Abstract:
Over the past several years, atom chips have grown as a capability to manipulate and confine cold atoms in a manner that is reproducible and long-term stable. The atom chip defines planar current sources that are used to create a confining magnetic field and is easily integrated into laser cooling configurations. Typically, atoms are confined at sub-mm distances from the surface of a chip in order to achieve the highest magnetic-field gradients and hence tightest trap confinement. This implies a requirement that atom chips be placed within the ultra-high vacuum envelope where the cold atoms reside so as to achieve the smallest possible atom-surface separations. This presentation demonstrates an alternative approach in which the atom chip resides completely outside the vacuum, separated from the atoms by a thin crystalline membrane. This setup allows rapid prototyping of atom chip designs. Formation of Bose-Einstein condensation of a $^{87}$Rb cloud in this setup demonstrates the viability of this approach.

A typical atom-chip trapping sequence involves first laser cooling, transfer to a magnetic trap, state preparation/probing, and a subsequent release of atoms from the trap. This process is then repeated for further measurements. This presentation will also describe a new effort at the Air Force Research Laboratory to achieve—for the first time ever—the Lamb-Dicke regime for neutral atoms in a magnetic trap. The Lamb-Dicke regime, routine for ion traps, will allow laser cooling during the magnetic trapping stage. This should allow for much longer trap lifetimes—often on the order of weeks or more for ions—and dramatically decrease the required duration of experimental measurement cycles.

Biography:
Dr. Spencer E. Olson is a research physicist in the Cold Atom group in the Space Vehicles Directorate of the U.S. Air Force Research Laboratory (AFRL) located at the Phillips Research Site on Kirtland Air Force Base in Albuquerque, NM. He received his B.S. in physics from Brigham Young University in 2000 and his Ph.D. in physics from the University of Michigan in 2006. His doctoral research was in high-gradient, magnetic-field atom guiding for the purpose of establishing a truly continuous-wave atom laser. Dr. Olson has pioneered methods of blue-detuned atom trapping that confine atoms in a toroidal configuration using a single laser beam and new computational methods of simulating collisional systems with application to both cold-atom physics as well as cold or hot plasma systems. Dr. Olson continues to pursue research in cold-atom systems, including high-gradient magnetic atom traps, high-production rate Bose-Einstein Condensate (BEC) systems all with application to atom-based sensors, such as gyroscopes and accelerometers.

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