S N BOSE NATIONAL CENTRE
FOR BASIC SCIENCES
Block JD, Sector III, Salt Lake, Kolkata 700 106

DEPARTMENTAL SEMINAR

Physics of Complex Systems

28th June,2023 **4.00 PM** **ONLINE / FERMION**

SPEAKER

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TITLE OF THE TALK

Quantum Bayes' Rule Affirms Consistency in Measurement Inferences in Quantum Mechanics

ABSTRACT

Classical Bayes' rule lays the foundation for the classical causal relation between cause (input) and effect (output). This causal relation is believed to be universally true for all physical processes. Here we show, on the contrary, that it is inadequate to establish correct correspondence between cause and effect in quantum mechanics. In fact, there are instances within the framework of quantum mechanics where the use of classical Bayes' rule leads to inconsistencies in quantum measurement inferences, such as Frauchiger-Renner's paradox. Similar inconsistency also appears in the context of Hardy's setup even after assuming quantum mechanics as a non-local theory. As a remedy, we introduce an input-output causal relation based on quantum Bayes' rule. It applies to general quantum processes even when a cause (or effect) is in coherent superposition with other causes (or effects), involves nonlocal correlations as allowed by quantum mechanics, and in the cases where causes belonging to one system induce effects in some other system as it happens in quantum measurement processes. This enables us to propose a resolution to the contradictions that appear in the context of Frauchiger-Renner's and Hardy's setups. Our results thereby affirm that quantum mechanics, equipped with quantum Bayes' rule, can indeed consistently explain the use of itself.

HOST FACULTY

Dr. Manik Banik, Associate Professor
DEPT. OF PHYSICS OF COMPLEX SYSTEMS

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