

NuInt 2024 Experiment Summary

Jonathan Paley
NuInt 2024

Outline

- Some highlights
- Some discussion points
- Future outlook

Like a Brazilian buffet, there's just too much to amazing stuff to consume in such a short time... we had 40+ "experimental" talks, so I apologize in advance if your presentation is not represented here!



Outline

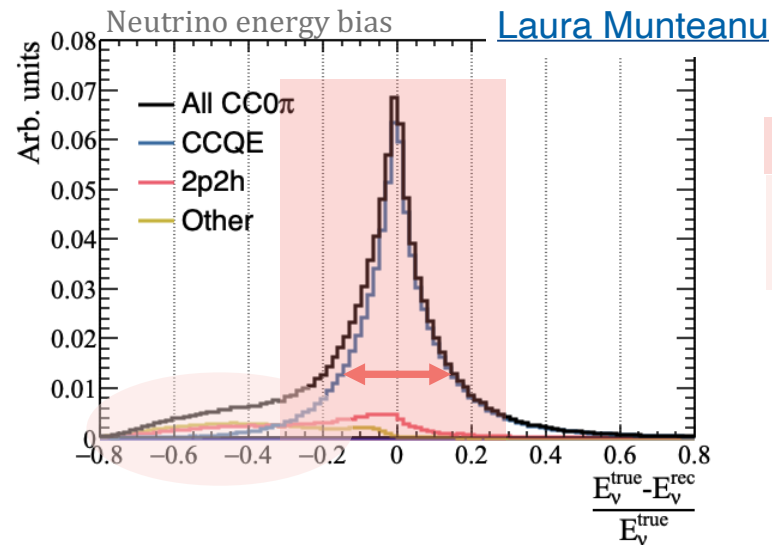
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But there's always have room for dessert...



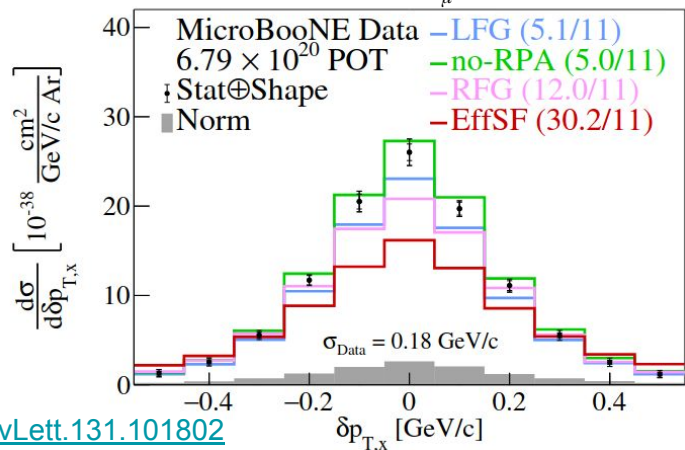
We Saw the Impact that Neutrinos Have on Neutrino Measurements...



Need to control: (1st order)

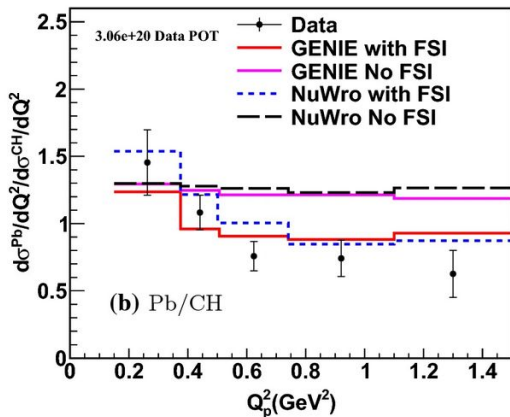
- Shape of **Fermi motion**
- Proportion of **QE vs non-QE** processes
- **Physics beyond PWIA**
- **Energy dependence** of the cross-section (due to oscillations)
- **A-scaling** (C and O)

Impact of Initial State Modeling in MicroBooNE ν_{μ} CC 1p0 π

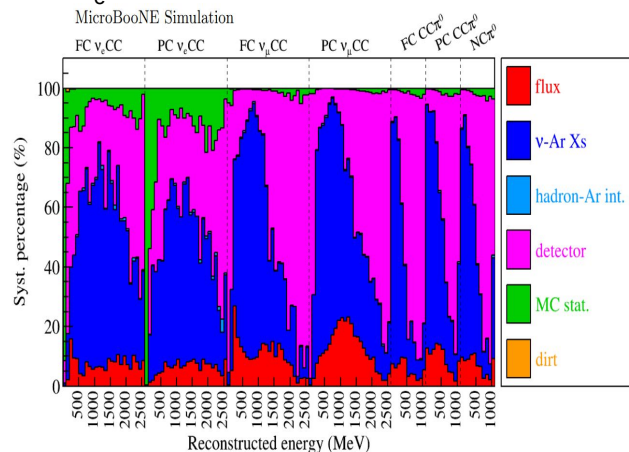


[arXiv:131.101802](https://arxiv.org/abs/131.101802)

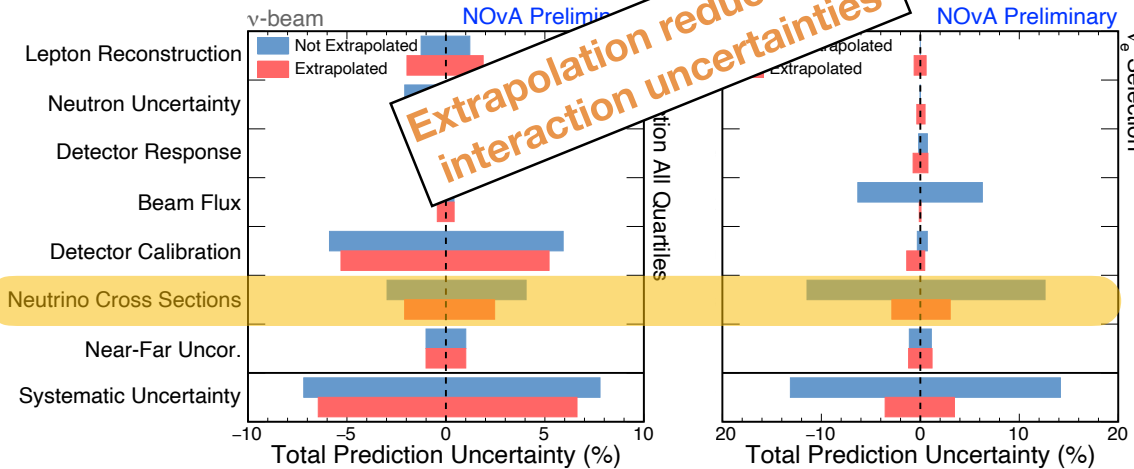
[London Cooper-Troendle](#)



ν_e CC Inclusive eLEE Search Uncertainty



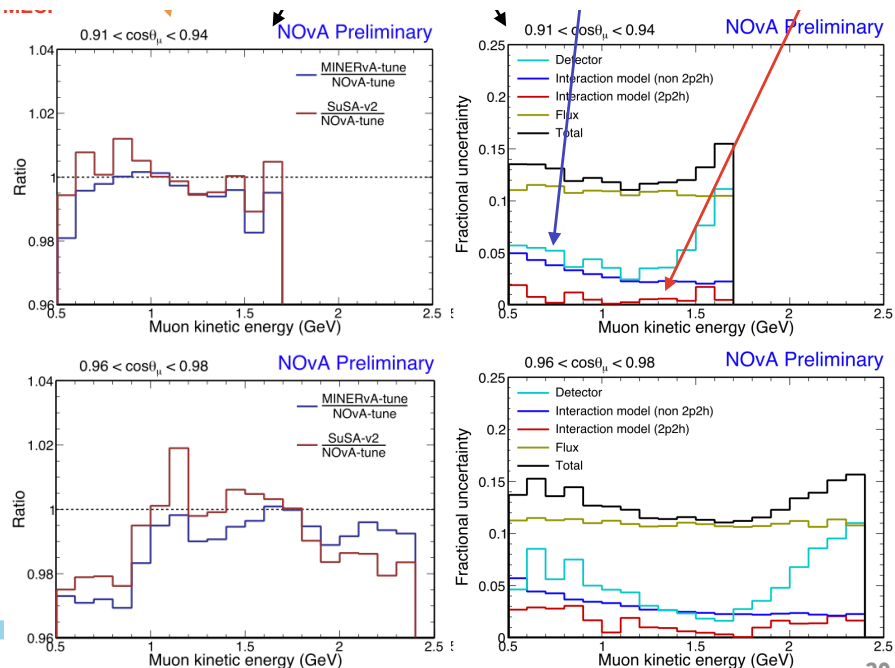
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Mike Dolce

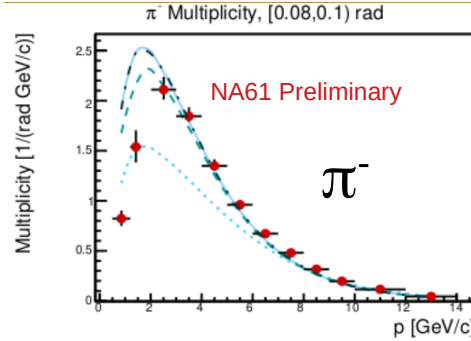
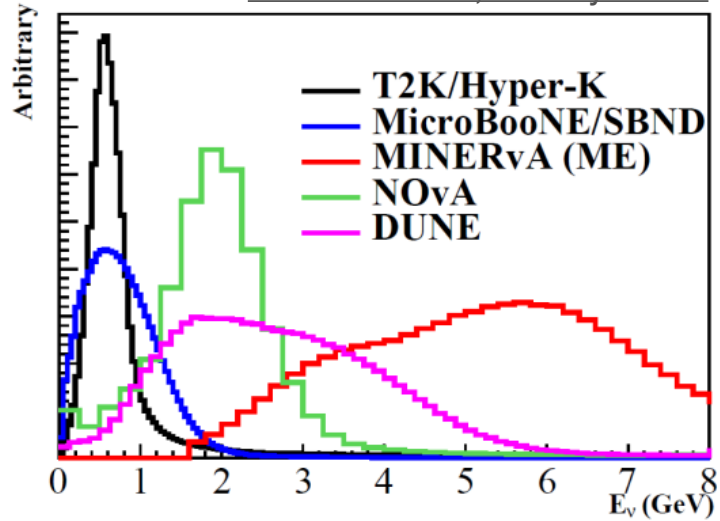
After extrapolation, xsec uncertainties are sub-dominant in the NOvA oscillation analysis.

ND and other analyses are moving to using a model spread for the 2p2h uncertainty...

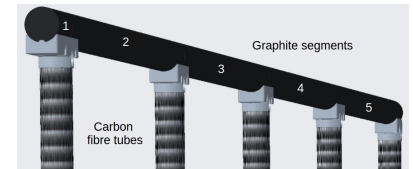
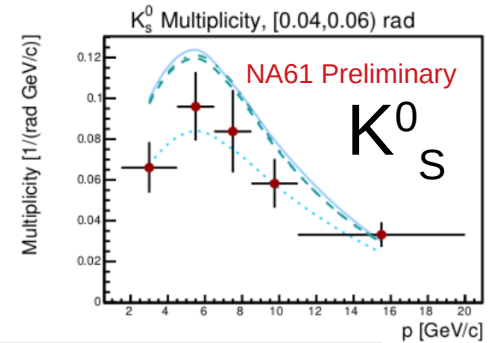


Ingredients to Cross Section Measurements: Flux

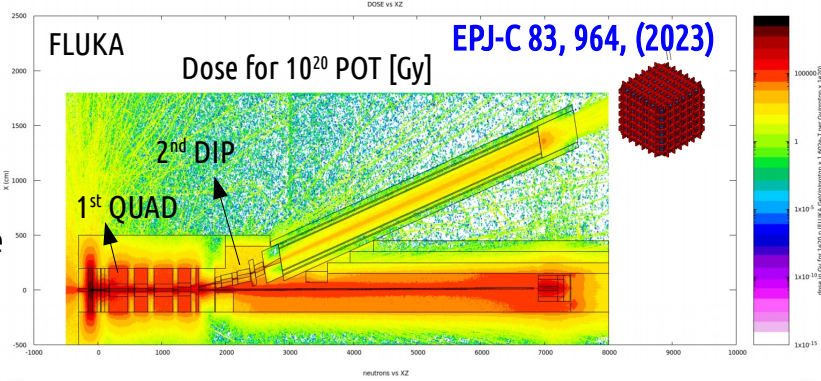
Marco Martini, NuPhys2016



Andrew Olivier, NA61/SHINE

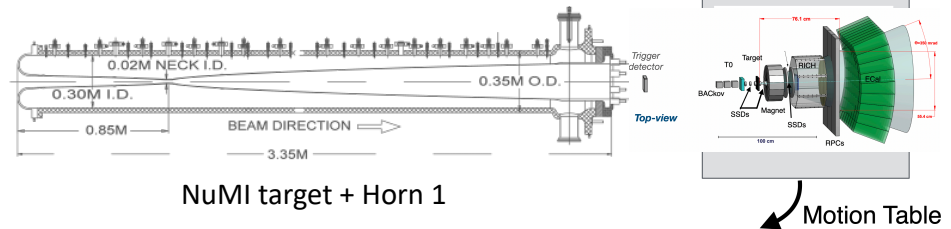


NA61 Replica of Planned DUNE Target



Andrea Longhin, ENUBET

EMPHATIC Phase 2: NuMI Target+Horn

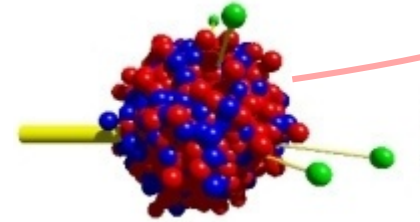
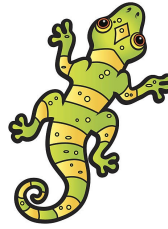


Leo Aliaga, EMPHATIC

Flux improvements coming from new thin and thick target (and horn) HP measurements and nu+e measurements, nu-e constraints a la MINERvA

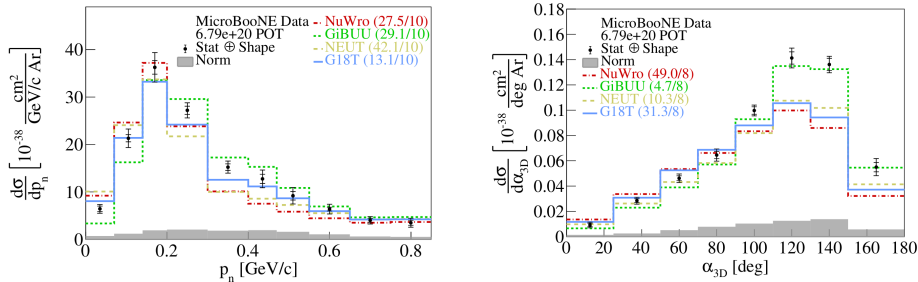
Ingredients to Cross Section Measurements: Generators

- We heard updates from the main generators, many new models have been implemented!
- Many have implemented comparison tools for both electrons and neutrinos. Some overlap with NUISANCE?

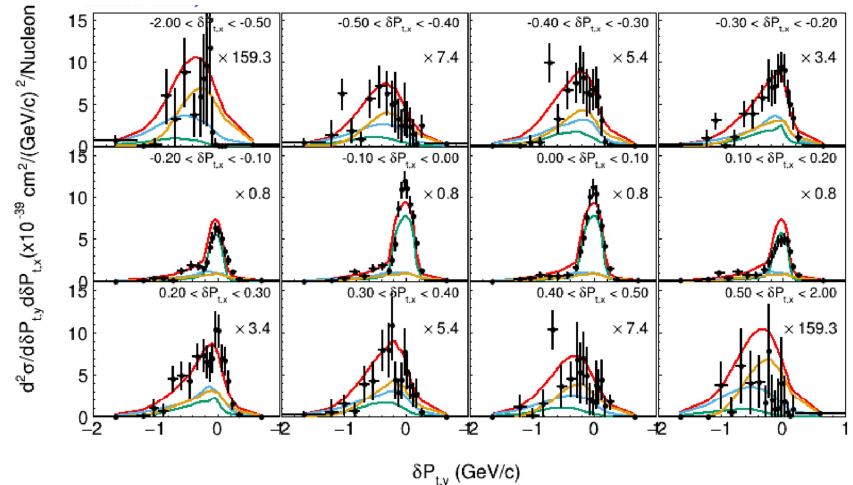


0π Measurements

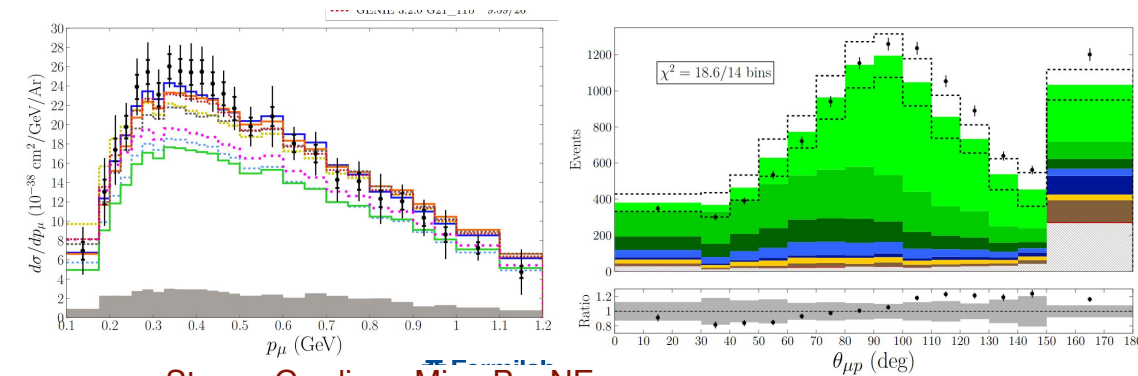
- Moving to more precise and sensitive measurements
- We are probing nuclear effects better with TKI and GKI variables
- High stats!



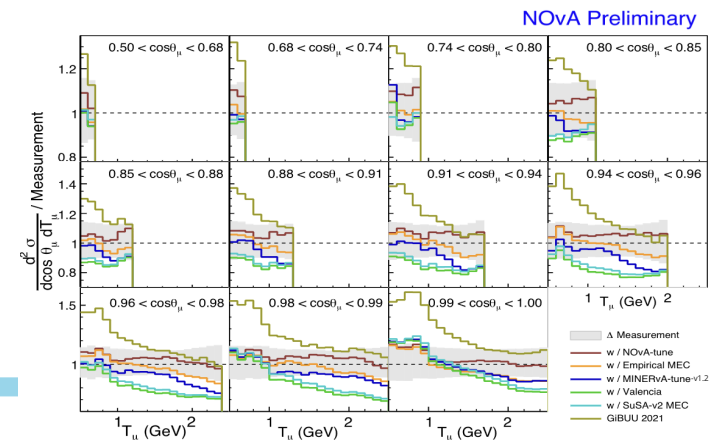
Andy Furmanski, MicroBooNE



Dan Ruterbories, MINERvA



Steven Gardiner, MicroBooNE

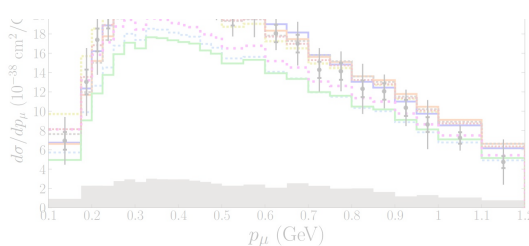
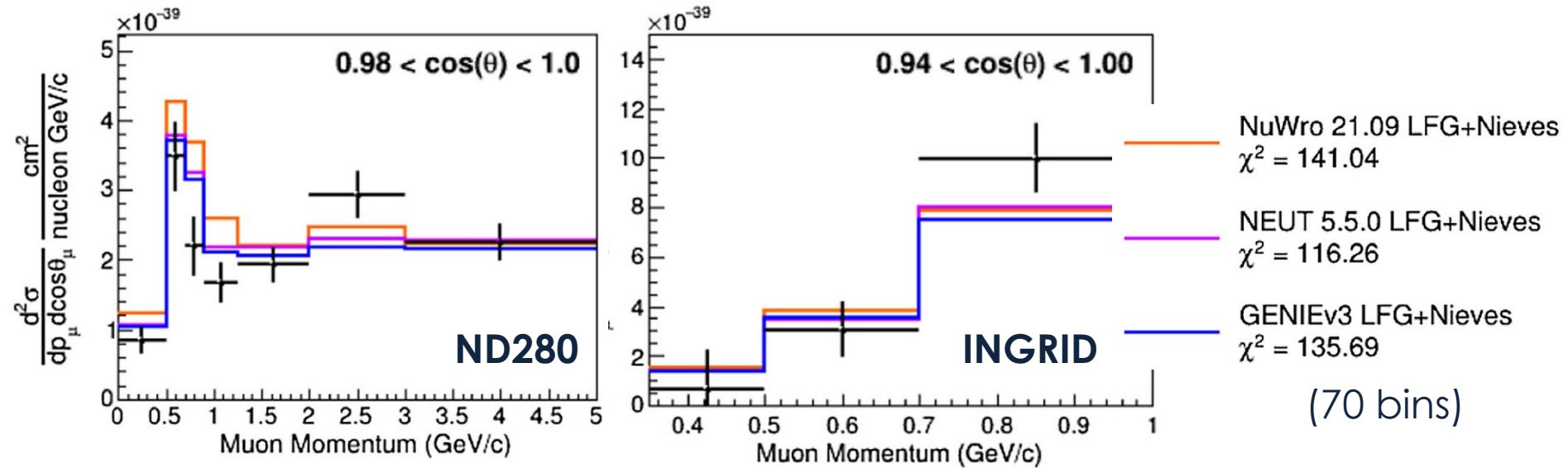


Sebastian Sanchez-Falero, NOvA

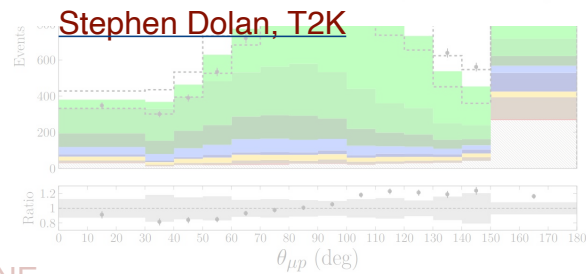
0π Measurements

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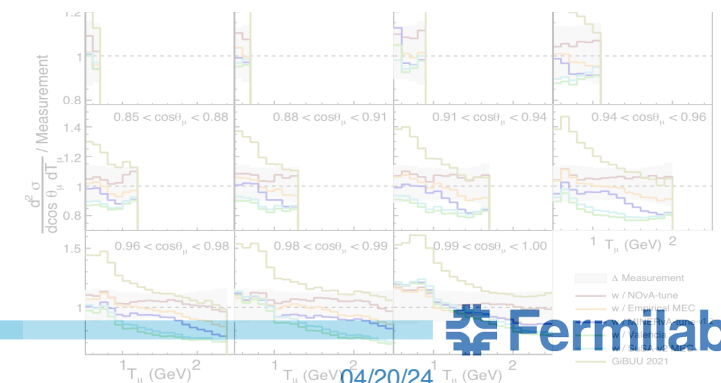
0.15 | -0.00 < δP | -0.50 | -0.50 < δP | -0.40 | -0.40 < δP | -0.30 | -0.30 < δP | -0.20



Steven Gardiner, MicroBooNE



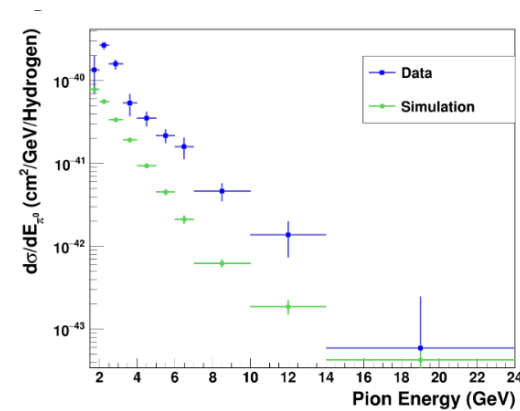
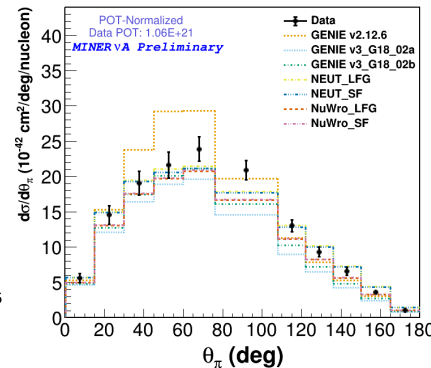
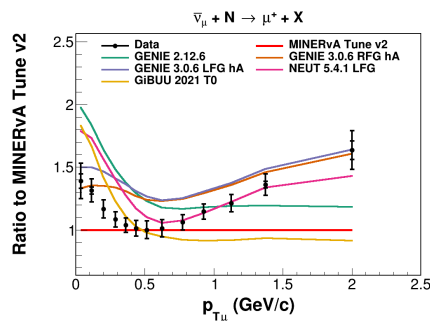
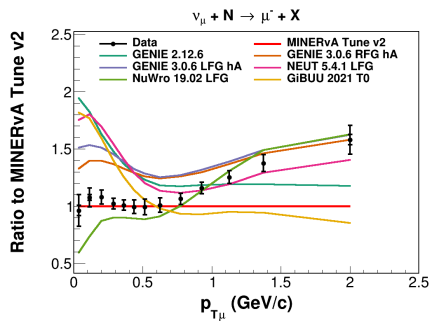
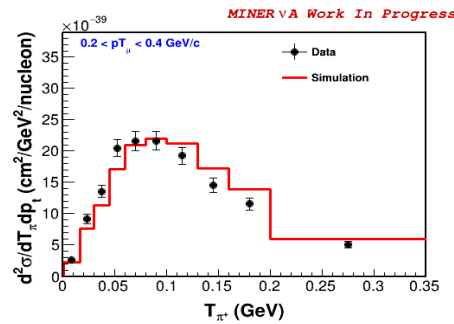
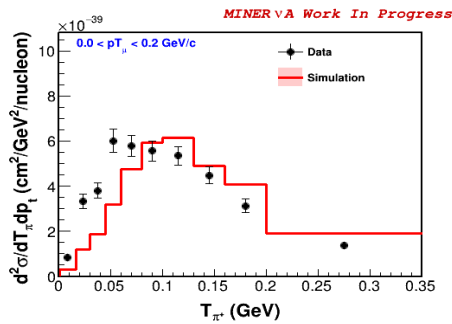
Stephen Dolan, T2K



Sebastian Sanchez-Falero, NOvA

Pion-Production Measurements

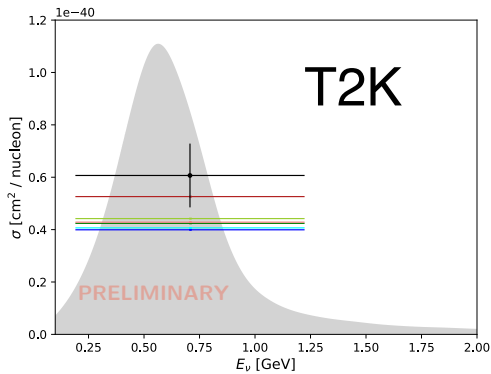
- Pion production results are all over the place, it's like watching a capoeira group fight-dance. In one moment two opponents almost hit each other, the next they're far apart...



MINERvA

Pion-Production Measurements

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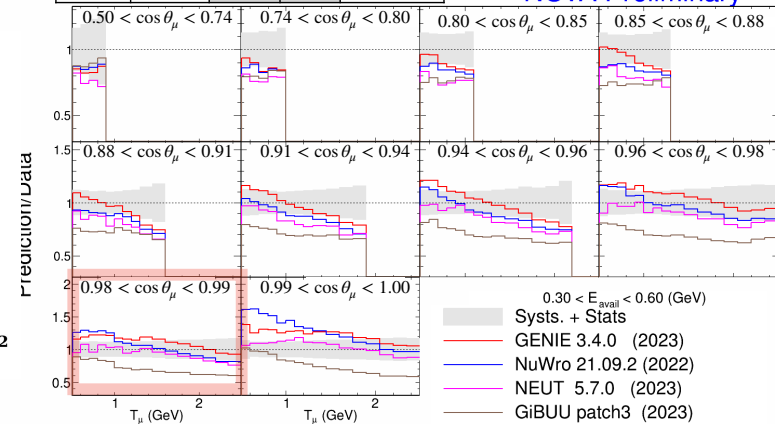
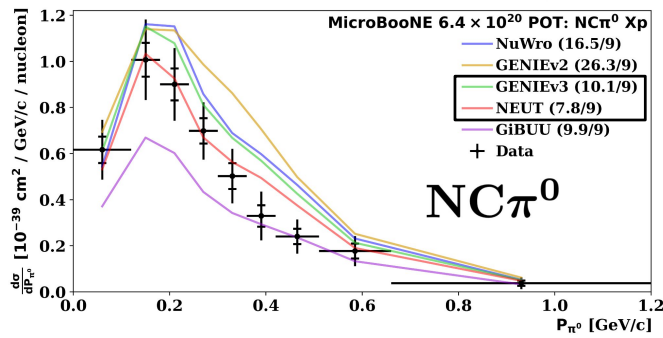
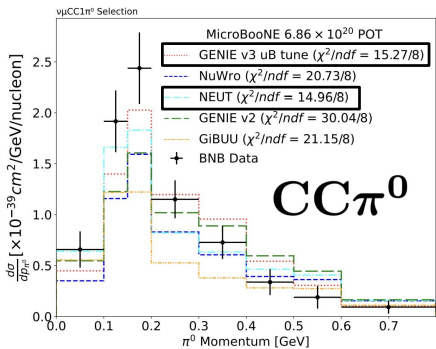
300 MeV < E_{avail} < 600 MeV

Table from NOvA-tuned GENIE

QE (%)	MEC (%)	RES (%)	DIS (%)	Others (%)
3.9	1.2	68.0	22.0	4.9

Events: 14%

NOvA Preliminary

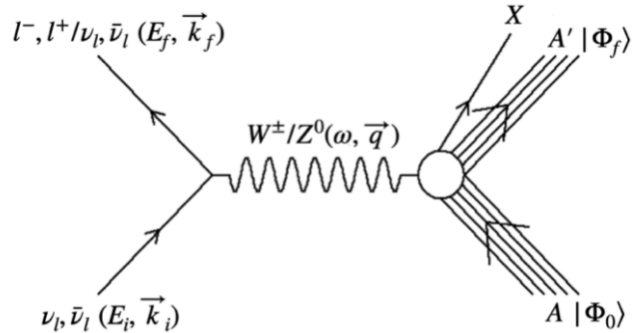


So much more that I did not cover...

- Pion-nucleus interactions
- Electron-nucleus interactions
- Scattering at MeV and lower energies
- Cross sections for colliders
- Electron-neutrino scattering

An opinion...

■ Physics happens right to left [Theorist's universe]



• Scattering Kinematics:

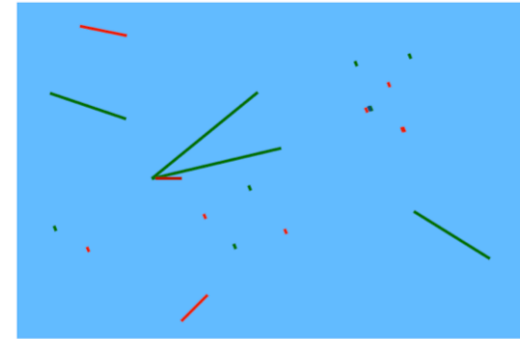
$$\omega = E_i - E_f, \quad q = |\vec{k}_i - \vec{k}_f|, \quad Q^2 = q^2 - \omega^2$$

■ Calculate neutrino-nucleus cross section

$$d\sigma \propto \sum_{fi} |\mathcal{M}|^2 \propto \frac{G_F^2}{2} L_{\mu\nu} W^{\mu\nu}$$

[Vishvas Pandey](#)

■ Analysis happens left to right [Experimentalist's universe]



■ Measure neutrino-nucleus cross section

- Extract Cross section in some observables x,

$$\frac{d\sigma}{dx_i} \propto \frac{\sum_j U_{ij} (N_j - B_j)}{\Phi_\nu T \epsilon_i \Delta x_i}$$

We have been reminded throughout the week that we should not report results on model-dependent variables. I completely agree with this, and I feel we should only do quantitative comparisons to generator predictions using direct observables. However, I do think that looking at some model-dependent variables provides qualitative insight, and we should not completely abandon them.

What I hope to see at the next NuInt...

- A plausible explanation of the MINERvA and NOvA observed excess at low E_{vis}
- More anti-neutrino measurements
- Results from DUNE 2x2 and ICARUS
- Implementation of, and comparisons to, new-ish models between data and generators



In Conclusion...



Relax! Have
some food and
drink, it'll all be ok.

Obrigado!

