



DEPARTMENT OF PHYSICS
INDIAN INSTITUTE OF TECHNOLOGY
KANPUR

PHYSICS SEMINAR ON

SCALING QUANTUM SOURCES BY EXPLOITING LIGHT'S ANGULAR MOMENTUM

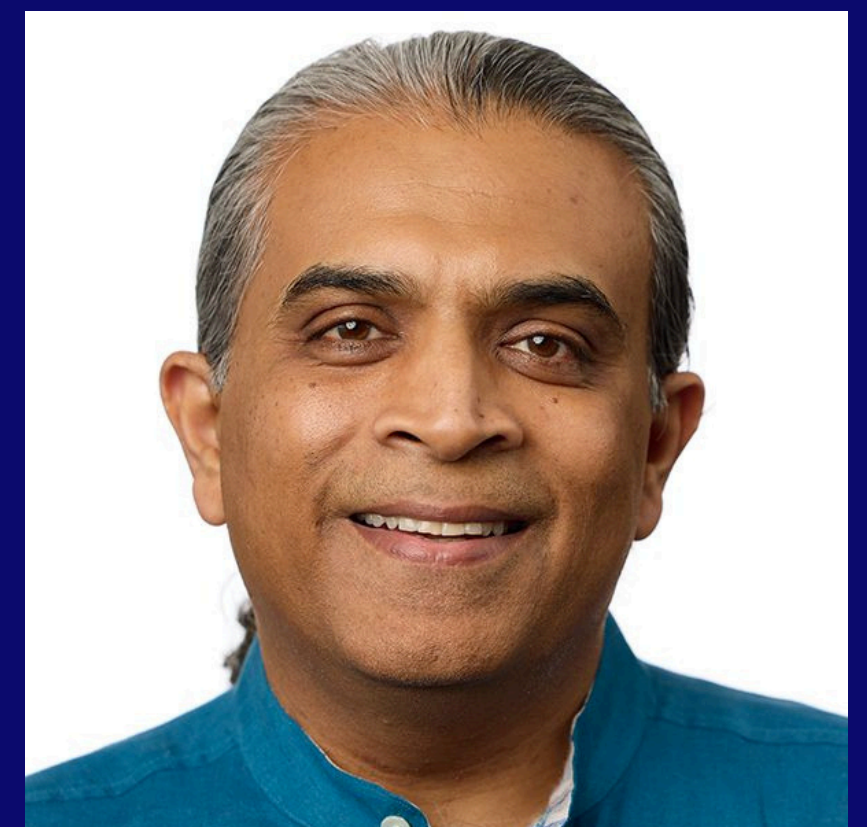
Abstract

Quantum information benefits from being encoded in high-dimensional Hilbert spaces – i.e. q-dits rather than q-bits – both for increased information capacity and greater noise resilience. Photons play an important role in a quantum network, enabling coherent transport of entanglement across (compute) nodes. Means for creating photonic q-dits include exploiting a photon's degree of freedom in frequency as well as space, both real as well as inverse (momentum) space. For photons, the momentum space (i.e. spatial eigenmodes) is particularly attractive since it appears most scalable, especially by exploiting the unbounded nature of its orbital angular momentum (OAM).

While photons entangled in the OAM degree of freedom were demonstrated ~25 years ago, this platform continues to face a debilitating problem associated with spatial eigenstates of light – transport, either in an optical fiber or free space, results in severe perturbative coupling, which destroys the quantum state.

Here, we discuss the exploitation of an inherent topological stability of OAM states, recently discovered in optical fiber eigenmodes, to develop a nonlinear photonic platform that could potentially yield a source with the highest dimensional maximally entangled state. This approach features the added benefit that the output is from a single fiber aperture that is compatible with the optical fiber network that is used to interconnect quantum (compute) nodes.

Speaker



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About The Speaker

Siddharth Ramachandran (B. Tech, IIT-Kanpur, 1991; MS, UW-Madison; PhD, UIUC, 1998) started his scientific career at Bell Labs. After a decade in industrial labs, he returned to academia, and is currently a Distinguished Professor of Engineering at Boston University.

For his work on structured light and quantum nonlinear photonics, he has been named a fellow of Optica (2010), IEEE (2019), SPIE (2019), APS (2022) and AAAS (2024), an IEEE Distinguished Lecturer (2013–2015), a Distinguished Visiting Fellow of the UK Royal Society of Eng. (2016), a Vannevar Bush Faculty Fellow (2019), and an SPIE G.G. Stokes awardee (2026). He currently serves the scientific community as the Editor-in-Chief of Optics Express.



**THURSDAY
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11:00 AM



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