Licht-Reflektionen

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Atoms cooled and controlled by light

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Forty years ago appeared the idea that laser light could be used to reduce the thermal motion of an atomic vapour. Since that date, the manipulation and the cooling of atomic gases with laser light has undergone spectacular developments, which went far beyond the most optimistic initial predictions. Light beams with well-chosen characteristics can bring an atomic assembly down to a temperature of only a few nanokelvins above the absolute zero.
The behaviour of theses cold gases is governed by Quantum Mechanics: The velocity distribution of the atoms is dramatically reduced and their wavelength is increased correspondingly, which allows one to realize atomic clocks and interferometric matter-wave sensors with an unprecedented precision. In addition, by concentrating these atoms in a small volume one realizes a novel type of "quantum matter", which constitutes a simulator of other many-body systems, such as the electronic fluid of some families of superconductors or of samples exhibiting the Quantum Hall effect.
In this talk I will briefly present the physical principles that are at the basis of the cooling. I will then describe some recent developments, dealing either with precision measurements at the single atom level or with collective phenomena related to condensed matter physics. I will close with a short summary of the many perspectives that are opened in this research field.

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