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**Orbitally driven behavior: Mott transition, quantum oscillations and colossal magnetoresistance in bilayered $Ca_3Ru_2O_7$** X.N. LIN, V. DURAIRAJ, S. CHIKARA, E. ELHAMI, G. CAO, Univ. of Kentucky, L. BALICAS, P. SCHLOTTMANN, J.E. CROW, National High Magnetic Field Laboratory — We report recent transport and thermodynamic experiments over a wide range of temperatures for the Mott-like system $Ca_3Ru_2O_7$ at high magnetic fields, $B(\leq 30$ T). This work reveals a rich and highly anisotropic phase diagram, where applying $B$ along the $a$-, $b$-, and $c$-axis leads to vastly different behavior. A fully spin-polarized state via a first-order metamagnetic transition is obtained for $B \geq 6$ T and $B||a$, and colossal magnetoresistance is seen for $B||b$, and quantum oscillations in the resistivity are observed for $B||c$, respectively. In addition, both magnetic and transport properties of the system are highly sensitive to oxygen content and other impurity doping. The orbital ordering is considered to be the driving force for the rich phase diagram.

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