

**SONDERSEMINAR/SPECIAL SEMINAR**  
**LMU/MPQ**

im Rahmen d. Gruppenseminars für Laserphysik,  
Molekül- und Festkörperphysik u. verw. Gebiete

- am:** **Thursday, January 10, 2013**
- Uhrzeit:** **9:30 a.m. s.t.**
- spricht:** **Dr. Ulrich Schneider**
- Thema:** **Negative Absolute Temperature  
for Motional Degrees of Freedom**
- Ort:** **Max-Planck-Institut for Quantum Optics,  
H.-W. Audience Hall**

**gez. Prof. T.W. Hänsch**

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**Abstract**

Absolute temperature, that is the fundamental temperature scale in thermodynamics, is usually bound to be positive.

Under special conditions, however, negative temperatures - where high-energy states are more occupied than low-energy states - are also possible.

So far, such states have been restricted to localize systems with finite, discrete spectra. In this talk, I will present a negative temperature state for motional degrees of freedom:

By tailoring the Bose-Hubbard Hamiltonian we created an attractively interacting ensemble of ultracold bosons at negative temperature, which is stable against collapse for arbitrary atom numbers. In this state, the quasi-momentum distribution develops sharp peaks at the upper band edge, revealing thermal equilibrium and bosonic coherence over several lattice sites. Negative temperatures imply negative pressures and open up new parameter regimes for cold atoms, enabling fundamentally new many-body states and counterintuitive effects such as Carnot engines above unity efficiency.