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Parity-Violating Electron Scattering: Recent Results and Future Prospects

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The technique of measuring tiny single-spin asymmetries in the scattering of longitudinally polarized relativistic electrons off unpolarized fixed targets is well-established. These measurements, which exploit the non-conservation of parity symmetry by the neutral weak interaction, are being used in a variety of applications to address fundamental questions in nuclear and particle physics. One thrust over the past two decades has been the measurements of nucleon neutral weak form factors at intermediate four-momentum transfer 0.1 < Q^2 < 1 (GeV/c)^2 , which provides information about the role of virtual strange quarks on the charge and current distributions inside nucleons. A more recent topic is the elastic neutral weak amplitude at very low Q^2 from scattering off a heavy spineless nucleus, which is sensitive to the presence of a neutron skin and provides model-independent information about the density dependence of the symmetry energy in dense nuclear matter. Finally, we discuss the neutral current elastic amplitude at very low Q^2 off protons and electrons and in the DIS regime off deuterium, which allows precision measurements of the weak mixing angle at low energy and is thus sensitive to new physics at the TeV scale, in a manner complementary to collider searches. The physics implications of recent results, potential measurements from experiments designed to exploit the 12 GeV upgrade of Jefferson Laboratory, as well as new ideas at future facilities are discussed.

Primary author: Mr KUMAR, Krishna (UMass Amherst)

Presenter: Mr KUMAR, Krishna (UMass Amherst)

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