In situ isotopic enrichment and growth of $^{28}\text{Si}$ for quantum information KEVIN DWYER, Materials Science and Engineering, University of Maryland, JOSHUA POMEROY, NIST — Starting from natural abundance silane gas, we deposit $^{28}\text{Si}$ films enriched in situ to 99.9% in support of solid state quantum information systems. Isotopically enriched materials such as $^{28}\text{Si}$ are known to act as a “solid state vacuum” allowing for qubits with coherence ($T_2$) times of minutes. Quantum coherent devices rely on long $T_2$ times, but nuclear spin impurities are a major cause of decoherence. Isotopically enriching materials to eliminate stray nuclear spins (such as the 4.7% $^{29}\text{Si}$ in natural silicon) greatly improves coherence. Our objective is to produce silicon that is not only isotopically enriched, but chemically pure and defect free. We crack and ionize a natural abundance source gas, magnetically mass filter the ions in a beam line, and deposit the enriched material hyperthermal energies. In addition to our first $^{28}\text{Si}$ samples assessed by SIMS to be enriched to $>99.9\%$, we previously implanted $^{22}\text{Ne}$ enriched at 99.4% (9.2% natural abundance) as proof of principle and have also grown $^{12}\text{C}$ films enriched at $>99.996\%$ (98.9% natural abundance). To our knowledge, no other effort is actively producing enriched solid silicon directly from natural abundance silane. Ongoing improvements are leading us towards our goal of $^{28}\text{Si}$ enriched to $>99.99\%$ and epitaxial deposition.