Oxbridge PDE Conference Programme

Lecture Room L3, Mathematical Institute, Oxford

20 & 21 March 2017

Monday 20 March 2017

11.00am	Registration and coffee
11.25am	Opening Remarks
11.30am	**David Stuart (University of Cambridge)** **From relativistic quantum field theory to the Schrodinger equation** Quantum feld theories are the mathematical framework for the description of many particle quantum dynamics. Solitons are spatially localized solutions of partial differential equations - nonlinear waves which exhibit a particle-like behaviour as disturbances of a continuous medium. There exist examples of solitons in classical relativistic field theories (mathematically these are Lorentz invariant hyperbolic partial differential equations). At low energy it is often possible to rigorously approximate the dynamics by systems of ordinary differential equations which amount to Newton's equation for the free motion of a particle for the case of a single soliton. We consider solitons in quantum field theories in one space dimension, and prove an approximation theorem which describes the quantized soliton in terms of the nonrelativistic Schrodinger equation for a massive particle.
12.30pm	**Jo Evans (University of Cambridge)** **Convergence to equilibrium for the linear Boltzmann equation in entropy** I will talk about the method of hypocoercivity for proving convergence to equilibrium for degenerate evolution equations by finding norms in which the equation is coercive. I will talk about how these ideas translate into working with functionals combining entropy and Fisher information. In particular, discussing how to use the ideas from hypocoercivity to show convergence to equilibrium for the linear Boltzmann equation, and compare this with the proof of convergence for the kinetic Fokker-Planck equation.
1.00pm	Lunch
2.00pm	Group photo
2.10pm	**HC Pang (University of Oxford)** **Existence of Invariant Measures to Stochastically Driven Equations** In this talk we will discuss the existence of invariant measures to two classes of nonlinear stochastic equations. The first are the first-order stochastic scalar conservation laws driven by multiplicative noise. Building on that analysis, I will show that this existence result can be extended to nonlinear

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	stochastic anisotropic parabolic-hyperbolic equations. This is work done under the supervision of Gui-Qiang Chen.
2.40pm	**Ariane Trescases (University of Cambridge)** **Cross-diffusion and competitive interaction in Population dynamics** In Population dynamics, reaction-cross diffusion systems model the evolution of populations of competing species with a repulsive effect between individuals. For these strongly coupled nonlinear systems, a question as basic as the existence of solutions appears to be extremely complex. We introduce an approach based on the most recent extensions of duality lemmas and on entropy methods. We prove the existence of weak solutions in a general setting of reaction-cross diffusion systems, as well as some qualitative properties of the solutions.
3.40pm	Refreshments
4.00pm	**Mikaela Iacobelli (Cambridge)** **Quantization of measures: a gradient flow approach** The problem of quantization of a d-dimension probability distribution by discrete probabilities with a given number of points can be stated as follows: given a probability density ρ, approximate it in the Wasserstein metric by a convex combination of a finite number N of Dirac masses. In collaboration with E. Caglioti and F. Golse we studied a gradient flow approach to this problem in one and two dimensions. By embedding the problem in L^2, we find a continuous version of it that corresponds to the limit as the number of particles tends to infinity. Under some suitable regularity assumptions on the density, we prove uniform stability and quantitative convergence result for the discrete and continuous dynamics.
5.00pm	**Daniel Coutand (Heriot-Watt)** **Finite time singularity formation for Euler interface problems** In this talk I will mainly describe a mechanism of finite time singularity formation for the two phase Euler vortex sheet problem with surface tension. In the simpler case of the rigid body moving in an inviscid fluid, I will provide further information at the time of contact (such as the acceleration of the rigid body becoming infinite).
7.00pm	Dinner, St Anne's College

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20 & 21 March 2017

Tuesday 24 March 2015

9.00am	Angkana Rüland (University of Oxford) (Higher) Regularity for the Thin Obstacle Problem
10.00am	Franz Gmeineder (University of Oxford) Regularity Theory for Functionals of Linear Growth In this talk we present recent results on the regularity theory for functionals of linear growth. Depending on whether the full or merely the symmetric gradients appear in such functionals, we give conditions on convex variational integrals to produce minimisers of higher Sobolev- or Hölder regularity within the framework of Dirichlet and Neumann problems, respectively. Finally, we discuss the regularity of minima of quasiconvex functionals of linear growth. The results presented in this talk have been obtained in collaboration with J. Kristensen (Oxford), L. Beck (Augsburg) and M. Bulícek (Prague).
10.30am	Refreshments
11.00am	Melanie Rupflin (University of Oxford) Flowing to solutions of the Plateau problem
Midday	Giacomo Canevari (University of Oxford) Topological defects in nematic shells: a discrete-to-continuum analysis Nematic shells are the datum of a surface coated with a thin film of nematic liquid crystals. These materials are composed by rod-shaped molecules, which tend to align to each other, locally. The interaction between the molecules and the surface induces topological defects - points where the average direction of the molecules is not well-defined. We discuss a (simplified) discrete model for nematic shells, where the molecules sit at the vertices of a triangular mesh, and study the emergence of defects in the limit as the mesh parameter tend to zero. This is joint work with Antonio Segatti (Università di Pavia, Italy).
1.00pm	Lunch

Oxbridge PDE Conference Programme

Lecture Room L3, Mathematical Institute, Oxford

20 & 21 March 2017

2.00pm	**Fritz Hiesmayr (University of Cambridge)** **The Allen--Cahn construction of minimal surfaces** In my talk I will give a description of the Allen--Cahn method of constructing minimal hypersurfaces in closed manifolds. I will then present my own work related to the Morse index of these hypersurfaces. This index is an important variational property that allows us to make estimates on the dimension of the singular set of the hypersurface.
2.30pm	**Ben Sharp (Warwick)** **Estimates on the first Betti number of closed and free-boundary minimal hypersurfaces in positively curved manifolds** We will present some recent results which relate the Morse index of a minimal hypersurface with its first Betti number. The Morse index of a minimal hypersurface measures the number of different ways in which one can reduce area (up to second order). In the presence of positive curvature it is expected that the index controls the topology of such objects. We will state and prove some special cases of this phenomenon; we show that in a variety of cases the first Betti number is linearly bounded from above by the index. In particular we will present separate joint works with Reto Buzano, Alessandro Carlotto and Lucas Ambrozio.
3.30pm	Concluding Remarks

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