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Neutrino-Interactions with nuclei and Long Baseline Experiments (15' + 3')

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Neutrino beams are necessarily broad in energy. This poses a unique challenge for any cross section studies with neutrinos since the incoming energy is not known, but must be reconstructed event-by-event. The reconstruction usually uses either kinematics for quasielastic scattering or a calorimetric approach in which the final state energy is measured. Both methods require event generators since, in the first method, the quasielastic scattering cannot be uniquely identified and, with the calorimetric method, detectors have acceptance thresholds and often cannot see all final state particles. All presently ongoing (MINERvA, T2K, MicroBooNE) and planned (DUNE) experiments use nuclear targets; this brings the additional complication of event identification in the presence of strong final state interactions.

In this talk I will argue that the planned precision era experiments require a new approach to generators that embed the latest knowledge of nuclear physics and of dynamic treatments of many-particle systems. Nuclear many-body theory has given so far unavailable insight into the response of static nuclei to electroweak couplings. Transport theory, well accepted and widely used in other areas of physics and also of nuclear physics, could help to improve the dynamical description of high-energy neutrino-nucleus interactions. Examples for such an approach will be given in this talk, together with some predictions for the LBNF near detector.

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