12:00pm-2:00pm  | <b>LUNCH</b>         |  |
| 2:00pm-2:40pm   | 이영란(서강대)             | Solutions of dispersion managed non-linear Schrödinger equations   |
| 2:55pm-3:35pm   | 김현정(POSTECH)         | Capillary oscillations at holes of two different cases.            |
|                 | <b>Closing</b>       |  |

## Stability of the Hamiltonian system in high sobolev spaces

채명주(한경대)

**Abstract:** TBA

## Asymptotics and computation of the solution to the conductivity equation in the presence of adjacent inclusions with extreme conductivities

임미경(KAIST)

**Abstract:** When inclusions with extreme conductivity (insulator or perfect conductor) are closely located, the gradient of the solution to the conductivity equation can be arbitrarily large. And computation of the gradient is extremely challenging due to its nature of blow-up in a narrow region in between inclusions. In this talk we characterize explicitly the singular term of the solution when two circular inclusions with extreme conductivities are adjacent. Moreover, we show through numerical computations that the characterization of the singular term can be used efficiently for computation of the gradient in the presence adjacent inclusions.

# **$L^p$ -SOBOLEV REGULARITY FOR INTEGRAL OPERATORS OVER CERTAIN HYPERSURFACES**

SUNGGEUM HONG

ABSTRACT. In this talk we prove the sharp  $L^p$ -Sobolev estimates for averaging operators associated to a certain type of convex hypersurfaces on  $\mathbb{R}^3$ . We also establish sharp  $L^p$ -Sobolev regularity estimates associated to certain hypersurfaces in  $\mathbb{R}^d$  ( $d \geq 2$ ) of the form  $y \rightarrow (y, \sum_{i=1}^{d-1} \pm |y_i|^{m_i})$ , where  $y \in \mathbb{R}^d$  with  $2 \leq m_1 \leq \dots \leq m_{d-1}$ . This work is a collaboration with Yaryong Heo and Chan Woo Yang.

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*Key words and phrases.*  $L^p$ -Sobolev regularity.

# Positive Solutions for Classes of Infinite Semipositone Problems

Eun Kyoung Lee

Department of Mathematics Education,  
Pusan National University

## Abstract

In this talk, we consider positive solutions for infinite semipositone systems of the form:

$$\begin{cases} -\Delta u = \lambda \frac{f(u)}{u^\alpha} & \text{in } \Omega \\ u = 0 & \text{on } \partial\Omega \end{cases} \quad (P)$$

where  $\Omega$  is a bounded domain in  $\mathbb{R}^n$  with smooth boundary,  $\alpha \in (0, 1)$ ,  $f \in C([0, \infty))$ ,  $f(0) < 0$  and satisfying a sublinear condition at  $\infty$ . We use the method of sub-supersolutions to prove the existence of positive solutions of (P) for  $\lambda \gg 1$ . We also extend our results to classes of  $p$ -Laplacian infinite semipositone systems.

## Quasi-static evolution and congested crowd motion

김인원(UCLA)

### **Abstract:**

In this talk we investigate the relationship between Hele-Shaw evolution with a drift and a transport equation with a drift potential, where the density is transported with a constraint on its maximum. The latter model, in a simplified setting, describes the congested crowd motion with a density constraint. When the drift potential is convex, the crowd density is likely to aggregate, and thus if the initial density starts as a patch (i.e. if it is a characteristic function of some set) then it is expected that the density evolves as a patch. We show that the evolving patch satisfies a Hele-Shaw type equation. This is joint work with Damon Alexander and Yao Yao.

# SPATIAL STABILITY OF 3D EXTERIOR STATIONARY NAVIER-STOKES FLOWS

JAIOK ROH

In this paper, we study the stability of stationary solutions  $\mathbf{w}$  for the Navier-Stokes flows in an exterior domain with zero velocity at infinity. With suitable assumptions of  $\mathbf{w}$ , by the works of Chen(1993), Kozono-Ogawa(1994) and Borchers-Miyakawa(1995), if  $\mathbf{u}_0 - \mathbf{w} \in L^r(\Omega) \cap L^3(\Omega)$  then one can obtain

$$\begin{aligned}\|\mathbf{u}(t) - \mathbf{w}\|_p &= O(t^{-\frac{3}{2}(\frac{1}{r} - \frac{1}{p})}) \quad \text{for } 1 < r < p < \infty, \\ \|\nabla(\mathbf{u}(t) - \mathbf{w})\|_p &= O(t^{-\frac{3}{2}(\frac{1}{r} - \frac{1}{p}) - \frac{1}{2}}) \quad \text{for } 1 < r < p < 3,\end{aligned}$$

where  $\mathbf{u}(x, t)$  is a solution of the Navier-Stokes equations with the initial condition  $\mathbf{u}_0$ . In this paper, we will prove that for any  $0 < \alpha < 3$  if  $|x|^\alpha(\mathbf{u}_0 - \mathbf{w})$  belongs to  $L^r(\Omega)$  then one has

$$\| |x|^\alpha(\mathbf{u}(t) - \mathbf{w}) \|_{L^p} = O(t^{-\frac{3}{2}(\frac{1}{r} - \frac{1}{p}) + \frac{\alpha}{2}}) \quad \text{for } p > \frac{3r}{3 - r\alpha}.$$

Also, we will discuss an inequality for the incompressible flows with a compact supported vorticity.

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*Key words and phrases.* Navier-Stokes equations, temporal decay, temporal-spatial decay , exterior domain.

## Solutions of dispersion managed non-linear Schrödinger equations

이영란(서강대)

### Abstract:

In this talk, we consider the existence, smoothness, and decay estimate of solutions for a certain dispersion managed non-linear Schrödinger equation which is related to non-linear optics.

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## Capillary oscillations at holes of two different cases.

김현정(POSTECH)

### Abstract:

We compute the natural frequencies for the oscillation of the free boundary of a perfect incompressible fluid in presence of capillary forces.

In this talk, two different geometries will be considered.

The first is the cross-section of a container, completely filled with a liquid, which has a small hole at the center of the top.

The second is the case when the fluid occupies a semi-infinite container with a circular orifice.

In both cases, dual integral equation systems must be solved by using eigenvalue problems.

We discuss the cases where the contact line between the free surface and the container is pinned as well as the case where it moves with a constant contact angle.