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SU(4) Kondo in a single donor transport in a Si FinFET G.P. LANSBERGEN, G.C. TETTAMANZI, A. VERDUIJN, M. BLAAUBOER, S. ROGGE — Recently, single dopants became experimentally accessible and there is a large effort to exploit their atomic characteristics in nano devices. Orbital Kondo effects in Si and SiGe are of fundamental interest since they explore the role of the valley degree of freedom in this material system. It has been theoretically predicted that the valley degeneracy leads to SU(4)-correlations which entangles the spin and momentum of exchanged electrons. Here, we experimentally study Kondo effects in a novel system, a single shallow donor in a three-terminal geometry. We use Si wrap-around gate (FinFET) devices with a single Arsenic donor atom in the channel dominating the sub-threshold transport characteristics. The ground state of this system originates from the hybridization of the donor hydrogen-like state which has no valley degeneracy (due to the strong valley-orbit interaction) and a quantum dot-like state which is two-fold valley degenerate. In the Coulomb-blockade regime with a single electron on the system we observe a set of transport resonances. We show these resonances to originate from Valley Kondo effects by means of their dependence on temperature, magnetic field, orbital splitting and their substructure. The entanglement between spin and momentum provides new opportunities for spin control in silicon. For example, we show that this device operates as a gated spin filter in Si with a potentially high transitivity.

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