The School of Theoretical Physics, DIAS in conjunction with The Irish Mathematical Society will hold a Winter Symposium on <u>THURSDAY AND FRIDAY 14 AND 15 DECEMBER 2006</u>

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

Notices concerning the Symposium will be sent by **<u>Electronic Mail only.</u>**

FINAL PROGRAMME FOR WINTER SYMPOSIUM 14 AND 15 DECEMBER 2006

THURSDAY 14 DECEMBER 2006

2.30 - 3.30		Martin Hynes (Director, IRCSET)	*Supporting mathematics research: an IRCSET perspective*
3.30 – 3.45	Tea		
3.45 – 4.45		Wally Greenberg (Univ. of Maryland & DIAS)	*How quarks got color; a participant view*
4.45 - 5.45		Tony O'Farrell (NUIM)	*Aspects of reversibility*
5.45-		Drinks	
6.00 -		Committee Meeting: Irish Mathematical Society	

FRIDAY 15 DECEMBER 2006

10.00-11:00		Jiri Vala (NUIM)	*Topological quantum computation*
11.00-11.20	Short Talk	Peter Lynch (UCD)	*Energy spectra from entropy principles*
11.20–11.40	Coffee		
11.40–12.00	Short Talk	Alexander Povolotsky (DIAS)	*Exact solution for discrete time asymmetric exclusion process*
12.00–13.00		Anna Avdeeva (School of Cosmic Physics, DIAS)	*Limited-memory quasi-Newton magnetotelluric inversion as an example of an optimization problem in geophysics*

2.00 – 2.20	Short Talk	Christian Römelsberger (DIAS)	*N=2 braine surgery*
2.20 – 2.40	Short Talk	Allan Solomon (The Open University)	*Positive aspects of dissipation*
2.40 – 3.40		Adrian Raftery (Univ. of Washington & Czech Academy of Sciences, Prague)	*Statistical inference for deterministic mathematical models*
3.40-	Tea		

Abstracts:

Tony O'Farrell: A reversible map is one that is conjugate to its inverse. Such maps appear naturally in classical dynamics, for instance in the pendulum, the n-body problem or billiards. They also arise in less obvious ways in connection with problems in geometry, complex analysis, approximation, and functional equations. When a problem has a connection to a reversible map, this opens it to attack using dynamical ideas, such as ergodic theory and the theory of flows. We'll discuss an example or two. It would be interesting to understand reversibility better. We'll discuss this problem, and a little progress. The subject relates to involutions, and to conjugacy problems, in classical groups, groups of power series, and larger groups. Some results are joint work with Maria Roginskaya, Ian Short, and Roman Lavicka.

Adrian Raftery: There are two main cultures of quantitative scientific research: statistical modeling and mechanistic modeling. The latter is often deterministic, using systems of differential equations. Disciplines tend to rely mainly on one or the other. Both are often useful, however, and I will review efforts over the past decade to achieve a synthesis. I will review Bayesian melding, which allows one to take account of evidence and uncertainty about a mechanistic model's inputs and outputs when making inference about a quantity of policy or research interest, and apply this to policy-making about whales. I will describe an extension to deal with situations where model outputs and the data relevant to them are on different scales, and apply it to air pollution mapping problems. Bayesian melding is difficult when the model takes a long time to run. I will describe how one can use Bayesian model averaging to make calibrated inference using only a few model runs, and apply it to probabilistic weather forecasting.

Anna Avdeeva: Inverse problems occur in many branches of science and mathematics where the values of some model parameters have to be recovered from observed data. Our talk focuses on the inversion of magnetotelluric (MT) data which consist of electric and magnetic fields recorded at the Earth surface. MT is one of the most popular inductive electromagnetic earth-sounding methods, which allows a conductivity image of the underground structures to be recovered. Usually, during three-dimensional (3D) MT inversion a 3D Earth conductivity model, discretized by N cells, is considered, and the electrical conductivity of each of the cells is sought. To solve the 3D MT inverse problem we apply a limited-memory quasi-Newton (QN) method with simple bounds. The method used is based on an iterative minimization of a classical Tikhonov-type regularized penalty function and requires calculation of the gradient of this penalty function only, hence avoiding calculation of second-derivative terms. To compute this gradient the adjoint approach, based on EM field reciprocity, is used. The computer storage requirement of the limited-memory QN method is much less than required by many other methods. To validate the robustness and effectiveness of the inversion method developed, we performed a number of numerical simulations with synthetic, but realistic, datasets. Although further research is required, we believe that the proposed approach will have a significant impact on developing and implementing practical solutions to large-scale 3D MT inverse problems.