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Theory of spontaneous time-reversal symmetry breaking in superconducting Bi/Ni epitaxial bilayers MEHDI KARGARIAN, VICTOR M. YAKOVENKO, VICTOR M. GALITSKI, Department of Physics, University of Maryland, College Park, MD 20742 — We develop a theory to understand the superconducting Bi/Ni epitaxial bilayers that breaks the time-reversal symmetry spontaneously. In order to explain this experimental observation [1], we adopt a model incorporating the exchange coupling between magnetic moments of nickel (Ni) and itinerant electron states of bismuth (Bi). Due to strong spin-orbit coupling, the surface states of Bi(110) are basically described by nondegenerate Fermi pockets with the largest one centered around the center of the surface Brillouin zone. The spin and momentum are strongly locked on the Fermi surface as in the surface states of 3D topological insulators. We showed that the spin-orbit coupling in Bi and magnetic fluctuations arising from Ni cooperatively induce pairing channels classified by definite total angular momentum J_z. The superconducting order parameter breaks the time-reversal symmetry selecting either $J_z = +2$ or $J_z = -2$, corresponding to $d_{xy} + id_{x^2-y^2}$ and $d_{xy} - id_{x^2-y^2}$ pairings, respectively, which can be controlled by a weak training magnetic field. [1] X. Gong, M. Kargarian, A. Stern, D. Yue, H. Zhou, X. Jin, V. M. Galitski, V. M. Yakovenko, J. Xia, "Time-Reversal-Symmetry-Breaking Superconductivity in Epitaxial Bismuth/Nickel Bilayers", arXiv:1609.08538

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