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Pseudo-spin Resolved Transport Spectroscopy of the Double Dot Kondo Effect

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The Kondo effect is a paradigmatic example of a highly correlated many-body state, describing how conduction electrons screen a localized spin via spin-flip scattering. Experimentally probing the spin physics of the Kondo effect is challenging, as spin-resolved measurements require either large magnetic fields that break the spin degeneracy of the localized site or ferromagnetic contacts that give the spin states different tunnel rates to the localized site. We demonstrate how the desired spin resolution can be achieved for arbitrary tunnel rates and fields in a double quantum dot system. A quantum dot consists of a confined droplet of electrons connected by tunnel barriers to conducting leads. We study two dots that are capacitively coupled with negligible inter-dot tunneling. In this system, one can have a degeneracy associated with an electron being in either dot 1 or dot 2, and this degeneracy acts as a pseudo-spin degree of freedom that gives rise to Kondo screening. We present transport spectroscopy measurements that show the zero-bias peak that is the hallmark of the Kondo effect. We use gate voltages to break the degeneracy between the pseudo-spin states, creating a pseudo-magnetic field. We show that spectroscopy measurements in this regime are analogous to measurements of the spin Kondo effect in a magnetic field. Finally, we demonstrate how measuring transport through each dot individually as a function of the bias voltage on the measured dot gives us the ability to perform pseudo-spin resolved measurements that are difficult to achieve in spin systems.