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Quantum oscillation signatures of spin-orbit interactions controlling the residual nodal bilayer-splitting in underdoped high-T_c cuprates

NEIL HARRISON, Los Alamos National Labs, ARKADY SHEKHTER, National High Magnetic Field Laboratory, Tallahassee — We investigate the origin of the small residual nodal bilayer-splitting in the underdoped high-T_c superconductor $YBa_2Cu_3O_{6+x}$ using the results of recently published angle-resolved quantum oscillation data [Sebastian *et al.*, Nature **511**, 61 (2014)]. A crucial clue to the origin of the residual bilayer-splitting is found to be provided by the anomalously small Zeeman-splitting of some of the observed cyclotron orbits. We show that such an anomalously Zeeman-splitting (or small effective g-factor) for a subset of orbits can be explained by spin-orbit interactions, which become significant in the nodal regions as a result of the vanishing bilayer coupling. The primary effect of spin-orbit interactions is to cause quasiparticles traversing the nodal region of the Brillouin zone to undergo a spin flip. We suggest that the Rashba-like spin-orbit interactions, naturally present in bilayer systems, have the right symmetry and magnitude to give rise to a network of coupled orbits consistent with experimental observations in underdoped $YBa_2Cu_3O_{6+x}$. This work is supported by the DOEm BES proposal LANLF100, while the magnet lab is supported by the NSF and Florida State.

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