

PREFACE

There is a growing body of physicists worldwide who are interested in the emerging field of foundations of quantum theory and quantum optics and their technological applications to quantum information processing (including quantum computation and quantum communication). The urgency of seeding and sustaining research collaborations in this field involving experimental as well as theoretical physicists led us to propose holding periodic winter institutes in India (about once every two years) on 'foundations of quantum theory and quantum optics'.

The scientific write-up of the proposal contained the following justification. 'The advance of technology has made it possible over the last decade or so to perform critical experiments to test the foundations of quantum theory that were until recently regarded as gedanken experiments. In particular, interference and correlation experiments using single photons, single electrons and single neutrons as well as atomic, molecular and solid state physics experiments coupled with quantum optical techniques have been particularly valuable in shedding new light on non-local quantum correlations, wave-particle complementarity, macroscopic quantum tunneling, Schrödinger Cat states, the quantum Zeno effect and Bose-Einstein condensation. Further, there have been new theoretical developments of great conceptual significance such as consistent histories, decoherence and spontaneous collapse, and the development of a causal quantum theory richer than the original theory of de Broglie and Bohm. In addition there is worldwide interest in the closely related fields of mesoscopic physics, quantum computation and quantum communication.'

The first winter institute was funded by the Department of Science and Technology in India and by the S.N. Bose National Centre for Basic Sciences, Kolkata, the BRNS of the Department of Atomic Energy and by the ASICTP, Trieste. It was held at the S.N. Bose Centre, Kolkata from January 1 to January 13, 2000. The academic planning included pedagogic lectures as well as study groups in different areas for possible collaborations and technical discussions.

The enthusiasm for the winter institute, including that of young postdoctoral fellows and research students has exceeded the expectations of the national organising committee. Perhaps, one factor was the explosive growth of the field of quantum information processing. Another factor was the efficient organisation by the local organising committee. There were 96 participants including 48 speakers, many of whom gave excellent and lucid presentations. There were separate discussion sessions in the afternoons with different coordinators (N Mukunda, D Home, M Jayannavar, S Dattagupta, D Atkinson) taking charge of different focussed areas of research.

The editorial board of *Pramana* agreed enthusiastically to bring out the Proceedings as a special issue (after appropriate screening and editing of the manuscripts). It is a pleasure to thank the editorial board as well as G Chandramohan and all other members of the *Pramana* editorial office for their tireless efforts in bringing out this special issue.

Of the 27 articles here, 11 are on foundations of quantum theory, six on quantum optics, seven on quantum information processing and three on mesoscopic physics. I hope that this special issue will bear testimony to the standards attained at this first winter institute and prove to be an important source of reference.

Shasanka Mohan Roy

Guest Editor

Theoretical Physics Group
Tata Institute of Fundamental Research
Mumbai 400 005