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Parity Violation in Atomic Systems

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Observation Atomic Parity Violation (APV) in atoms was crucial for the acceptance of the Standard Model as a general theory in physics. So far APV has been determined most precisely in Cs atoms. This measurement provides for a precise value of the weak mixing (Weinberg) angle at the lowest accessible energies with sub % accuracy. A significant deviation of this number from predictions based on measurements in all accessible ranges of momentum transfer would clearly indicate New Physics outside the present Standard Model. APV provides for an excellent opportunity to obtain hints towards, e.g., dark Z bosons. Lowest mass bounds on them can be set in new experiments. The extraction of the weak mixing angle from APV measurements requires precise calculations of atomic structure. Accurate calculations, e.g. from using coupled clusters methods, are by far best possible for alkali atoms and alkali-earth singly charged ions. The weak effects scale stronger than Zˆ3, where Z is the atoms's nuclear charge. Therefore heavy atoms or ions such as Fr or Ra+ are well suited for such research. Experiments on F and Ba+ may be viewed as precursors for experiments in (radioactive) Ra+, where effects are largest. It appears that for atomic theory the knowledge of the absolute value of the nuclear radii will become the limiting factor in the theoretical description of the ion. Muonic atom spectroscopy has a very high potential to provide the required nuclear parameters to sufficient accuracy. Present and near future possibilities will be discussed.

Content of the contribution

Experiment

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