CONDENSED MATTER SEMINAR

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Time-Reversal-Symmetry-Breaking Superconductivity in Epitaxial Bismuth/Nickel Bilayers

Superconductivity that spontaneously breaks time-reversal symmetry (TRS) has been found, so far, only in a handful of 3D crystals with bulk inversion symmetry. Recently, spontaneous TRS breaking was observed in a 2D superconducting system without inversion symmetry: the epitaxial bilayer films of bismuth and nickel [1]. The evidence comes from the onset of the polar Kerr effect at the superconducting transition in the absence of an external magnetic field, detected by the ultrasensitive loop-less fiber-optic Sagnac interferometer. Because of strong spin-orbit interaction and lack of inversion symmetry in a Bi/Ni bilayer, super-conducting pairing cannot be classified as singlet or triplet. We propose a theoretical model where magnetic fluctuations in Ni induce superconducting pairing between the electrons in Bi with the total angular momentum J_z=+-2 (equivalent to d_{xy}+-id_{x^2-y^2} for the crystal). This order parameter spontaneously breaks the TRS and has a non-zero phase winding number around the Fermi surface, thus making Bi/Ni a rare example of an intrinsic 2D topological superconductor.

[1] Xinxin Gong, Mehdi Kargarian, Alex Stern, Di Yue, Hexin Zhou, Xiaofeng Jin, Victor M. Galitski, Victor M. Yakovenko, Jing Xia, arXiv:1609.08538

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