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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 Lanczos strength method [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 Vud matrix element from the superallowed Fermi transition measurements [5]. Finally, we will highlight recent calculations of the nuclear electric dipole polarizability of the 12C ground state and the first excited 2+ state, the latter needed to determine the 2+ electric quadrupole moment from Coulomb excitation experiments.

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[1] B. R. Barrett, P. Navratil, J. P. Vary, Progress in Particle and Nuclear Physics 69, 131 (2013). [2] R. Haydock, J. Phys. A 7, 2120 (1974). [3] Yongliang Hao, Petr Navratil, Eric B. Norrgard, Miroslav Ilias, Ephraim Eliav, Rob G. E. Timmermans, Victor V. Flambaum, and Anastasia Borschevsky, "Nuclear spin-dependent parity-violating effects in light polyatomic molecules,"Phys. Rev. A 102, 052828 (2020). [4] Paul Froese and Petr Navratil, "Ab initio calculations of electric dipole moments of light nuclei,"Phys. Rev. C 104, 025502 (2021). [5] Michael Gennari, Mehdi Drissi, Mikhail Gorchtein, Petr Navratil, and Chien-Yeah Seng, "Ab initio calculation of the nuclear-structure-dependent radiative corrections in 10C superallowed transition,"Phys. Rev. Lett. 134, 012501 (2025).

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