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Electron scattering for neutrino physics with e4nu

The extraction of oscillation parameters from next-generation neutrino experiments such as DUNE and Hyper-K will rely on precise estimation of the properties of the incoming neutrino. The relationship between reconstructed and true neutrino energies depends critically on accurate models of neutrino-nucleus interactions, for which uncertainties in nuclear structure and reaction mechanisms are expected to become leading systematic limitations.

Electron scattering provides a powerful complementary probe of these same nuclear dynamics at energies relevant for neutrino experiments. Unlike neutrino beams, electron beams can be delivered at fixed energies and high intensities, enabling high-statistics measurements with well-controlled kinematics. The Electrons for Neutrinos (e4nu) collaboration uses data from electron scattering experiments, including CLAS and CLAS12 at Jefferson Lab, to test and constrain the underlying models used in neutrino event generators, exploiting the close connection between electron- and neutrino-nucleus scattering.

In this talk, we will present the e4nu research program and recent results from the CLAS12 analysis campaign. These include novel inclusive and semi-exclusive electron scattering on various targets, including argon. We will discuss how these measurements provide stringent benchmarks for interaction models and how electron-scattering data can help reduce nuclear-model uncertainties in future neutrino oscillation measurements.

Primary author: BARHAM ALZÁS, Pablo (Tel Aviv University)

Presenter: BARHAM ALZÁS, Pablo (Tel Aviv University)

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