

# Quiprocone Funding Report: QIPROCONE GRANT 037

P. D. Drummond

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A Quiprocone funded visit to the UK by P. D. Drummond and M. D Reid.

## Introduction

This grant was used to fund travel between the group of Gert Leuchs at Erlangen, and the research groups in Quantum Information and BEC at Imperial College and Oxford University, by Professor P. D. Drummond and Dr M. D. Reid, on the 14-22nd December . The purpose of the travel was to give seminars at Imperial College and Oxford, and to exchange ideas on quantum information, specifically on the computer simulation of quantum systems (P.D.D.), and on measuring macroscopic entanglement (M.D.R.).

## Imperial College Physics Department

The trip to Imperial was first, and involved discussions and seminars organised by V. Vedral in the research group of Professor Peter Knight. The topic of the seminar of Professor Drummond was:

- *Stochastic gauge simulations: from genetics and astrophysics to quantum dynamics*

This outlined a new technique for the numerical simulation of exponentially complex master equations, including examples from several areas, ranging from genetic and astrophysical chemical kinetics to quantum problems including both equilibrium and dynamical problems.

A lively discussion ensued, including an interesting debate concerning the famous claim of Feynman that many-body quantum dynamics could not be classically simulated.

The topic of the seminar of Dr Reid at Imperial College was:

- *Macroscopic Quantum Entanglement*

This gave new techniques for measuring the extent of quantum entanglement in macroscopic systems via criteria based on Heisenberg-like uncertainty relations for quadrature variables. This has resulted in a publication which is now underway.

## **Oxford University Physics Department**

A seminar was given at Oxford, (by Professor Drummond) along with laboratory tours of the quantum information laboratories. Discussion at the seminar revolved around the comparison of stochastic gauge methods with other techniques like stochastic wave-functions and the Kohn method.

A publication based on the ideas of these seminars will shortly appear in J. Opt. B with the title: 'Quantum dynamics with stochastic gauge representations', in the Wigner Centennial issue of the journal.

Discussions also took place at Oxford on the topic of macroscopic entanglement, with the Quantum Information and Quantum Computing groups, and in particular with Professor Andrew Steane of the ion-trapping group. This led to a discussion of possible experimental tests of macroscopic entanglement.