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Extraction of the Transverse Enhancement and Longitudinal Suppressio of quasielastic scattering data (ONLINE)

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Reliable modeling of quasielastic (QE) lepton scattering on nuclei is of great interest to neutrino oscillations experiments, especially at low values of the 3-momentum transfer $\mathbf{q}$. We report on a phenomenological fit to all available electron scattering data on $^{12}_{6}\mathrm{C}$ (about 8000 differential cross section measurements) and $^{12}_{\mathrm{O}}\mathrm{C}$ (about 250 measurements) within the framework of the superscaling model (including Pauli blocking). The fit can be used as benchmark for the validation of electron and neutrino Monte Carlo generators. We find that in addition to the expected enhancement of the transverse QE response function (R_T^{QE}), at low values of momentum transfer $\mathbf{q}$ there is "Extra Suppression" of the QE longitudinal response function (R_L^{QE}) beyond the expected suppression from Pauli blocking. We extract $|\mathbf{q}|$ dependent parameterizations that can be used to determine the "Extra Suppression" factor and the "Transverse Enhancement" for any nucleon momentum distribution for use in electron and neutrino Monte Carlo generators, We obtain the best measurement of the inelastic Coulomb Sum Rule $S_L(\mathbf{q})$ for $|\mathbf{q}| < \mathbf{0.8}$ GeV . The measured $S_L(\mathbf{q})$ for $^{12}_{6}\mathrm{C}$ is consistent with but somewhat lower than the Lovato 2000 "First Principle Green's Function MC" calculation. $S_L(\mathbf{q})$ for $^{16}_{8}\mathrm{O}$ is consistent with being equal to to $S_L(\mathbf{q})$ for $^{12}_{6}\mathrm{C}$. It is consistent with but somewhat higher than the Sobczyk 2020 "coupled-cluster with singles-and doubles (CCSD) NNLO$_{sat}$" calculation. The contribution of nuclear excitations to $S_L(\mathbf{q})$ is significant (up to 29\%) and we provide parameterizations of the form factors for the electro-excitation of nuclear states in $^{12}_{6}\mathrm{C}$ and $^{16}_{8}\mathrm{O}$.

Primary author: BODEK, Arie (University of Rochester (US))

Co-author: Dr CHRISTY, M. Eric (Thomas Jeerson National Accelerator Facility)

Presenter: BODEK, Arie (University of Rochester (US))

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