Dr.Urbasi Sinha

The founder head of India's first quantum computing lab

When asked why she chose be a physicist, Dr Urbasi Sinha in a recent interview to **Nature Communications Physics** replied, "The choice of pursuing science stems from my very early years as I had a natural inclination towards science and maths-based topics in school, and I was always intrigued by various natural phenomena. I am a logical, curious and rather direct person and thus the scientific method has been a natural choice of vocation." This internationally reputed quantum scientist is the founding head of the **Quantum Information and Computing** (QuIC) laboratory at the Raman Research Institute (RRI), Bengaluru, India.

Even as a school girl, the keen interest little Urbasi showed in Mathematics and Physics helped her parents understand her inclination. Though both of them were not scientists, they supported her choice to pursue pure science and sign up for B.Sc. Physics (Hons.) in Jadavpur University, when most parents in that period preferred their wards to take up engineering. Their encouragement throughout her formative years has been instrumental in making her choice become a reality.

Young Urbasi then proceeded to University of Cambridge, U.K. to pursue her Masters with financial aid through Chevening-Nehru Cambridge Scholarship in 2000. Her superlative scholastic performance gained her tutorial and travel awards of St. Edmund's College during 2001-2002. With the prestigious Gates Cambridge Scholarship, where just 1% scholars are chosen every year from around 10,000 applicants worldwide, she completed her Ph.D. in Physics and Material Science by 2006. In this period she received Overseas Research Students awards (2002-2005) that recognises only one

• **A qutrit** (or quantum trit) is a unit of quantum information that is realized by a 3-level quantum system, which may be in a superposition of three mutually orthogonal quantum states.

or two students every year in a department. Later, she immersed herself on an industry funded research project as a postdoc fellow in the Cavendish laboratories investigating soft condensed matter based techniques to develop a thinner, whiter version of papers.

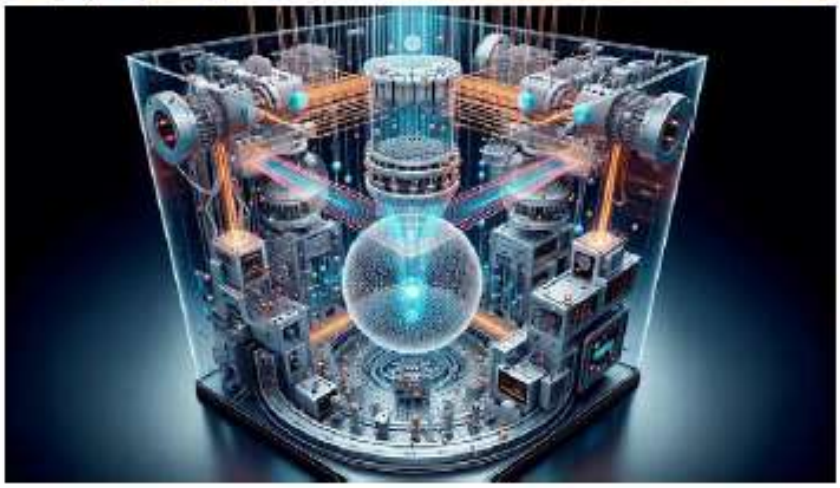
Dr.Urbasi strongly believes that scientific bent of mind can transform the world and it is necessary that each of us should continuously contribute to building the society. That's why we can see her interact with young minds in different forums all through her career. In fact, while pursuing her research at Cambridge, she supervised junior students and mentored them through tutorial sessions. Creating excitement at a young age and mending them towards research are crucial to build scientific temperament. Dr.Sinha has been engaging with society, be it public, students and teachers all throughout and this shows her faith in outreach.

With passion for experimental Physics and inclination for breakthrough research, she plunged into the field of quantum mechanics as a postdoctoral fellow in the **Institute for Quantum Computing (IQC)**, Canada in 2007. Here she was encouraged by the founder-director Raymond Laflamme (student of Stephen Hawking) to perform experiments in the quantum optics lab. "I wanted to learn quantum optics by experimentation, and this was one of the best environments to do that in," Dr.Sinha exclaims.

One of her first experiments there was to test a key concept of the Nobel Laureate Max Born, which had never been explicitly tested until then. She proved its validity and received broad media coverage after it was published in Science magazine in 2010. The "thank you note" she received from Gustav Born that adorns the walls of her lab at RRI speaks volumes on how much she treasures it.

Back from Canada, Dr.Urbasi was offered a position at Raman Research Institute, Bengaluru, India. She established Quantum Optics Laboratory there, focusing on ground-breaking research in quantum information and computing. This is one of the first labs in India to manufacture and establish the usage of entangled single photon sources for various applications in quantum technology. She is also a professor at **Light and Atomic Matter Physics group (LAMP)** at RRI.

Dr.Urbasi Sinha has been investigating new frontiers in the world of quantum optics and quantum computing. Her current research areas include experimental secure quantum communications including **quantum key distribution (QKD)** in free space, fibre and integrated photonics, quantum teleportation, quantum entanglement, fundamental tests in quantum optics and quantum mechanics. One of the activities at her lab is investigating a higher dimensional system, a unit of



quantum information called a **qutrit.** "Quantum information is a very new area in India, especially experimental, and ours is one of the first modern labs to be dedicated to this field," Sinha explains, referring to their superior innovative technology.

Urbasi is among the 34 global scientists who was selected for the latest **Canada Excellence Research Chair (CERC)** in Photonic Quantum Science and Technologies recently. Sinha's CERC will create a test bed for quantum computing technology that could revolutionize our lives by disrupting the foundation of information science. It is for the first time that a scientist based in India has bagged this top recognition awarded by the Government of Canada. Over a period of eight years, she will receive a grant worth $8 million opening up possibilities for international interactions at various levels in academia, industry, and other relevant sectors, developing lab-to-market innovative models - all important steps towards a future ecosystem based on quantum technologies.

"I have always believed that science is global and that it is through international as well as national alliances and collaborations we can achieve more than what we would do working in silos. The CERC gives me an opportunity to put these words to action. Not only does it allow me to expand our activities to a different country and environment, it also provides a once in a lifetime opportunity to contribute towards quantum ecosystem development in India and Canada in parallel," says Dr.Urbasi Sinha.

Dr.Urbasi Sinha plays multiple national and international leadership roles. For her exemplary work in quantum technology and quantum communications, our government has funded her research under **Ministry of Electronics and Information Technology (MEITY), DST, India Trento Programme on Advanced Research (ITPAR), VAJRA (Visiting Advanced Joint Research)** scheme of the SERB, DST and many.

Career highlights / accolades

2017 - Homi Bhabha Fellowship.

2018 - International Commission for Optics(ICO)/ICTP Gallieno Denardo Award.

2020 - Led the two-member winning team as a mentor, at the World Skills International Competition in Quantum Technology organised by the Russian Quantum Centre.

2021

- Won the ASSOCHAM Women in Cyber: Making a Difference award in the category "Cyber - Leading from the front".
- Appointed a Simons Emmy Noether Fellow.

Sinha's lab has been chosen to represent India, through the Indian Space Research Organization, in an international collaboration with Canada to explore satellite-based experiments for hack-proof communications.

"Do not let your gender limit your thinking, aspirations and desire to pursue STEM. Half the world's population is female. Let us work towards creating gender balance in STEM as well. This requires a change in mind-set at various levels across age groups. **Let us be the change we want to see,"** says Dr Urbasi.