Introduction

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ν-A scattering:

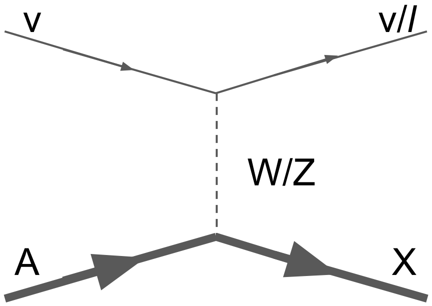
- Accelerator-based neutrino oscillation experiments need to:
    - Tag the flavor of neutrino interactions
    - Determine the energy of the incident neutrino from the outgoing particles
- Arises from the basic phenomenology of neutrino oscillations
    - Neutrino flavor change a function of propagation distance (L) and neutrino energy (E)
    - Flavor content vs. energy allows us to extract the fundamental mixing/mass parameters
- The modeling of ν-A (neutrino-Nucleus) scattering is now at the forefront
    - Effectively all neutrinos in experiments are observed through ν-A interactions
    - Neutrino flavor change in several channels is well established
    - Next steps, such as CP violation and mass ordering measurements, require precise understanding of the flavor change as a function of neutrino energy

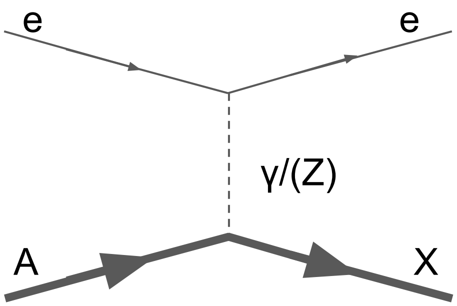
Complications in ν-A interactions

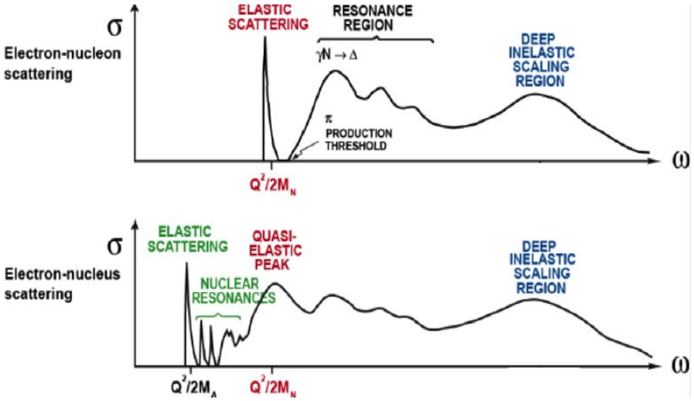
- A nucleus is a bound system of nucleons
- A few categories of non-factorizable effects:
  - Initial state dynamics (Fermi motion and binding of nucleons)
  - Interaction (multi-body currents)
  - Propagation of particles in nucleus (dense hadronic) medium (“final state interactions”)
- Many commonly used models nonetheless factorize:
  - Consider a target nucleon with kinematics drawn according to initial state model
  - Select an interaction channel between the neutrino and nucleon and determine final state
  - Propagate final state particles through the nucleus and determine exiting/visible particles
- Experimental challenges:
  - Fundamental: energy of incident neutrino is not known and must be reconstructed
  - Practically:
    - energy spectrum of incident neutrinos is broad typically with large uncertainty (>10%)
    - What we can measure often relies on the model we are trying to understand

Why e-A scattering?

- The same complications arise in e-A scattering

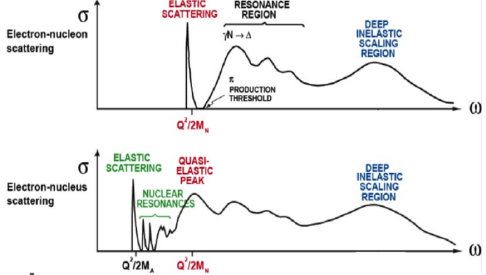


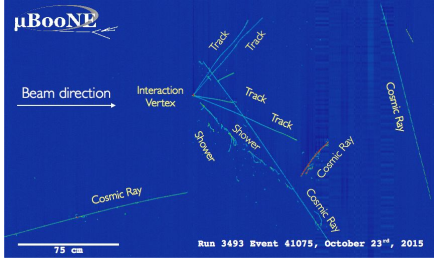




- Many of the same modeling issues can be studied in a system where:
  - Kinematics are much better understood (incoming electron energy is a priori known)
  - Other experimental issues (incoming beam, etc.) are better controlled
- For every v-A process we study, would like to have corresponding e-A study

Personal view/prejudice





- Not original, just not universally agreed upon . . . .
- “for every v-A process we study, would like to have corresponding e-A study
- comparable/better particle tracking/id to the v-A experiments we use
  - Select particular outgoing particle state and kinematic configuation
  - Measure kinematic (sometimes correlated) among outgoing particles
  - Sufficient precision on outgoing electron kinematics to determine four-momentum transfer
- To me, this means:
  - Electron beam with very well defined energy and count
  - Localized target, interchangeable amongst nuclei of interest (H, C, O, Ar . . . ?)
  - Full tracking acceptance with particle identification comparable to LAr detector
  - Calorimetry to tag photons, and possibly neutrons

Goals of Meeting

- Review:
  - S30XL ("Sector 30 Transfer Line") beam
  - LDMX detector and potential modifications and enhancements
- Is the S30XL beam suitable for performing e-A studies useful for the neutrino program?
- Is the LDMX detector a suitable starting point for a detector for such studies?
  - Are modifications needed?
  - Can suitable modifications be accommodated without comprising dark sector program?
    - Alternatively, are there suitable configurations that can be switched
    - Or is it better to start from scratch with a new detector concept
- Does the facility/detector offer capabilities beyond programs currently envisaged?

Agenda

9:00 AM	→ 9:05 AM	**Introduction** **Speaker**: Hirohisa Tanaka (SLAC)	5m
9:05 AM	→ 9:35 AM	**Neutrino-Nuclear Generators (20'+10')** **Speaker**: Mosel Ulrich	30m
9:35 AM	→ 9:50 AM	**Uses of electron scattering for neutrino oscillation experimentss** **Speaker**: Kendall Mahn	15m
9:50 AM	→ 10:05 AM	**Prospects for eN measurements at Mainz** **Speaker**: Federico Sanchez	15m
10:05 AM	→ 10:20 AM	**Discussion**	15m
10:20 AM	→ 10:45 AM	**Final States & Energy Reconstruction (15'+10')** **Speaker**: Shirley Li (SLAC)	25m
10:45 AM	→ 11:10 AM	**Generators and Electronuclear Data (15'+10')** **Speaker**: Alexander Friedland (SLAC)	25m
11:10 AM	→ 11:25 AM	**Coffee Break**	15m
11:25 AM	→ 11:50 AM	**Sector 30 Transfer Line at SLAC (15'+10')** **Speakers**: Thomas Markiewicz (SLAC), Tor Raubenheimer (SLAC)	25m
11:50 AM	→ 12:10 PM	**LDMX Performance and First Look at eN Measurements** **Speaker**: Nhan Tran (Fermilab)	20m
12:10 PM	→ 12:35 PM	**Adding on to LDMX (10'+15')** **Speaker**: Timothy Nelson (SLAC)	25m
12:35 PM	→ 12:55 PM	**Discussion**	20m
12:55 PM	→ 1:25 PM	**Lunch and additional discussion**	30m