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A laser-cooled single-atom-on-demand source for Si quantum computing[1] SIU AU LEE, WILLIAM FAIRBANK, KATHERINE ZAUNBRECHER, WILLIAM CZAJKOWSKI, Colorado State University — A promising proposal by B. Kane for a scalable silicon quantum computer requires the placement of P-31 atoms 20 nm apart and 10 nm below the surface in pure Si-28 to 1 nm precision. Attempts to do this with 10-30 keV P-31 beams have not yet succeeded. This paper presents a scheme for laser cooling and trapping Si-31 atoms in a magneto-optical trap (MOT), detecting by fluorescence when there is only one atom in the trap, resonantly ionizing that one atom near threshold, and softly depositing the single 31Si+ ion in Si to nm precision at ∼100 eV. A few hours after deposition Si-31 beta decays in situ to the desired species 31P+. The hyperfine structure and isotope shifts of the 221.7 nm cooling transition for the stable isotopes of Si have been measured with precision for the first time. Additional progress, including demonstration of sufficient power at 221.7 nm for the MOT will also be reported.

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William Fairbank
Colorado State University

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