Roman Pot occupancy study

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Datasets

Particle Gun:

- Generated 10k protons at a beam energy of 275 GeV and shot them straight down the ion beam pipe.
- Peter Steinberg's code used to generate EICsmear events which are then subjected to the magnetic fields, beam divergence, and crab cavity angular kick.

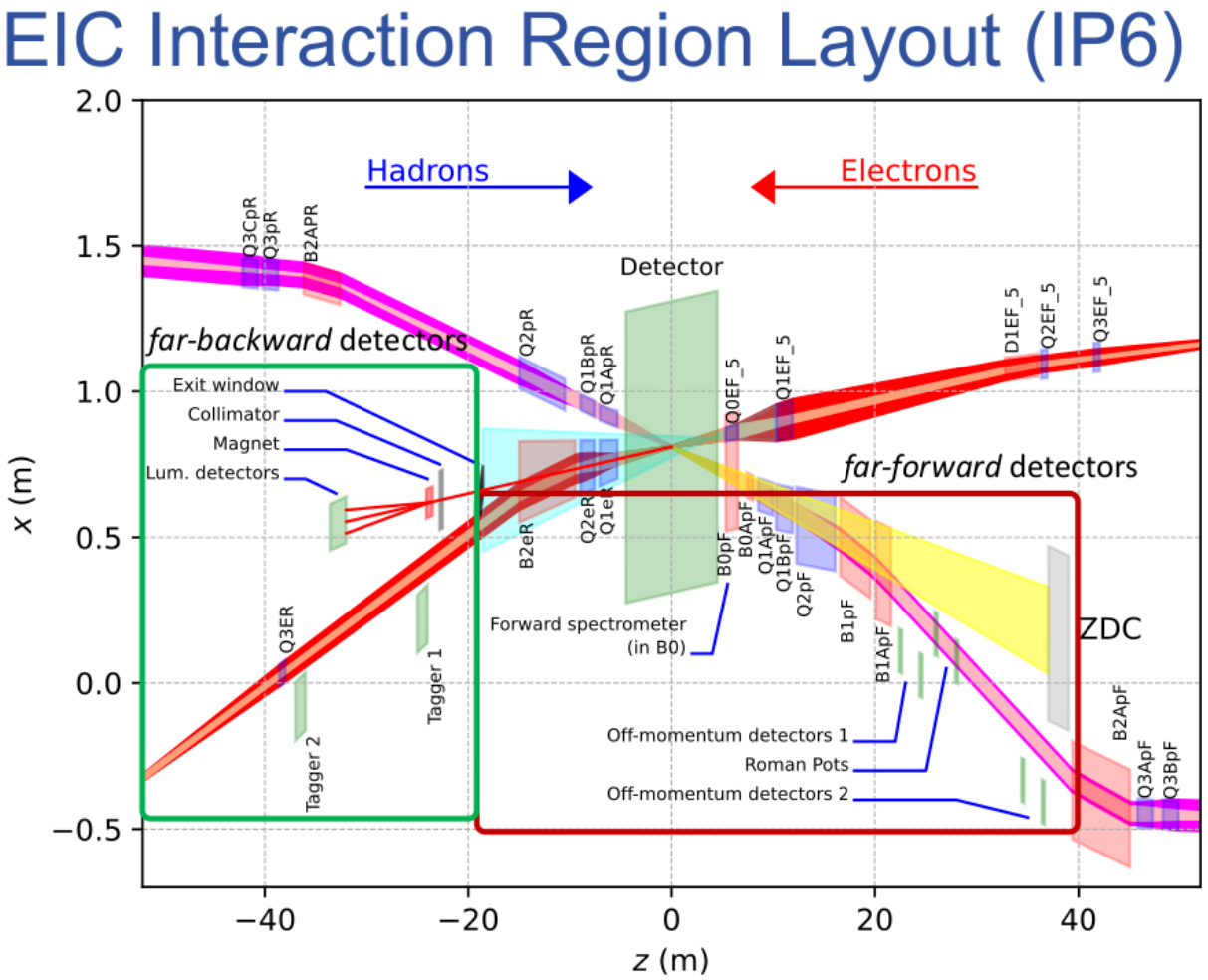
Bill Lee's simulation round 4 datasets: process (generator):

- Pion FF (DEMP)
- Pion structure function (EIC_mesonMC)
- KaonFF KLambda (DEMP), KaonFF KSigma (DEMP)
- SRC e+A (BeAGLE)
- Neutron spin structure (CLASDIS)
- u-Channel pi0 (DEMP)
- Diffractive e+Pb (BeAGLE), Diffractive e+Zr (BeAGLE)
- XYZ meson photoproduction (eISpectro)
- XYZ meson photoproduction twopi (eISpectro)

Mark Bakers BeAGLE data:

- Ran Geant4 over 1000 events from e+Zr: Jpsi → e- e+ eZr_18x122.22_tune3_tau10_B1.1_extracted_Je

Algorithm to extract the RP hit in its own coordinate frame

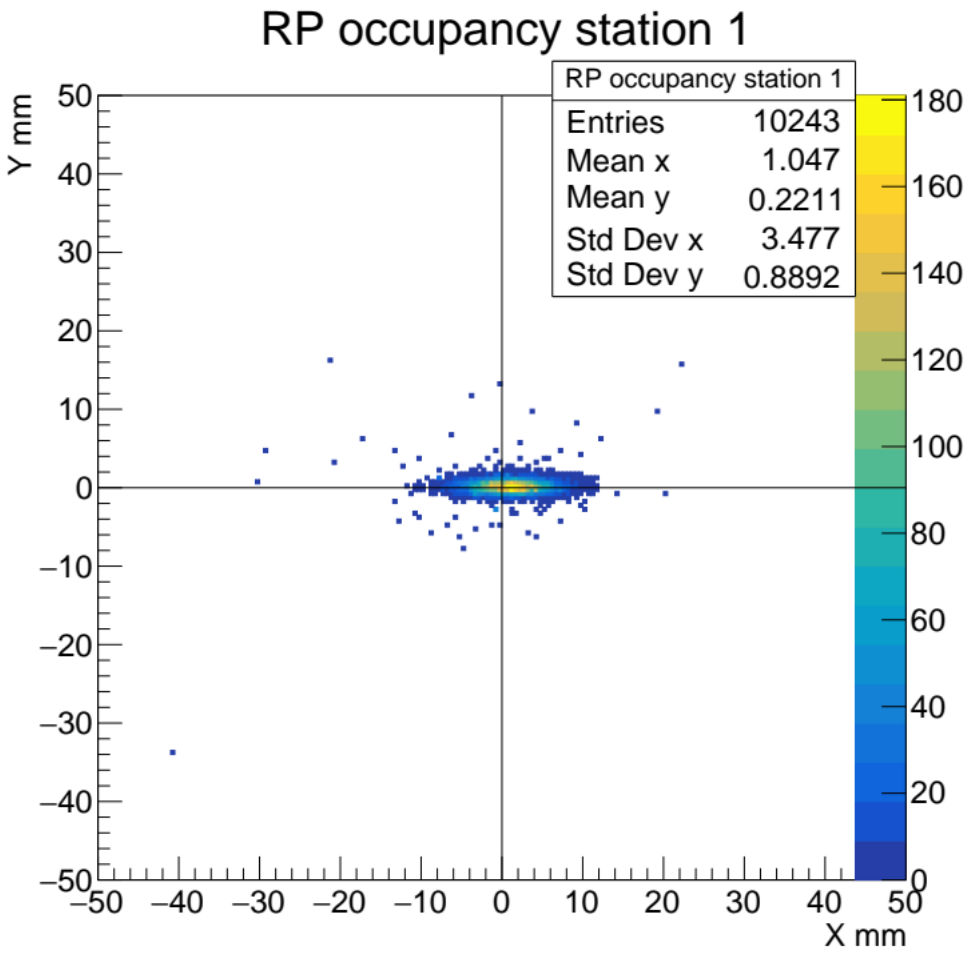


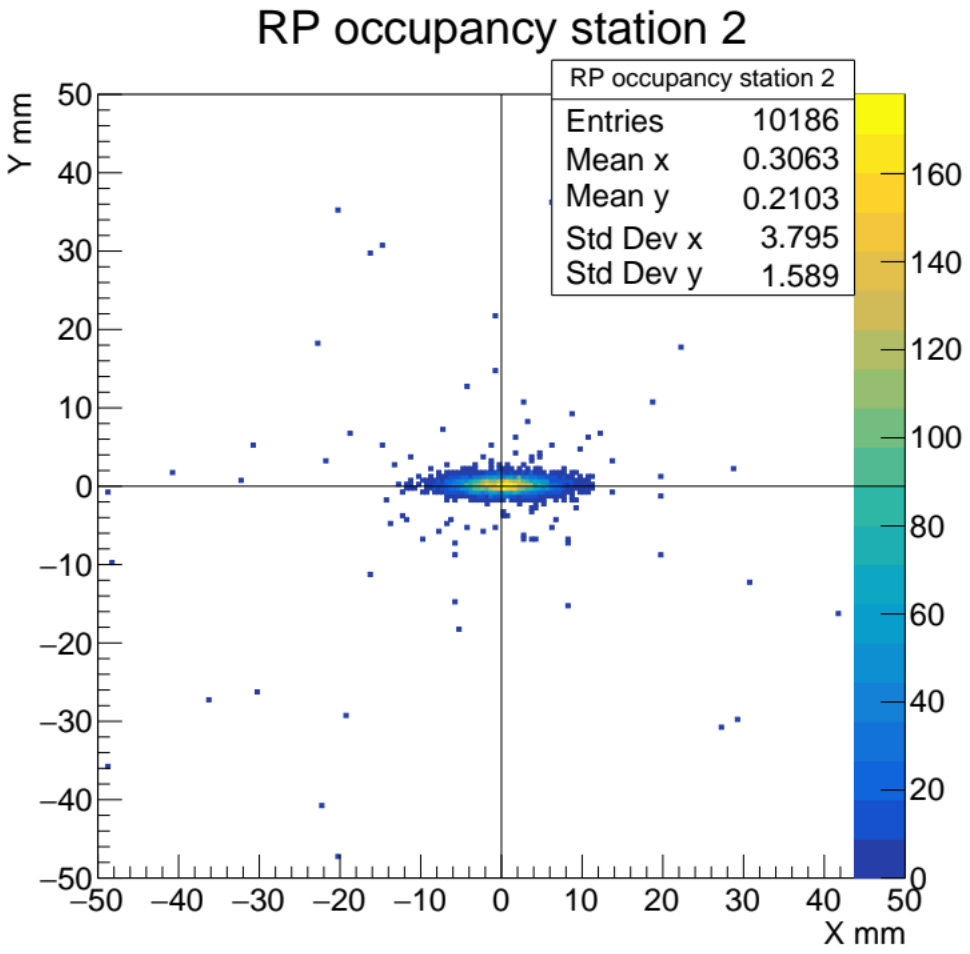
- RP hits are extracted from the node: G4HIT_rpTruth.
- They are given in the “global” coordinate system but we want to plot them in the frame of the RP. Roman Pots are also rotated about the y-axis wrt to global system.

$$X = \frac{X_{\text{global}} - x_{\text{rp center}}}{\cos\theta_{rp}} \qquad Y = Y_{\text{global}} \qquad Z_{\text{global}}$$

Used to distinguish each station

Particle gun emulating the proton beam @ IP6

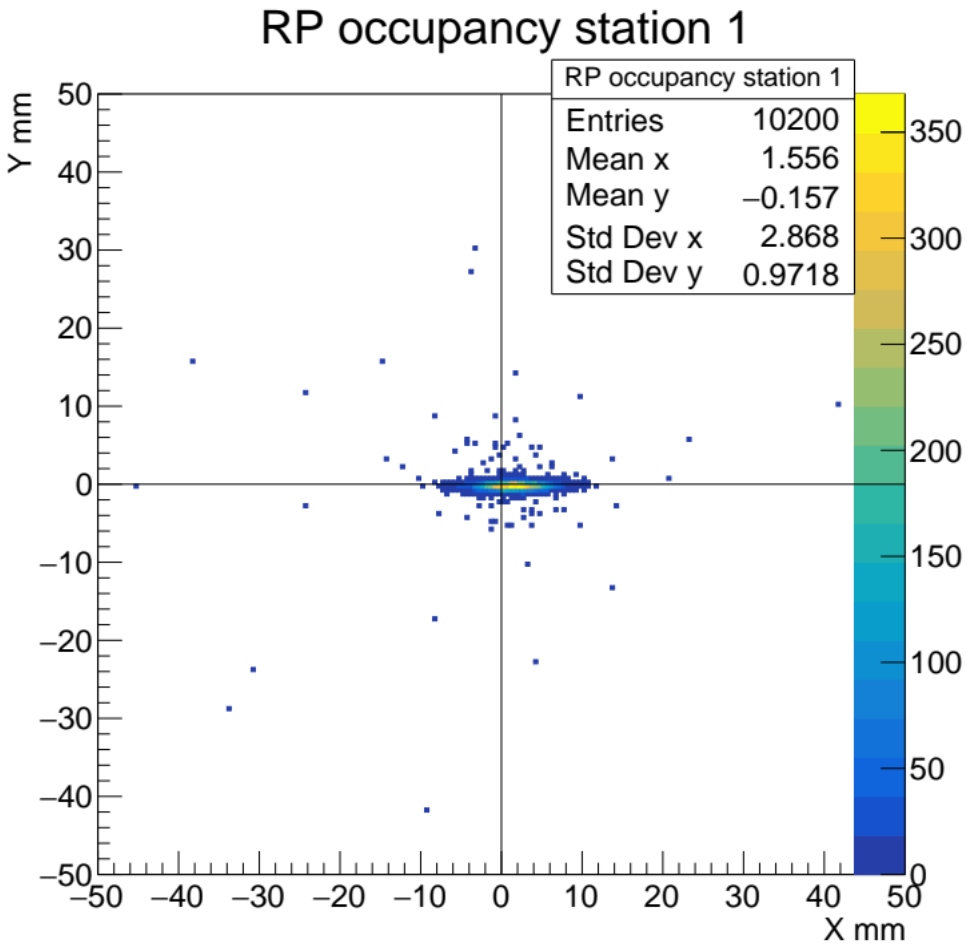


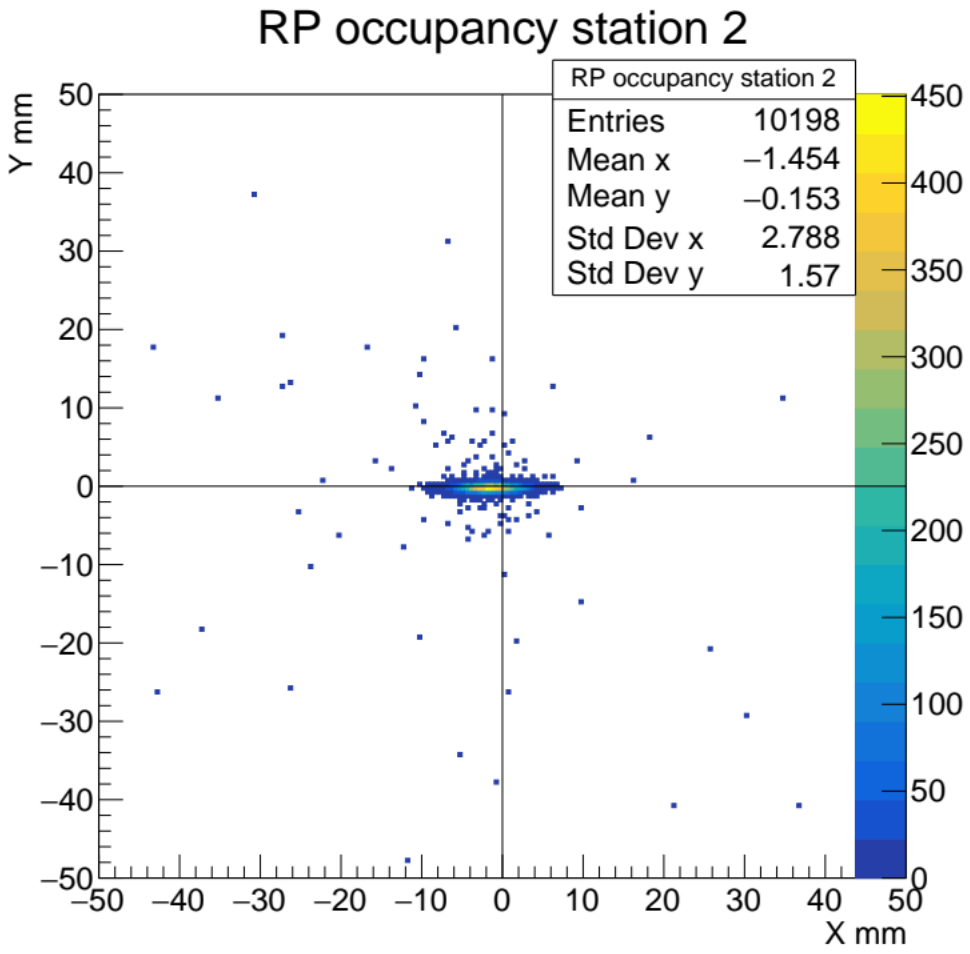


- Beam center is slightly off from the roman pot center (0,0).
- Expected beam widths are given by the standard deviations above?

Particle gun emulating the proton beam @ **IP8**

RP set before secondary focus





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Particle gun emulating the proton beam @ **IP8**

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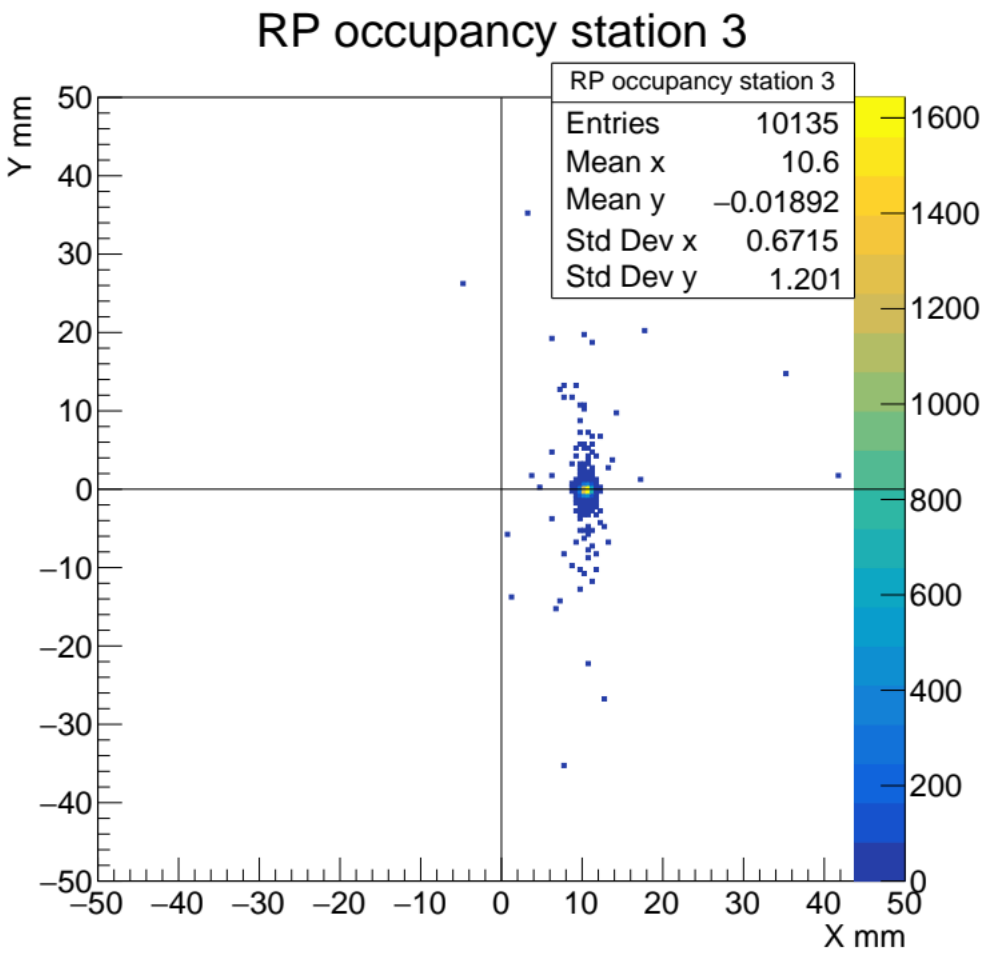
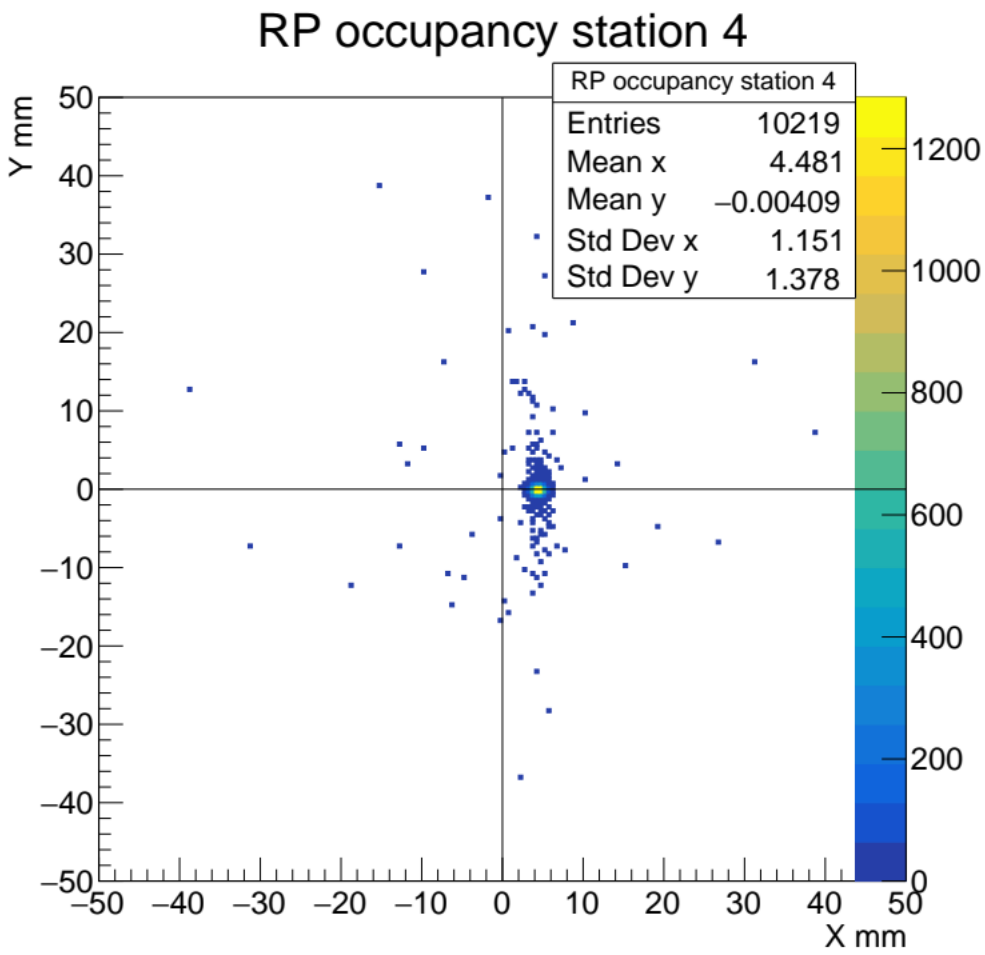




- Beam center is <u>way off</u> from the roman pot center (0,0).
- Expected beam widths are given by the standard deviations above?

Occupancies in some of Bill Lee's datasets

Sets with very little RP hits:

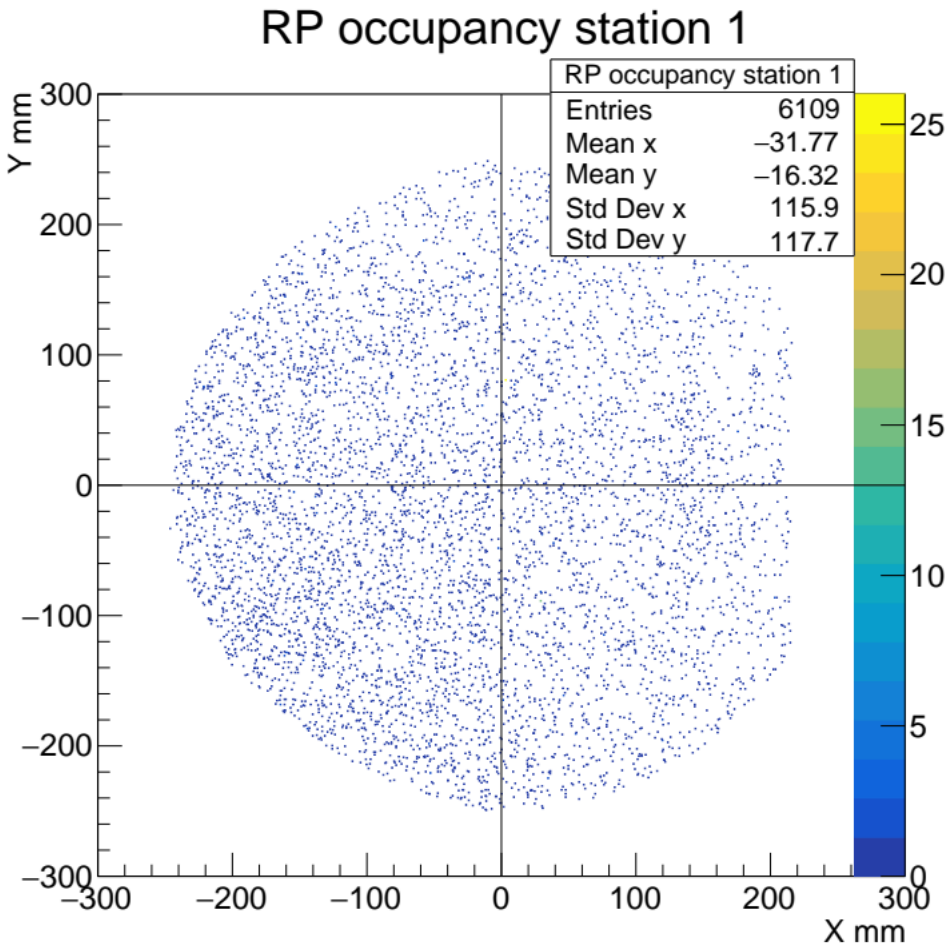
- Pion FF,
- Pion structure function study,
- Kaon FF Ksigma,
- Kaon FF Klambda,
- SRC e+A

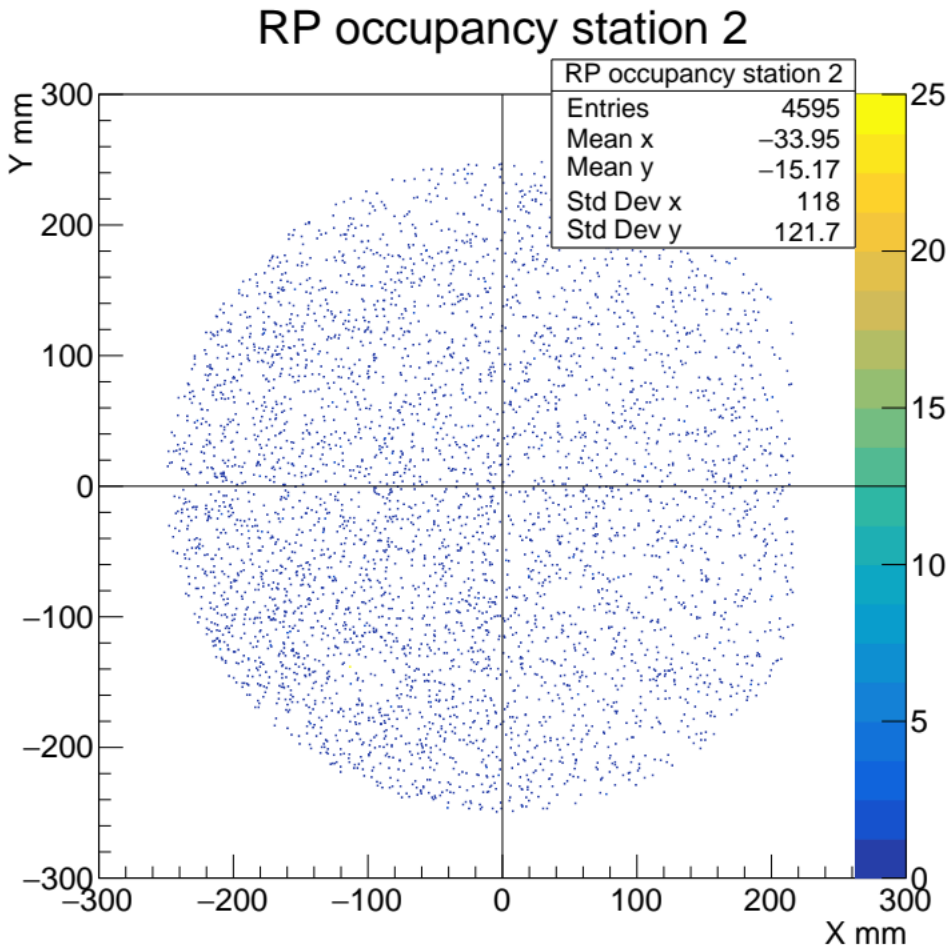
Sets with no RP hits:

- Diffractive e+Pb & e+Zr
  - These were the only two IP8 productions.
    The setup in G4_hFarFwdBeamLine_EIC.C wasn't ready. Now it is.

Plots from the other datasets will be shown

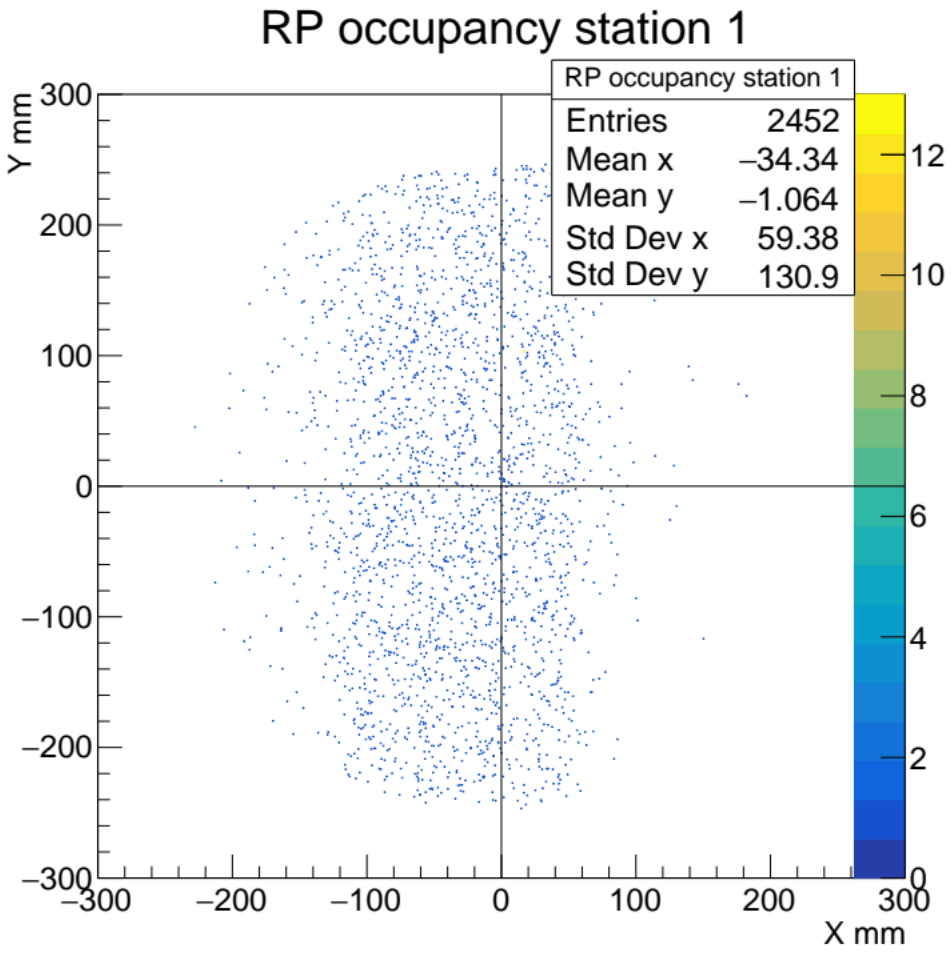
Neutron spin structure (CLASDIS)

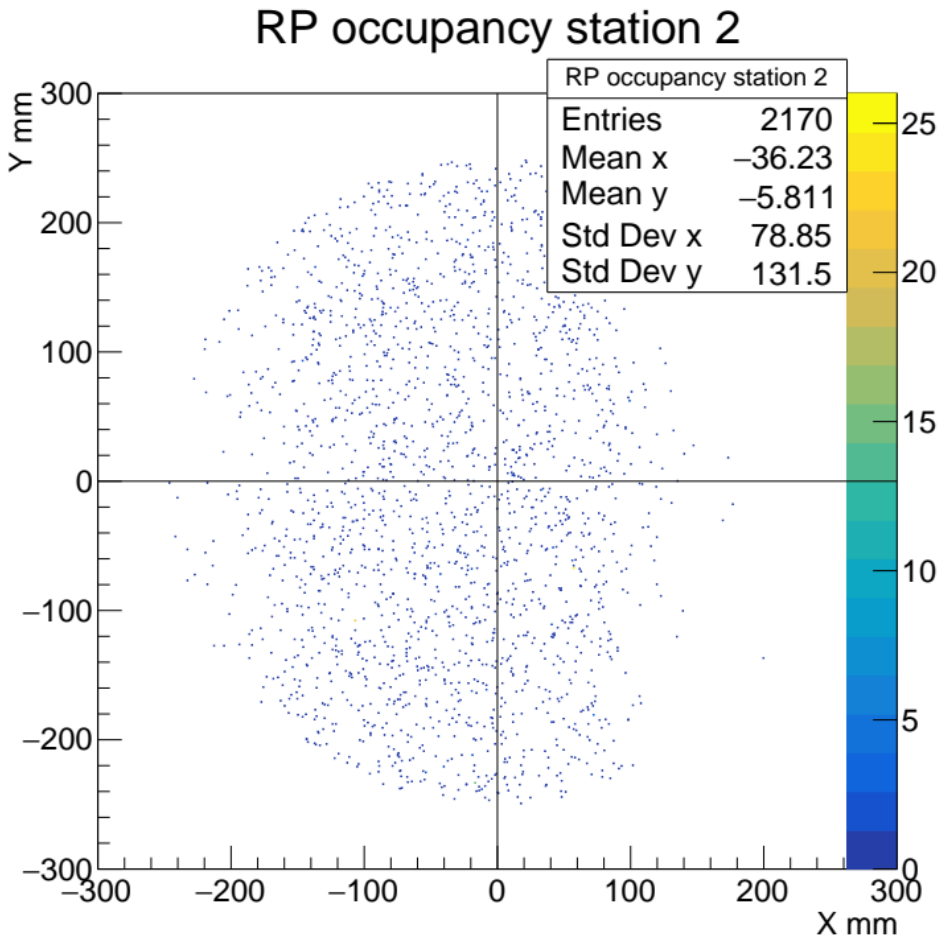




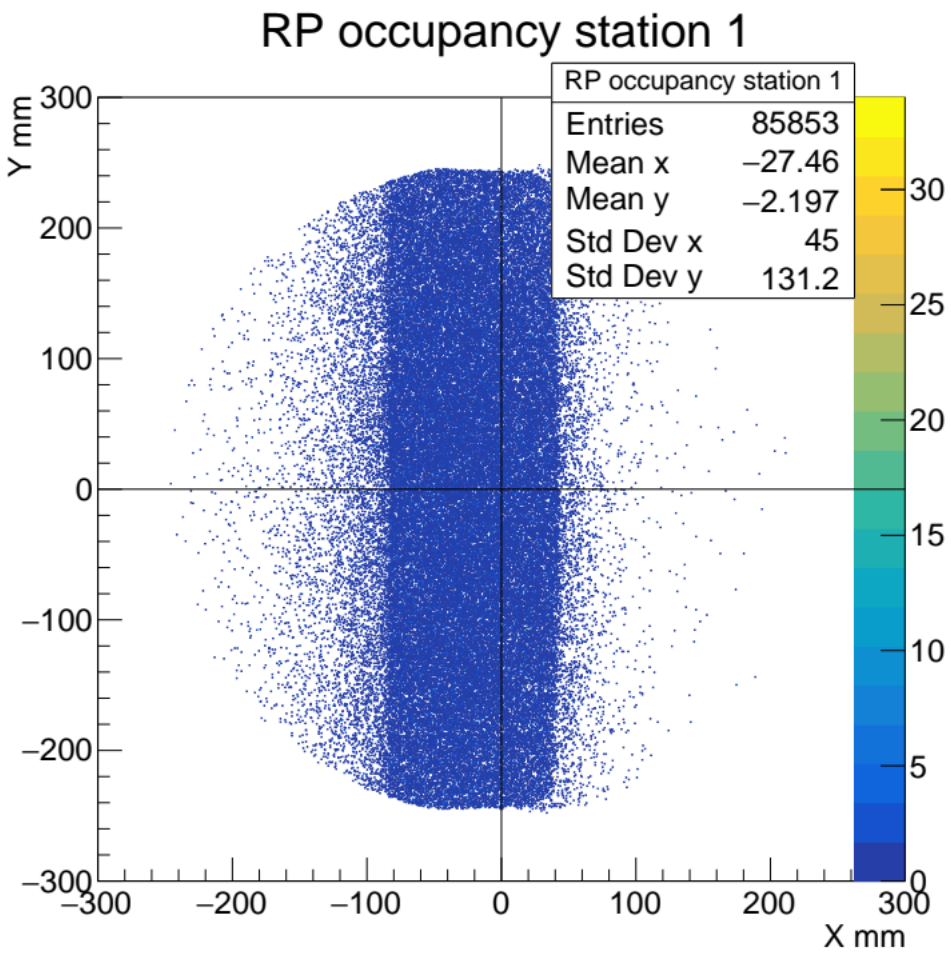
- This sample with diffuse hits allows the visualization of the whole RP disk at IP6 (R=25 cm).
- The right side is clipped for some reason...

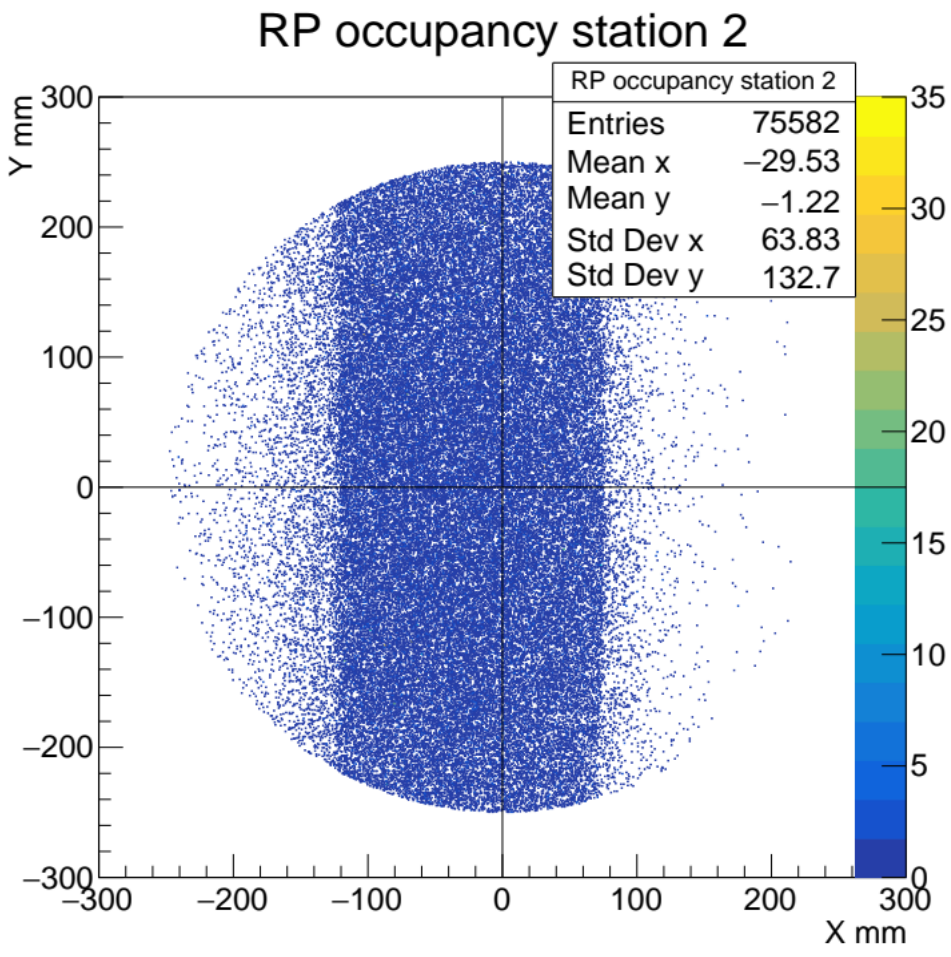
XYZ meson photoproduction (eISpectro)





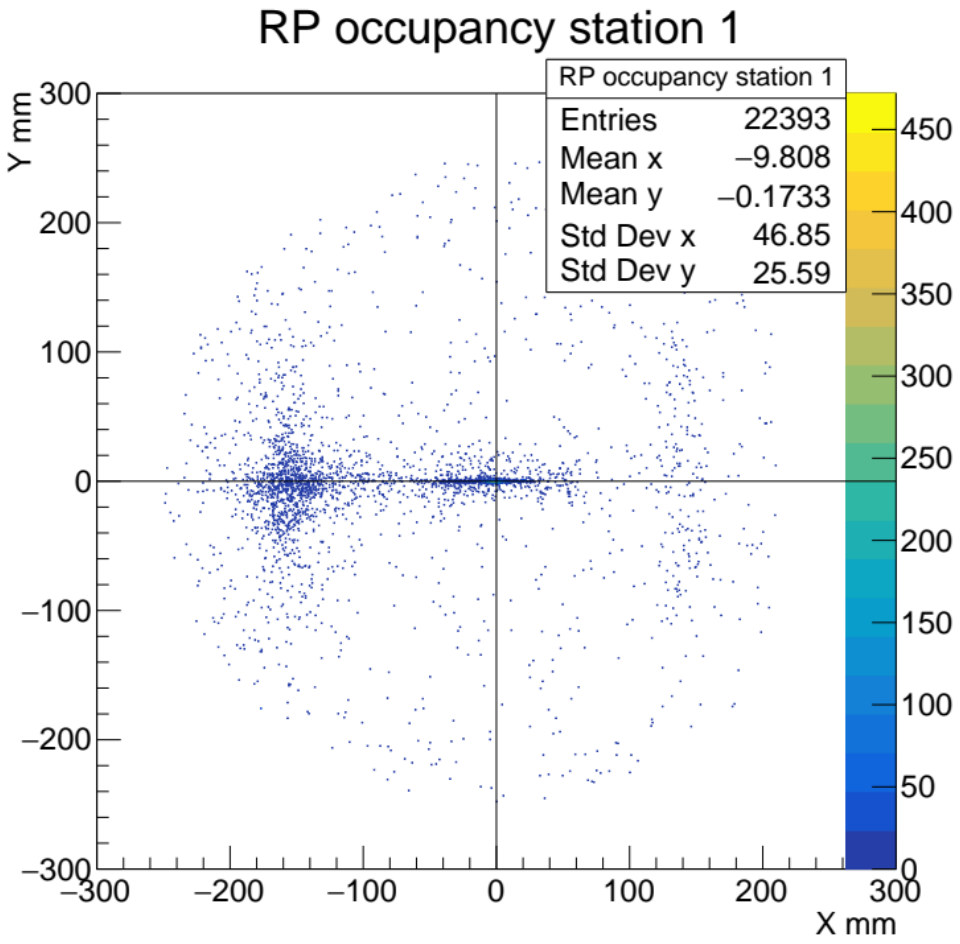
XYZ meson photoproduction twopi (eISpectro)

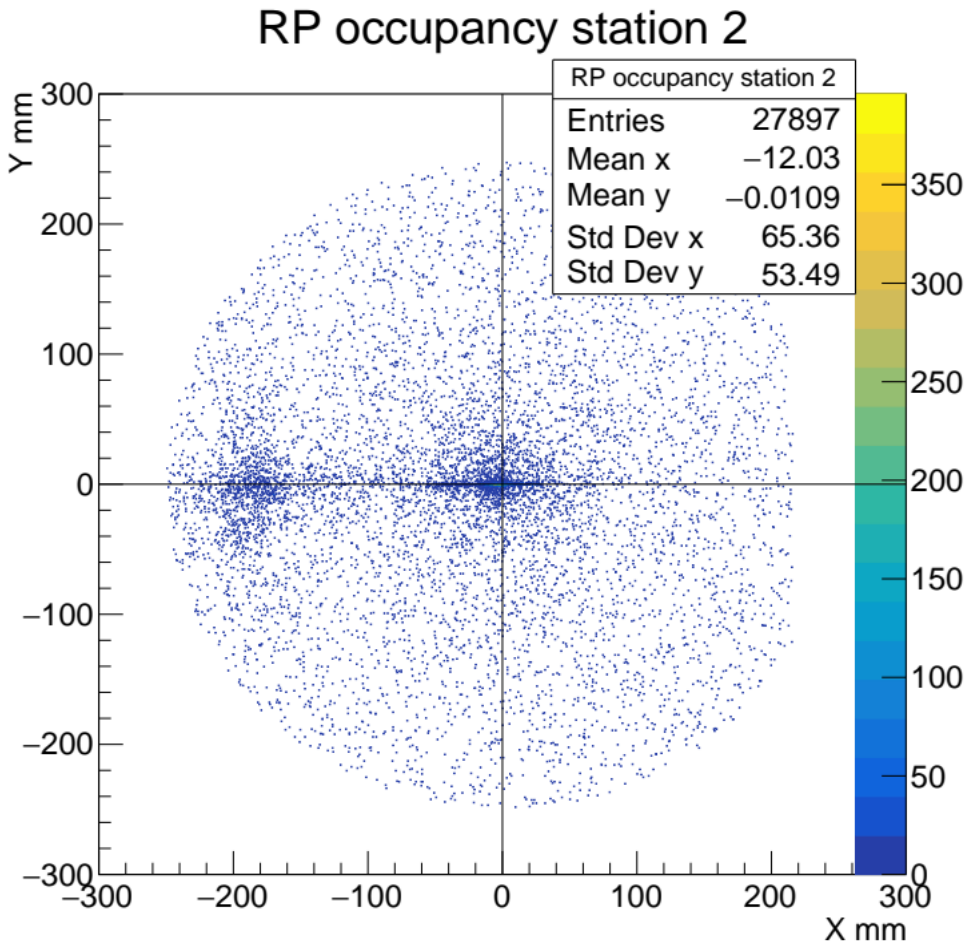




e+Zr: Jpsi → e- e+ (BeAGLE)

IP6





- Also checked the PID of the PHG4Particle corresponding to the hits
- Separated electrons, muons, kaons, pions, and protons from the “rest”
- Almost all of these hits were from the “rest”

Summary & Questions

- Roman Pot Truth hit information has been analyzed for various datasets
- Using the particle gun to simulate the proton beam, the RP centers are not quite aligned with the beam center. What's the reason for this?

- The Roman Pot parameters are currently hardcoded in G4_hFarFwdBeamLine_EIC.C. Should we move the parameters to a .dat file as done for the magnetic fields and located in the dir $CALIBRATIONROOT?
- I created a .dat file from which the parameters are read into my code:

```
## ----------------------------------------------------
##
## sizes are in cm and angles in radians
##
##  name (IP #, Station #)    Pos_x    Pos_z    Size_x   Size_y    Rot_y
IP6_St1                      -83.22    2600      25       0       +0.047
IP6_St2                      -92.20    2800      25       0       +0.047
IP8_St1                      +75.60    2600      25       20      -0.035
IP8_St2                      +78.15    2800      25       20      -0.035
IP8_St3                      +101.94   4300      25       20      -0.029
IP8_St4                      +106.94   4450      25       20      -0.029
```

- PHG4Particle get_pid() for BeAGLE returns numbers like 1000400860 with momenta in the TeV range. How does one decode this to obtain the nucleus, excited state, etc?