Topology-controlled macroscopic quantum coherent effects in multi-terminal Andreev interferometers

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Proximity induced long range quantum coherence of electrons in multi-terminal voltage-driven hybrid normal-superconducting (NS) nanostructures may result in a non-trivial interplay between topology-dependent Josephson and Aharonov-Bohm effects. Further intriguing phenomena emerge due to the combination of quantum coherence and electron-hole asymmetry generated by the mechanism of sequential Andreev reflection at different NS interfaces [1]. In this talk I will elucidate several recent developments [2-4] associated with the above effects. In particular, I will demonstrate that a trade-off between voltage-dependent Josephson (I_J) and Aharonov-Bohm (I_{AB}) currents may yield a novel topology-controlled ϕ_0-junction behavior [2]. An even richer physical picture emerges if one accounts for the competition between stimulation of I_J due to non-equilibrium effects and reduction of both I_J and I_{AB} caused by quantum dephasing of quasiparticles. Finally, I will address quantum coherent topology-dependent oscillations of the thermopower in Andreev interferometers [4] and formulate predictions possibly resolving several long-standing experimental puzzles. Our results may be employed for engineering superconducting nanocircuits with controlled quantum properties.

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