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Removal Energies and Optical Potential in Lepton Nucleus Scattering

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We investigate the binding energy parameters that should be used in modeling electron and neutrino scattering from nucleons bound in a nucleus within the framework of the impulse approximation. We discuss the relation between binding energy, missing energy, removal energy (ϵ), spectral functions and shell model energy levels and extract updated removal energy parameters from ee′p spectral function data. We address the difference in parameters for scattering from bound protons and neutrons. We also use inclusive e-A data to extract an empirical parameter
$U_{FSI}((\vec{q}_3 + \vec{k})^2)$ to account for the interaction of final state nucleons (FSI) with the optical potential of the nucleus. Similarly we use V_{eff} to account for the Coulomb potential of the nucleus. With three parameters $\epsilon, U_{FSI}((\vec{q}_3 + \vec{k})^2)$ and V_{eff} we can describe the energy of final state electrons for all available electron QE scattering data. The use of the updated parameters in neutrino Monte Carlo generators reduces the systematic uncertainty in the combined removal energy (with FSI corrections) from $\pm$ 20 MeV to $\pm$ 5 MeV.

Primary authors: BODEK, Arie (University of Rochester (US)); Mr CAI, Tejin (University of Rochester)

Presenter: Mr CAI, Tejin (University of Rochester)

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