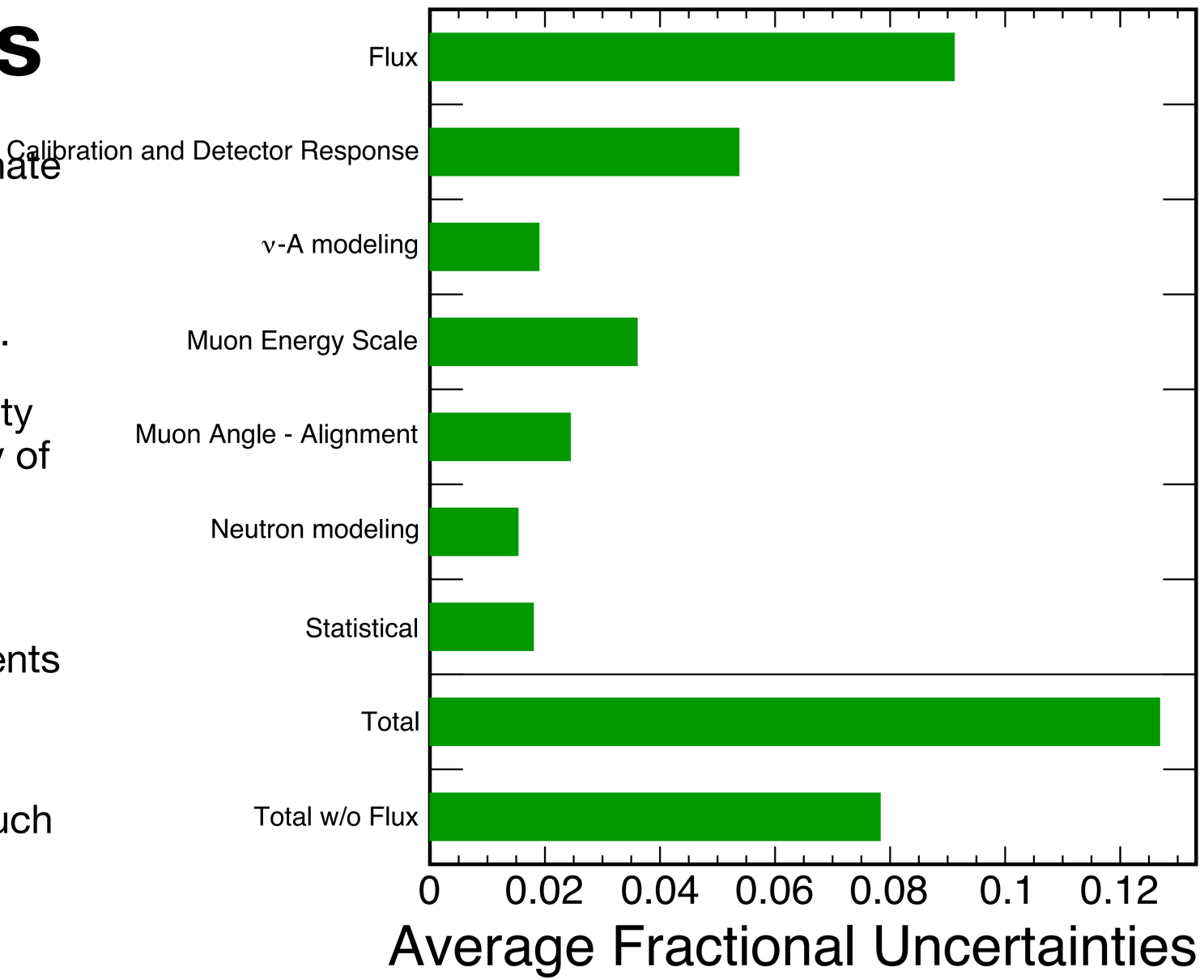
Toward Percent-level Neutrino Flux Predictions

Jonathan Paley, NuSTEC Board Meeting, July 8, 2020

Flux Uncertainties

- Neutrino flux uncertainties currently dominate many neutrino-nucleus cross section measurements.
- Driven by hadron production uncertainties.
- Normalization component of the uncertainty can be significantly reduced from a variety of in-situ and external measurements:
  - nu-electron scattering
  - external hadron production measurements
  - beam/target/horn monitoring
- Shape component of the uncertainty is much more difficult to constrain, and much of it comes from beam focusing uncertainties.



Reminder: The LBNF Spectrometer Concept

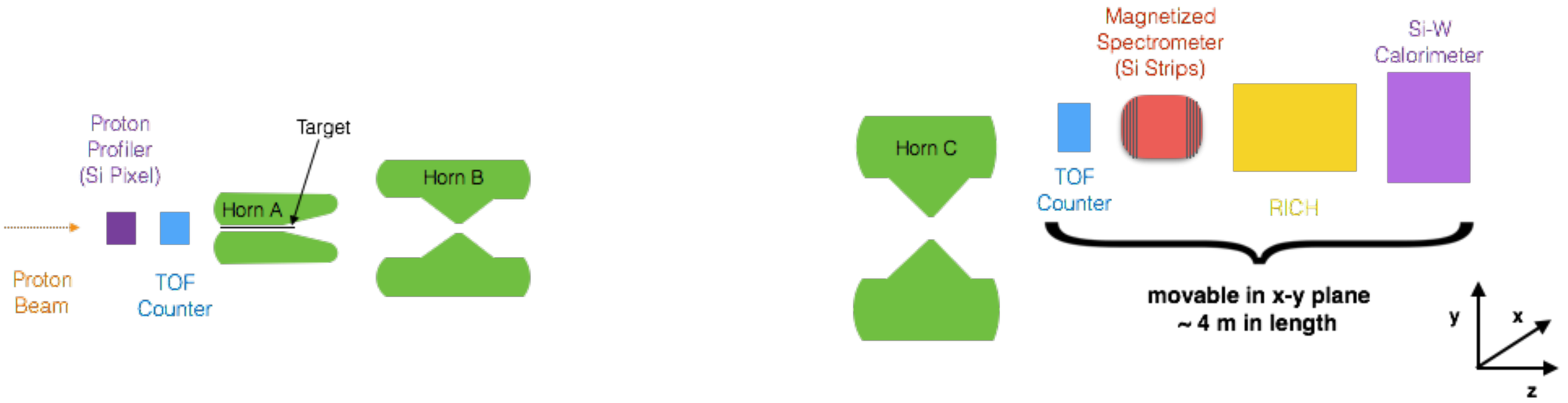
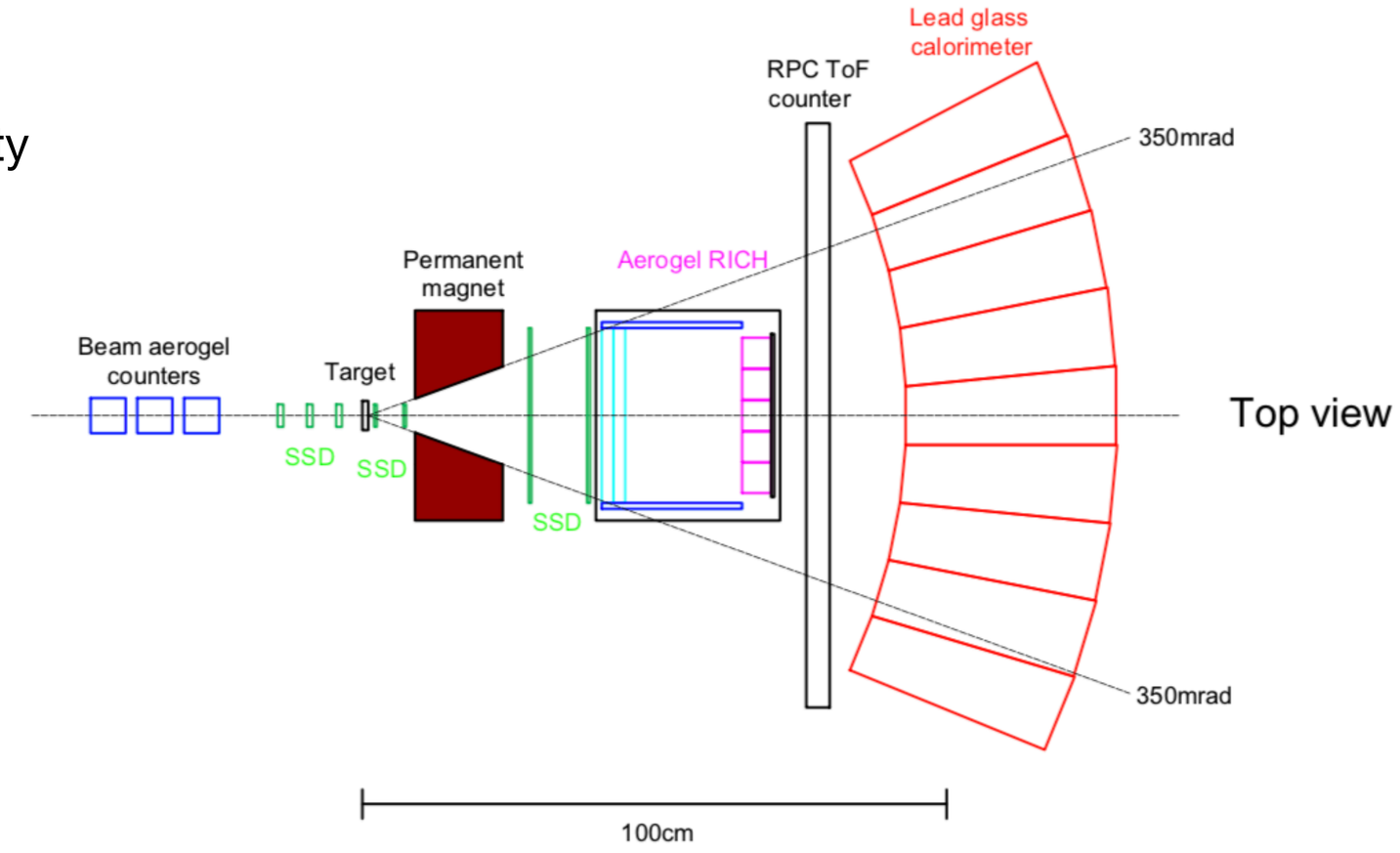


Figure 1: Schematic of one possible configuration of the spectrometer. Not to scale.

Proposed by Laura Fields, Paul Lebrun, Alberto Marchionni in 2017.

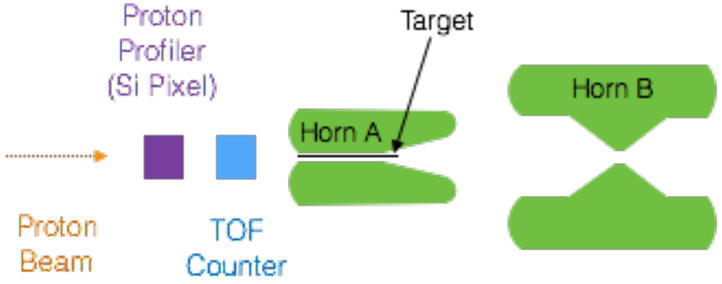
Reminder: The EMPHATIC Spectrometer Concept

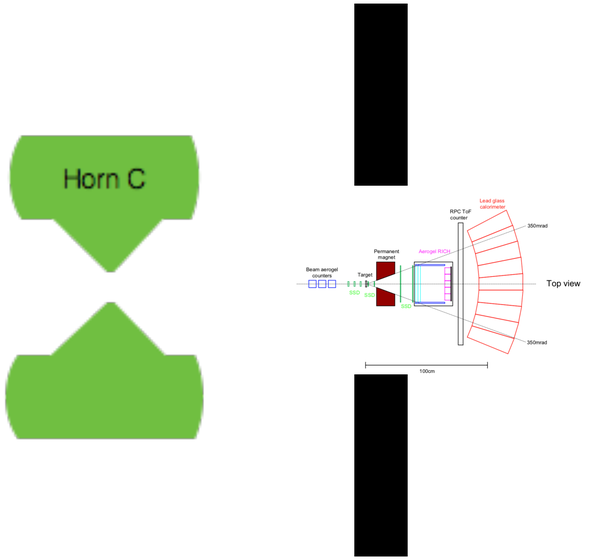
- Experiment to Measure the Production of Hadrons At a Test beam in Chicagoland
  - Makes use of the FNAL Test Beam Facility
  - Table-top size experiment, focused on hadron production measurements with $p_{beam} < 15$ GeV/c.
  - Compact size reduces overall cost.
  - High-rate DAQ, precision tracking and timing
- International collaboration with involvement of experts from NOvA/DUNE and T2K/HK
- Received Stage 1 Approval from Fermilab PAC.



Full disclosure: I am a co-spokesperson of the EMPHATIC Collaboration

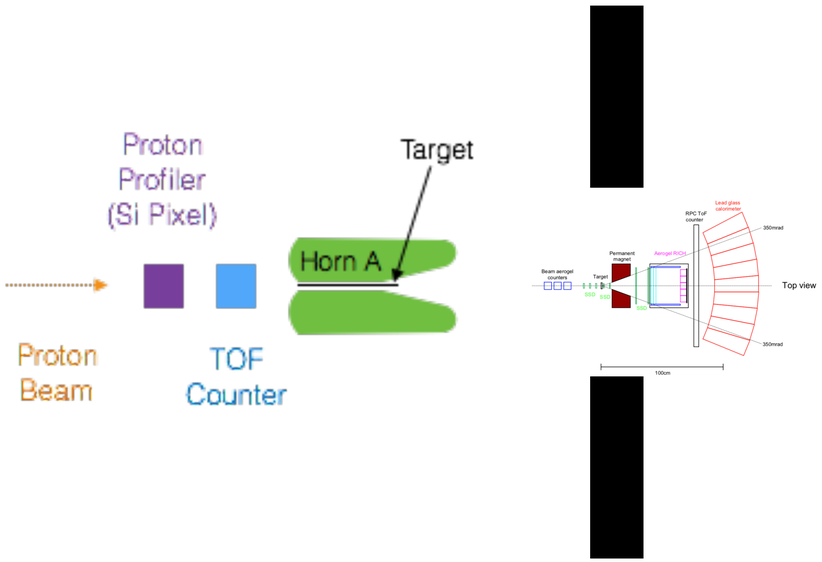
Marriage Proposal Between These Two?





motion table or rails

Marriage Requires Compromise



motion table or rails

Spare target and horns for LBNF won’t be available until the late 20’s.

Start with NuMI components?

Next Steps

- Laura Fields and I are planning on putting together a LOI.
- Others are welcome to join the fun, especially if you have other ideas of how else an EMPHATIC-like spectrometer could be used.