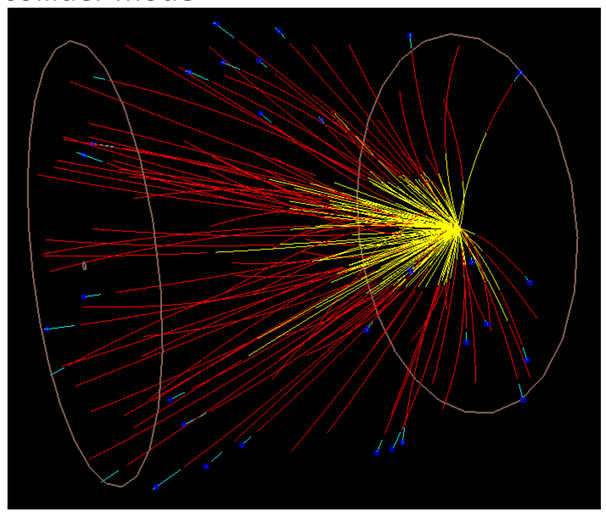
Results from Fixed Target Collisions at STAR

Kathryn Meehan, for the STAR Collaboration
University of California, Davis

Why a Fixed Target Program?

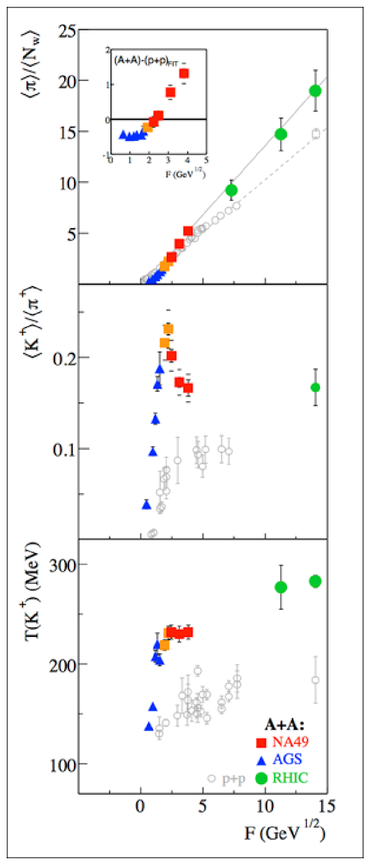
- Results from NA-49 have been used to claim onset of deconfinement at $\sqrt{s_{NN}}$ =7.7 GeV
- To test this claim STAR needs to access energies below 7.7 GeV where we expect no QGP formation
- At these lower energies the luminosity of RHIC is too low, making it impractical to take data in collider mode



Event display of an actual Au + Au fixed target event with $\sqrt{s_{NN}}$ = 3.9 GeV

The Goals of the Beam Energy Scan Program:
1) Find the disappearance of QGP signatures
2) Find evidence of a first-order phase transition
3) Find the possible Critical Point

The Fixed-Target Program will extend the search range for all of these features of the QCD phase diagram up to μ_B = 720 MeV from 420 MeV

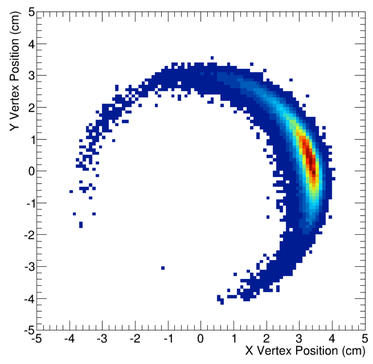


Above, in descending order, are the "kink", "horn", and "step" features used by NA49 to claim onset of deconfinement at about 7 GeV.

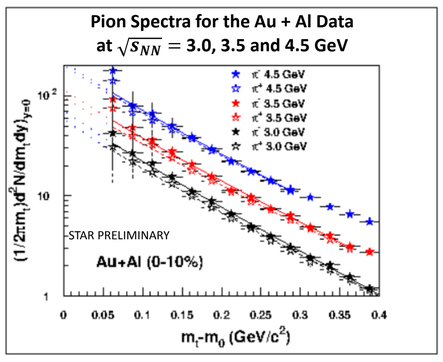
Reference: PR C77 024903 (08)

Proof of Principle: Au + Al Beam Pipe Studies

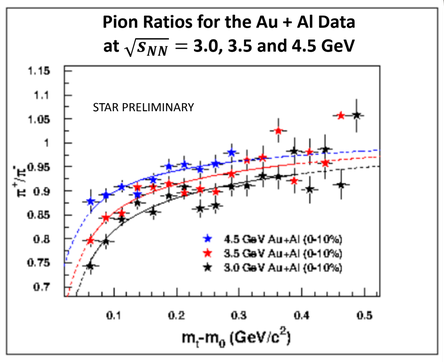
Vertex Distribution of Au + Al Beampipe Events



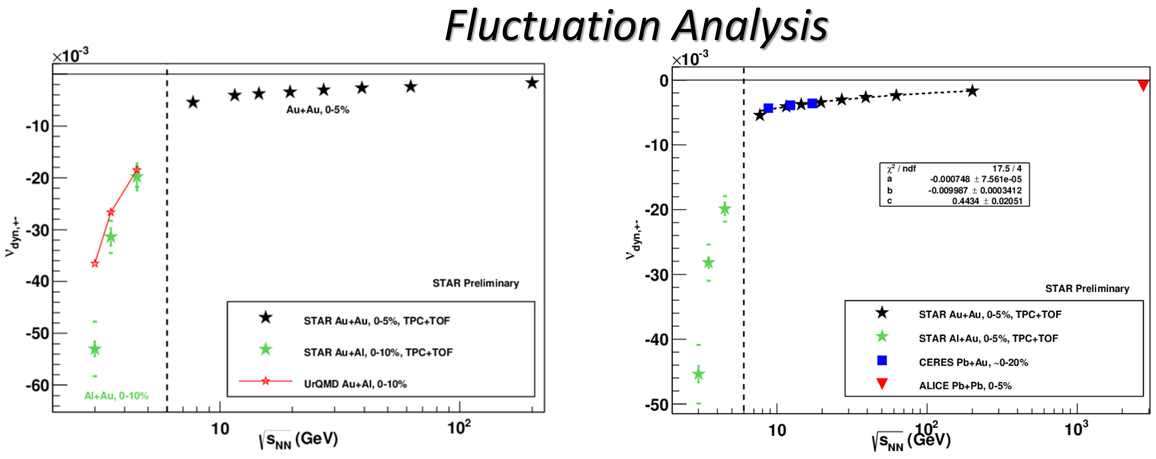
Pion Spectra for the Au + Al Data at $\sqrt{s_{NN}}$ = 3.0, 3.5 and 4.5 GeV



Pion Ratios for the Au + Al Data at $\sqrt{s_{NN}}$ = 3.0, 3.5 and 4.5 GeV



Fluctuation Analysis



Gold Target Installation

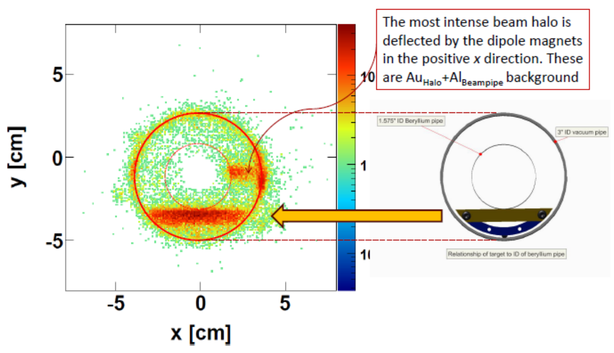
A technician installing the fixed target.

Run 14 details:

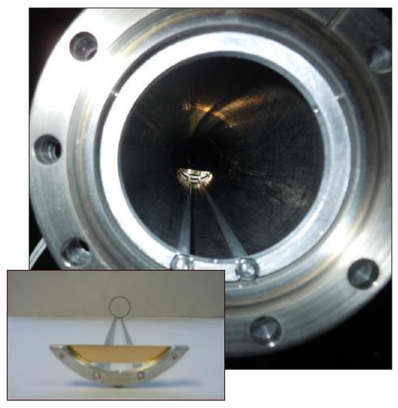
The target foil is held 2 cm below the beam axis.

The foil is 1 mm thick (4%).

Not the defining (most narrow) aperture.

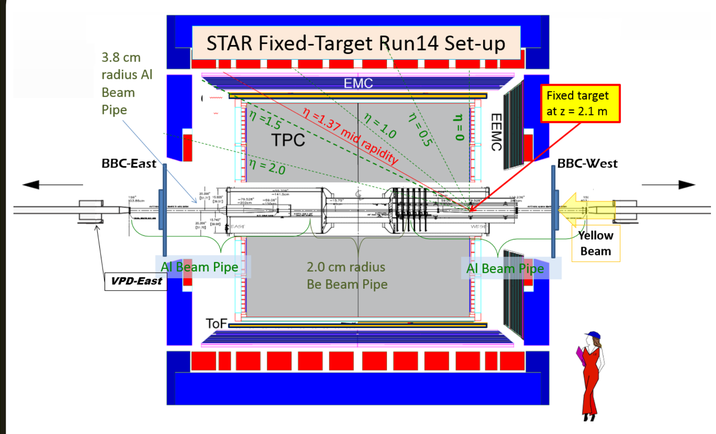


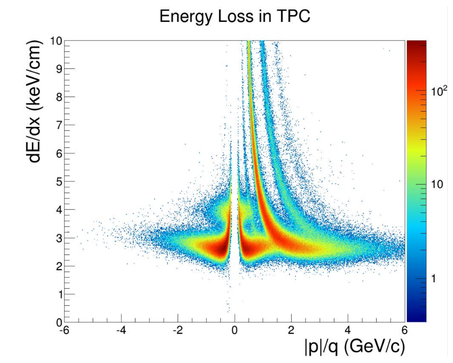
Au + Au 3.9 GeV vertex distribution QA plot illuminating the target



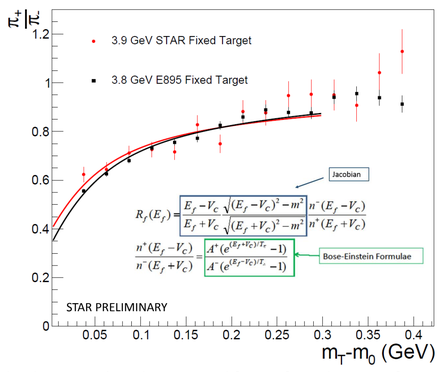
Insertion of the thin gold target and support structure inside the beam pipe

3.9 GeV Au + Au Test Run 2014



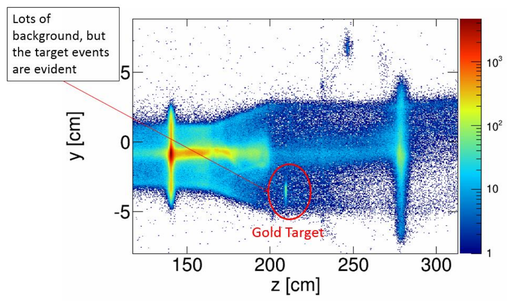


Pion Ratios with Effective Coulomb Potential



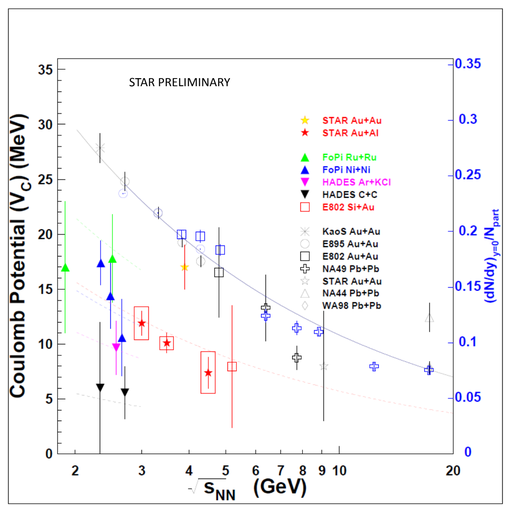
The Coulomb potential can be extracted from a fit to the ratio of pion yields.

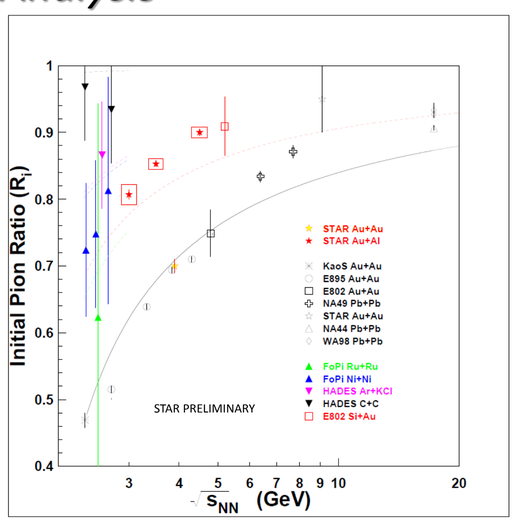
Lots of background, but the target events are evident



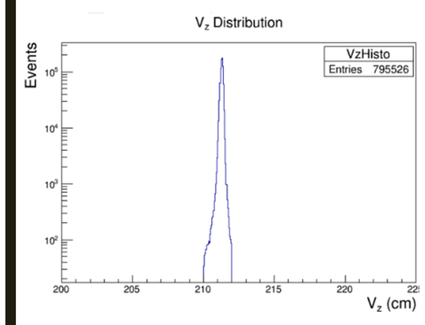
QA Plot illuminating target and beam pipe flanges. In run 14 the beam pipe narrows between z~ 170 cm – 300 cm.

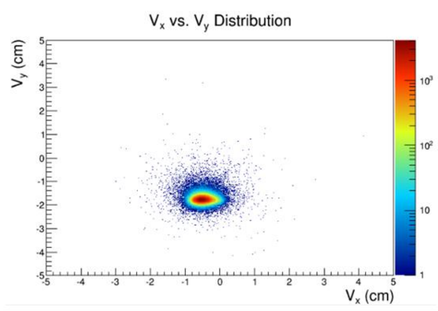
Coulomb Analysis

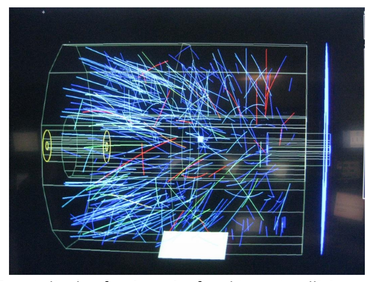




4.5 GeV Au + Au Test Run Performance 2015

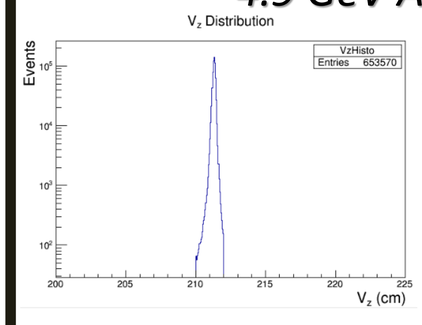


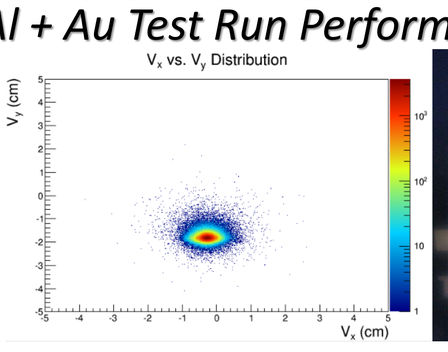


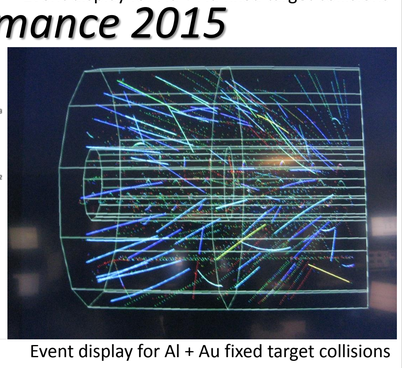


Event display for Au + Au fixed target collisions

4.9 GeV Al + Au Test Run Performance 2015

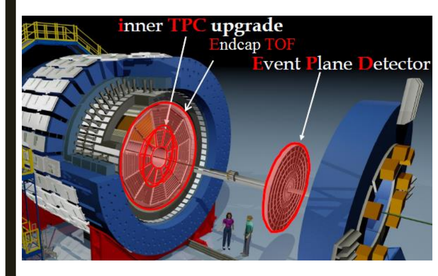




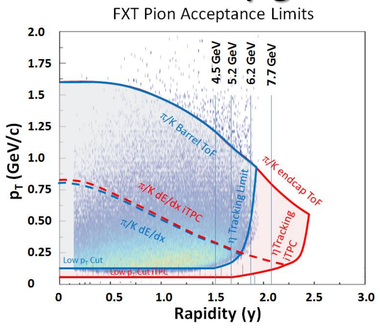


Event display for Al + Au fixed target collisions

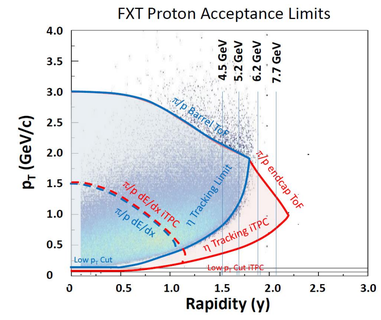
Detector Upgrades



FXT Pion Acceptance Limits

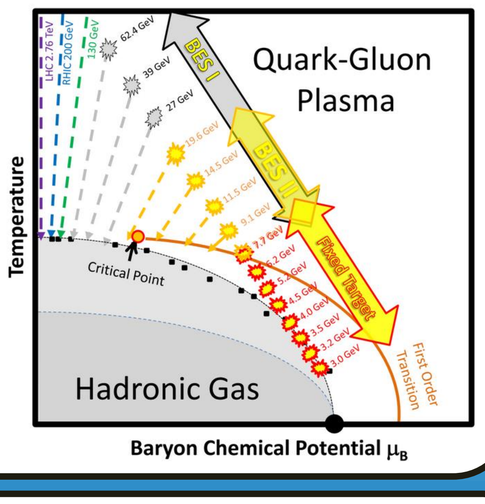


FXT Proton Acceptance Limits



Conclusions

- Successful fixed target test runs have been taken at different center of mass energies with both gold and aluminum beams.
- These test runs demonstrate that the STAR detector works well in this novel setup
- Preliminary ratio results are consistent with previous experiments
- The detector upgrades will allow us to extend the BES energies down to 3.0 GeV without sacrificing luminosity



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