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Coherent effects in junctions based on p-wave superconductor

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The famed p-wave superconductivity harbors a variety of exotic topological states. The practical ways for its implementing are being extensively discussed in literature, and the contact of a superconductor with the topological insulator is expected to become the most promising candidate. There have been reports of the 4π-periodicity in such contacts, which are a hallmark of the p-wave superconductivity. However, the phase-sensitive measurements of the Josephson currents that would serve as conclusive evidence of the p-wave symmetry are still lacking. In this work we report direct observation of the Josephson effect in the Nb/Bi2Te2Se/Nb structures which are characterized by ballistic electronic transport across the Bi2Te2Se nanocrystals. We show that in the mK temperature range the investigated junctions exhibit a new type of oscillations of the Josephson current in magnetic field with an ultra-short period ~ 1 Oe corresponding to energy spectrum with the level spacing of order of 1 μeV. We develop theoretical model explaining these oscillations in terms of fine structure of low-energy Andreev bound states. The results are consistent with emerging p-wave superconducting correlations induced at the Bi2Te2Se surface due to an interplay between the s-wave superconductivity in Nb and a peculiar symmetry of the topological insulator Bi2Te2Se. This work is supported by the Russian Science Foundation (Project No. 18-72-10118), the EU H2020-WIDESPREAD-05-2017-Twinning project “SPINTECH” (the Grant Agreement No. 810144) and by Dutch FOM.

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