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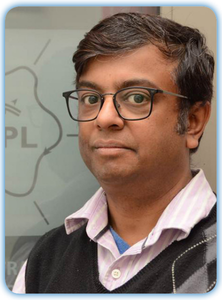

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Quantum technology based on superconductivity in boron-doped nanocrystalline diamond films

Diamond is considered as the ideal material for making quantum devices since the lattice constant does not change even in extreme conditions. The ways one can construct qubits in diamond are creating nitrogen vacancy centers and superconducting quantum interference devices. Although the later one has not realized yet, we find there are some similarities between two cases based on the recently developed concept of topological nature of diamond nitrogen vacancy centers and the transport property measurements in the boron-doped nanocrystalline diamond films. Over decade superconductivity in boron-doped diamond initiated intense research due to possible unconventional superconducting state. This can be established in two ways namely introducing graphitic carbon layers which can have a chiral nature and incorporating excess boron atoms in diamond lattice which can form a spin triplet state. Having understood a non-s wave character of these diamond films we are searching for p-wave (odd frequency) character which is related to topologically protected phases. This work will potentially motivate us for a deeper study into the application of this material for a new class of topological qubit which has the capability of revolutionizing the field of quantum computing. The theoretically predicted non-Abelian gauge field and associated Berry phase in diamond system is to be realized experimentally. In this talk we elaborate the novel heterostructures of superconducting nanodiamond films and some exotic transport properties that can be useful for developing topological qubits. Some quantum device concepts combining nitrogen vacancy center and boron doped superconducting diamond are thus discussed.

Biography

Somnath Bhattacharyya is a Professor in the School of Physics at the University of the Witwatersrand, Johannesburg, South Africa. After completing his Doctoral degree from the Indian Institute of Science, Bangalore, he has worked as a Researcher in the USA, Germany and England. Later, he established his new research group the Nano-Scale Transport Physics Laboratory at the University of the Witwatersrand. His major interest is in the transport properties of carbon and has achievements including the demonstration of resonant tunnel devices based on amorphous carbon, gigahertz transport in carbon devices, n-type doping of nanocrystalline diamond and developing theoretical models for transport in disordered carbon. He has published 04 book chapters and over 70 papers in peer reviewed journals.

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