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Mobile metallic domain walls in an all-in-all-out magnetic insulator[1]

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Magnetic domain walls are boundaries between regions with different configurations of the same magnetic order. In a magnetic insulator where the magnetic order is tied to its bulk insulating property, it has been postulated that electrical properties are drastically different along the domain walls, where the order is inevitably disturbed. Here we report the discovery of highly conductive magnetic domain walls in a magnetic insulator $Nd_2Ir_2O_7$, which has an unusual all-in-all-out magnetic order, via transport and spatially resolved microwave impedance microscopy. The domain walls have a virtually temperature-independent sheet resistance (averaged over mesoscopic distances) of ˜1 kilohm per square, show smooth morphology with no preferred orientation, are free from pinning by disorders, and have strong thermal and magnetic field responses that agree with expectations for all-in-all-out magnetic order.

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