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# 40 Years of Laser Cooling; 20 Years of BEC: still surprises

William Phillips\*<sup>1</sup>

<sup>1</sup>Joint Quantum Institute, University of Maryland and the National Institute of Standards and Technology – Joint Quantum Institute University of Maryland and National Institute of Standards and Technology, Stop 8424 Gaithersburg MD 20899-8424, United States

## Abstract

The first proposals for laser cooling came in 1975, and ions were first cooled in 1978. The eventual success of laser cooling of a gas of neutral atoms, and the unexpectedly cold temperatures of sub-Doppler cooling, were important precursors to Bose-Einstein condensation of an atomic gas. The earliest attempts to achieve BEC in an atomic gas used spin-polarized atomic hydrogen, working on the assumptions that weak atom-atom interactions would be best and that the inability to form molecules was essential. Surprisingly (to some), neither assumption was true. BEC was achieved in 1995 with alkali gases having relatively strong interactions and many molecular bound states. Such surprises have been commonplace in the development of cold, quantum degenerate, atomic gases. Today, 20 years after the first demonstration of BEC by Cornell, Wieman, and Ketterle, we continue to find a wealth of interesting and surprising behavior in cold gases. One example from the laser cooling group at JQI/NIST is atomtronic circuitry of superfluid atoms, where a quantized flow is controlled by Josephson-junction-like weak-links and visualized through interference of atom waves.

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\*Speaker