

# 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 ( ${}^6\text{Li}$ ) and Potassium 40 ( ${}^{40}\text{K}$ ) 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  $-273\text{ C}$ ).

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  $6\text{Li}$  and  $40\text{K}$  atoms, *European Physical Journal D* (EPJ D), 65, 1-2. [DOI: 10.1140/epjd/e2011-20069-4](https://doi.org/10.1140/epjd/e2011-20069-4)

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