Preliminary Elastic Scattering Data from the MIPP Experiment

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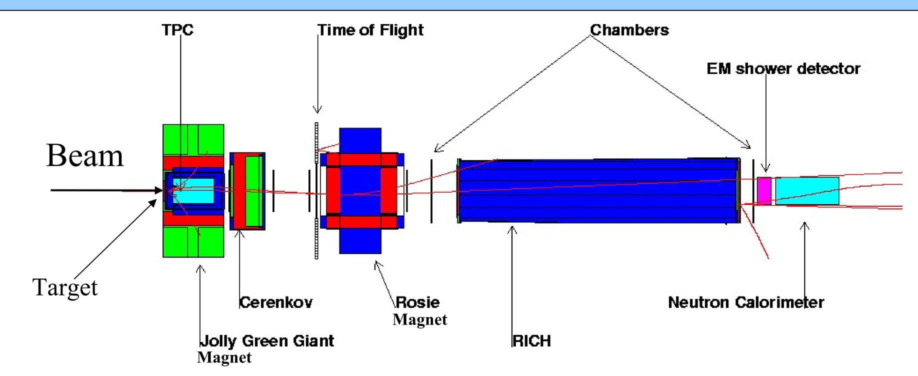
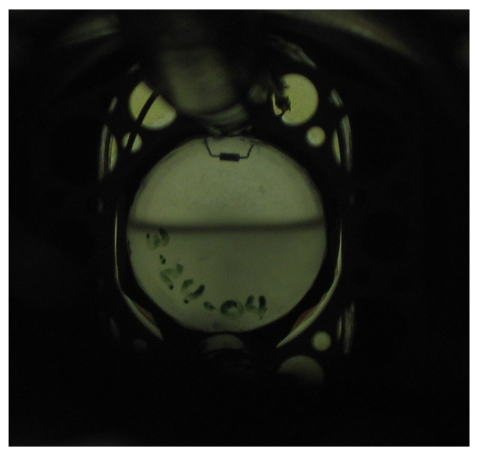
Detector Performance:

Detectors are preforming well in various stages of calibration, which we expect to finish in July. Plots shown use data from the 2005 run without selection. Beam particle ID for various momentum and targets were used in this analysis. Secondary particles where only identified by RICH, and momentum measured by tracking chambers.

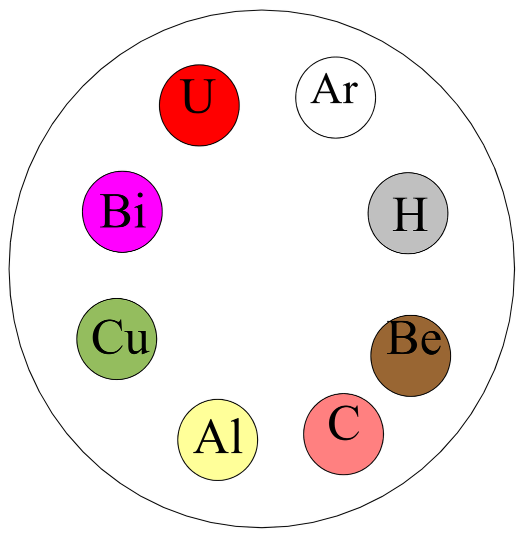


Targets and Events:

MIPP collected 2 M events on the composite NuMI target and 10 M events on 6 thin Nuclear targets of 1% λ.



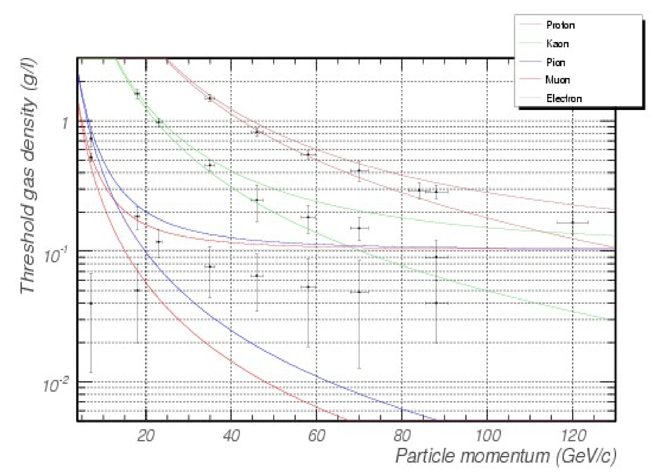
MIPP used a cryogenic Liquid Hydrogen target for 5 M events. Shown here while it is being filled.

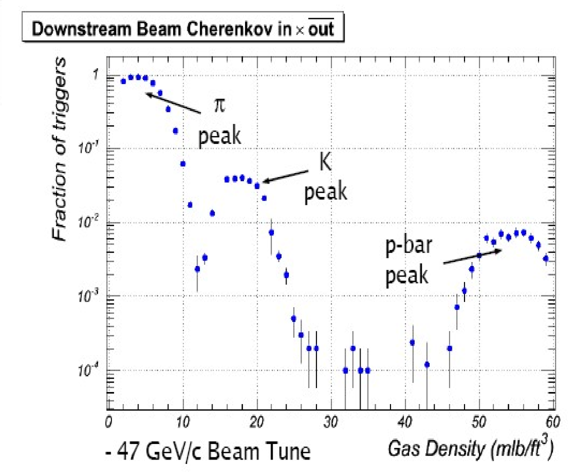


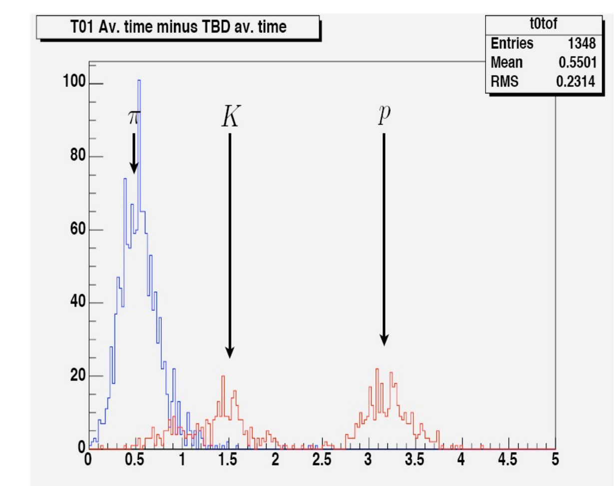
In addition we have a Argon gas target in the TPC and empty target runs for background subtraction.

Beam Particle Identification:

Six beam species: π^+, K^+, p and antiparticles are triggered with 98% tagging efficiency by the Beamline-Ckov They work over a wide beam momentum range from 10 to 120 GeV/c. At low momentum a TOF system tags the beam as well as providing PID for produced particles.

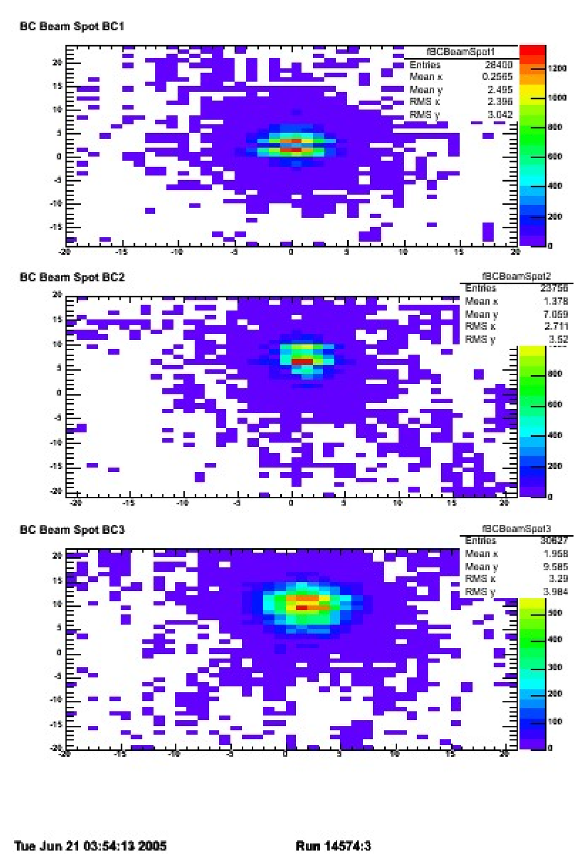




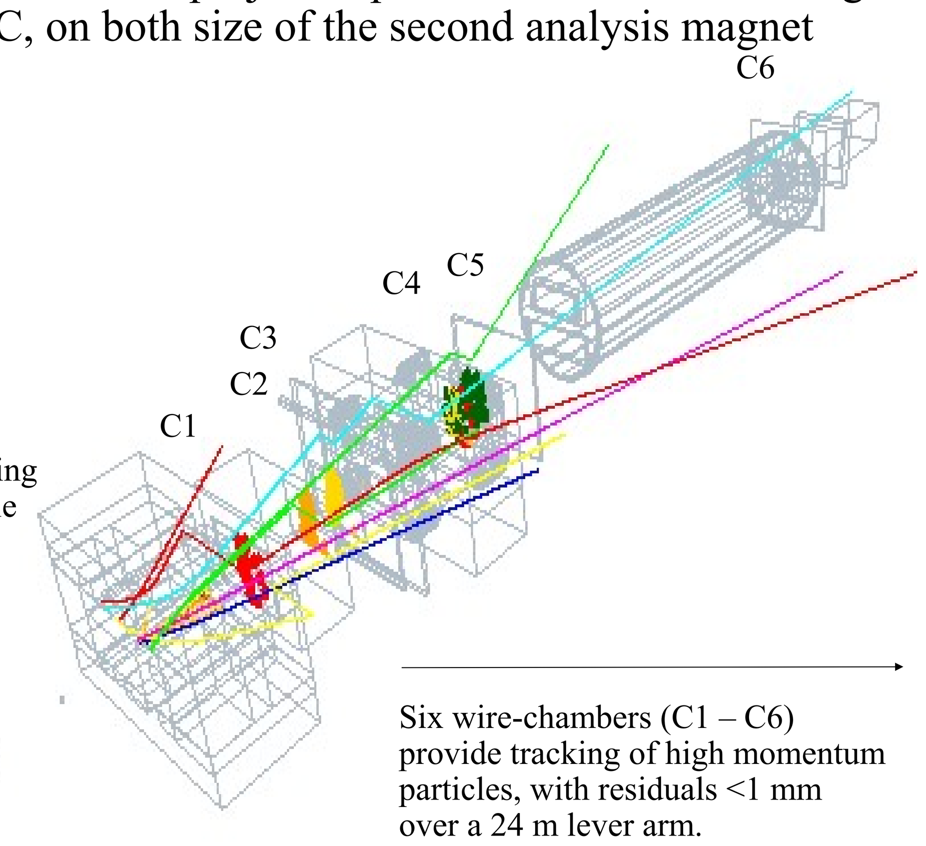


Tracking Chambers:

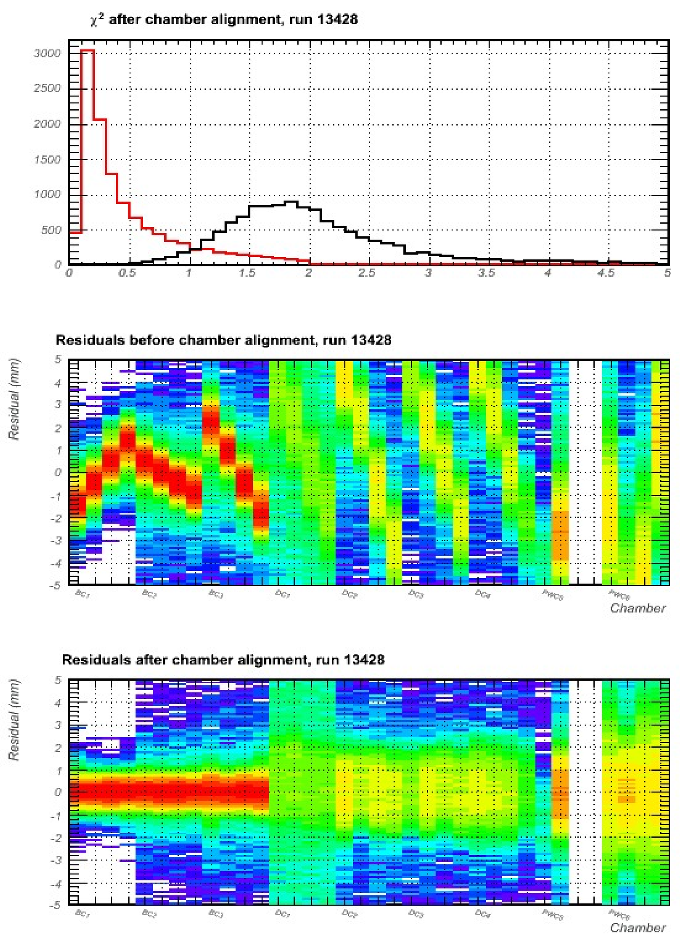
There are 9 wire chambers, 3 to track the projectile particle incident on the target and six downstream of the TPC, on both size of the second analysis magnet



Three beam chambers provide tracking of projectile to the target. For reliable cross section measurements this is constantly monitored run by run.



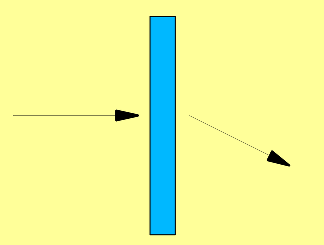
Six wire-chambers (C1 – C6) provide tracking of high momentum particles, with residuals <1 mm over a 24 m lever arm.

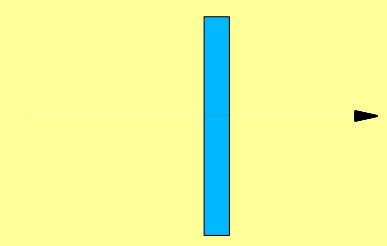


How to select interaction type:

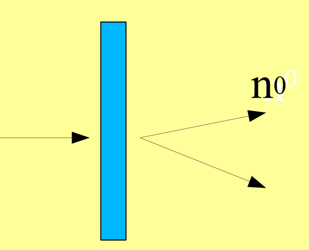
elastic: no interactions is just scattering:

straight track is a good sign of no interaction

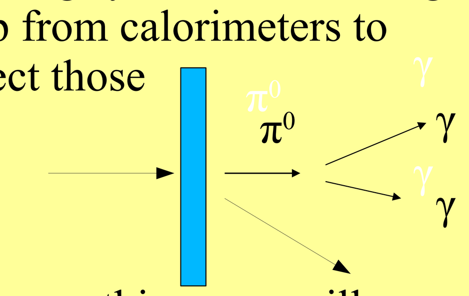




There are some elastic that will look like inelastic:



Neutrals are not in charged tracking system so we will get help from calorimeters to detect those



inelastic: a hard interaction, our trigger enhances this so we will have a lot

Just like elastic had backgrounds from inelastic so do inelastic have backgrounds from elastic events.

Theory Behind Cross Section:

The elastic scattering amplitude F(q,s), where s is total hadron-nucleon center of mass energy squared and q is the momentum transfer vector, gives us a possibility to calculate total cross section through the optical theorem.

$$\sigma(s)=(4\pi/k)\mathrm{Im}F(0,s)$$

where k is the hadron projectile momentum in the target-nucleus rest frame. Using this amplitude we are also able to calculate differential elastic cross section.

$$d\sigma_{elast.}(s)/d\Omega=|F(q,s)|^2 \qquad d\sigma_{elast.}(s)/dt=\pi/k^2|F(q,s)|^2$$

and total elastic cross section is: $\sigma_{elast.}(s)=\int d\Omega|F(q,s)|^2=1/k^2\int dq|F(q,s)|^2$

The elastic scattering amplitude can be expressed through the profile function:

$$\Gamma(B,s)=1-S(B,s) \qquad F(q,s)=ik/2\pi\int d^2Be^{iq}\Gamma(B,s)$$

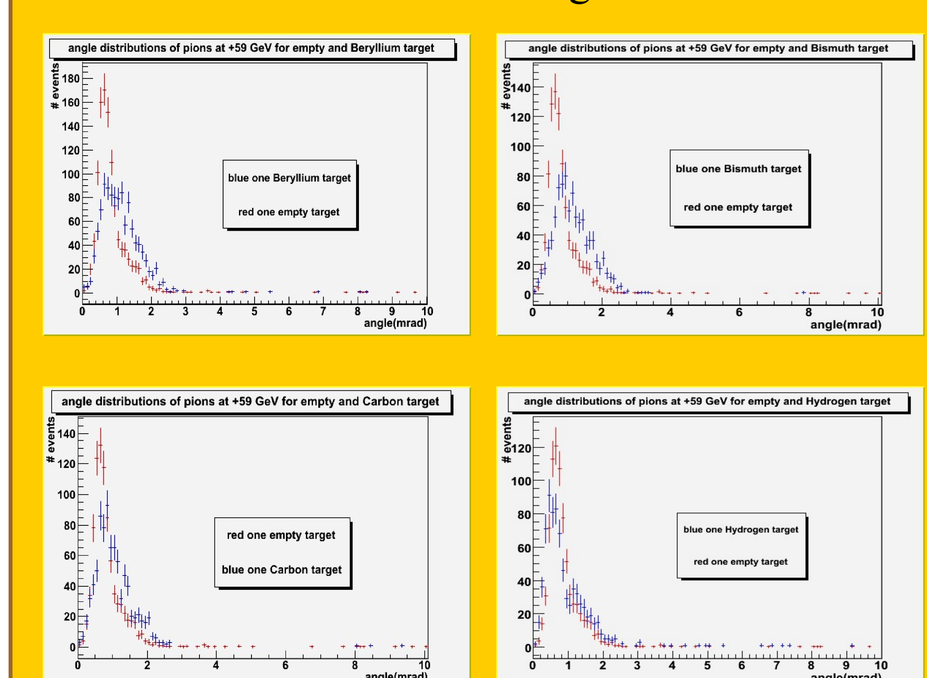
where S(B,s) is the S-matrix and B is the impact parameter vector perpendicular to the incident momentum k. The total and elastic cross sections can be obtained from the profile function Γ(B,s):

$$\sigma_{tot}(s)=2\int d^2B\mathrm{Re}[\Gamma(B,s)] \qquad \sigma_{elast.}(s)=\int d^2B|\Gamma(B,s)|^2$$

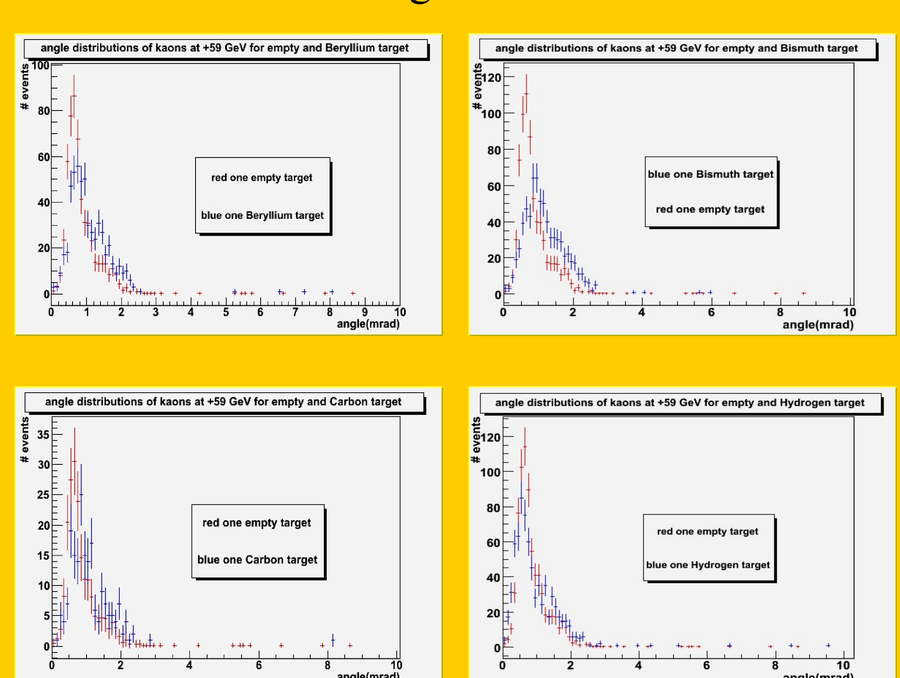
Thus to calculate the total, elastic and differential cross sections we need to know S-matrix S(B,s).

Preliminary Elastic Scattering Results:

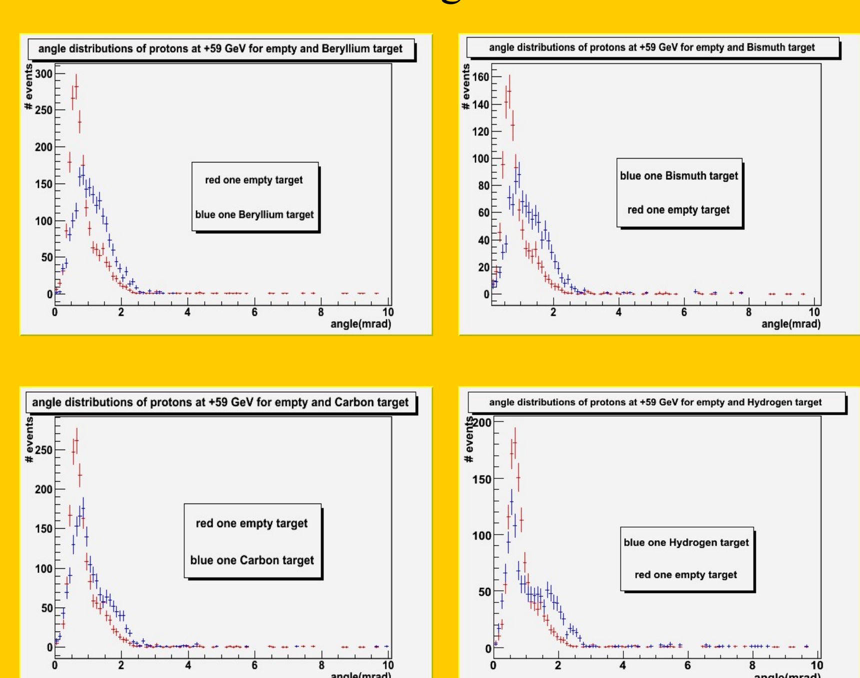
Elastic scattering of pions at +59 GeV at different nuclear targets:



Elastic scattering of kaons at +59 GeV at different nuclear targets:



Elastic scattering of protons at +59 GeV at different nuclear targets:



-We are searching for elastically scattered pions, kaons and protons from different nuclear targets at +59 GeV.

-Since we only used particle I.D. From RICH, we are limited in acceptance angle. We do not see substantial number of tracks scattered in this angle.

-With increased particle I.D. From Time of Flight and Cherenkov counter we will have more elastically scattered particles.