Supplementary Materials: Superconductor-metal quantum transition at the EuO/$KTaO_3$ interface

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Supplementary Note 1. Estimation of the coherence length of the superconducting EuO/$KTaO_3$ interface.

The coherence length (ξ_{GL}) at absolute zero tempeature is calculated using the following equation,

$$\xi_{GL} = \sqrt{\frac{\Phi_0}{2\pi B_{\mathrm{C}\perp(T\to 0)}}}\,, \tag{S1}$$

where Φ_0 is the quantum flux, $B_{C\perp(T\to 0)}$ is the critical perpendicular magnetic field at absolute zero tempeature. $B_{C\perp}$ at each tempeature can be obtained form the half value of the normal resitance during the superconductor-metal transition. Based on the $B_{C\perp}$ vs. T curve (Fig. S2), the critical magnetic field at zero temperature is determined to be ~ 1.51 T, and the coherence length is calculated to be ~ 14.8 nm.

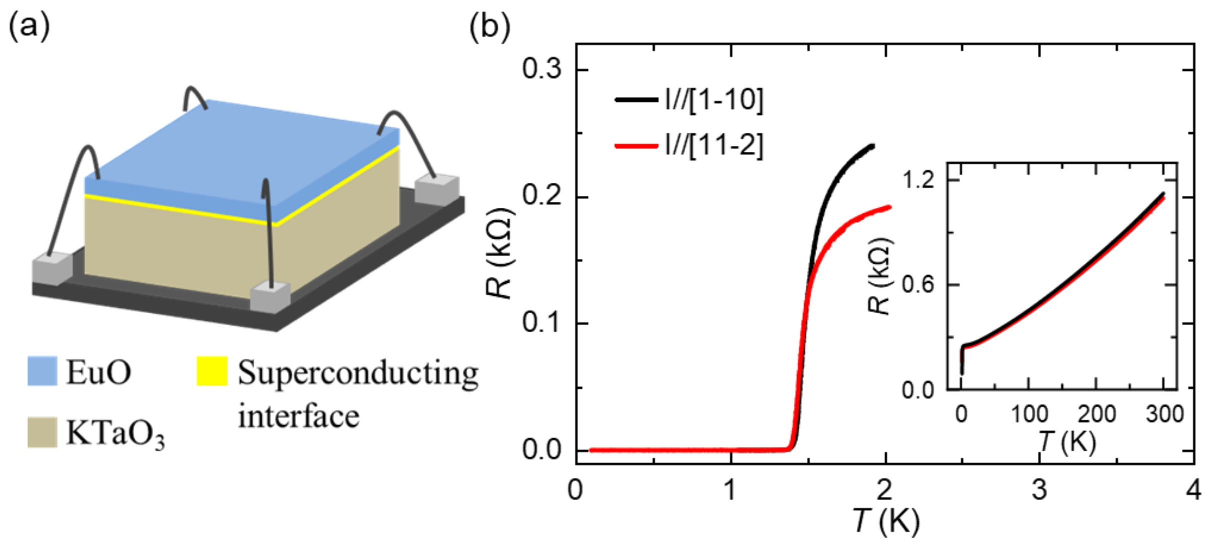

Figure S1. The transport properties of the EuO/$KTaO_3$ interface in the VdP geometry.
(a) The schematic illustration of the van der Pauw measurement geometry of the EuO/$KTaO_3$ interface. (b) The electrical measurement of the interface superconductivity with the current along the $KTaO_3$ substrate's [1-10] and [11-2] directions. Inset: The measured resistance as a function of temperature from 300 K to 1.5 K.

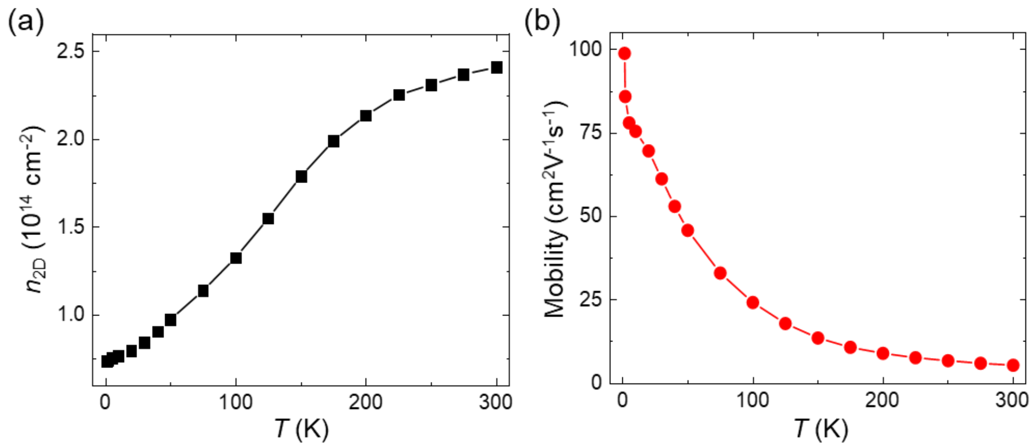

Figure S2. The electron transport properties of the EuO/KTaO$_3$ interface above T_C. (a-b) The sheet carrier density and electron mobility as a function of temperature.

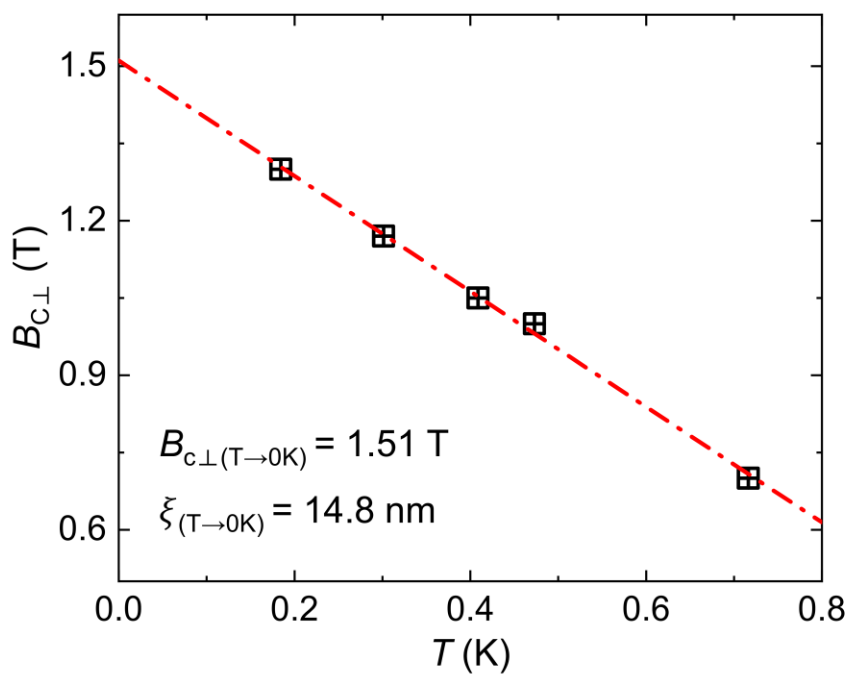

Figure S3. Temperature dependence of the critical perpendicular magnetic field of the EuO/KTaO$_3$ interface. The red line represents the best linear fit.