The School of Theoretical Physics, DIAS in conjunction with The Irish Mathematical Society will hold a Winter Symposium on THURSDAY AND FRIDAY 13 AND 14 DECEMBER 2007

Venue: DIAS, 10 Burlington Road, Dublin 4, Lecture Room, Floor 1

Notices concerning the Symposium will be sent by **Electronic Mail only.**

FINAL PROGRAMME FOR WINTER SYMPOSIUM 13 AND 14 DECEMBER 2007

THURSDAY 13 DECEMBER 2007

2.30 – 3.30	Brian Dolan (NUIM)	*The Quantum Hall Effect and Modular Symmetry*
3.30 – 4.00	Tea	
4.00 – 5.00	Brendan Guilfoyle (IT Tralee)	*Lagrangian Curves on Spectral Curves of Monopoles*
5.00 - 5.10	Oliver Murphy (Irish Applied Mathematics Teachers' Association)	*Applied Maths in Ireland – where is it going?*
5.10 -	Discussion	
5.45-	Drinks	
6.00 -	Committee Meeting: Irish Mathematical Society	

FRIDAY 14 DECEMBER 2007

10.00-10.25		Vitaly Skachek (Claude Shannon Inst., UCD)	*Linear-programming Decoding of Error-correcting Codes*
10.25-10.50		Jean Charpin (Univ. of Limerick)	*Non Newtonian Fluids and Spin Coating*
10.50–11.10	Coffee		
11.10–11.40		Alexander Povolotsky (DIAS)	*Totally Asymmetric Exclusion Process with Parallel Update. Determinant Formulas for Transition Probabilities.*
11.40-12.10		Oliver Rosten (DIAS)	*An Introduction to the Exact Renormalization Group*

1.50 – 2.40		Werner Nahm (DIAS)	*Number Theory, Quantum Fields and Blue Gene*
2.40 – 3.00		Luke Drury (DIAS)	*An Overview of the IBM Blue Gene System*
3.00 – 3.30	Tea		
3.30 – 3.45		Jonathan Coleman (TCD)	*High Yield Production of Graphene*

Abstracts:

Jonathan N Coleman: High Yield Production of Graphene

School of Physics, TCD

We employ liquid phase methods to disperse and exfoliate graphite in common solvents. A simple energy balance model predicts that the enthalpy of mixing of graphene in solvents is minimised when the surface energies of graphene and solvent match. We confirm this prediction by measuring the maximum mass of graphite dispersed as a function of solvent tension. We find a peak in dispersed mass for solvents with surface energy ~70 mJ/m^2 (surface tension ~40 mJ/m^2), very close to the surface energy of graphite. Transmission electron microscopy studies show that the dispersed graphite is exclusively in the form of graphene with less than ~5 layers. The yield of monolayer graphene is estimated to be 25%. We can confirm the accuracy of our visible identification with analysis of electron diffraction patterns.

Brian Dolan: The Quantum Hall Effect and Modular Symmetry

Dept. of Mathematical Physics, NUI Maynooth

The quantum Hall effect is a phenomenon observed in 2-dimensional electron gases, in strong transverse magnetic fields at low temperataures, which raises many interesting questions relating to low dimensional quantum field thoery and topology. It will be argued that the modular group emerges as a symmetry of some of the physics in an effective field theory description in the long wavelength limit. The action of the modular group will be described and some experimental predictions in both semi-conductor and graphene samples will be given, and compared with current experimental data.

Luke Drury: **An Overview of the IBM Blue Gene System**

DIAS

This talk will describe the special features of the IBM Blue Gene architecture and the classes of problems for which it is particularly suited. The local system currently being installed will be discussed and the procedures for access explained.

Brendan Guilfoyle: **Lagrangian Curves on Spectral Curves of Monopoles**

IT Tralee

The space L of oriented lines in R^3 is a 4-manifold with a natural Kaehler structure. In this talk we will explain some of the properties of this structure and, in particular, the holomorphic curves in L. We describe the points on these curves where the symplectic form vanishes and give an interpretation of these oriented lines in R^3. By way of example, we apply these results to the spectral curves of certain monopoles.

Oliver Rosten: **An Introduction to the Exact Renormalization Group**

DIAS

I will introduce the Exact Renormalization Group (ERG), explaining why it is such a powerful tool for studying quantum field theory. In particular, I will describe how the ERG allows one to construct nonperturbatively renormalizable quantum field theories. Finally, I will briefly discuss some of the applications of the ERG, emphasising a manifestly gauge invariant formulation of QCD.

Vitaly Skachek: **Linear-programming Decoding of Error-correcting Codes**

Claude Shannon Institute, UCD

Error-correcting codes are used to improve reliability of the information transmission over noisy communication channels. Linear codes, which are defined as null-spaces of so-called parity-check matrices, are widely used in real applications. Low-density parity-check (LDPC) codes are linear codes whose parity-check matrices are sparse. LDPC codes have attracted a lot of interest in the recent years due to their practical efficiency.

Maximum-likelihood (ML) decoding is a decoding method when the decoder outputs a codeword which has maximal similarity with the received noisy word. Generally, ML decoding is an NP-hard problem, and so there are no efficient known algorithms to solve it.

Approximate maximum-likelihood decoding for binary LDPC codes was suggested by Jon Feldman et.al. in 2003. This method is based on a formulation of a respective linear programming (LP) problem. The respective optimum of this problem is an approximation to a maximum-likelihood codeword.

In our work, we extend the approach of Feldman et.al. towards non-binary codes. We show that the problem of decoding may be formulated as a (higher-dimensional) LP problem for the non-binary case. We provide generalizations for various properties of non-binary LP problem.

Joint work with M.F. Flanagan, E. Byrne and M. Greferath.