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# Physics news on the Internet (based on electronic preprints)

## A Bose–Einstein condensate of sodium atoms

Wolfgang Ketterle and his colleagues at MIT obtained a Bose–Einstein condensate of sodium atoms by the laser cooling method. The existence of the condensate was determined by light diffraction on a microscopic specimen. The condensate consisted of about half a million sodium atoms, substantially more than the number of atoms condensed in previous experiments.

A Bose–Einstein condensate was first observed at the Colorado University and consisted of 2000 rubidium atoms [M N Anderson, J R Ensher, C E Wieman, E A Cornell *Science* **269** 198 (1965)]. Subsequent experiments were performed at the Rice University on a condensate containing 100 000 lithium atoms [C C Bradley, C A Sackett, J J Tollett, R G Hulet *Phys. Rev. Lett.* **75** 1687 (1995)]. The Bose–Einstein condensate behaves like a single quantum entity. The properties of this new state of matter are as yet largely unknown. In these latest experiments the condensation rate was some 10 000 times faster than at Colorado. The greater number of atoms and the fast condensation will aid a more profound study of the properties of the Bose–Einstein condensate.

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## Verification of the Strong Equivalence Principle

According to the Strong Equivalence Principle the contribution of the gravitational interaction does not violate the equality of inertial and gravitational masses. If the Strong Equivalence Principle is only approximately true, then one would expect that these masses would differ to the greatest extent in strong fields, that is for bodies whose gravitational energy is comparable to their energy at rest. Among such bodies are neutron stars. Their gravitational energy amounts to about 20% of their energy at rest, whereas for the Earth and the planets the ratio of the gravitational energy to the energy at rest is of the order of $\sim 10^{-10}$, which makes testing of the Strong Equivalence Principle in the Solar system difficult. Excellent conditions for testing the Strong Equivalence Principle would be provided by a binary pulsar with a white dwarf companion. Violation of the Strong Equivalence Principle would require corrections to the orbital motion of stars. N Wex studied binary systems from Taylor's catalogue and found new limits for the violation of the Strong Equivalence Principle. He made use of the formalism recently developed by Damour and Esposito–FareÕse for interpreting experimental tests of the relativistic theory of gravitation. In this formalism, gravitational action is transferred by a tensor and one or more scalar fields. To describe deviations from the Einstein theory two new parameters are introduced: $\varepsilon$ and $\zeta$. For binary pulsar systems Wex obtained a constraint on the combination of these parameters: $|\varepsilon/2 - \zeta| \lesssim 0.06$.

At present, and probably also in the near future, experiments performed in the Solar system will not make it possible to measure the parameters $\varepsilon$ and $\zeta$.

Source: now@gravi.physik.uni-jena.de

## Measurement of the B-hadron lifetime

Measurement of the lifetime of B-hadrons–particles comprising a b-quark — are useful in the study of the b-quark and, in particular allow us to derive the value of the interaction of a b-quark with less massive quarks. In the SLC particle accelerator at SLAC a study was made of the $Z^0 \to b\bar{b}$ decays. From the decay length distribution a more accurate value for the average B-hadron lifetime was obtained: $\tau_B = 1.564 \pm 0.030 \pm 0.037$; the first error limit is statistical and the second systematic.

Source: WILLOCQ@SLAC.Stanford.EDU

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