HYBRID φ_0 JOSEPHSON JUNCTION AS A POSSIBLE HOST FOR SPACE-TIME CRYSTALLINE-LIKE PATTERN

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We report the possibility of emergence of an intrinsic space-time crystalline order in a long ferromagnetic φ_0 Josephson junction on a topological insulator, achieved without external periodic modulation of the critical current [1,2]. The proposed system assumes ferromagnetic layer with broken inversion symmetry. In the presence of the exchange and Dzyaloshinskii-Moriya interactions, the critical current is internally modulated through the coupling between the magnetic moment and the Josephson phase. This internal modulation breaks time translation symmetry, giving rise to a space-time crystalline pattern in the spatiotemporal distribution of the in-plane current, which oscillates at nearly twice the ferromagnetic resonance frequency.

We demonstrate also, in the absence of such internal modulation of the critical current, the space-time crystalline order appears only when an external parametric modulation is applied. In this case, the system exhibits a classical discrete space-time crystalline order, oscillating at half the modulation frequency.

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