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THEORETICAL PHYSICS

Foundations of Quantum Theory

The Four Marginals Theorem

If we consider a particle moving in one dimension and we are given the marginals corresponding to the position and momentum distributions, it is possible to give a joint probability distribution for the position and momentum in both the classical and quantum cases. In the next more complicated case of a particle moving in two dimensions, there are four marginal distributions referring to the commuting sets $(q_1, q_2), (q_1, p_2), (p_1, q_2), (p_1, p_2)$ where q and p refer to the positions and momenta of the two particles. In a tour de force of analysis, it is proved in both the classical and quantum cases that, in general a positive joint probability distribution does not exist which can reproduce all the four marginals. We can at most reproduce three of them. The most general maximally realistic positive definite phase space density (which reproduces the quantum probability densities of three complete commuting sets of observables) is derived. [G. Auberson (Université Montpellier II, France), G. Mahoux (CEN, Saclay, France), S.M. Roy and V. Singh]

Quantum Zeno and Anti-Zeno Paradoxes

Continuous observation of a time independent projection operator is known to prevent change of state (the quantum Zeno paradox). This result and its consequences for nonexponential decay are reviewed; the recent result of Balachandran and Roy that "generic continuous measurement of time dependent projection operators will in fact ensure change of state: an anti-Zeno paradox" is contrasted with the Zeno paradox . [S. M. Roy]

Contextual Deterministic Quantum Mechanics

A proof of quantum contextuality for a spinless particle with a one dimensional configuration space is presented. [S. M. Roy]

Rigorous Consequences of Analyticity and Unitarity

This is an invited review article for a chapter of the book "Scattering Theory" (Editors: R.Pike and P.Sabatier, Academic Press, London (2001))which summarises rigorous consequences of axiomatic field theory for strong interation scattering amplitudes . It includes high energy theorems and the applications of the Roy equations for pion-pion scattering. [S.M.Roy]