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On d-Wave Superconductors with a Zeeman or Exchange Splitting of the Spin-Up and –Down Fermi Surfaces[1] CHIA-REN HU, Texas A&M University — For a given Zeeman (or exchange) energy h, we used the Fermi-surface splitting, $\delta\mu$, as a variational parameter, and showed: (1) For an s-wave superconductor, the Sarma state is actually an unstable equilibrium state, which is known to exist for $0.5< h <1$ only, and has energy higher than the un-polarized BCS state and the normal state. (2) For a d-wave superconductor, the Sarma-like state can actually exist down to $h\sim0$, and is a stable equilibrium state up to some h_{max}, if not considering other possible deformations of the order parameter (possibly symmetry breaking, such as going toward the FFLO state, which is known to exist at higher h only), and its energy is lower than those of the un-polarized BCS state and the normal state. (3) The state can be further improved by introducing more variational parameters, which are still not symmetry-breaking. Thus we predict that for $CeCoIn_5$and other d-wave superconductors the low-field superconducting state in a magnetic field parallel to the layers should already show some bulk spin-polarization, an d is NOT the usual un-polarized BCS state.

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