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Ab initio calculations of nuclear parity-violating moments and nuclear structure corrections for tests of fundamental symmetries

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First principles, or ab initio, nuclear theory describes atomic nuclei as systems of nucleons interacting by QCD-based chiral effective field theory (EFT) nucleon-nucleon and three-nucleon forces. In combination with chiral EFT electroweak currents, ab initio nuclear calculations can provide model-independent results with quantifiable uncertainties relevant for precision electroweak physics.

We will discuss large-scale calculations performed within the ab initio no-core shell model (NCSM) [1] for observables requiring a computation of the nuclear Green's function that we construct by applying the continued fraction Lanczos algorithm [2]. We will review recent results for parity violating anapole [3], electric dipole [4], and Schiff moments in light atomic nuclei. Also, we will present ongoing calculations of two-photon exchange nuclear structure dependent corrections needed to extract nuclear radii from the measured X-ray spectra of muonic atoms and highlight the effort to compute nuclear structure corrections for the extraction of the V_{ud} matrix element from the superallowed Fermi transition measurements [5].

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Keyword-2

Ab initio nuclear theory

Keyword-3

Electroweak interactions

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