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The Fermi volume as a probe of hidden order ALIX MCCOLLAM, High Field Magnet Laboratory, Radboud University Nijmegen, The Netherlands, BOHDAN ANDRAKA, Department of Physics, University of Florida, USA, STEPHEN JULIAN, Department of Physics, University of Toronto, Canada —
Quantum oscillations are a highly sensitive probe of electronic structure, and provide valuable information about the Fermi surface and quasiparticle properties. We demonstrate that the volume of the Fermi surface, measured very precisely using de Haas-van Alphen (dHvA) oscillations, can be used to probe changes in the nature and occupancy of localized electronic states. In systems with unconventional ordered states, this allows an underlying electronic order parameter to be followed to very low temperatures. $PrOs_4Sb_{12}$ has an unusual antiferroquadrupolar (AFQ) ordered phase that forms at low temperature and high magnetic field. We find that the phase of dHvA oscillations is sensitively coupled, through the Fermi volume, to the configuration of Pr f-electron states that are responsible for AFQ order. Specifically, a given sheet of the Fermi surface expands or shrinks as the occupancy of competing localized Pr crystal field states changes. In addition, the low temperature sensitivity of the dHvA effect reveals a strong and previously unrecognized influence of hyperfine coupling on the order parameter below 300mK within the AFQ phase. Our approach to quantum oscillations in $PrOs_4Sb_{12}$ might be more widely applicable and provide new insights in hidden order systems.

Alix McCollam
HFML, Radboud University Nijmegen

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