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Spin-orbit coupled Fermi liquid theory with magnetic dipolar interaction YI LI, CONGJUN WU, Department of Physics, University of California, San Diego — We investigate the Fermi liquid properties of the ultra-cold magnetic dipolar Fermi gases in the simplest case of two-component. The magnetic dipolar interaction is invariant under the simultaneous spin-orbit rotation, but not under either spin or orbit rotation separately, thus the corresponding Fermi liquid theory is intrinsically spin-orbit coupled. The Landau interaction matrix is diagonalized in terms of the partial-wave channels of the total angular momentum J. The leading thermodynamic instabilities lie in the channels of ferromagnetism hybridized with the ferro-nematic order with $J = 1^+$ and the spin-current mode with $J = 1^-$, where $\pm$ represents even and odd parities, respectively. An exotic propagating collective mode is identified as spin-orbit coupled Fermi surface oscillations in which the spin distribution on the Fermi surface is topologically non-trivial.

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