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A trapped single ion inside a Bose-Einstein condensate CARLO SIAS, CHRISTOPH ZIPKES, STEFAN PALZER, MICHAEL KOEHL, Cavendish Laboratory, University of Cambridge, AMOP TEAM — The achievement of excellent control of the motional and the internal quantum states of ultracold neutral atoms and ions has opened intriguing possibilities for quantum simulation and quantum computation. Until now quantum gases and single trapped ions have been disconnected in experiments. Their complementarity suggests, however, that they could be advantageously combined into one hybrid system. In our experiment, we explore the immersion of a single trapped $^{174}Yb^{+}$ ion into a Bose-Einstein condensate of ^{87}Rb neutral atoms. We demonstrate the independent control over the two systems, study the fundamental interaction processes, and observe sympathetic cooling of a single ion by immersion into a Bose-Einstein condensate. Our experiment opens possibilities for continuous cooling of a quantum computer and for exploring entanglement in hybrid quantum systems. Moreover, it will pave the way for fundamental studies of decoherence of a single locally controlled impurity particle coupled to a quantum environment.

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