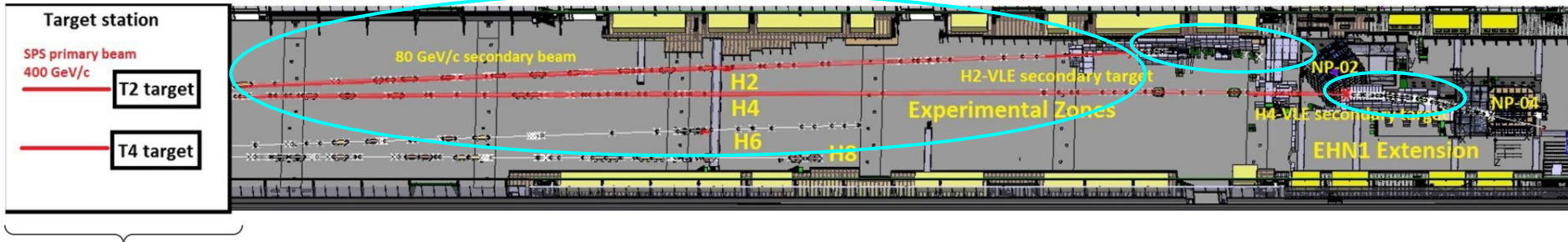# Beam Instrumentation & Simulation

Jake Calcutt
DUNE France Workshop
June 5, 2024
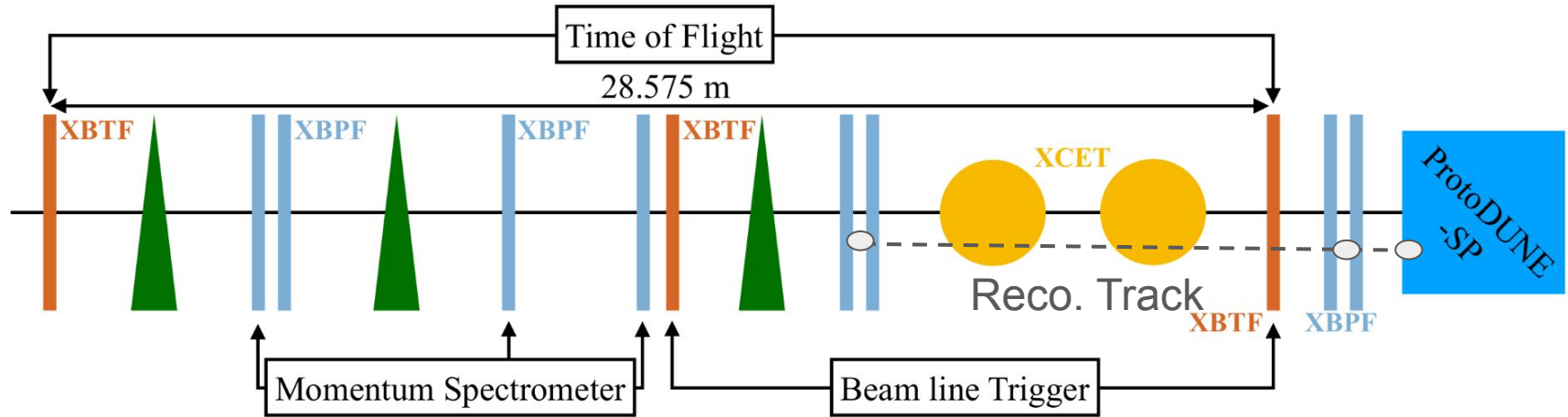
Overall Beam Layouts

Sections:

- **400 GeV/c protons from SPS → Primary targets**
  - Target material and beam momentum fixed
- **80 GeV/c particles → Secondary targets**
  - Incident momentum, target material, target length can be varied
- **~1–7 GeV/c e/K/p/pi/mu**
  - Can go down to ~300 MeV/c but highly dominated by electron/positron

Beam Layout – H4-VLE (NP04/PDSP/PDHD)

Blue lines: 192-channel scint. fiber monitors. 1D Profiles (2 orthogonal →2D Profile)
Orange lines: Bundled scint fiber monitors, 2-channel time of flight/trigger
Green triangles: magnets
Yellow circles: cherenkov detectors

Beam Layout – H2-VLE (NP02/PDDP/PDVD)
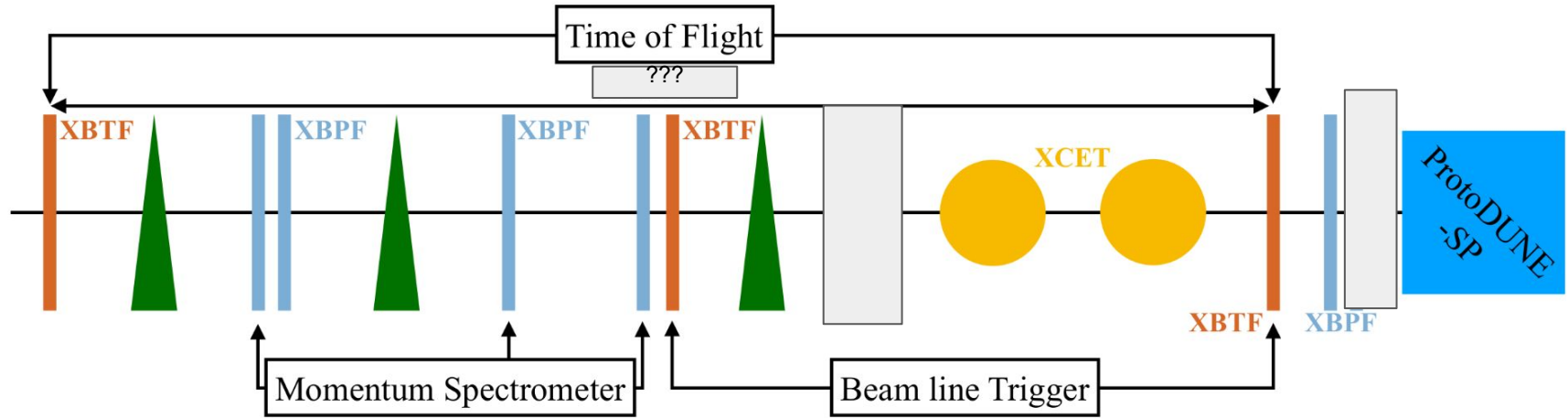
Only 1 profile monitors in the downstream section → No track reconstruction/projection to the beam
Rest of layout is relatively the same (modulo lengths)

Simulations

G4Beamline simulation of the entire beam line

- Detector geometries + Cherenkov fill gas are simulated
- <u>No dedicated detector simulation!!</u>
    - Make some assumptions/constraints in data
        - i. Cherenkov efficiency/purity ~99% (From beam experts)
        - ii. Exclude data events with degenerate hits in the momentum spect. and tracking monitors
            - Suppress pile-up/cross-talk
    - Inherent 2.5% resolution on momentum reconstruction
        - i. Driven by 1mm-width of fibers

LArSoft-based event generator uses this as input

- Creates particles at the face of the cryostat
- Accounts for interactions/decays (halo, pile-up, etc.)

Simulations – Production

Previously: Beam Expert (DUNE member) had role to produce the simulation

- Delay between request + production

Now: Handed-off package + configurations to us

- Integrated into justIN to make use of OSG grid computing to speed up turnaround
- Working with data management to put these in metacat/rucio
  - Need to finish metadata-creator script (will accept help!)

Also: have worked to make integration into LArSoft Event Gen easier

Hope to improve MC statistics for future analyses
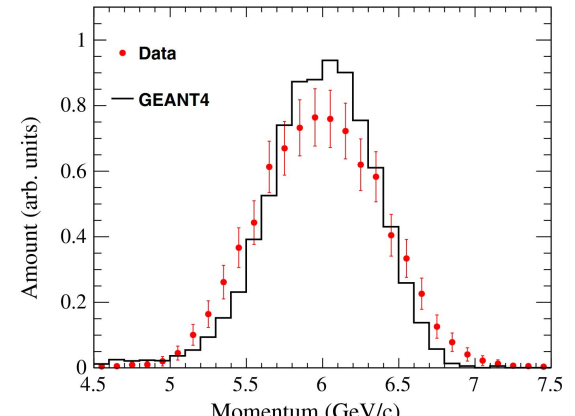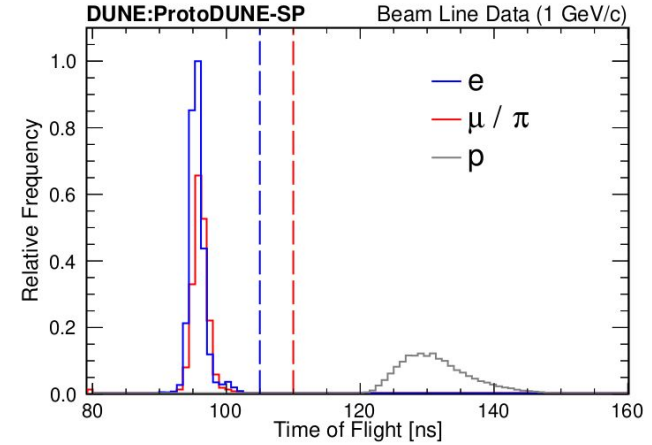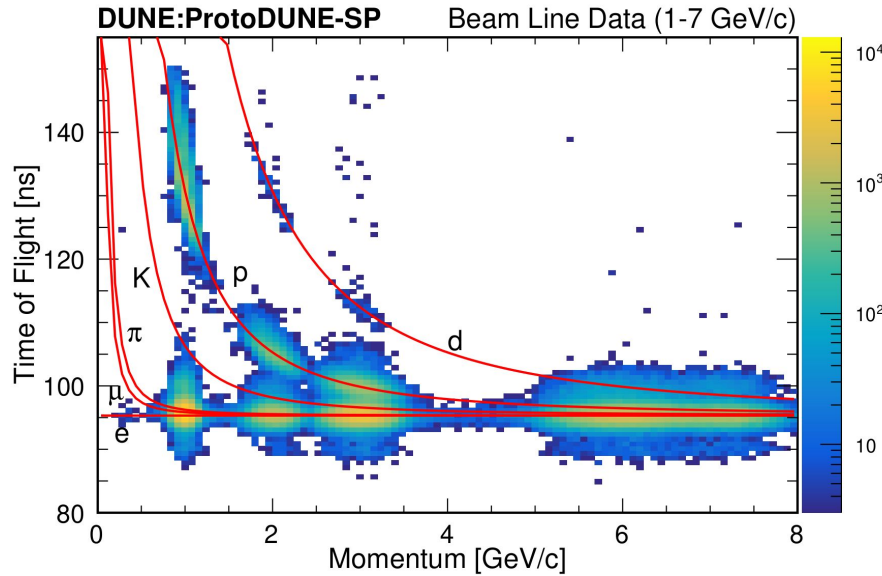
Extracting Beam Inst. Information in Data

Interface to IFBeam database at FNAL

- Information stored in a per-spill basis
- Query based off of event time stamp
- Form 'beam events' by matching individual device information to a 'general trigger'
  - Match in time to ProtoDUNE event

Will need some reconfiguration/updates for PDHD/PDVD

- Device names changed
- PDVD (H2-VLE) has different set of devices

Example of Beam Instrumentation Information

Thank You