Quantum Information, Communication, Computation and Cryptography

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PREFACE

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The application of quantum mechanics to information related fields such as communication, computation and cryptography is a fast growing line of research that has been witnessing an outburst of theoretical and experimental results, with possible practical applications. On the one hand, quantum cryptography with its impact on secrecy of transmission is having its first important actual implementations; on the other hand, the recent advances in quantum optics, ion trapping, BEC manipulation, spin and quantum dot technologies allow us to put to direct test a great deal of theoretical ideas and results. These achievements have stimulated a reborn interest in various aspects of quantum mechanics, creating a unique interplay between physics, both theoretical and experimental, mathematics, information theory and computer science.

In view of all these developments, it appeared timely to organize a meeting where graduate students and young researchers could be exposed to the fundamentals of the theory, while senior experts could exchange their latest results.

The activity was structured as a school followed by a workshop, and took place at The Abdus Salam International Center for Theoretical Physics (ICTP) and The International School for Advanced Studies (SISSA) in Trieste, Italy, from 12–23 June 2006. The meeting was part of the activity of the Joint European Master Curriculum Development Programme in Quantum Information, Communication, Cryptography and Computation, involving the Universities of Cergy–Pontoise (France), Chania (Greece), Leuven (Belgium), Rennes1 (France) and Trieste (Italy).

This special issue of *Journal of Physics A: Mathematical and Theoretical* collects 22 contributions from well known experts who took part in the workshop. They summarize the present day status of the research in the manifold aspects of quantum information.

The issue is opened by two review articles, the first by G Adesso and F Illuminati discussing entanglement in continuous variable systems, the second by T Prosen, discussing chaos and complexity in quantum systems. Both topics have theoretical as well as experimental relevance and are likely to witness a fast growing development in the near future. The remaining contributions present more specific and very recent results. They involve the study of the structure of quantum states and their estimation (B Baumgartner *et al*, C King *et al*, S Olivares *et al*, D Petz *et al* and W van Dam *et al*), of entanglement generation and its quantification (G Brida *et al*, F Ciccarello *et al*, G Costantini *et al*, O Romero-Isart *et al*, D Rossini *et al*, A Serafini *et al* and D Vitali *et al*), of randomness related effects on entanglement behaviour (I Akhalwaya *et al*, O Dahlsten *et al* and L Viola *et al*), and of abstract and applied aspects of quantum computation and communication (K Audenart, G M D'Ariano *et al*, N Datta *et al*, L C Kwek *et al* and M Nathanson *et al*).

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F Benatti, M Fannes, R Floreanini and D Petritis
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