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New Type of Atom Trap Developed at NIST

Magneto-optical trap captures highly magnetic erbium atoms

Erbium is generally used in optical communication components, due to the magneto-optical properties it has and may one day be used to build optical computing systems and quantum computing. A new study conducted at the National Institute of Standards and Technology, in collaboration with the University of Maryland, succeeded in cooling atoms of erbium to temperatures approaching two millionths of a degree about absolute zero, capturing it in a newly developed ion trap. Laser cooling has become a highly used technique in atomic physics today. When combined with uniquely configured magnetic fields, one may obtain a magneto-optical trap, in order to create a trap for non-changed atoms used in quantum computing, time keeping and spectrometry experiments. Originally, the technique was designed for weakly magnetic atoms, however a NIST team showed a few years ago that other complex atoms can also be manipulated with its help. Magneto-optical traps usually rely on six laser beams which are pointing towards a common point, that is surrounded by a low-power magnetic field. The laser beams were supposed to induce a natural energy oscillation into the atom, so that it could be brought to temperatures close to absolute zero. However, NIST researchers used a technique through which laser beams would only induce a weak resonance frequency inside the atom, so that it would cool to a temperature only a millionth of a degree above absolute zero. Only atoms with very complex energy structures and non-magnetic atoms are able to cool through this process, such as erbium. During the experiment, NIST researchers shifted the laser beam towards the blue side of the electromagnetic spectrum, in oder to make use of the highly magnetic properties of erbium. By doing so, the magnetic field captures the erbium atoms, thus cooling them even further.