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Cold atom experiments aboard the international space station

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Bose-Einstein condensates (BECs) are excellent systems for quantum sensing applications like navigation, relativistic geodesy and tests of the universality of free fall. The sensitivity of most such atom interferometers increases quadratically with the interrogation time, which makes it beneficial to extend the free fall time. To accomplish this goal NASA has launched the Cold Atom Lab (CAL) [1] to the International Space Station
Here we report recent results of experiments performed on CAL. We show fast and reliable quantum gas transport protocols, matter wave lensing to picokelvin temperature [2], different interferometer geometries, as well as mixture experiments. We will also discuss recent results on two-species (Rb and K) atom interferometry. Furthermore, we discuss current limitations as well as prospective future experiments on CAL. These results pave the way towards future precision measurements with BECs in space.

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[1] Aveline, D. C. et al. Observation of Bose–Einstein condensates in an Earth-orbiting research lab. Nature 582, 193–197 (2020).
[2] Gaaloul, N. et al. A space-based quantum gas laboratory at picokelvin energy scales.
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Primary authors: CUAS TEAM; MÜLLER, Gabriel (Institut für Quantenoptik); Dr MEISTER, Matthias (Institute of Quantum Technologies); Dr GAALOUL, Naceur (Institut für Quantenoptik); Prof. BIGELOW, Nicholas (University of Rochester); BOEGEL, Patrick (Institut für Quantenphysik)

Presenter: Prof. BIGELOW, Nicholas (University of Rochester)

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