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Laser Cooling of Silicon JEFFREY LYONS, HEITH KIPPENHAN, Colorado State University — As the world moves toward faster processors and computers, the need for more sophisticated technology grows. Quantum computers show great potential for reducing computing time and increasing internet security. The main complexity in building a quantum computer arises in finding a reliable technique for producing the qubits that are the fundamental units of quantum computing. Because much of the computer manufacturing today is done using silicon, we use a silicon-based quantum computing approach. This solid-state approach is scalable to many qubits and is a unique solution for fabricating a quantum computer. The challenge is that in order to produce these qubits a single atom has to be trapped and implanted into a silicon substrate with nanometer precision. This level of deterministic deposition is not achievable with conventional ion beam techniques. To achieve this precision, the single atom source must have small spatial extent and low kinetic energy. We are using laser cooling techniques to trap a single atom, followed by resonance ionization, to achieve these low energies. Using a tunable single frequency deep ultra-violet laser, we plan to demonstrate laser cooling of silicon. This will be the first step in making a single atom cold ion source.

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