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Metastable Magnetic states in $Ca_3Ru_2O_7$ D. FOBES, J. PENG, Z.Q. MAO, Department of Physics and Engineering Physics, Tulane University, New Orleans, LA 70118 — We have performed systematic in-plane angle dependent c-axis transverse magnetotransport measurements on the double layered ruthenate $Ca_3Ru_2O_7$ throughout a broad field and temperature range. Our results reveal the magnetic states for $H\|b$ to be significantly more complex than for $H\|a$. When magnetic field is applied along the b-axis we probe several metastable magnetic states in close proximity to phase boundaries of long-range ordered antiferromagnetic (AFM) states previously revealed by neutron scattering, i.e. AFM states with magnetic moments oriented along the b-axis (AFM-b) and a-axis (AFM-a); canted AFM state (CAFM) (Wei Bao *et al.*, Phys. Rev. Lett. **100**, 247203 (2006)). These metastable states are characterized by magnetoresistivity anisotropy distinct from that seen in the AFM-a, AFM-b, or CAFM phases, and switch either to a weakly ferromagnetic or AFM-b state when the magnetic field is rotated toward the a-axis. Additionally, our results highlight the complex nature of the spin-charge coupling in $Ca_3Ru_2O_7$.

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