IISc Swarnajayanti fellow to work on creating particles that can shape future quantum computing

Ettore Mejorama, an Italian scientist, hypothesised a particle in 1937 which has the potential to shape the future of quantum computing. The particle called Mejorama Fermions, a special type of Fermion (Fermion is a particle that follows Fermi–Dirac statistics) that is its own antiparticle, can have a powerful influence in shaping the future area of decoherence-free Quantum Computers. It is needed because decoherence can lead to loss of information from the quantum system to the surrounding environment.

Though Mejorama Fermions has been hypothesised long back, the discovery of the particle remains elusive to date as the creation and identification of Majorana Fermions remain one of the biggest challenges in physics. Professor Anindya Das, Associate Professor of Physics at the Indian Institute of Science, Bangalore (IISB), who has received the prestigious ‘Swarnajayanti Fellowship of the Department of Science and Technology aims to create and explore environments that can help identification of Majorana Fermions.

In condensed matter physics, bound Majorana fermions can appear as quasiparticle excitations—the collective movement of several individual particles, not a single one. With his fellowship, Professor Das aims to explore the emergent topological quasiparticles in a cleaner system, which hosts the exotic Majorana Fermions so that the particles will be identified unambiguously using a new kind of probe like thermal transport measurement. This can help the group to demonstrate Majorana fermions, thereby helping application in quantum computing as well as fundamental research.

The cleanest topological state achieved in condensed matter systems is the Quantum Hall (QH) state of grapheme. These states have topologically exotic ground states with possible Majorana Fermions excitations. It has been theoretically predicted that the existence of Majorana Fermions can be unambiguously determined by measuring the ‘half-integer of the quantum limit of thermal conductance’ value via heat flow measurements. The recent demonstration of ‘Universal quantized thermal conductance in graphene’ using a new probe based on heat flow measurements by Dr. Das’s group, which was published in Science Advances, has shown the exciting possibilities to detect the Majorana Fermions. This demonstration will change the fate of Quantum Computers, and the fellowship support will help take it further.

Prof. Das alumni of the Indian Institute of Science, Bangalore, and a Postdoctoral fellow from Weizmann Institute of Science, Israel, mainly works on quantum transport properties of mesoscopic structures in reduced dimensions like two-dimensional graphene, two- dimensional transition metal dichalcogenides, topological insulators, and one-dimensional nanowires.