QuanTalks

IISc Quantum Technologies Initiative (IQTI) Seminar Series

Title: Revealing new facets in experimental quantum information processing with photons

Speaker: Urbasi Sinha,
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About the Speaker: Urbasi Sinha is a Professor at the Raman Research Institute in Bangalore, India. She is heading the Quantum Information and Computing (QuIC) laboratory at RRI. Prof. Sinha is a Simons Emmy Noether Fellow at the Perimeter Institute, Canada as well as an associate faculty member at the Institute for Quantum Computing (IQC), University of Waterloo, Canada, and the Centre for Quantum Information and Quantum Control, University of Toronto, Canada.

She completed her PhD at Cambridge University, UK, on experiments in high temperature Superconductivity. She completed her M.Sc in Physics also from Cambridge. She has been a Gates Cambridge scholar during her Ph.D and a Nehru-Chevening scholar during her masters. She was a post-doctoral research associate in the Cavendish labs, Cambridge as well as at IQC Canada.

Her lab at RRI specializes in experiments on photonic quantum information processing including quantum computing and quantum communication, primarily using single and entangled photons. She is heading India's first project on satellite based secure quantum communications.

Her scientific recognitions include the Homi Bhabha Fellowship in the year 2017 as well as the 2018 ICTP-ICO Gallieno Denardo Award in Optics. She was recognised as one of Asia's Top 100 scientists by the Asian Scientist for the year 2019 and has also been awarded the Simon's Emmy Noether Fellowship at the Perimeter Institute, Canada. In August 2020, she led the two-member winning team as a mentor, at the World Skills International Competition in Quantum Technology at the BRICS Future Skills Challenge, organised by the Russian Quantum Centre in

Moscow, Russia with competitors from several countries worldwide. She won the ASSOCHAM Women in Cyber: Making a Difference award in the category "Cyber - Leading from the front" in 2021.

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Date & Time
Wednesday,
30th March 2022,
6:00 PM IST

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Abstract: In this talk, we present new facets in the domain of photonic quantum information processing. In the first part, we present the first loophole-free experiment wherein both the LGI and the WLGI inequalities have been decisively violated using single photons[1], thus providing a comprehensive refutation of the classical realist worldview along with measurements ensured to be non-invasive. Our results also demonstrate perfect matching of these observed violations with quantum-mechanical predictions incorporating experimental nonidealities, again not analysed in earlier such experiments. Our carefully designed strategies make this setup a powerful platform for harnessing this most general unambiguous signature of nonclassicality of single photon states towards various information theoretic applications wherein the single photon is a ubiquitous workhorse.

In the second part of the talk, we provide a novel scheme for direct determination of different entanglement monotones used to quantify entanglement in arbitrary system dimensions using only one pair of complementary observables, as opposed to the standard d^2 measurements needed in dimensions. Our experiment [2] is the first direct empirical determination of the standard entanglement monotones in higher dimensions, that uses only one set of joint local measurements. This naturally motivates the question as regards the extent to which this scheme can be extended for two-qubit mixed states and what would be its ramifications. This is thoroughly studied in [3] for different types of mixed entangled states, showing that the efficacy of this scheme is restricted to not only distillable entangled states, but extends to bound entangled states as well.

References

[1] Loophole free interferometric test of macrorealism using heralded single photons, K.Joarder, D.Saha, D.Home, U.Sinha, PRX Quantum, 3, 010307, 2022.
[2] Direct determination of entanglement monotones for arbitrary dimensional bipartite states using statistical correlators and one set of complementary measurements, D. Ghosh, T.Jennewein, U.Sinha, arXiv:2201.00131.
[3] Relating an entanglement measure with statistical correlators for two-qudit mixed states using only a pair of complementary observables, S. Sadana, S. Kanjilal, D.Home, U.Sinha, arXiv: 2201.06188, 2022

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