Seminar, Department of Physical Sciences, Bose Institute, Kolkata

Entangling light without uncertainties

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Abstract: Deterministic entanglement is the source of almost all advantages of quantum information systems over their classical counterparts. We have shown a new way of deterministically entangling two quantum-mechanical subsystems comprising photons. Our protocol entangles photons that occupy distinguishable, spatially localized modes, and works for arbitrarily large number of photons in these modes. Our protocol is deterministic, since it makes use of deterministic, unitary, quantum evolution—as described by Schrodinger's equation—and does not require quantum measurements, which are inescapably probabilistic. Unlike systems of atoms, ions, molecules, or superconducting circuit elements, existent protocols for entangling quantum states of light are probabilistic, which leads to quantum information processing schemes that are inherently non-deterministic, that is, the probability of success of useful quantum operations is less than unity even in the absence of any errors. To entangle photons without uncertainties, we have utilized a deep connection between quantum mechanics and differential geometry, namely, topology. In particular, we have shown that optical waveguides can be coupled in such a way that they synthesize a mathematical structure known as holonomy, which—by utilizing the principles of conservation of total photon number and superposition of probability amplitudes—deterministically entangles photons that are incident on these waveguides.

Date/time: February 20, 2025 (Thursday) at 12:00 Noon

Venue: Room 204, Physics Seminar Room, (Second floor, UAC, BI)