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A Tunable Anomalous Hall effect in a Non-Ferromagnetic System[1]

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The anomalous Hall effect (AHE) is a ubiquitous signature of ferromagnetism that has been known for almost as long as the Hall effect itself. Despite this, its theoretical origins nevertheless remain a subject of debate. In recent years, the physics behind the AHE has been employed to control spin transport in non-magnetic conductors via its sister phenomenon, the spin Hall effect (SHE). In this talk, I will present measurements of a magnetically-doped semiconductor quantum well that reveal a robust and tunable AHE, despite the absence of ferromagnetism. I will show that the AHE can be tuned in-situ by the application of a voltage to a nearby gate electrode and that this helps to uncover the origins of the effect. Most surprising is the fact that the parent material, ZnSe, is known to have only weak spin-orbit coupling, a property usually believed to be required for a strong AHE or SHE. This suggests that controllable semiconductor spin-transport might be realized in a larger class of materials than previously thought. Collaborators: L. S. Moore, H. T. Chou, K. C. Ku, G. Xiang, S. A. Crooker, N. Samarth, and D. Goldhaber-Gordon. See PRL 96, 196404.

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