On d-Wave Superconductors with a Zeeman or Exchange Splitting of the Spin-Up and –Down Fermi Surfaces\textsuperscript{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 \textit{unstable} equilibrium state, which is known to exist for \( 0.5 < h < 1 \) only, and has energy \textit{higher} than the un-polarized BCS state and the normal state. (2) For a d-wave superconductor, the Sarma-like state can actually \textit{exist} down to \( h \sim 0 \), and is a \textit{stable} equilibrium state up to some \( h_{\text{max}} \), 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 \textit{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\textsubscript{5} and other d-wave superconductors the \textit{low-field} superconducting state in a magnetic field parallel to the layers should already show some bulk spin-polarization, \textit{and} \( d \) is \textit{not} the usual un-polarized BCS state.

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