Non-trivial electronic states in the EuO/$KTaO_3$ interface revealed by quantum oscillations in high magnetic fields

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The coexistence of electric-field controlled superconductivity and spin-orbit interaction in two-dimensional electron gas (2DEG) based on complex oxides (e.g., $SrTiO_3$ and $KTaO_3$) hold great promise for advancement in spintronics and quantum computing. However, a comprehensive understanding of the electronic bands that give rise to the multifunctional character of these 2DEGs remains elusive. To address this, we recently investigated quantum oscillations in the magnetoresistance of the $KTaO_3$-2DEG in high magnetic fields (60 T).

$KTaO_3$ is a 5*d* transition metal oxide, exhibiting a lighter effective mass of electrons and a stronger spin-orbit interaction at its conducting surface/interface than its counterpart $SrTiO_3$ [1-2]. A high-mobility spin-polarized 2DEG with the superconducting feature is discovered at the EuO/$KTaO_3$ interface [3]. In this talk, I will present novel insights into the electronic states of the EuO/$KTaO_3$ interface investigated through Shubnikov-de Haas (SdH) oscillations (Fig.1a). Remarkably, we observed a progressive increase in cyclotron mass and oscillation frequency with the magnetic field (Fig. 1b and c), indicating the presence of non-trivial electronic bands [4]. Besides providing experimental evidence for topological-like electronic states in $KTaO_3$-2DEG, these findings shed light on the recent predictions of topological states in the 2DEG based on similar perovskite transition metal oxides.

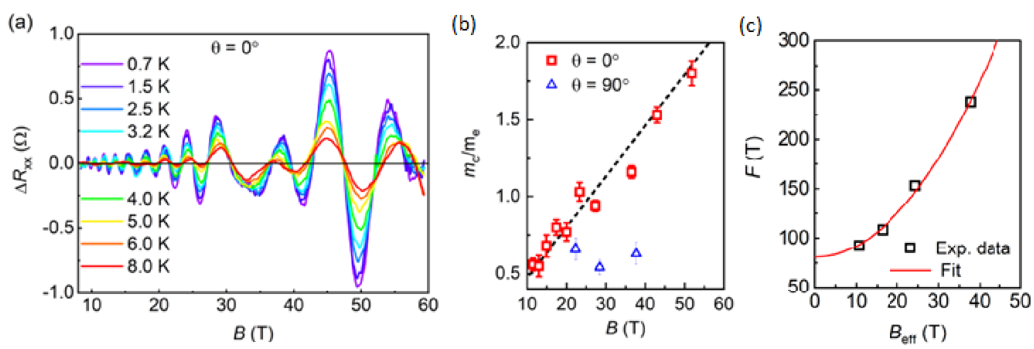

Fig. 1 (a) SdH oscillations in EuO/$KTaO_3$ measured at different temperatures. Magnetic field dependencies of cyclotron mass and oscillations frequency in 1/*B* are displayed in (b) and (c).

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