

Preface

The development of a consistent picture of the processes of decoherence and quantum measurement is among the most interesting fundamental problems with far-reaching consequences for our understanding of the physical world. A satisfactory solution of this problem requires a treatment which is compatible with the theory of relativity, and many diverse approaches to solve or circumvent the arising difficulties have been suggested. This volume collects the contributions of a workshop on *Relativistic Quantum Measurement and Decoherence* held at the Istituto Italiano per gli Studi Filosofici in Naples, April 9-10, 1999. The workshop was intended to continue a previous meeting entitled *Open Systems and Measurement in Relativistic Quantum Theory*, the talks of which are also published in the Lecture Notes in Physics Series (Vol. 526).

The different attitudes and concepts used to approach the decoherence and quantum measurement problem led to lively discussions during the workshop and are reflected in the diversity of the contributions. In the first article the measurement problem is introduced and the various levels of compatibility with special relativity are critically reviewed. In other contributions the rôles of non-locality and entanglement in quantum measurement and state vector preparation are discussed from a pragmatic quantum-optical and quantum-information perspective. In a further article the viewpoint of the consistent histories approach is presented and a new criterion is proposed which refines the notion of consistency. Also, the phenomenon of decoherence is examined from an open system's point of view and on the basis of superselection rules employing group theoretic and algebraic methods. The notions of hard and soft superselection rules are addressed, as well as the distinction between real and apparent loss of quantum coherence. Furthermore, the emergence of real decoherence in quantum electrodynamics is studied through an investigation of the reduced dynamics of the matter variables and is traced back to the emission of bremsstrahlung.

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