QUIPROCONE PROJECT REPORT: NUMBER 004

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Project: Much attention is currently focused on developing measures of entanglement. Entanglement is the key resource in quantum information processing. Most investigated measures include the Entanglement of Formation (EOF), the Entanglement of Distillation and the Relative Entropy of entanglement (REE). In a lot of the current investigation the EOF is used as the processing measure due to simple analytic formula for two qubits. There has been proposed a class of state (MEMS) that has the largest EOF for a given degree of mixture. Nemoto et al have recently found that these states are the most difficult to violate the convenient Bell inequality. For information processing the entanglement of distillation may be a more useful measure for the entanglement. Our project involves investigating the following questions: for these MEMS what is their EOD? Is this maximized for this class of state? As the EOD is a measure of the useable entanglement, what is the difference the EOF and EOD? What states minimize and maximize the difference between EOF and EOD?

Progress: We have analysed the relationship between EOF and REE. Henderson and Vedral were able to show that the Holevo bound can be used to provide an upper bound to the difference between EOF and REE. In this project we have been working on finding both a tighter upper bound and a lower bound. We have employed the lower bound to the accessible information by Jozsa et al. (the Holevo bound being the upper bound to this accessible information). A conjecture that we have at this stage is that the difference between the Holevo bound and the lower bound to the accessible information is a good upper bound to (EOF-REE). We have confirmed this numerically for a number of different two qubit entangled states and hope to be able to prove it analytically in the most general setting.

Dr. Nemoto's two visits have also firmly established links between Imperial College and University of Bangor. We are still planning one more visit of Dr. Nemoto to Imperial College from the current QUIPROCONE grant. The QUIPROCONE grant has been paramount in establishing links between the Bangor University and Imperial College; the collaboration is proving very valuable and this could not have been done with the funding from the QUIPROCONE grant. It will continue in the future and I expect several more papers to come out as a result.

Publications:

1. W. J. Munro, K. Nemoto, D. F. V. James and V. Vedral, Conference Proceedings, International Conference on Quantum Information (ICQI), Rochester, NY, June 10-13 (2001). Title: "*Maximally entangled mixed states for two qubits*" (included as a pdf file).

Talks:

1. W. J. Munro et. al., International Conference on Quantum Information (ICQI), Rochester, NY, June 10-13 (2001).