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Spontaneous movable semifluxons - New phenomenon arising in nano-electronic superconducting system

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Abstract

Semifluxon is a very rare topological excitation. It is a spontaneous Josephson vortex carrying a half of the magnetic flux quantum ϕ_0 created on the boundary between 0 and π junctions. Semifluxons play an important role as qubits for quantum computing. Typically they are static and arise in a variety of Josephson 0- π nano-junctions, in particular. The properties of semifluxons are very different from the properties of fluxon. Typically, semifluxons are pinned at the phase discontinuity point in 0- π long Josephson junctions (LJJ) and may have two polarities carrying the flux $\phi_0/2$, that was attracting to use them as qubits. In this paper, we report for a first time about a novel type of semifluxons arising in superconductors, which are movable, i.e. not pinned. We show that a spontaneous generation of movable semifluxons is created in conventional LJJ due to flux cloning in extended T-Josephson nano-junctions. We also show that there is a strong interaction between semifluxon and anti-semifluxon once they have been generated and that leads to their very short life time, i.e. to their fast annihilation and next recreation. © 2010 IOP Publishing Ltd.

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