KI-NET UT-AUSTIN WORKSHOP
CURRENT TOPICS ON NON-LOCAL TRANSPORT THEORY

OCTOBER 7 AND 8, 2013
ICES AND MATHEMATICS DEPARTMENT

This is an informal workshop and open discussions on issues raging from non-linear theory of non-local diffusions, quantum and kinetic transport theory in connection with macroscopic fluid dynamics. Lectures with be held at the Peter O'Donnell Building (POB). Organizer: Irene M. Gamba.

CONFIRMED SPEAKERS

CLAUDE BARDOS, UNIVERSITY OF PARIS VI, FRANCE
ALEXANDER BOBYLEV, KARLSTAD UNIVERSITY, SWEDEN
LUIS CAFFARELLI, UT AUSTIN
THOMAS CHEN, UT AUSTIN
FRANCOIS GOLSE, ECOLE POLYTECNIQUE, PARIS, FRANCE
JEFF HAACK, UT AUSTIN
PHIL MORRISON, UT AUSTIN
NATASA PAVLOVIC, UT AUSTIN
ALEXIS VASSEUR, UT AUSTIN

Schedule

Monday, October 7th	**POB Building, Room 4.304**
MORNING SESSION	**Room 4.304**
9:30 am	***Coffee***
9:45-10:15	**Claude Bardos – '***About a Variant of the Vlasov equation dubbed Vlasov-Dirac Benney equation'*
10:15– 10:30	***Break/discussions***
10:30 -11:00	**Luis Caffarelli -** `*Some problems for non local diffusion equations'*
11:00 – 1 2:00pm	***Discussions in POB Seminar Area*** **Room 3.430**
12:00 -2:15 pm	***Lunch break***

AFTERNOON SESSION	**POB Building – Discussion Area 3.430**
2:15 - 2:45pm	**Natasa Pavlovic -** **"***Unconditional uniqueness for the cubic Gross-Pitaevskii hierarchy via quantum de Finetti - Part I"*
3:00 – 3:30	**Thomas Chen -** **"***Unconditional uniqueness for the cubic Gross-Pitaevskii hierarchy via quantum de Finetti - Part II"*
3:30 – 4:00	***Break/discussions***

Tuesday, October 8th	**POB Building, Room 2.402**
MORNING SESSION	**Room 2.402**
9:30	***Coffee***
10:00 – 10:30	**Francois Golse -** *"Diffusion Approximation of the Linear Boltzmann Equation with Vanishing Scattering Rate"*
10:30 – 11:00	***Break/discussions***
11:00 – 11:30	**Phil Morrison -** *`A Transformation for Diagonalizing the Continuous Spectra of a Large Class of Hamiltonian Transport Equations'*
11:30 – 1:30	***Discussions/Lunch***
AFTERNOON SESSION	**Room 2.402**
1:30 – 2:00	**Alexis Vasseur -** *"Relative entropy applied to shocks for Conservation Laws and applications"*
2:00 -2:30	***Break/discussions***
2:30 – 3:00	**Jeff Haack -** *`Numerical computation of the Boltzmann collision operator with angularly dependent cross section'*
3:00 – 3:30	***Break/discussions***
3:30 – 4:30	**Alexander Bobylev - ICES/CNA seminar at POB 6.304 --** "DSMC for Simulations of Coulomb Collisions in Multi-component Plasma"

4:30 - 6:30	**Discussions/ happy hour**

ABSTRACTS

Claude Bardos
'About a Variant of the Vlasov equation dubbed Vlasov-Dirac Benney equation':

This is a report on project initiated with Anne Nouri in progress, in collaboration with Nicolas Besse, and also in interactions with other colleagues: Yan Brennier, Bruno Despres and Remi Sentis.

It concerns a version of the Vlasov equation where the self interacting Coulomb potential is replaced by a Dirac mass. Hence the instabilities when they appear have a much more severe effect than in the classical Vlasov Poisson equation.

Emphazis is put on the relations between the linearized version, the full non linear problem leading to the importance of the "one bump " stability and also natural connections with several other equations of physic mathematic.

Jeff Haack
`Numerical computation of the Boltzmann collision operator with angularly dependent cross section.'

I will present an extension of the conservative spectral method to the case of angular dependent scattering mechanisms arising from potential interactions between particles. In particular, we test this method by computing the Boltzmann equation with screened Coulomb potentials and numerically study the rate of convergence of the Boltzmann collision operator in the grazing collisions limit to the limiting Landau collision operator, in Fourier space. We show that the decay rate to equilibrium depends on the parameters associated with the collision cross section, and specifically study the differences between the classical Rutherford scattering angular cross section, which has logarithmic error, and an artificial one with a linear error.

Natasa Pavlovic
`Unconditional uniqueness for the cubic Gross-Pitaevskii hierarchy via quantum de Finetti - Part I'

Thomas Chen
`Unconditional uniqueness for the cubic Gross-Pitaevskii hierarchy via quantum de Finetti - Part II'

The derivation of nonlinear dispersive PDE, such as the nonlinear Schroedinger (NLS) or nonlinear Hartree (NLH) equations, from many body quantum dynamics is central topic

in mathematical physics, which has been approached by many authors in a variety of ways. In particular, one way to derive NLS is via the Gross-Pitaevskii (GP) hierarchy, which is an infinite system of coupled linear non-homogeneous PDE. The most involved part in such a derivation of NLS consists in establishing uniqueness of solutions to the GP. That was achieved in seminal papers of Erdos-Schlein-Yau. Recently, with T. Chen, C. Hainzl and R. Seiringer we obtained a new, simpler proof of the unconditional uniqueness of solutions to the cubic Gross-Pitaevskii hierarchy in the 3-Dimensional space. One of the main tools in our analysis is the quantum de Finetti theorem.

In the first talk, Natasa will present a brief review of the derivation of NLS via the GP, describing the context in which the new uniqueness result appears. In the second talk, Thomas will illustrate how quantum de Finetti's theorem can be used to obtain unconditional uniqueness of the GP.

Alexander Bobylev

`DSMC methods for simulation of Coulomb collisions in multi-component plasma'

A.V. Bobylev*, S.A. Karpov** and I.F.Potapenko**
*Department of Mathematics, Karlstad University, Sweden
**Keldysh Institute of Applied Mathematics, Russian Academy of Sciences, Moscow

The general DSMC method for solving Boltzmann equation for long-range potentials and Landau-Fokker-Planck equation was proposed by Bobylev and Nanbu in 2000 [1] (partly as a development of earlier appoach of Nanbu [2] to Coulomb collisions). The methods of [1,2] were later applied to various model problems of plasma physics, discussed in detail and further developed by several authors (see, for example, [3,4] and references in [4]). However the general method of [1] was not clearly understood and therefore many authors still use a more complicated original scheme of [2] with reference to [1] just for the formal proof of consistency with the Landau-Fokker-Planck equation. The reason is that the first presentation of the method was done in [1] in too formal and general way. We present in this paper a completely difeerent approach, which leads to basically the same general method, but makes its essence absolutely clear and transparent. The method is explained for the general case of multi-component plasma. We also present some rigorous estimates for accuracy of the method. Finally some numerical results on typical problems of physics of collisional plasma are presented and discussed.

References

1. A.V.Bobylev and K.Nanbu, Theory of collision algorithms for gases and plasmas based on the Boltzmann equation and the Landau-Fokker-Planck equation, Phys.Rev.E 61, 4576-4586 (2000).
2. K.Nanbu, Theory of cumulative small-angle collisions in plasmas, Phys.Rev. E 55, 4642-4652 (1997).
3. A.V.Bobylev, E.Mossberg and I.F.Potapenko, A DSMC method for the Landau-Fokker-Planck equation, in the book Rarefied Gas Dynamics (Proc. of 25th RGD Symposium, St. Petersburg, July 2006), Eds. M.S.Ivanov and A.K.Rebrov, 479-483, Novosibirsk 2007.

4. G.Dimarco, R.Caflisch, L.Pareschi, Direct Simulation Monte Carlo schemes for Coulomb interactions in plasmas, Commun. Appl. Indust. Math. 1, 72-91 (2010).