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Towards a single P donor in Si SUDDHASATTA MAHAPATRA, TANG WEI, Australian Research Council Centre of Excellence for Quantum Computer Technology, University of New South Wales, Sydney NSW 2052, Australia, HOON RYU, GERHARD KLIMECK, Network for Computational Nanotechnology, Purdue University, West Lafayette, IN 47907, USA, MICHELLE SIMMONS, Australian Research Council Centre of Excellence for Quantum Computer Technology, University of New South Wales, Sydney NSW 2052, Australia — Individual P donors in Si form the basis of several schemes for realizing solid-state qubits. Technologically, all such schemes rely on the precise positioning of P donors in the Si crystal and fabrication of local gates, only a few tens of nanometers wide. Towards this goal, we have demonstrated that the spatial resolution of STM-lithography allows precise positioning of donors on the sub-nm length scale and also fabrication of *all-epitaxial, planar* quantum dot (QD) architectures, with source, drain, and gate patterns of precisely defined dimensions. Here, we report the STM-lithography fabrication of an ultra-small QD consisting, in the extreme limit, of a single P donor. Transport spectroscopy of the QD-device at mK temperatures shows stable Coulomb oscillations with an addition energy (around zero gate bias) of 44±2 meV. This value corresponds to the difference in the binding energies of the 1-electron (D^0) and the 2 –electron (D^-) states of a P donor in Si. The first two D^0excited states have also been identified.

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