MODELING ELECTROMAGNETIC PROPERTIES OF HADRONS

ABSTRACT

by

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Two problems at the intersection of atomic theory and particle phenomenology are investigated. In the first, the electric dipole moment (edm) of the neutron is calculated field-theoretically within the cavity approximation in terms of the edms of its constituent up and down quarks. A 17% overall reduction is found with respect to the naive SU(6) estimate of this relation, and no relativistic edm enhancement is found. This work is motivated by the existence of edm enhancement in relativistic atoms; a novel calculation of this enhancement effect in alkali atoms is presented using a modification of the Furry representation that extends standard screening effects to a field-theoretical framework. The calculation demonstrates the utility of this representation in many-body bound-state field theory. In the second problem, the polarizability of the proton in muonic hydrogen is calculated using another variation of the modified Furry representation, in this case for the purpose of generating nuclear structure corrections to the energy levels of the atom. The proton is modeled using the cavity approximation. The proton polarizability is found to agree with existing estimates using dispersion relation theory, indicating that this effect is incapable of resolving the outstanding proton size puzzle.