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Time-Reversal Symmetry Breaking and Spontaneous Anomalous Hall Effect in Fermi Fluids KAI SUN, EDUARDO FRADKIN, UIUC — We study the spontaneous non-magnetic time-reversal symmetry breaking in a 2D Fermi liquid without breaking either the translational symmetry or the $U(1)$ charge symmetry. Using a Berry phase approach, we found that for a large class of models, including all one- and two-band models, the time-reversal symmetry breaking states can be classified into two classes, dubbed type I and II, depending on the accompanying spatial symmetry breaking patterns. The properties of each class are studied. In particularly, we show that the states breaking both time-reversal and chiral symmetries (type II) are described by spontaneously generated Berry phases and exhibit anomalous Hall effect in the absence of magnetic fields and magnetic impurities. We also show examples of the time-reversal symmetry breaking phases in several different microscopically motivated models and calculate their associated Hall conductance within a mean-field approximation. In particularly, we found a simple lattice structure in which the time-reversal symmetry breaking phases is stabilized by infinitesimal interactions.

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