

In search of quantum reality

An international conference on the conceptual foundations of quantum theory, 'In Search of Quantum Reality' (ISQR), was held at the India International Centre, New Delhi from 28 December 1989 to 2 January 1990. The conference was organized by NISTADS (CSIR) and co-sponsored by many institutes and organizations including the Raman Research Institute, the Physical Research Laboratory, the S. N. Bose National Centre for Basic Sciences, the Department of Science and Technology, the University Grants Commission, and the Department of Atomic Energy. It is particularly noteworthy that this conference, concerning the much debated questions raised about the nature of physical reality in the interpretations of quantum theory, is the first of its kind to be held in India. In recent years this topic has attracted considerable international attention (see, for example, Proc. 3rd Int. Symp. on Foundations of Quantum Mechanics in the Light of New Technology, Physical Society of Japan, Tokyo, 1990; F. Selleri, *Quantum Paradoxes and Physical Reality*, Kluwer, Dordrecht, 1990) in view of the emerging link between the relevant recon-dite conceptual issues and experimental studies based on modern technological advances. These advances have enabled many 'thought experiments' to be realized in practice, thereby making the physicists more acutely aware of the physical relevance of the various paradoxes of quantum theory.

The conceptual difficulties inherent in quantum mechanics, which in the words of Richard Feynman 'nobody really understands', led to a celebrated schism between Einstein and Bohr. Criticising the fundamental status given to indeterminism in quantum theory, Einstein remarked 'God does not play dice.' This prompted the famous rejoinder from Bohr to the effect that Einstein should stop telling God what to do. Challenging the universal validity of the quantum mechanical doctrines and the claim that quantum reality depends on observation,

Einstein raised the question 'Is the moon there when nobody looks at it?' In his later years, Heisenberg remarked: 'The strangest experience was that the paradoxes of quantum theory did not disappear during the process of clarification; on the contrary, they became even more marked and more exciting.'

The conference re-examined some of these exciting and profound issues. There were about eighty participants from India and abroad. Thirty selected papers were presented which dealt with a wide spectrum of issues ranging from the quantum measurement problem, the Einstein-Podolsky-Rosen Paradox and the status of local realism, the many worlds interpretation, inflationary cosmologies and quantum non-locality, 'beable' quantum field theory to hard-core experimental studies involving electron holography and laser interferometry. Among the Indian speakers were Professors V. Singh and S. M. Roy from the Tata Institute of Fundamental Research, Bombay; Prof. R. K. Varma from the Physical Research Laboratory, Ahmedabad; Dr R. Bhandari from the Raman Research Institute, Bangalore; Dr K. Datta from the University of Delhi; Dr M. D. Srinivas from the University of Madras; Dr. A. Datta from Jadavpur University; Dr P. Ghose from S. N. Bose National Centre for Basic Sciences, Calcutta; and Dr R. Nair from NISTADS, New Delhi. Some of the eminent foreign speakers included Prof. F. Selleri (University of Bari, Italy); Prof. J. S. Anandan (University of South Carolina, USA); Prof. A. Sudbery (University of York, UK); Prof. M. A. B. Whitaker (Queen's University of Belfast, N. Ireland); Prof. E. Santos (University of Cantabria, Spain); Dr Y. Murayama (Hitachi Ltd, Japan); Prof. J. Corbett (Macquarie University, Australia); Prof. H. Lichte (University of Tübingen, FRG) and Prof. A. Qadir (Quaid-i-Azam University, Pakistan). Proceedings of this conference will be published by the Plenum Press, New York.

The ISQR conference succeeded in

conveying a flavour of the delicate complexity and subtle philosophical predilections involved in issues concerning the quantum physicist's conception of 'physical reality'. The current world view of physics presents us with two radically different pictures of reality at two different levels, micro-reality (quantum reality) and macro-reality (classical reality). The essence of the puzzle lies not in the feature that these two pictures are not derivable from one another but in that they are mutually incompatible when applied to the macroscopic arena (as is demonstrated in the very existence of the quantum measurement problem), and that there is no clear-cut prescription as to precisely where quantum reality turns into classical reality. It is therefore imperative to dispense with this peculiar conceptual dichotomy of physics into microscopic and macroscopic phenomena, and try to re-establish a unitary account of the physical world. It is in this context that one needs decisive experimental tests of the extrapolation of some of the key ingredients in the quantum formalism (such as the superposition principle) to the macroscopic domain. Recent studies on 'mesoscopic physics' related to the transition areas between microscopic and macroscopic physics promise to shed more light on such problematic conceptual issues concerning the connection between quantum and classical physics. It also needs to be noted that quantum non-local effects are becoming increasingly important in various physical situations and their intriguing implications regarding the conceptual structure of relativity and basic notions of space and time are bound to be far-reaching.

To quote W. Pauli: 'I think the important and extremely difficult task of our time is to try to build up a fresh idea of reality'. The proceedings of ISQR, when published, should be of considerable interest to anyone who wishes to be kept abreast of explorations in quest of 'a fresh idea of reality' in the arena of the foundational problems of quantum theory.

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