I.C.M. DAY

27 August 2014
2pm – 6.30pm
S17 #04-06

NUS National University of Singapore
Department of Mathematics
Faculty of Science

Programme

2.00pm – 2.50pm	**Duality in Boltzmann Equation and its Applications** *Yu Shih-Hsien, National University of Singapore*
2.50pm – 3.40pm	**Mathematical Models and Numerical Methods for Bose-Einstein Condensation** *Bao Weizhu, National University of Singapore*
3.40pm – 4.00pm	Break @ Mathematics Department Lounge
4.00pm – 4.50pm	**Recent Developments in Interval Dynamics** *Shen Weixiao, National University of Singapore*
4.50pm – 5.10pm	Break @ Mathematics Department Lounge
5.10pm – 6.10pm	**Computer Proof Assistants – The Future of Mathematics** *Vladimir Voevodsky, Institute for Advanced Study, USA*

~ This is a special event in connection with the International Congress of Mathematicians (ICM 2014), in Seoul, Korea. The lectures will be delivered by 3 of our colleagues who spoke at the Seoul ICM, and the final guest lecture by Vladimir Voevodsky (2002 Fields Medal winner).*

**Prof Gan Wee Teck, who also spoke at the Seoul ICM, is unable to participate in this special event due to sabbatical leave.*

Abstract

Duality in Boltzmann Equation and its Applications

Yu Shih-Hsien, National University of Singapore

In this paper we will survey a quantitative and qualitative development on the Boltzmann equation. This development reveals the dual natures of the Boltzmann equation: The particlelike nature and the fluidlike nature. This dual nature property gives rise to the precise construction of the Green's function for Boltzmann equation around a global Maxwellian state. With the precise structure of the Green's function, one can implement the Green's function to study various problems such as invariant manifolds for the steady Boltzmann flows, time asymptotic nonlinear stability of Boltzmann shock layers and Boltzmann boundary layers, Riemann Problem, and bifurcation problem of boundary layer problem, etc.

Mathematical Models and Numerical Methods for Bose-Einstein Condensation

Bao Weizhu, National University of Singapore

The achievement of Bose-Einstein condensation (BEC) in ultracold vapors of alkali atoms has given enormous impulse to the theoretical and experimental study of dilute atomic gases in condensed quantum states inside magnetic traps and optical lattices.

In this talk, I will present a short survey on mathematical models and theories as well as numerical methods for BEC based on the mean field theory.

We start with the Gross-Pitaevskii equation (GPE) in three dimensions (3D) for modeling one-component BEC of the weakly interacting bosons, scale it to obtain a three-parameter model and show how to reduce it to two dimensions (2D) and one dimension (1D) GPEs in certain limiting regimes. Mathematical theories and numerical methods for ground states and dynamics of BEC are provided.

Extensions to GPE with an angular momentum rotation term for a rotating BEC, to GPE with long-range anisotropic dipole-dipole interaction for a dipolar BEC and to coupled GPEs for spin-orbit coupled BECs are discussed.

Finally, some conclusions are drawn and future research perspectives are discussed.

Recent Developments in Interval Dynamics

Shen Weixiao, National University of Singapore

Dynamics in dimension-one has been an extremely active research area over the last decades. In this talk, we will describe some of the new developments of the recent years.(joint work van Strien).

Computer Proof Assistants – The Future of Mathematics

Vladimir Voevodsky, Institute for Advanced Study, USA

I will tell about the movement to create new foundations of mathematics, new common language and new commonly accepted methods of inference, to be used to express mathematics in forms that can be verified by computer proof assistants. Almost miraculously the new ideas that were required to resolve some of the outstanding problems that stalled the development of such foundations came from homotopy theory. There is now a growing new synthesis of constructive mathematics with Grothendieck style pure mathematics that can be effectively developed using existing proof assistants such as Coq.