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Semi-Meissner state and neither type-I nor type-II superconductivity in multicomponent systems[1] EGOR BABAEV, Cornell University, MARTIN SPEIGHT, Leeds University — Traditionally, superconductors are categorized as type-I or type-II. Type-I superconductors support only Meissner and normal states, while type-II superconductors form magnetic vortices in sufficiently strong applied magnetic fields. Recently there has been much interest in superconducting systems with several species of condensates, in fields ranging from Condensed Matter to High Energy Physics. Here we show that the type-I/type-II classification is insufficient for such multicomponent superconductors. We obtain solutions representing thermodynamically stable vortices with properties falling outside the usual type-I/type-II dichotomy, in that they have the following features: (i) Pippard electrodynamics, (ii) interaction potential with long-range attractive and short-range repulsive parts, (iii) for an n-quantum vortex, a non-monotonic ratio E(n)/n where E(n) is the energy per unit length, (iv) energetic preference for non-axisymmetric vortex states, "vortex molecules". Consequently, these superconductors exhibit an emerging first order transition into a "semi-Meissner" state, an inhomogeneous state comprising a mixture of domains of two-component Meissner state and vortex clusters. We also discuss a counterpart of this state which may occur in type-I/type-II superconducting bilayers.

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