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Reentrant high-magnetic field superconductivity in a clean two-dimensional superconductor with shallow band[1] ALEXEI E. KOSHELEV, KOK WEE SONG, Materials Science Division, Argonne National Laboratory — We investigate the superconducting instability in the magnetic field for a clean two-dimensional multiple-band superconductor in the vicinity of the Lifshitz transition when one of the bands is very shallow. Due to a small number of carriers in this band, the quasiclassical Werthamer-Helfand approximation breaks down and Landau quantization has to be taken into account. We found that the transition temperature $T_{c2}(H)$ has giant oscillations and is resonantly enhanced at the magnetic fields corresponding to full occupancy of the Landau levels in the shallow band. This enhancement is especially pronounced for the lowest Landau level. As a consequence, the reentrant superconducting regions in the temperature-field phase diagram emerge at low temperatures near the magnetic fields at which the chemical potential matches the Landau levels. These regions may be disconnected from the main low-field superconducting region. The specific behavior depends on the relative strength of the intraband and interband coupling constants and the effect is most pronounced when the interband coupling dominates. The Zeeman spin splitting reduces sizes of the reentrant regions and changes their location in the parameter space. The predicted behavior may realize in the gate-tuned FeSe monolayer.

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