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Nonlocal anomalous Hall effect[1] SHULEI ZHANG, GIOVANNI VIGNALE, Department of Physics and Astronomy, University of Missouri — Anomalous Hall effect (AHE) is a distinctive transport property of ferromagnetic metals arising from spin orbit coupling (SOC) in concert with spontaneous spin polarization. Nonetheless, recent experiments have shown that the effect also appears in a nonmagnetic metal in contact with a magnetic insulator. The main puzzle lies in the apparent absence of spin polarized electrons in the non-magnetic metal. Here, we theoretically demonstrate that the scattering of electrons from a rough metal-insulator interface is generally spin-dependent, which results in mutual conversion between spin and charge currents flowing in the plane of the layer. It is the current-carrying spin polarized electrons and the spin Hall effect in the bulk of the metal layer that conspire to generate the AH current. This novel AHE differs from the conventional one only in the spatial separation of the SOC and the magnetization, so we name it as nonlocal AHE. In contrast to other previously proposed mechanisms (e.g., spin Hall AHE and magnetic proximity effect (MPE)), the nonlocal AHE appears on the *first order* of spin Hall angle and does *not* rely on the induced moments in the metal layer, which make it experimentally detectable by contrasting the AH current directions of two layered structures such as Pt/Cu/YIG and β -Ta/Cu/YIG (with a thin inserted Cu layer to eliminate the MPE). We predict that the directions of the AH currents in these two trilayers would be *opposite* since the spin Hall angles of Pt and β -Ta are of opposite signs.

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