CFEL SCIENCE SEMINAR

September 23rd, 2010, 10.00 a.m. – DESY Bldg. 49, Room 108

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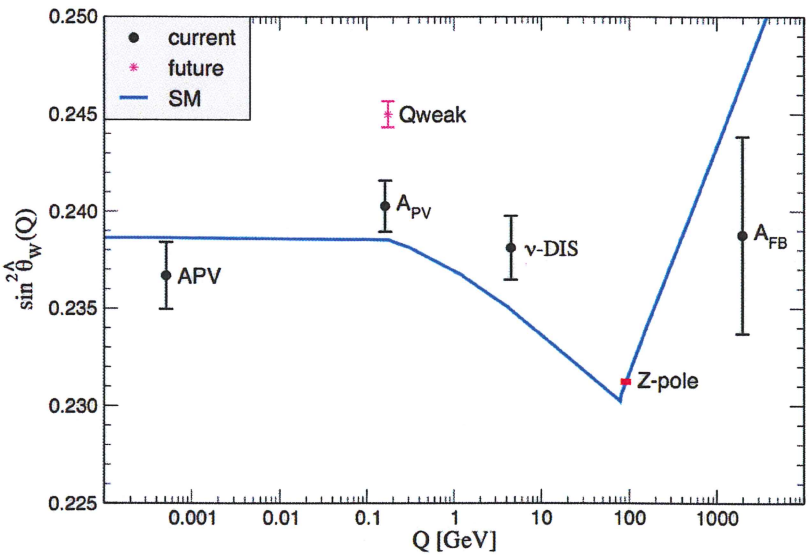
One Single Trapped Radium Ion and the Standard Model of Particle Physics

Complementary to large collider experiments such as the LHC, it is also possible to test the Standard Model (SM) at very low energies in atomic physics experiments. One such example is the ongoing experiment at the KVI in Groningen to measure atomic parity violation (APV) in a single trapped Ra+ ion. The 7S-6D transition in this ion is a forbidden E2 transition. However, because of the exchange of Z0-bosons between the quarks in the radium nucleus and the electrons, the 7S1/2 ground state acquires tiny admixtures of nP1/2 states enabling an E1APV transition. Measuring this amplitude will provide us with a low-energy value for the photon-Z0 mixing ("Weinberg") angle, a fundamental parameter of the Standard Model.

For the interpretation of the experiment the atomic wave functions of radium are required to sub-1% accuracy. Currently our calculations are accurate to some 3%. Therefore we study the option of looking at the ratio E1APV/ E1'APV for several isotopes, utilizing the fact that radium has a wide range of isotopes. In this ratio, atomic uncertainties are cancelled. Remaining nuclear structure effects can, for instance, be studied by looking at isotope shifts.

A single trapped radium ion is also an excellent candidate for a new optical frequency standard, or atomic clock. In a clock setup, the Ra+ ion is a highly sensitive candidate for the search of time-variation of the fine-structure constant α.



Host: Robin Santra, CFEL Theory Group