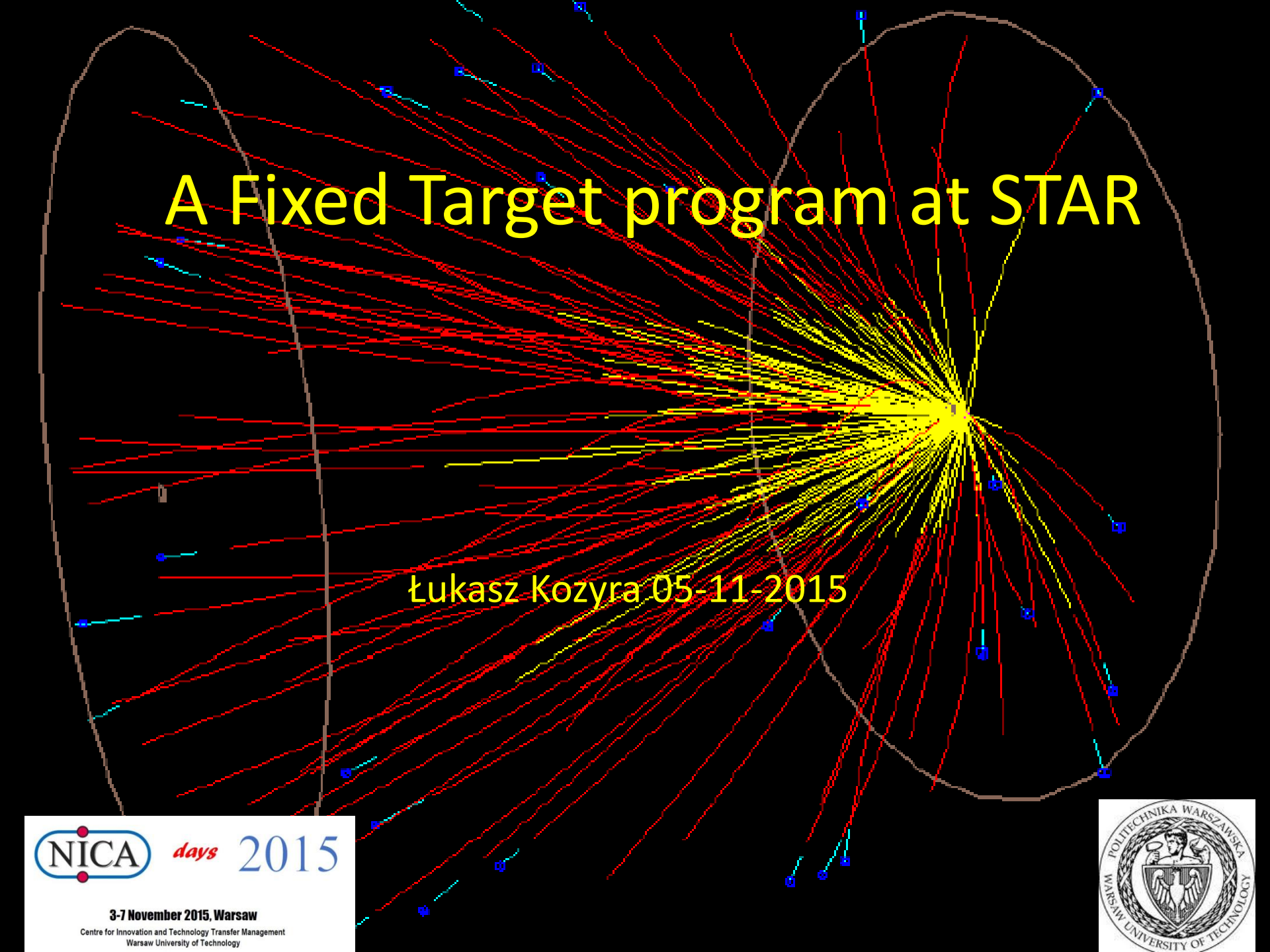


A Fixed Target program at STAR

Łukasz Kozyra 05-11-2015

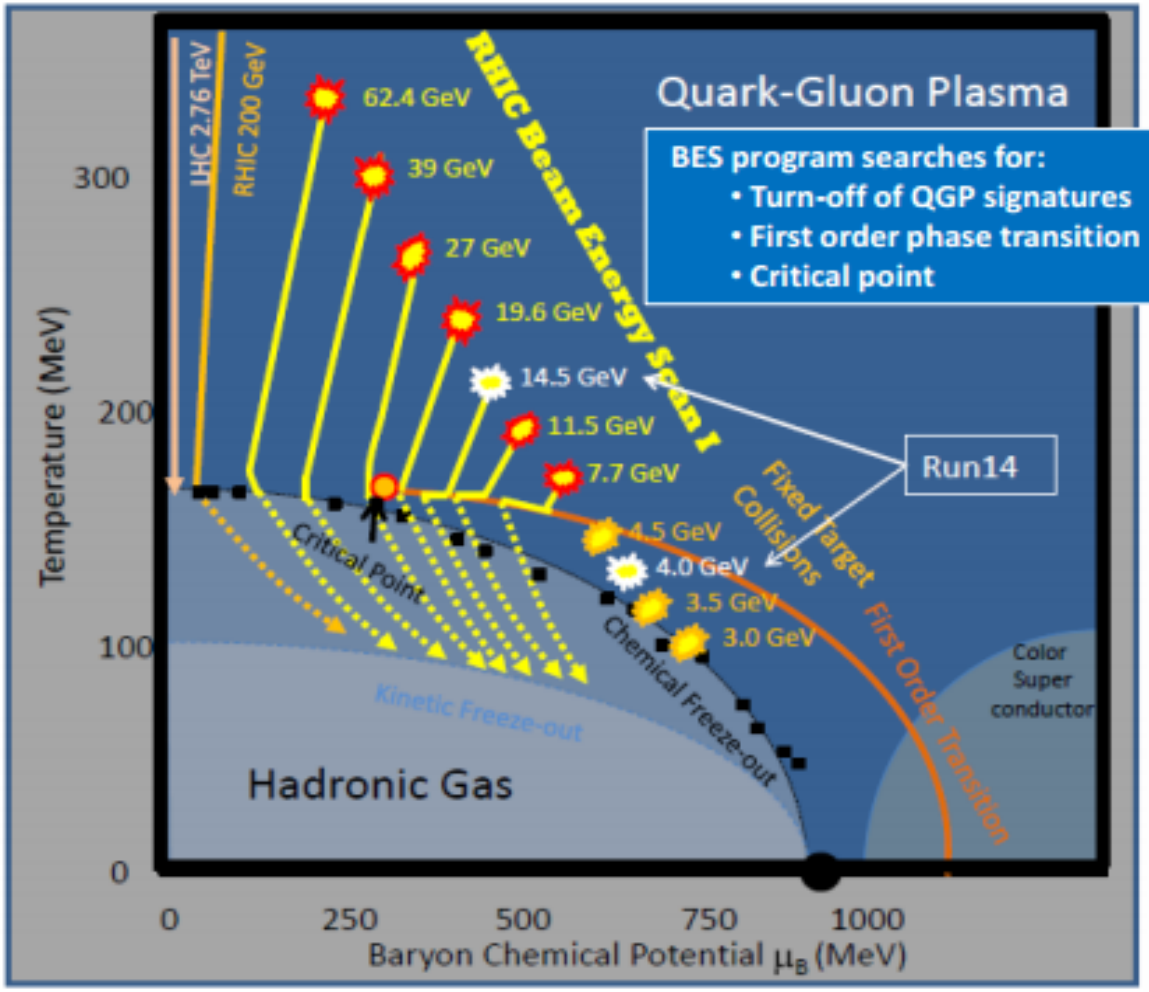
NICA days 2015

3-7 November 2015, Warsaw

Centre for Innovation and Technology Transfer Management
Warsaw University of Technology

POLITECHNIKA WARSZAWSKA
WARSAW UNIVERSITY OF TECHNOLOGY

Phase Diagram of QCD Matter

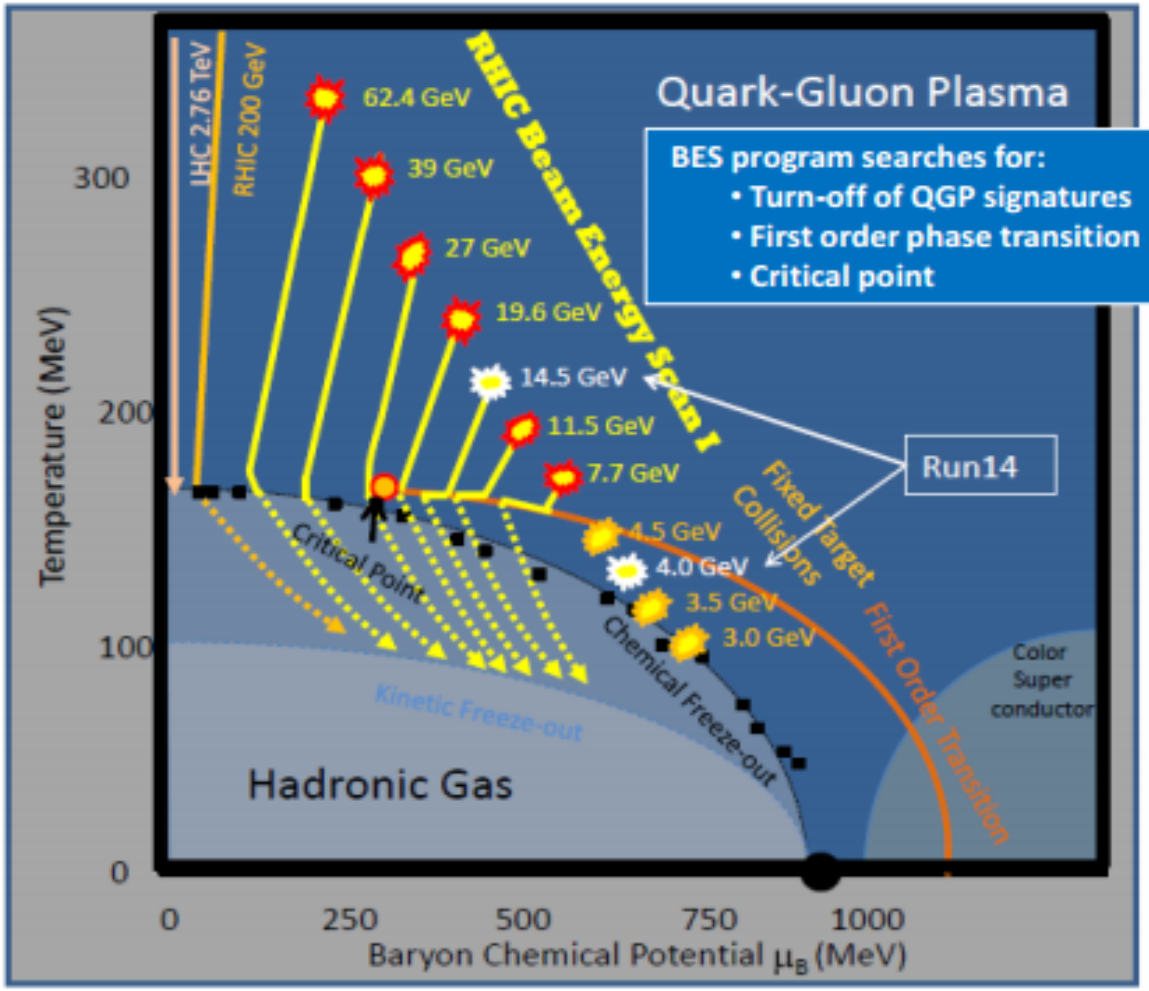


The Fixed Target Program will extend the reach of the RHIC BES to higher bayron chemical Potential

Goals:

1) Search of evidence of first entrance into the mixed phase
2) Control measurements for BES search for onset of deconfinement
3) Control measurements for critical point search

Phase Diagram of QCD Matter



	Energy (GeV)	Baryon Chemical Potential* μ_B	Pred. Temp.* (MeV)
LHC	2760.0	2	166.0
RHIC	200.0	24	165.9
RHIC	130.0	36	165.8
RHIC	62.4	73	165.3
RHIC	39.0	112	164.2
RHIC	27.0	156	162.6
RHIC	19.6	206	160.0
SPS	17.3	229	158.6
RHIC	14.5	262	156.2
SPS	12.4	299	153.1
RHIC	11.5	316	151.6
SPS	8.8	383	144.4
RHIC	7.7	422	139.6
SPS	7.7	422	139.6
SPS	6.4	476	131.7
AGS	4.7	573	114.6
RHIC	4.5	589	111
AGS	4.3	602	108.8
RHIC	3.9	633	101
AGS	3.8	638	100.6
RHIC	3.5	666	93
AGS	3.3	686	88.9
RHIC	3.0	721	76
AGS	2.7	752	70.4
SIS	2.3	799	55.8

* PRC73 (2006) 34905

Why Fixed Target Program?

- Results from NA-49 have been used to suggest onset of deconfinement at 7.7 GeV

- STAR needs to access **energies below 7.7 GeV** where no QGP formation is expected

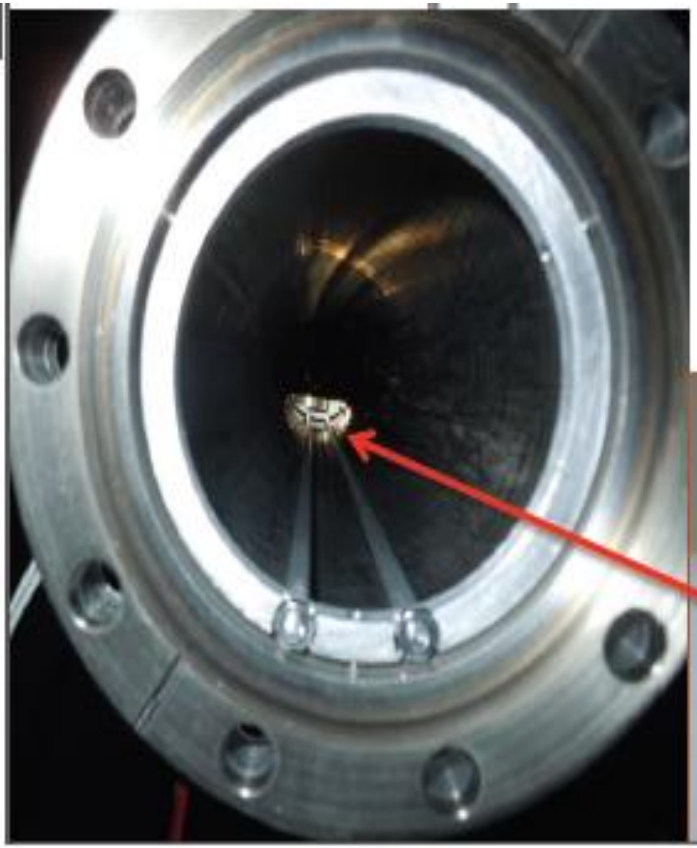
- **At lower energies luminosity of RHIC is too low** , making it inpractical to use it in **collider mode.**

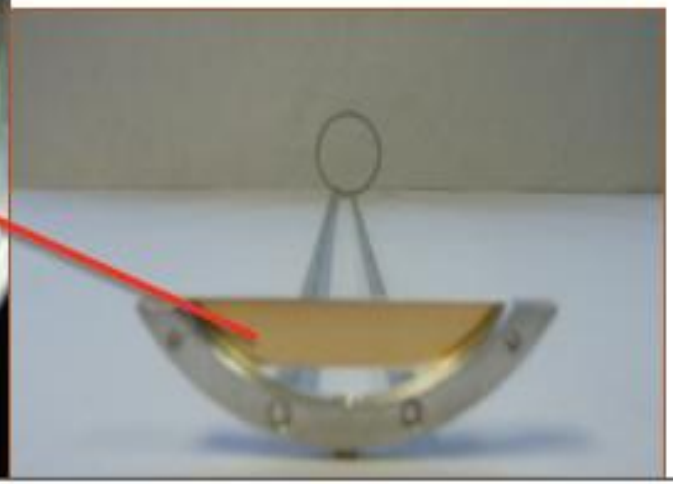
Fixed Target Program History

- **2009**: Started analyzing Au + Al beampipe collisions
- **2012-2011:**Au + Al. Background during BES program
- **2013:** Au+Au fixed target program proposed
- **2014:** First preliminary physics results from Au + Al.
- **2014:** Gold Target insttallled in 14.5 GeV Au + Au run
- **2015:** Test run with beam lowerd for direct collisions with target(4.5GeV)
- **2019-2020:** fixed target working as a part of BES II

Target Design

A technician installing the fixed target.

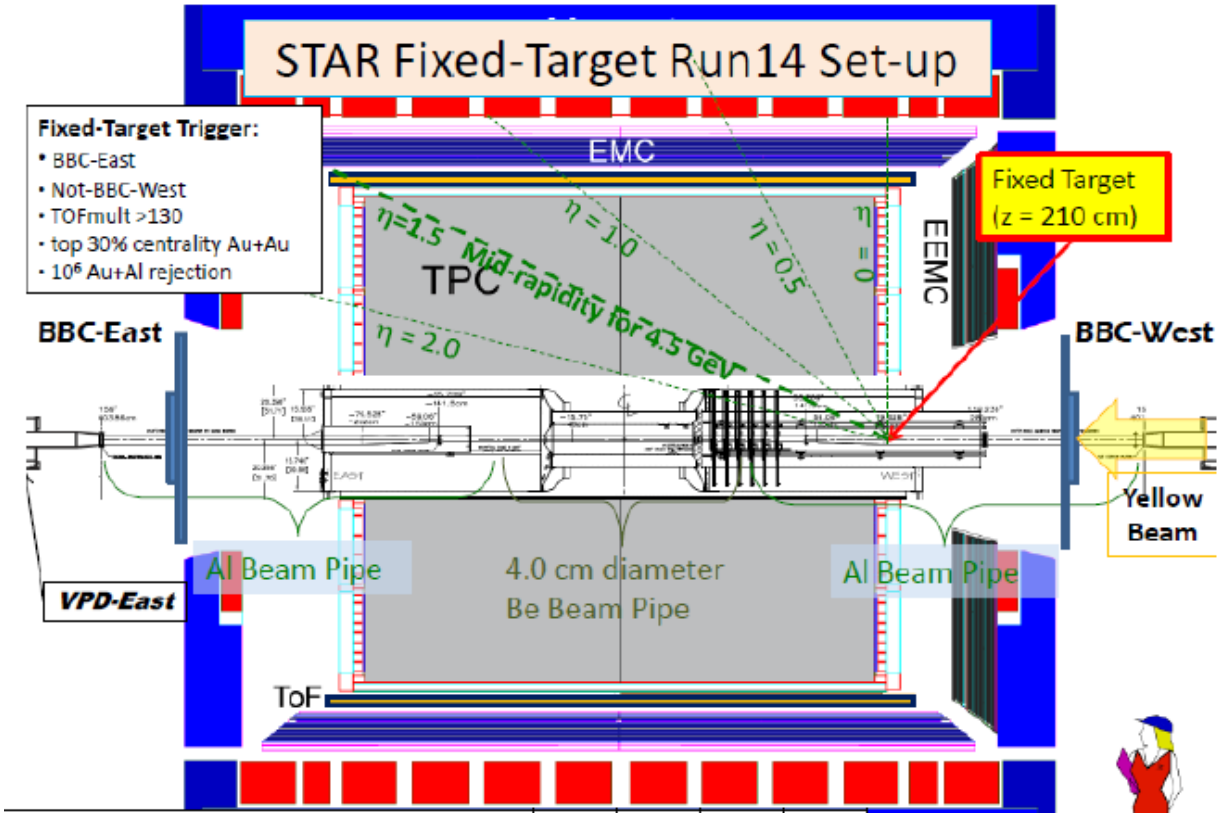




Target:- gold foil:
1 mm thick
~ 1 cm high
~ 4 cm wide
210 cm from IR

Target Geometry in STAR Detector

20 MeV< μ_B<720 MeV



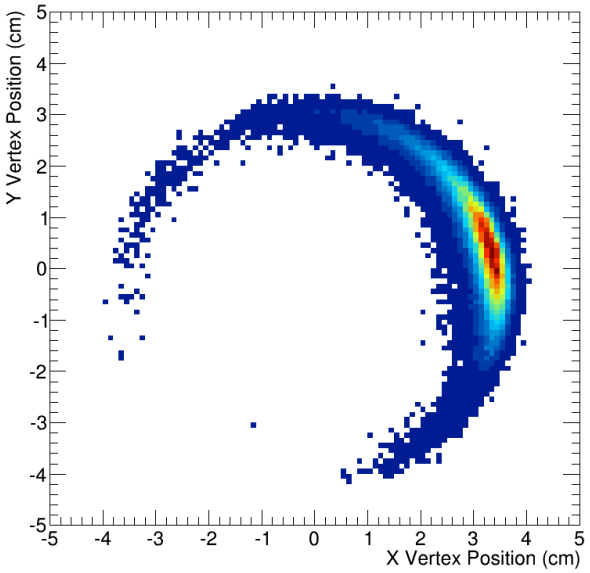
Collider mode Energies (GeV)	7.7	11.5	***14.5***	19.6
Fixed Target $\sqrt{s_{NN}}$ (GeV)	*3.0*	*3.5*	***3.9***	*4.5*
Fixed Target μ_B (MeV)	*720*	*670*	***633***	*585*

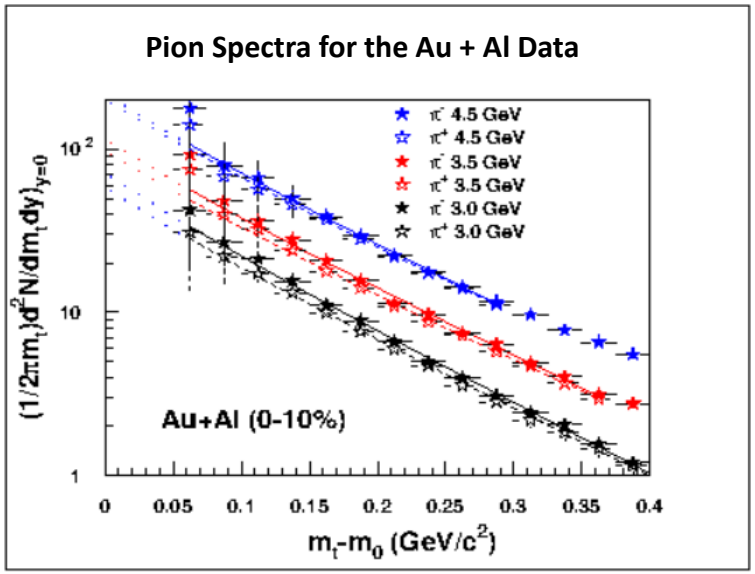
- Schematic diagram of STAR showing the fixed-target location
- The target is a gold foil
- The projectiles are ions from the halo of the "yellow beam"

Au + Al Beampipe collisions

Kathryn Meehan - UC Davis
APS DNP Meeting 2015

Vertex Distribution of Au + Al Beam Pipe Events

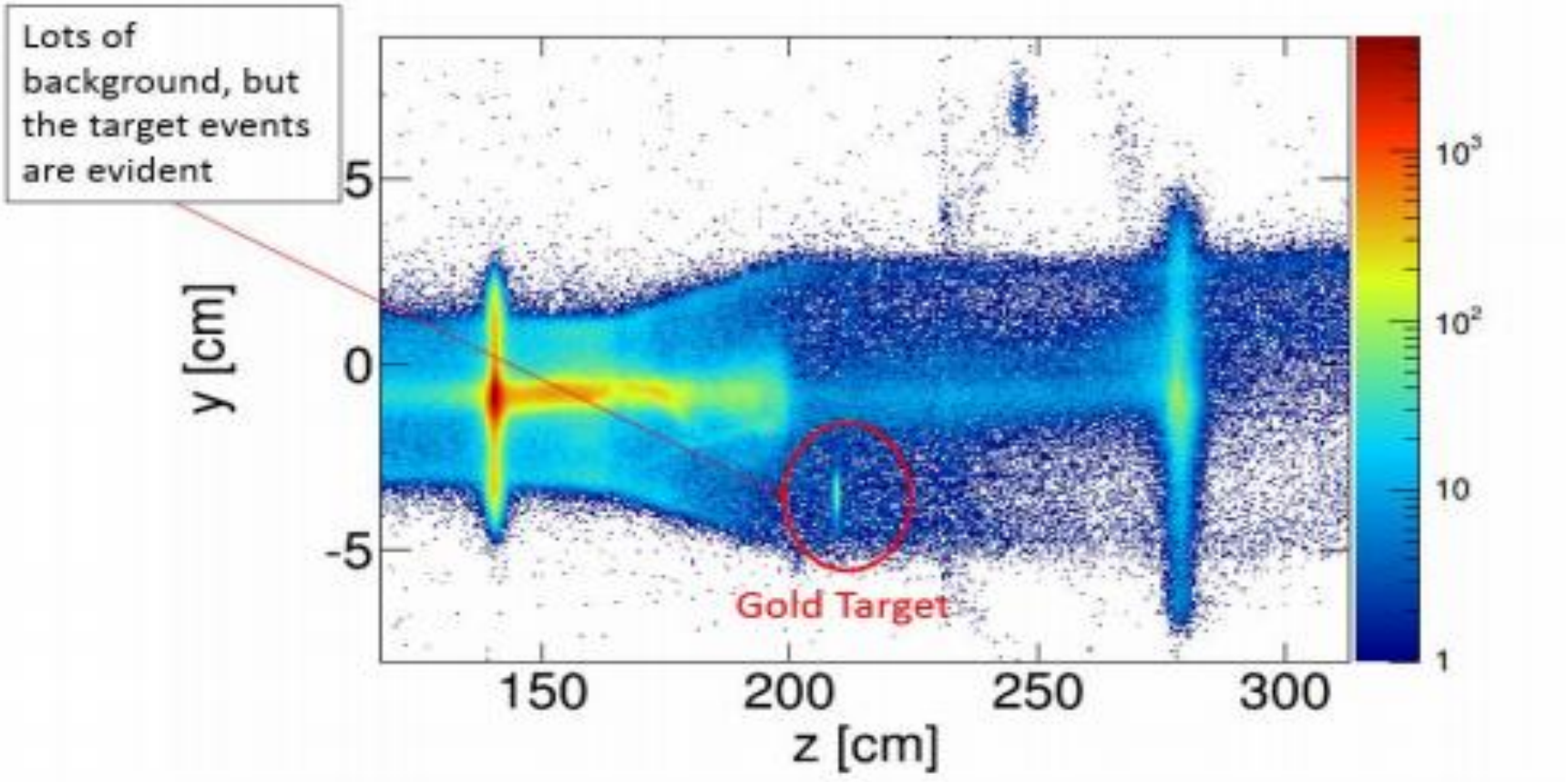




- **Coulomb Potential has been extracted and shown to be consistent with previous experiments**

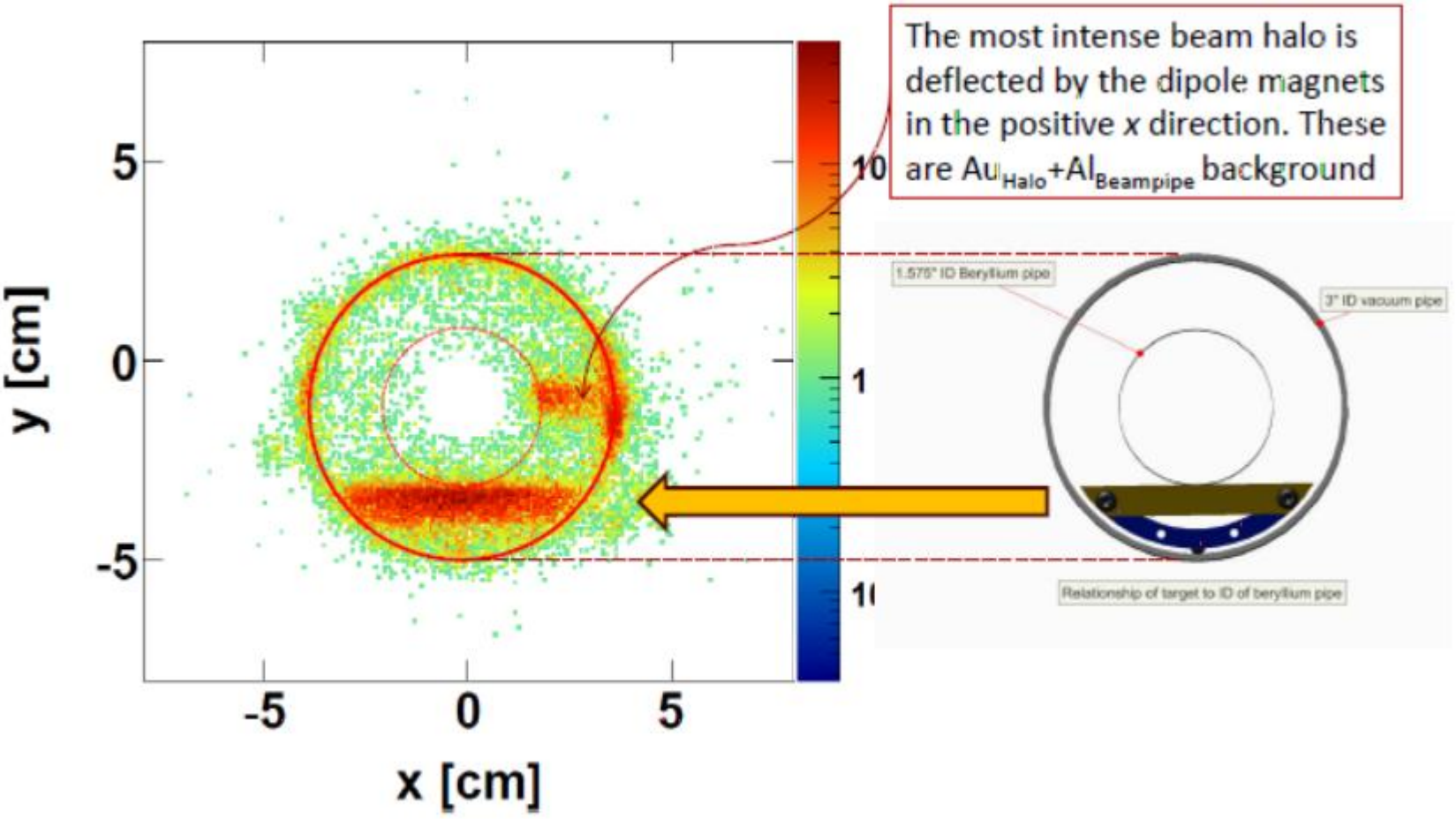
- **STAR software can reconstruct Fixed-Target vertices, and has good acceptance and PID capabilities**

Au + Au 3.9 GeV test run 2014



Identifying target event

Au + Au 3.9 GeV test run 2014



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

Fixed Target PID

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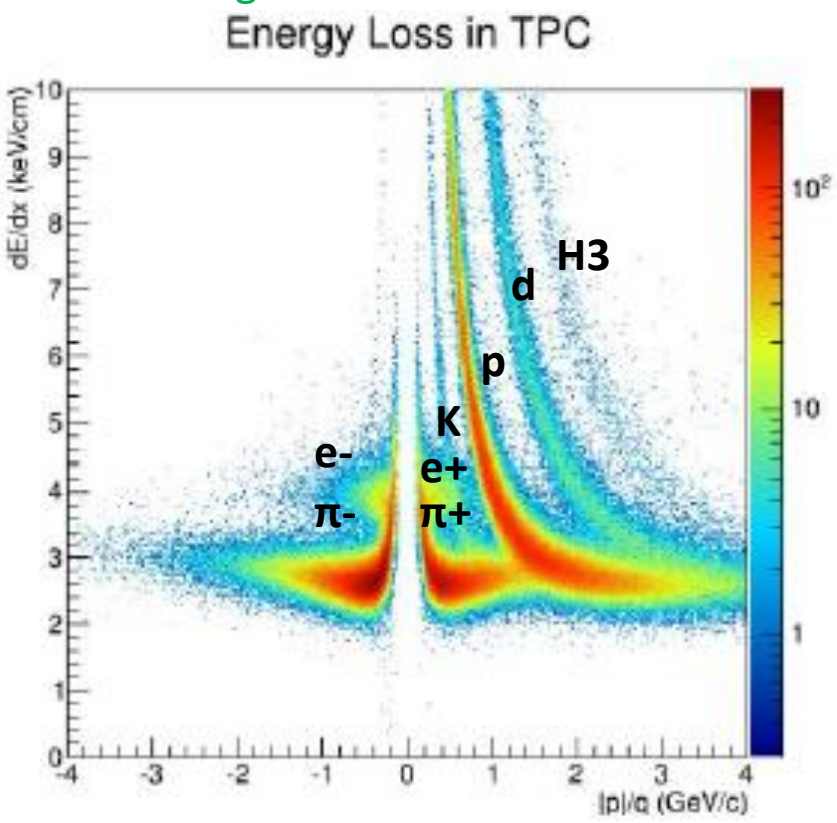
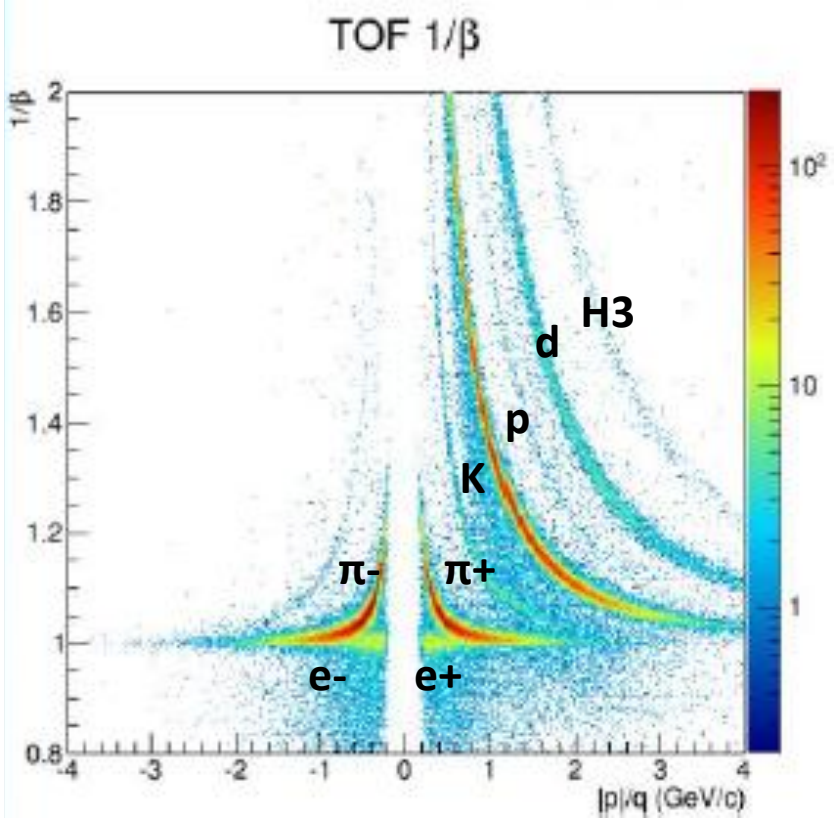
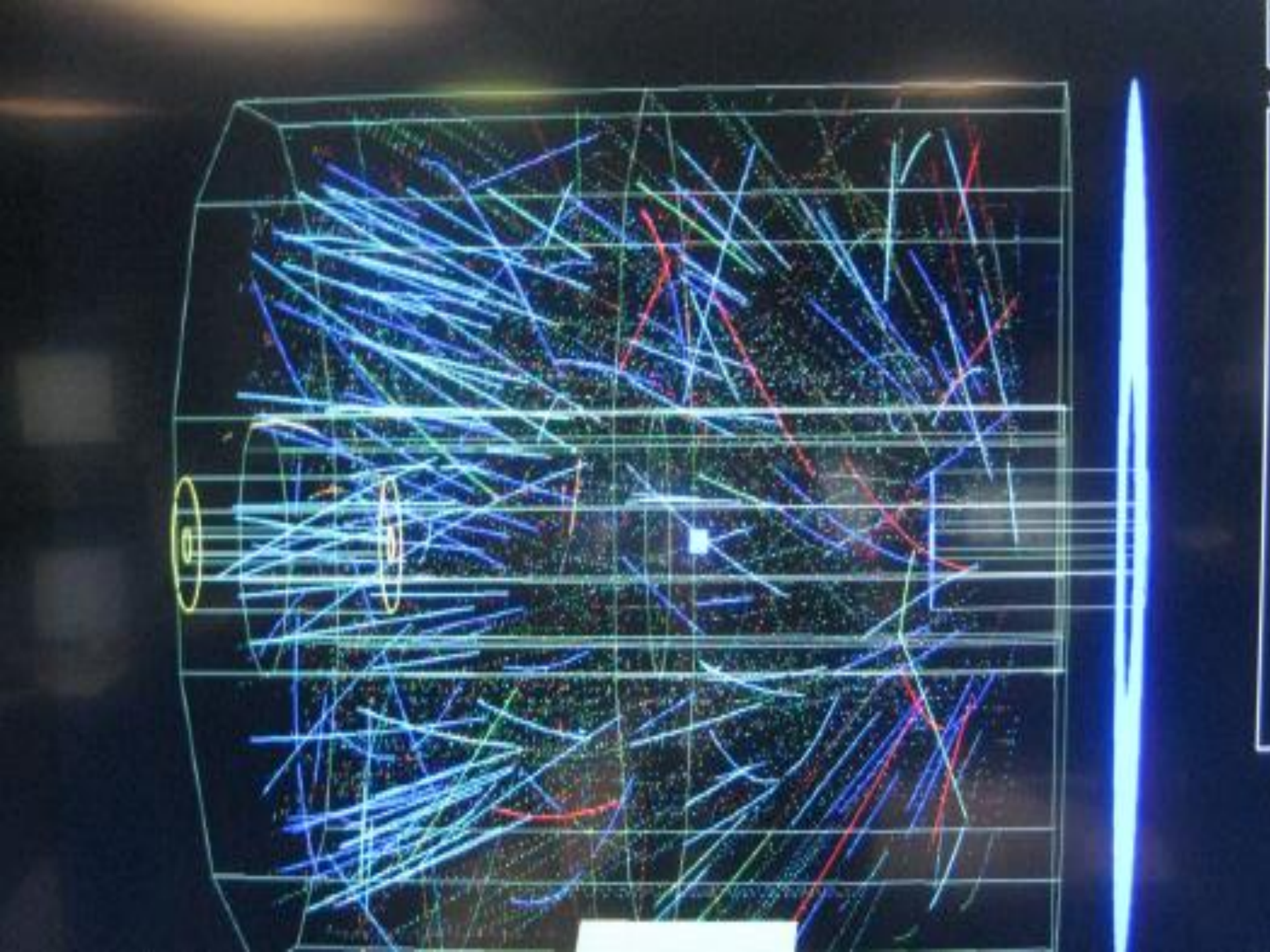
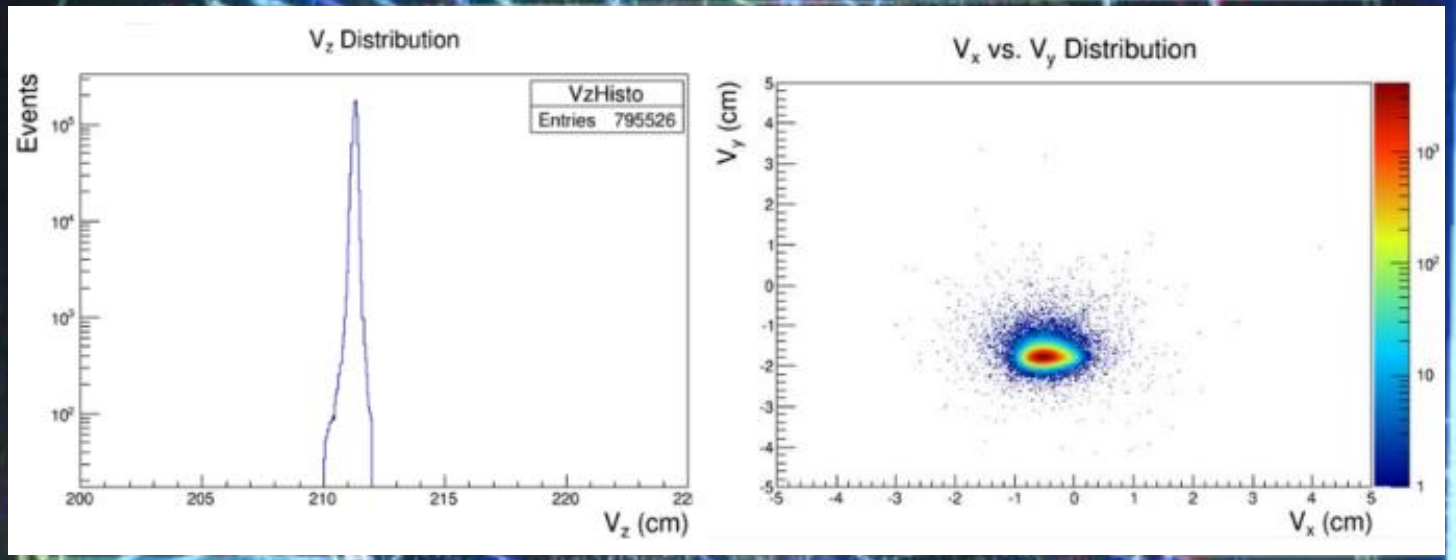




ToF and TPC data used for particle identification



4.5 Au + Au test run performance



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1.4 M triggers in 40 min (relatively short), runs: 16140033-0036
1 M events, at least 100 k central Au+Au events (from display: ~10% good central FT Au+Au
Low background
Beam lowered by 1 cm, C-AD did not drive beam into detector
Approach was suitably cautious, we have enough data to make rate estimates and refine goals of program

Conclusions

- **Addition of fixed-target program will enable STAR to make key measurements related to the phase diagram of QCD matter below the $\sqrt{s_{NN}}$ = 7.7 GeV.**

- **The Gold target has been successfully installed in the STAR detector**

- **Data show that trigger is able to select fixed target events**

- **PID and track and vertex reconstruction work well**

- **Physics analysis in progress: flow, spectra,…**

Thank you for your attention!