Monday, 19 January

R202, 9:50-10:50

Prof. Motoko Kotani (Tohoku University)

Mathematical challenge to structural understanding of materials

I would like to discuss how mathematics can contribute to understanding of materials. At AIMR, we set three target projects non-equilibrium materials based on mathematical dynamical system, topological functional materials, and multi-hierarchical materials based on discrete geometric analysis. I will present recent progress in them such as short-mid range order of glassy materials via persistent homology, application of index theorem to counting interface currents, differential geometry of carbon networks.

R202, 11:00-12:00

Prof. Panki Kim (Seoul National University)

Global Dirichlet Heat Kernel Estimates for Symmetric Levy Processes in Half-space

In this talk, we discuss explicit sharp two-sided estimates for the Dirichlet heat kernels of a large class of symmetric (but not necessarily rotationally symmetric) Levy processes on half spaces for all $t > 0$. These Levy processes may or may not have Gaussian component. When Levy density is comparable to a decreasing function with damping exponent, our estimate is explicit in terms of the distance to the boundary, the Levy exponent and the damping exponent of Levy density. This is a joint work with Zhen-Qing Chen.

Tuesday, 20 January

R202, 9:30-10:30

Prof. Zhiqiang WANG (Fudan University)

Stabilization of extrusion process modeled by hyperbolic systems coupled through a moving interface

In this talk, we consider a physical model of the extrusion process, which is described by two systems of conservation laws coupled through a moving interface. We first study the well-posedness of both the open-loop and closed-loop system. Then using a Lyapunov approach, we obtain the exponential stabilization for the closed-loop system under natural feedbacks.

R202, 10:40-11:40

Prof. Yoshikata Kida (Kyoto University)

Mackey's virtual group theory and orbit equivalence rigidity

This talk is about measure-preserving actions of countable groups on probability measure spaces and their orbit structure. Two such actions are called orbit equivalent if there exists an isomorphism between the spaces preserving orbits of the actions. Various results on various group actions have been obtained since relationship between orbit equivalence and operator algebras was discovered in 1950s. Virtual group theory, introduced by George W. Mackey, often gives fruitful insights into a rigidity aspect of orbit equivalence. I will talk about what a virtual group is and how it is applied. Examples include Zimmer's rigidity for lattices in some Lie groups, and rigidity for mapping class groups of surfaces by myself.

Thursday, 22 January

R202, 9:30-10:30

Prof. Yuji Odaka (Kyoto University)

Canonical Kahler metrics and Moduli of varieties

It has been classically known that:
A: [Metric] Compact Riemann surface has a unique metric with constant curvature (Koebe, Poincare 1907)
B: [Moduli] They form a "nice" (quasi-projective) moduli space M_g (Riemann 19c, Teichmuller,.. Mumford 60s).

We introductorily explain how these two phenomena are actually "equivalent", even for singular varieties or higher dimensional varieties, and will also show some number of future problems.

For dimensions at least 2:
A: [Metric] side has been developed by Calabi, Yau, Tian, Donaldson etc in Kahler geometry.
B: [Moduli] side's "General type case" has been developed by Shepherd-Barron, Kollar, Alexeev etc in birational geometry. (For other class of varieties, it's open).

In 2008-2011 the speaker showed an unexpected equivalence of the above two with different background by using the Minimal Model Program (MMP) and proposed "K-moduli conjecture" to give nice moduli theory of (more general) higher dimensional varieties.

In 2012-2014 we roughly settled the K-moduli conjecture for Fano varieties case: in the latter half of the talk, he will explain that case i.e. giving compact moduli of Fano varieties by using recent developement of Kahler-Einstein geometry. The key notion of the above theory is K-stability, originally introduced by Tian, Donaldson.

There are many interesting and important problems remaining, which we discuss at the end of the talk.

R202, 10:40-11:40

Prof. Pin Yu (TsingHua University)

Shock formation for three dimensional wave equations

We study a geometric perspective on shock formations for a class of quasilinear wave equations (which admit global smooth solutions for small data). Without any symmetry conditions, we exhibit a family of large smooth initial data leading to shocks.