DAMOP10-2010-020083

Abstract for an Invited Paper
for the DAMOP10 Meeting of
the American Physical Society

Observation of an unusually large atomic parity-violation effect

KONSTANTIN TSIGUTKIN[1], University of California, Berkeley

We report on observation of a large parity-violation effect in the atoms of ytterbium (Yb). This left-right asymmetry appears naturally in the Standard Model, and is associated with the exchange of a virtual heavy "gauge" boson between subatomic particles. Eventually, parity violation has been observed and precisely measured by a number of groups in several different atoms, culminating in a 0.3% measurement in cesium (Cs) by Carl Wieman and co-workers at Boulder. The parity-violating amplitude of the $6x^2\ ^1S_0 \rightarrow 5d6s\ ^3D_1$ 408-nm forbidden transition of ytterbium is found to be two orders of magnitude larger than in cesium. This is the largest atomic parity-violating amplitude yet observed. This also opens the way to future measurements of the parity violation effects for different Yb isotopes in order to test the effect of the neutron distributions within the nucleus and detect the so-called "anapole moment" by comparing parity-violating amplitudes for various hyperfine components of the transition. So far, Cs is the only system where such a moment has been detected. Measurements of anapole moments are important for understanding the electroweak interactions within the nucleus which are hard to probe by other means.

[1]In collaboration with D. Dounas-Frazer, A. Family, J. E. Stalnaker, University of California, Berkeley; V. V. Yashchuk, Lawrence Berkeley National Laboratory; D. Budker, University of California, Berkeley and Lawrence Berkeley National Laboratory.