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Emergent Polar Metal Phase in a Van der Waals Mott Magnet

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We report the emergence of a polar metal phase in layered van der Waals compound $FePSe_3$. This Mott insulator with antiferromagnetic order offers a unique opportunity to fully tune an insulator into a polar metal state with pressure, without doping-induced disorder or impurities. Our synchrotron and neutron diffraction data unambiguously show a structural transition and loss of the inversion symmetry. We also observed the suppression of magnetic ordering and an insulator-to-metal transition correspondent with this structural transformation. The loss of the inversion symmetry combined with the pressure-induced metallicity in $FePSe_3$ offers a new platform to investigate polar metallicity at accessible pressures. Moreover, the high-pressure metallic phase shows unconventional resistivity deviating from the Fermi-liquid description, close to the magnetic critical transition pressure at sufficiently low temperatures, which strongly suggests underlying quantum criticality. Our work not only explores the comprehensive temperature-pressure phase diagram of $FePSe_3$ but also provides insights for further investigation of van der Waals strongly correlated magnetic compounds.

The paper is available open-access: arXiv: 2501.13635v1

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