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A Mott insulator of fermionic atoms in an optical lattice

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In a solid material strong interactions between the electrons can lead to surprising properties. A prime example is the Mott insulator, where the suppression of conductivity is a result of interactions and not the consequence of a filled Bloch band. The proximity to the Mott insulating phase in fermionic systems is the origin for many intriguing phenomena in condensed matter physics, most notably high-temperature superconductivity. Compared to real materials, a fermionic quantum gas trapped in an optical lattice offers a very pure realisation of the Hubbard model, giving a new approach to understand the physics of strongly correlated systems. We report on the formation of a Mott insulator of a repulsively interacting two-component Fermi gas in an optical lattice. It is signalled by three features: a drastic suppression of doubly occupied lattice sites, a strong reduction of the compressibility inferred from the response of double occupancy to atom number increase, and the appearance of a gapped mode in the excitation spectrum. In collaboration with Robert Jördens, Niels Strohmaier, and Daniel Greif, ETH Zurich; Kenneth Günter, ETH Zurich, ENS Paris; Leticia Tarruell and Tilman Esslinger, ETH Zurich.