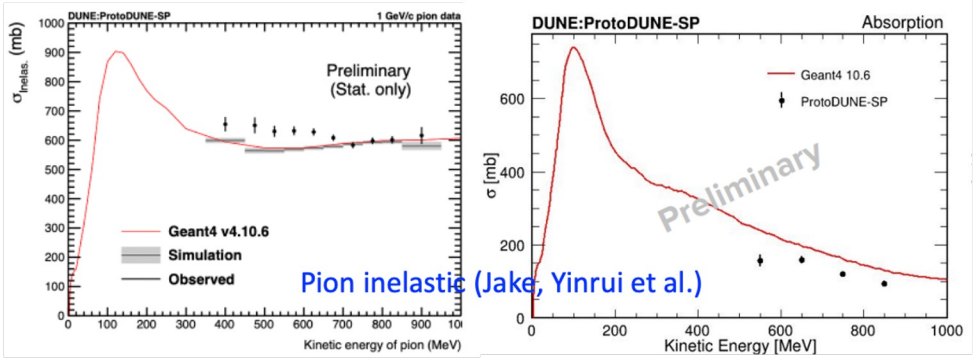
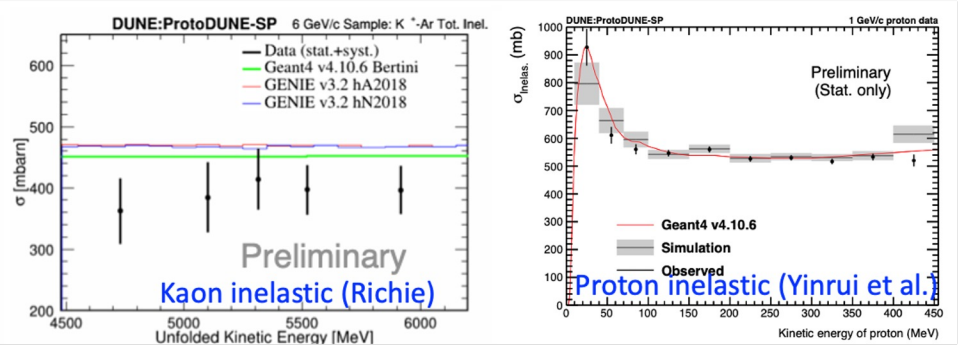
Planning of Beam Request for ProtoDUNE (HD/VD)

- With many inputs from experts

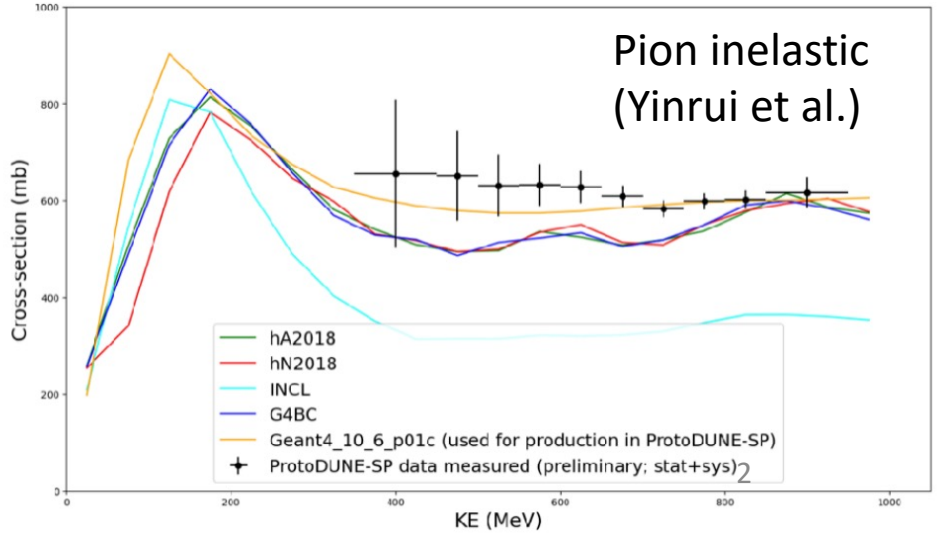
Wenqiang Gu, Laura Zambelli, Leigh Whitehead

Status of Hadron Analysis





- Except proton inelastic cross section, other analyses are limited around the resonance region
- Low energy cross section data are important for evaluating the final-state interaction (FSI) uncertainties for DUNE

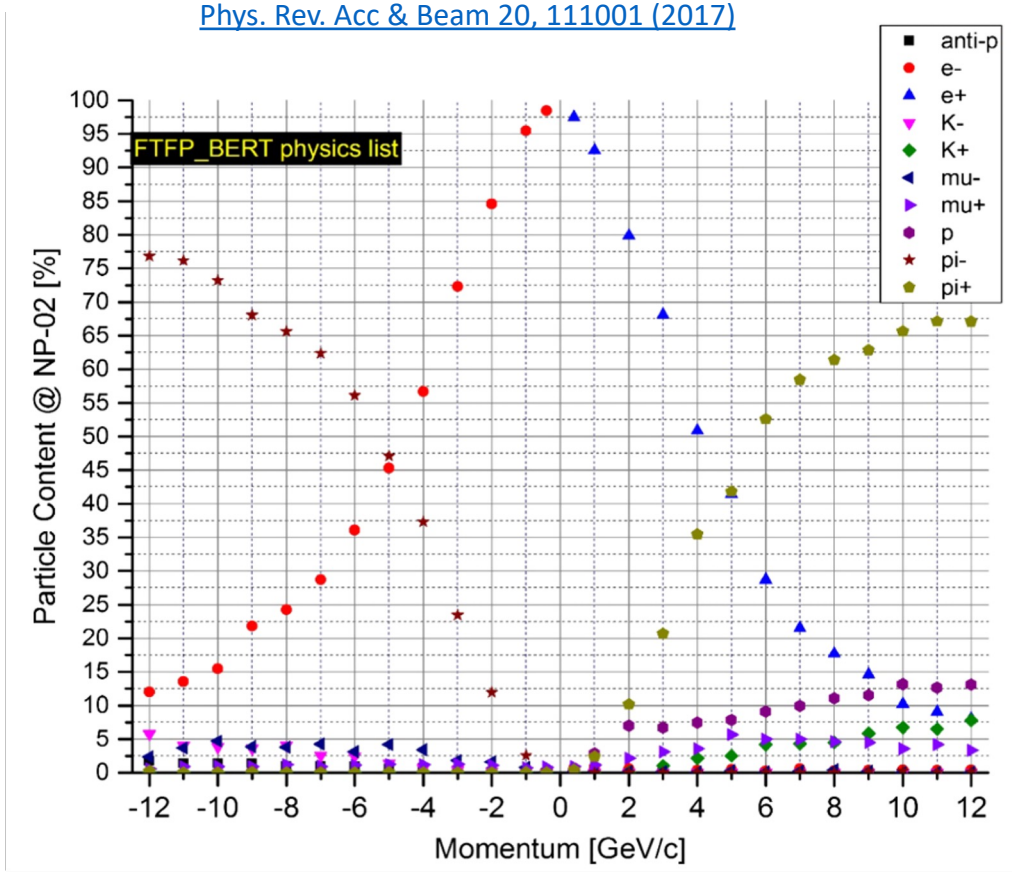


What can we add at ProtoDUNE HD & VD?

- Hadron-argon cross section data at lower energy
  - More pion data with low momentum 1 GeV/c or even lower(?)
  - Kaon triggering at lower momentum. Now only 6,7GeV/c available
- Negative polarity
  - Electron vs positron: same calorimetry performance?
  - Pi+ vs. Pi-: Pi- mostly(~75%) go through muon capture, requiring PDS for event selection
- Tune the charged particle fraction with different beam target configuration (Niko, Jake et al.)

Beam particle fraction @NP02

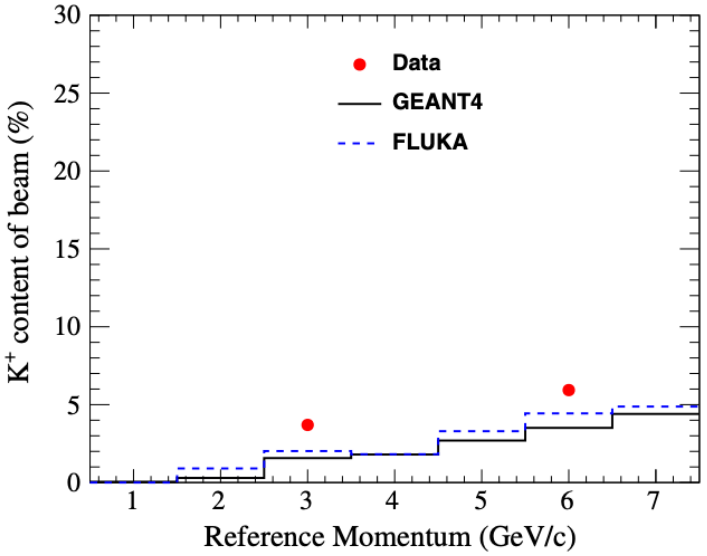
Phys. Rev. Acc & Beam 20, 111001 (2017)

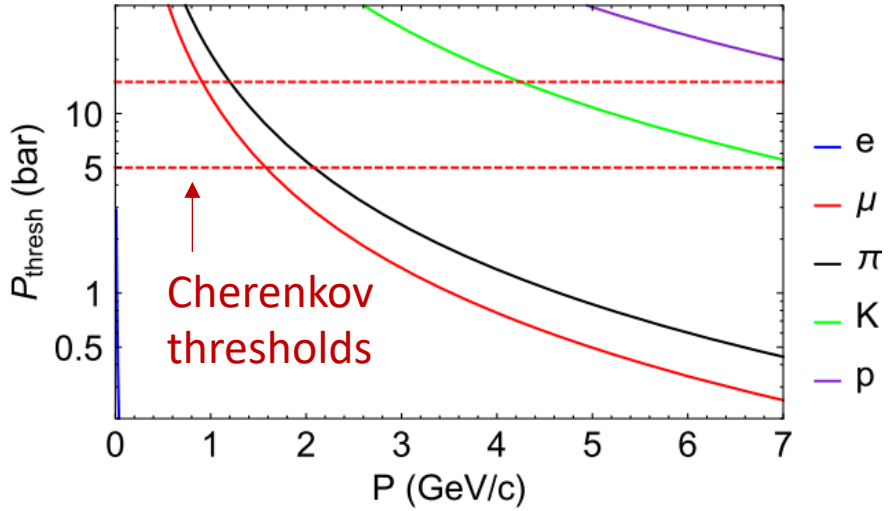


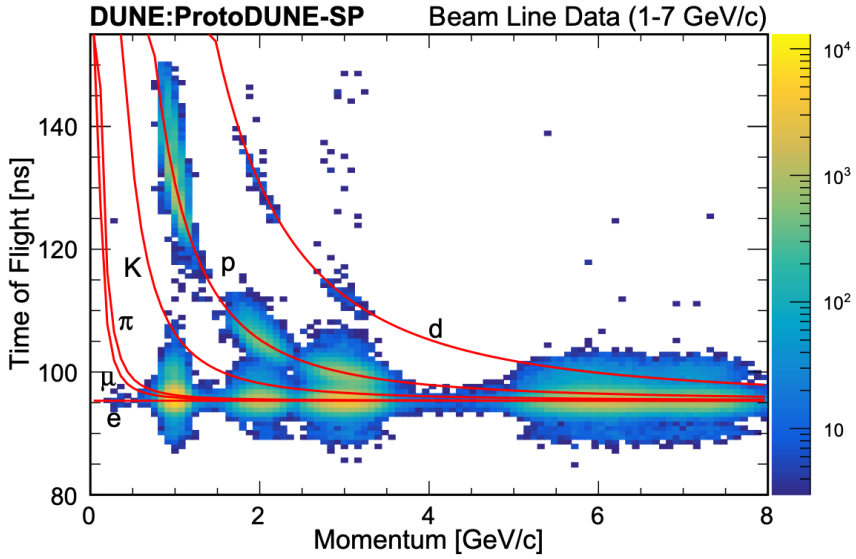
- Very similar particle fraction for negative polarity
- Still can be interesting to understand the systematic difference between different beam polarities

2GeV/c Momentum Kaon Triggers

- We are more interested in low energy cross sections
- According to G4 simulation, 2GeV/c kaons are available at 1%-ish
- Kaon trigger at 2GeV/c is possible with high Cherenkov thresholding and TOF separation for proton & kaon







General Recommendations

- A general recommendation can be given although the schedule has not been decided for ProtoDUNE HD & VD
- ProtoDUNE HD
  - Priority: more statistics of 1GeV/c beam data to perform exclusive cross section studies and probe the delta resonance
  - Bonus: 2 GeV/c beam for kaon cross section analysis
- ProtoDUNE VD
  - 1-? GeV negative beam (with pion and K or p tagging)
  - Calorimetry linearity and calibration studies
  - Compare SP/HD and VD measurements with different polarities or with same momentum

Other Inputs from Experts (Niko et al.)

- Need more manpower to restart the commissioning of beam instrumentation (~6 years since SP)
- H4 beam line layout not changed, but movement of earth surface occurred, and systematic survey needed
- Moving instrumentation between H4 & H2 is possible but may require additional instrumentation for H2

- More inputs or comments are welcome!