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Type-1.5 superconductivity from interband Josephson coupling JOHAN CARLSTROM, KTH Stockholm, EGOR BABAEV, University of Massachusetts Amherst & KTH Stockholm, MARTIN SPEIGHT, University of Leeds — In Ginzburg-Landau (GL) theory, the critical value of the GL parameter $\kappa_c = 1/\sqrt{2}$ separates regimes of type-I and type-II superconductivity. However, it was found recently that $U(1) \times U(1)$ GL models, possess a distinct "type-1.5" phase with vortex excitations which interact attractively at large length scales and repulsively at shorter distances, resulting in a magnetic response which involves phase separation into domains of Meissner and vortex states. Inclusion of the interband Josephson coupling in the $U(1) \times U(1)$ GL model shrinks (or can even eliminate) the parameter range of this "type-1.5" regime. Here we report on the situation which is quite generic for multiband systems, but is principally different from $U(1) \times U(1)$ superconductivity: namely a system with only one superconducting band which induces some superfluid density in another band via the interband proximity effect. We show that in this case the role of interband Josephson coupling reverses: instead of suppressing, it promotes type-1.5 superconductivity by producing nontrivial variation of the condensate density at intermediate scales, resulting in nonmonotonic vortex interaction despite the long-range behavior of the condensate densities in both bands being identical.

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