Largest ever gas mix caught in ultra-freeze trap

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A team of scientists have made it easier to study atomic or subatomic-scale properties of the building blocks of matter (which also include protons, neutrons and electrons) known as fermions by slowing down the movement of a large quantity of gaseous atoms at ultra-low temperature. This is according to a study recently published in the *European Physical Journal D* as part of a cold quantum matter special issue, by researchers from the Paris-based École Normale Supérieure and the Non-Linear Institute at Nice Sophia-Antipolis University in France.

Thanks to the laser cooling method for which Claude Cohen-Tannoudji, Steven Chu and William D. Phillips received the Nobel Prize in 1997, Armin Ridinger and his colleagues succeeded in creating the largest Lithium 6 (^{6}Li) and Potassium 40 (^{40}K) gas mixture to date. The method used involved confining gaseous atoms under an ultra-high vacuum using electromagnetic forces, in an ultra-freeze trap of sorts.

This trap enabled them to load twice as many atoms than previous attempts at studying such gas mixtures, reaching a total on the order of a few billion atoms under study at a temperature of only a few hundred microKelvins (corresponding to a temperature near the absolute zero of roughly –273 C).

Given that the results of this study significantly increased the number of gaseous atoms under study, it will facilitate future simulation of subatomic-scale phenomena in gases. In particular, it will enable future experiments in which the gas mixture is brought to a so-called degenerate state characterised by particles of different species with very strong interactions. Following international efforts to produce the conditions to study subatomic-scale properties of matter under the quantum simulation program, this could ultimately help scientists to understand quantum mechanical phenomena occurring in neutron stars and so-called many-body problems such as high-temperature superconductivity.

More information: Ridinger A, Chaudhuri S, Salez T, Eismann U, Rio Fernandes D, Wilkowski D, Chevy F, and Salomon C (2011). Large atom number dual-species magneto-optical trap for fermionic 6Li and 40K atoms, *European Physical Journal D* (EPJ D), 65, 1-2. DOI: 10.1140/epjd/e2011-20069-4

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