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Steps toward donor based qubits in Si through integrating single ion Geiger mode avalanche diode detectors J.A. SEAMONS, E. BIELEJEC, M.S. CARROLL, Sandia National Laboratories — Donor based qubits in Si for solid-state quantum information processing require precise dopant placement into the bulk Si. Placement precision donor is limited by straggle which is strongly dependant upon dopant selection and implantation energy, therefore detection of low energy ions (<10 keV) is desired. Great progress has been made using the combination of a $p-i-n$ diode and electron beam lithography patterned surface mask resulting in a signal to noise limited $\sim 10^3$ electron-hole (e-h) pairs detection (D. N. Jamieson *et al.,* Appl. Phys. Lett. **86**, 202101 (2005)). We present experimental results for a single ion Geiger mode avalanche diode (SIGMA) detector has been shown to be sensitive to a single 250 keV H+ ion with 100% detection efficiency (J. A. Seamons *et al.,* Appl. Phys. Lett. **93**, 403124 (2008)) as well as advances that have been made with the SIGMA detector in reducing dark (false) counts by three orders of magnitude and placing an upper bound on the e-h pair sensitivity of $\sim 10^3$ produced outside the active region of the SIGMA detector. Future SIGMA designs will enable low energy single ion detection with reduced straggle single donor qubit integration. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract No. DE-AC04-94AL85000.

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