

The e4nu collaboration

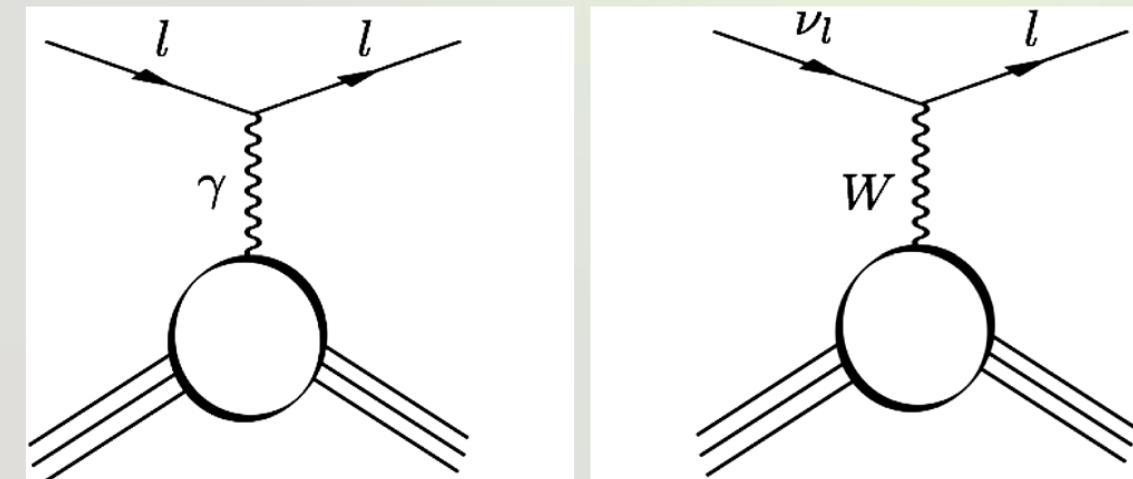
The experimental extraction of neutrino oscillation parameters depends on the accuracy of the interaction models used. These have many degrees of freedom requiring constraints.

Using electrons to constrain neutrino models!

Both leptons experience the similar nuclear effects and interact with nuclei through the **vector current**. The neutrino also interacts through the **axial vector current**.

$$j_{\mu}^{em} = \bar{u} \gamma^{\mu} u$$

$$j_{\mu}^{\pm} = \bar{u} \frac{-ig_W}{2\sqrt{2}} (\gamma^{\mu} - \gamma^{\mu} \gamma^5) u$$



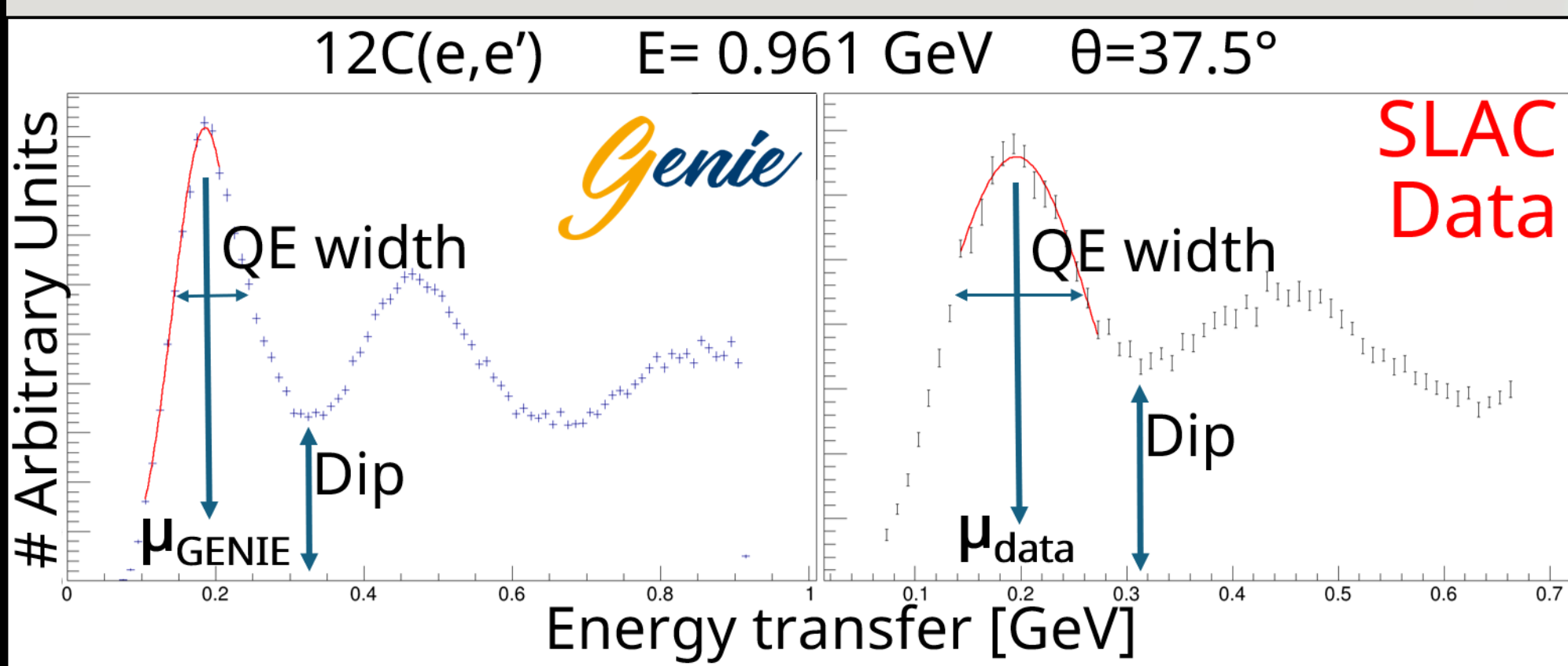
If a model fails with **electrons**, it might fail with **neutrinos** as well!

PhysRevD.103.113003

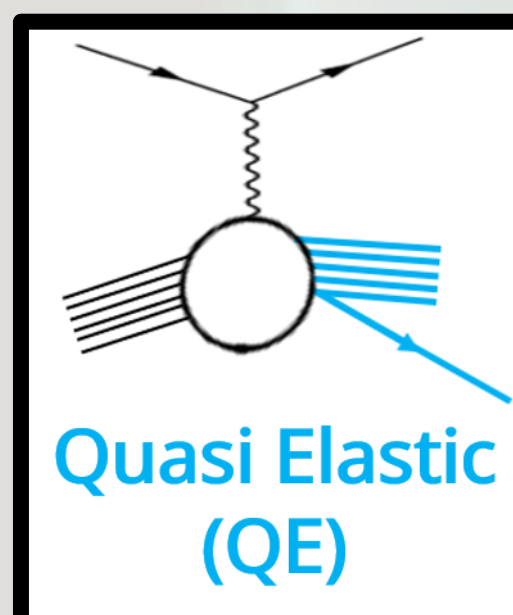
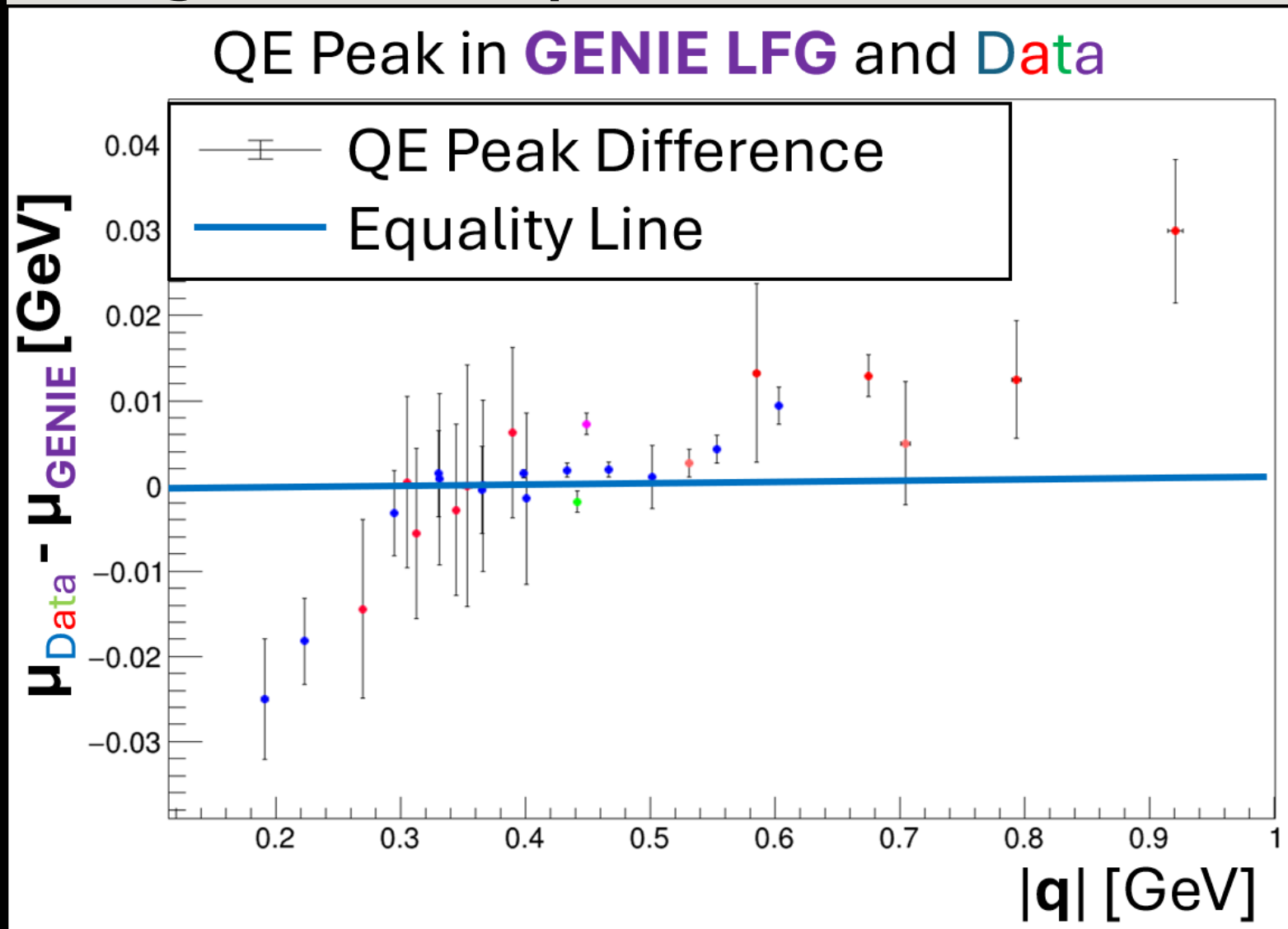
Historic Inclusive Electron Data

It proved to be a useful tool to study both nuclear and leptonic physics.

The widely used **Genie** neutrino event generator simulates MeV-TeV neutrino-nuclei interactions using semi-empirical models.

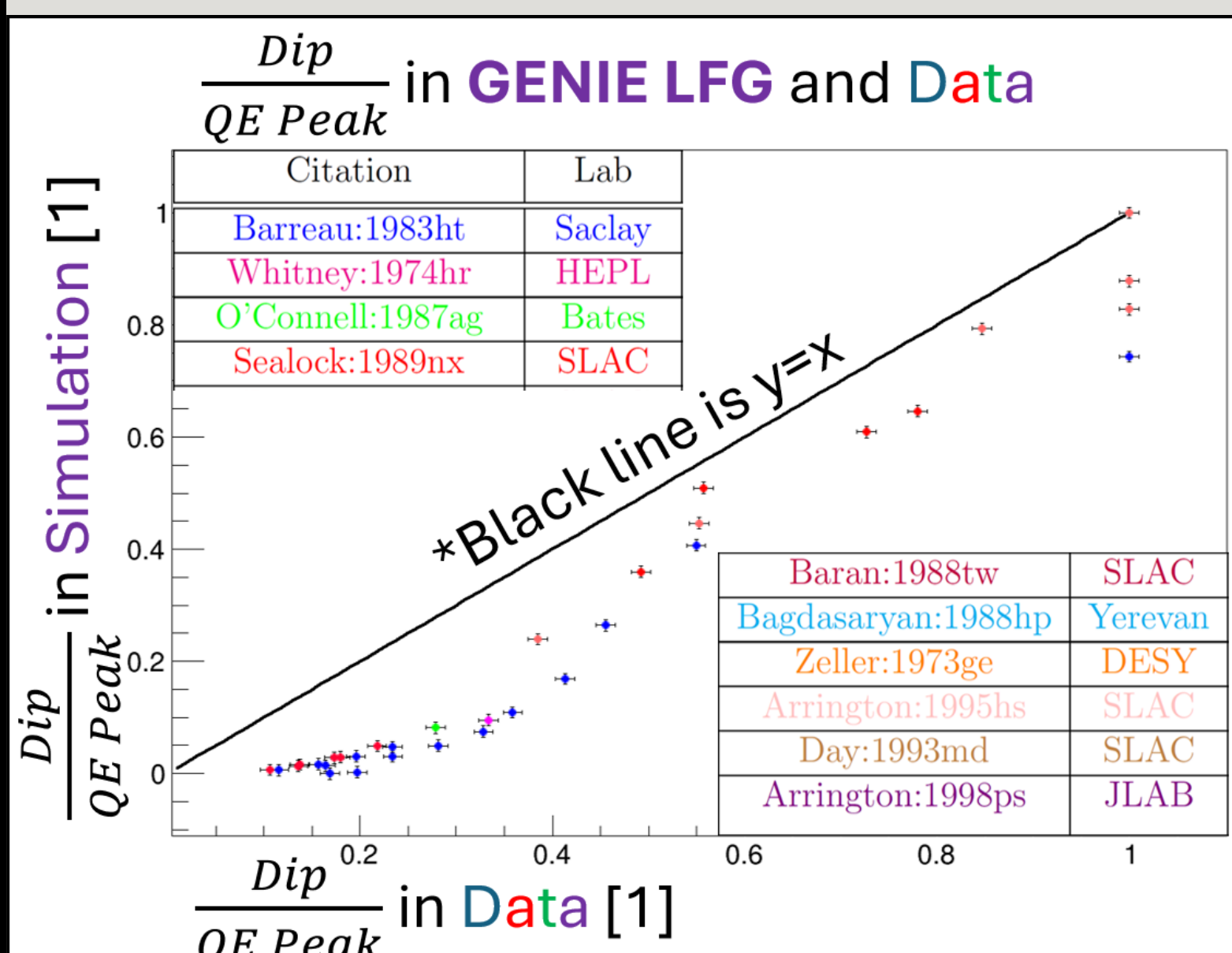


GENIE Local Fermi Gas (LFG) & Historic Inclusive Data Disagree on QE peak locations!



*Also, QE peaks' Widths disagree!

Dip to QE peak height ratio:



Shows a Visible and Structured difference!

*Similar difference for GENIE relativistic Fermi Gas

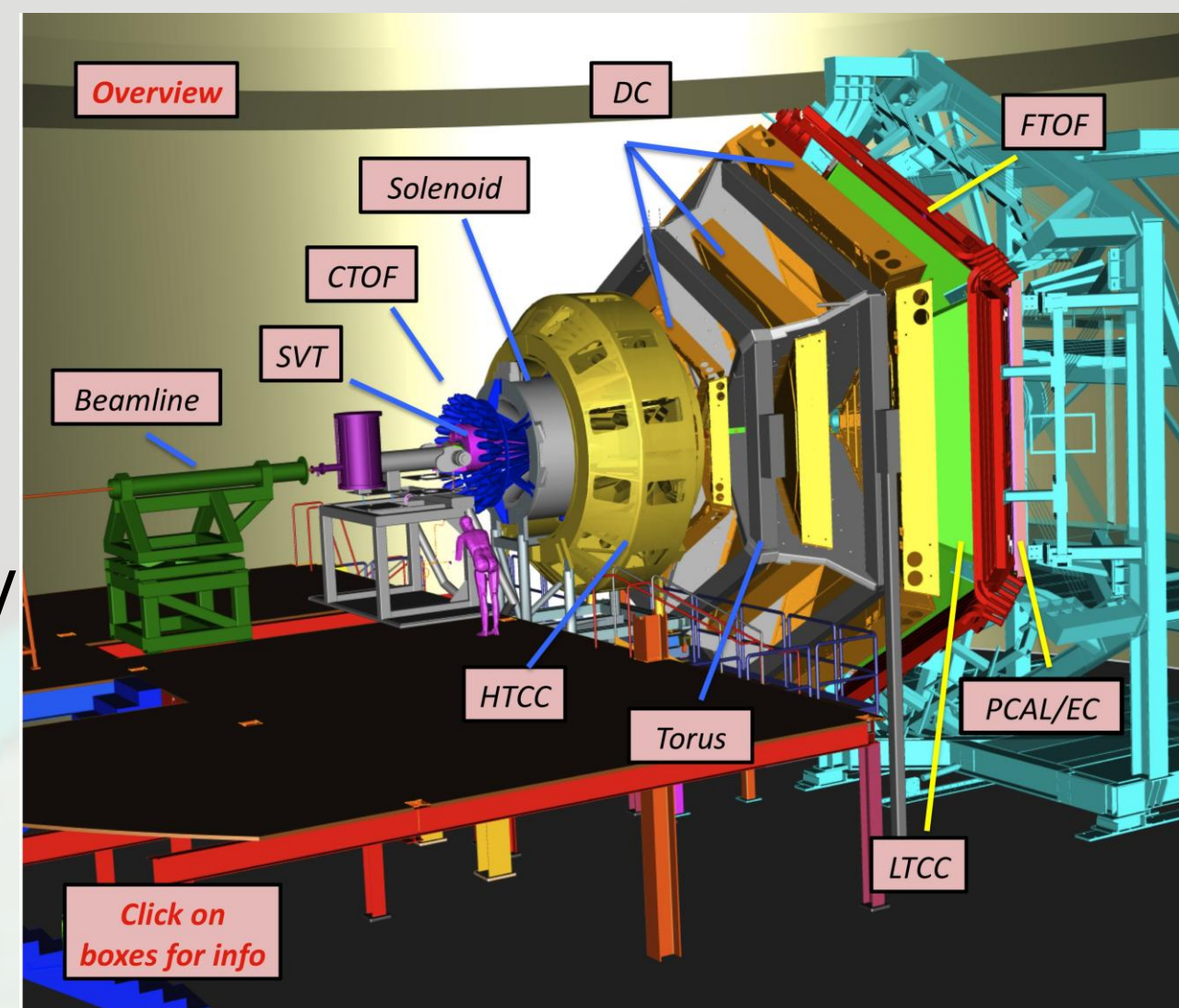
The CLAS12 detector on the JLab CEBAF

EM Calorimeter:
 θ coverage : $5^{\circ} - 35^{\circ}$
 ϕ acceptance: 50% - 85%

The RGM data:

Beam Energies: 2, 4, 6 GeV
 Targets:
 1H, 2D, 4He, **12C**,
 40Ca, 48Ca, 120Sn, **40Ar**

Event Selection:
 events with 1 e-.



What's in the new cross sections?

The raw inclusive measurements were:

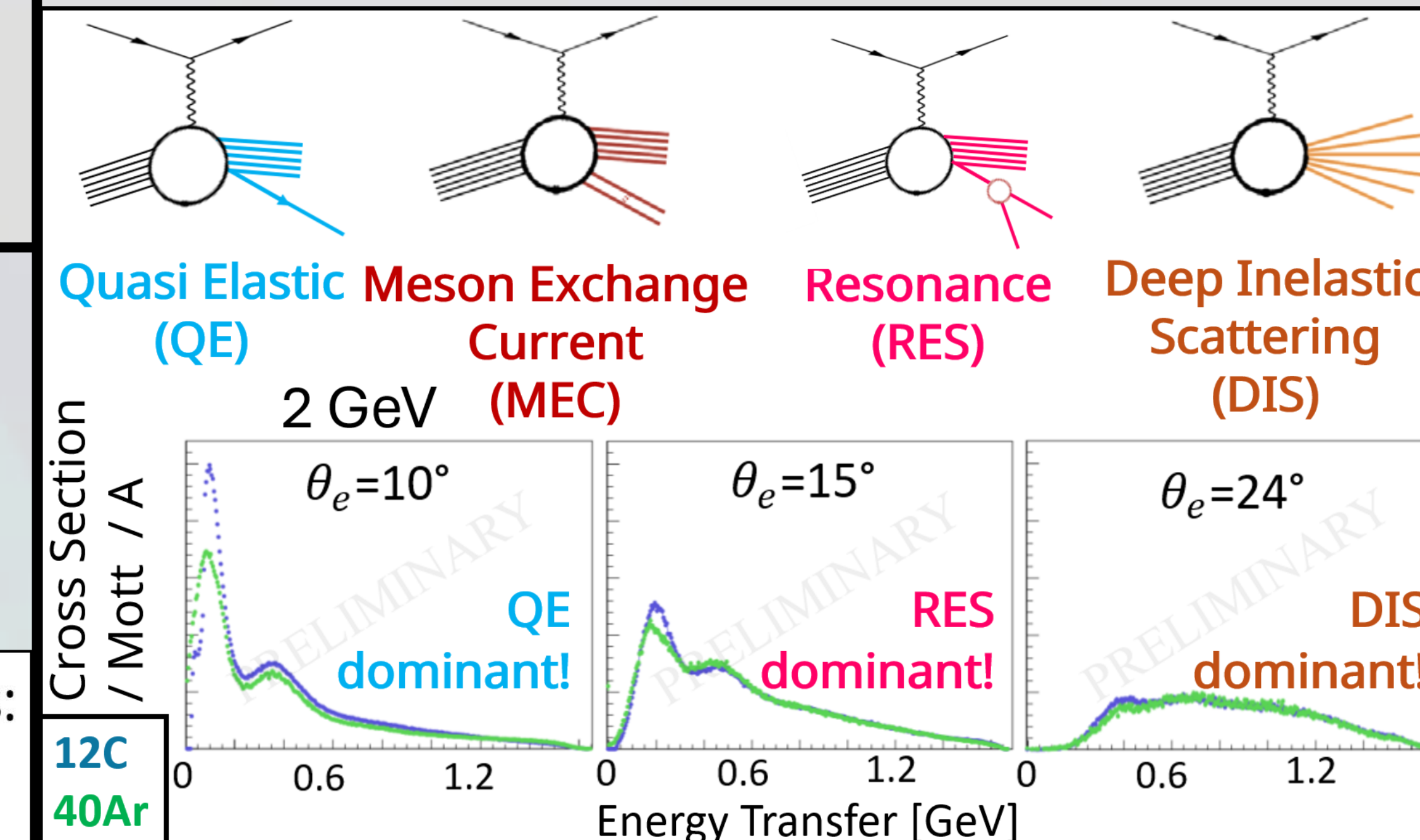
1. Normalized to luminosity
2. Momentum corrected by using the elastic peaks in inclusive 1H distribution (only for the 2 GeV case)
3. Global acceptance corrected (per target, beam energy and angle)
4. Radiative corrected (PhysRevC.106.L061305)

CLAS12 has Very large angular acceptance:

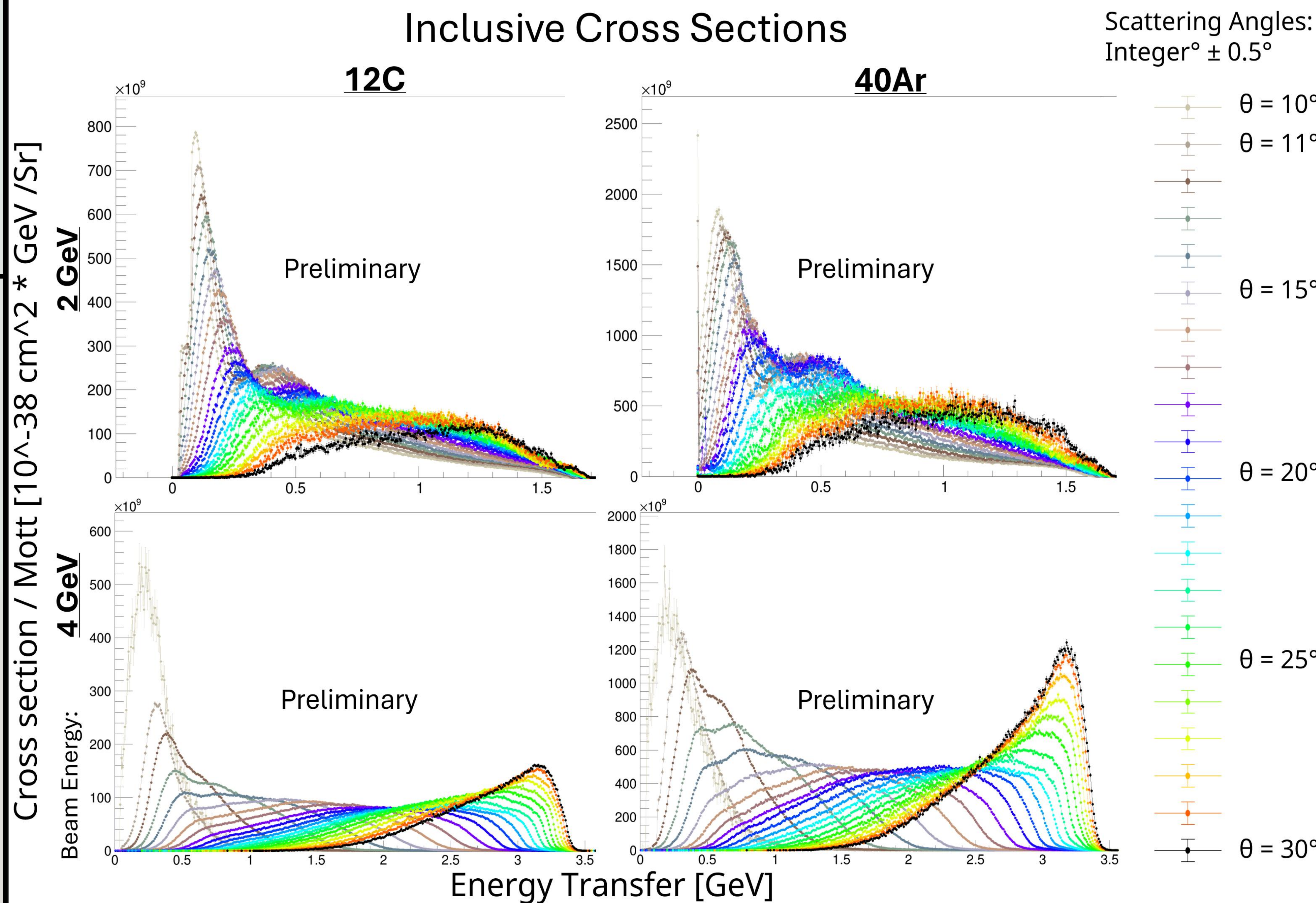
Many scattering angles
 Consistent measurements

Different target nuclei

Allows probing different interaction mechanisms!



Using LArTPCs? Have a look at my (e,e')40Ar distributions!



Consistent with previous 15 degree 40Ar measurement.

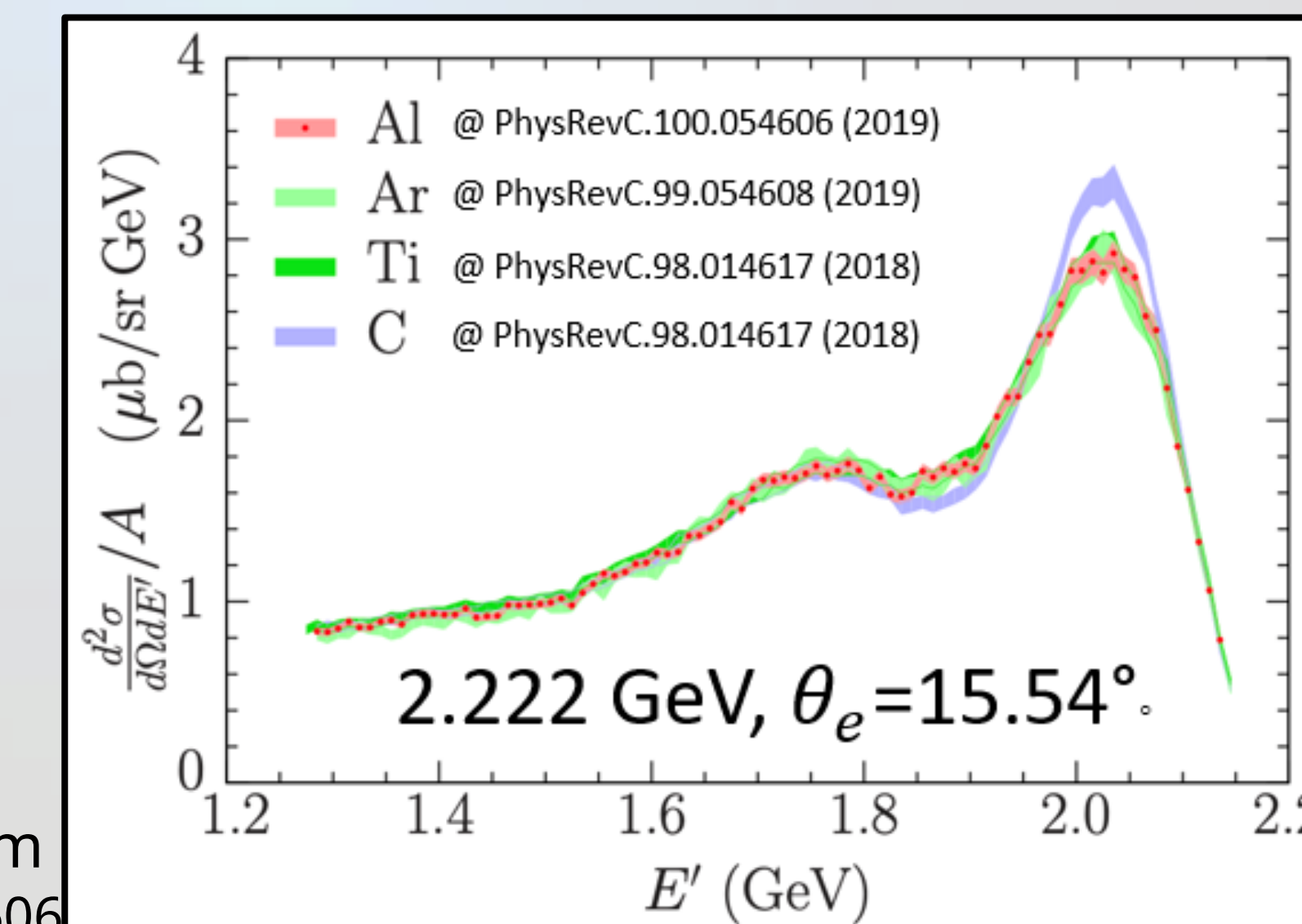


Figure taken from PhysRevC.100.054606

Conclusion:

1. Simple mass scaling is not sufficient!
2. Different angles probe different interaction mechanisms.
3. Measurements in very fine angular bins will allow us to consistently constrain GENIE reaction mechanisms.

