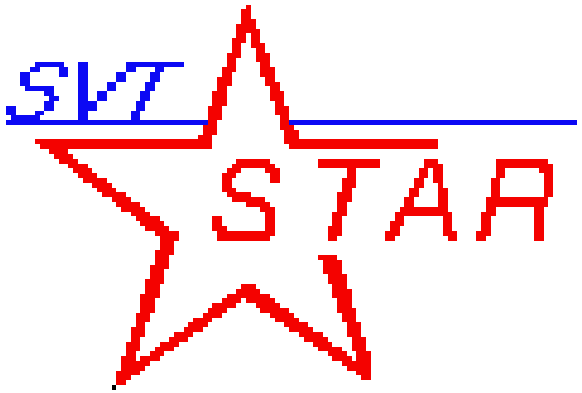
Year 2 Tracking Strategies

For STAR



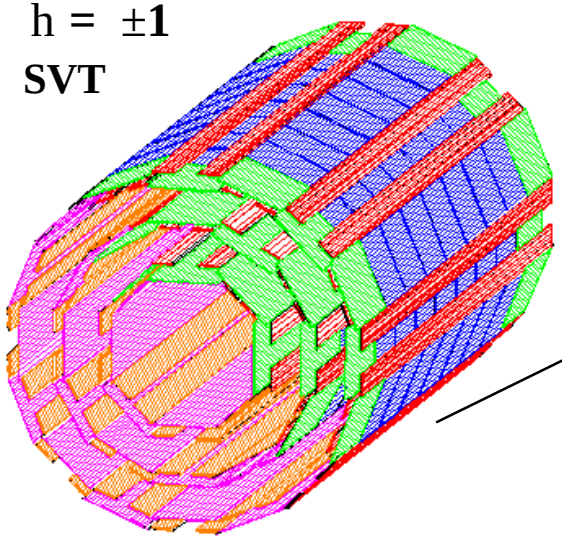
STAR/ALICE Meeting

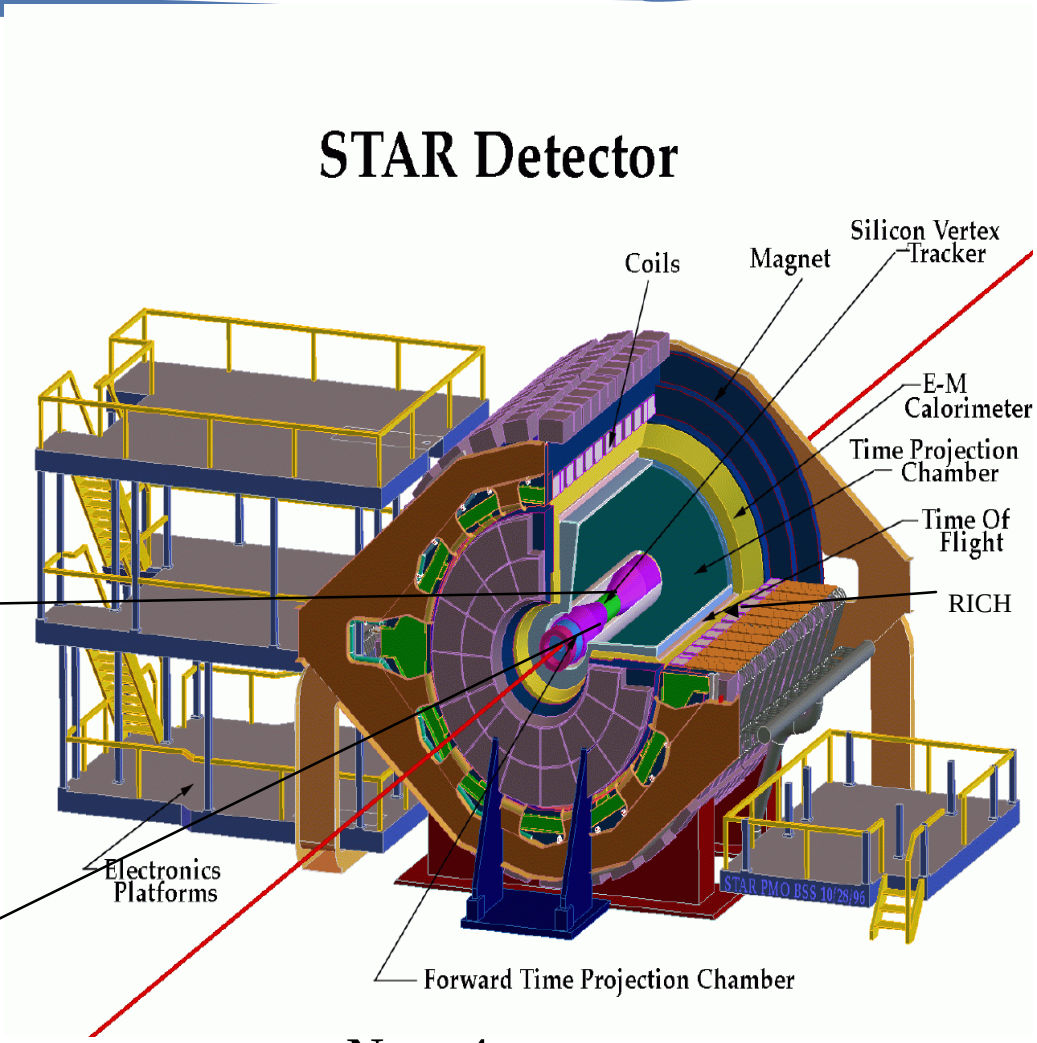
April 2000

Helen Caines

STAR in Year 2

TPC Inner radius = 50cm
Outer radius = 200cm
h = ±1.7
SSD layer radius = 25cm
h = **±1**
SVT
1st layer radius= 6cm
2nd layer radius=10cm
3rd layer radius= 15cm
h = **±1**
SVT





Near 4π acceptance

multi-signature Event-by-Event analysis

SVT - Details

The SVT:

A wafer is 6.2 cm x 6.2 cm area, 300 micron thick - 0.3%X_0

Average radiation length seen by a particle if 4.5%X_0 incl. fee cards etc.

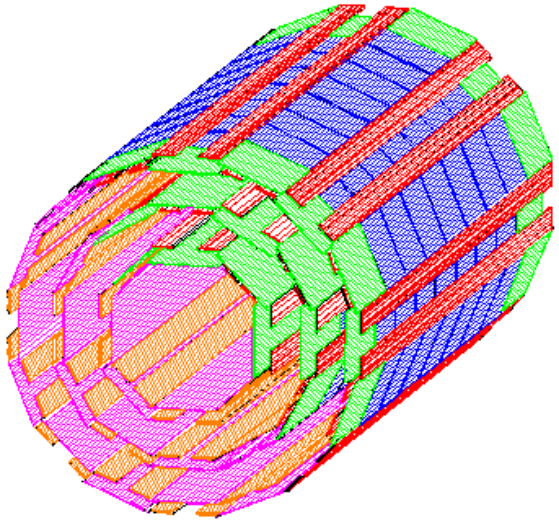
Consists of 216 wafers

3 barrels: Inner barrel has 8 ladders – 4 wafers/ladder

Middle barrel has 12 ladders – 6 wafers/ladder

Outer barrel has 16 ladders – 7 wafers/ladder

Resolution: ~ 20 microns



Outer radius – 15cm

Middle Radius – 10cm

Inner radius - 6cm

Length - ±21cm

SSD Details

The SSD:

Double sided silicon strip detectors 16 wafers per ladder

Stereo angle 35 mrad pitch 95 microns.

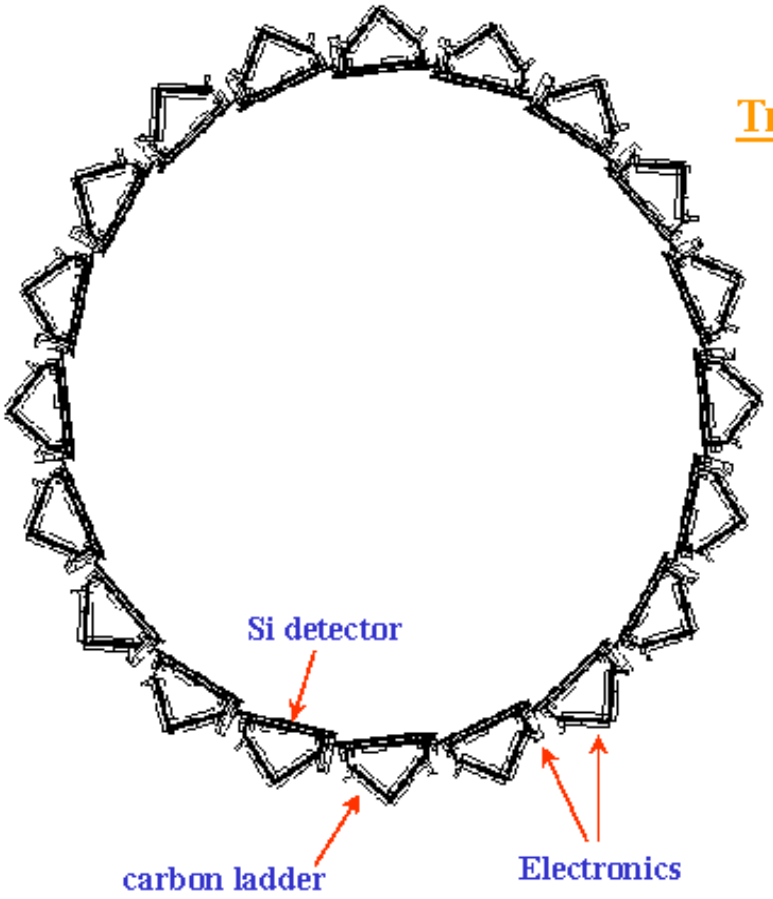
Detector size is 7.5cm x 4.2xm

300 microns thick.
Resolution is:

15 microns in r

700 microns in z

radiation length of 1 ladder is 0.7%X_0



Tranverse view of the SSD

Geometrical characteristics

The center of the detectors are positionned at a radius of 23 cm from the interaction point.

The SSD barrel features 20 carbon fiber ladders, tilted with an angle of 5^0 .

The SSD represents a total area $\approx 1\ m^2$ and the pseudo-rapidity domain covered by the silicon detectors ranges from $\eta = -1.2$ to $\eta = +1.2$

Integrated Tracking Methods with the Year 2 detectors

Two methods:

- Track-Track matching between TPC and vertex detectors
- Form tracks independently in the SVT+SSD and the TPC.
- Then project all tracks to a given radius and match vectors
- Track-Space point matching between TPC and vertex detectors

Project the TPC to individual barrels and match the closest space-point within given constraints.

SVT-SSD Stand-Alone Tracking Algorithms

Grouping Technique (finder only):

If one assumes straight lines for the tracks instead of helices a trivial mapping in ϕ–φ from the primary vertex places all hits on a track into the same location.

For a particle with pt =100MeV/c in a 0.5T field

$\phi(R=15cm) - \phi(R=5cm) = 5.1^0$

So we need bins of close to 5^0 so most tracks have all their space points within a ϕ bin

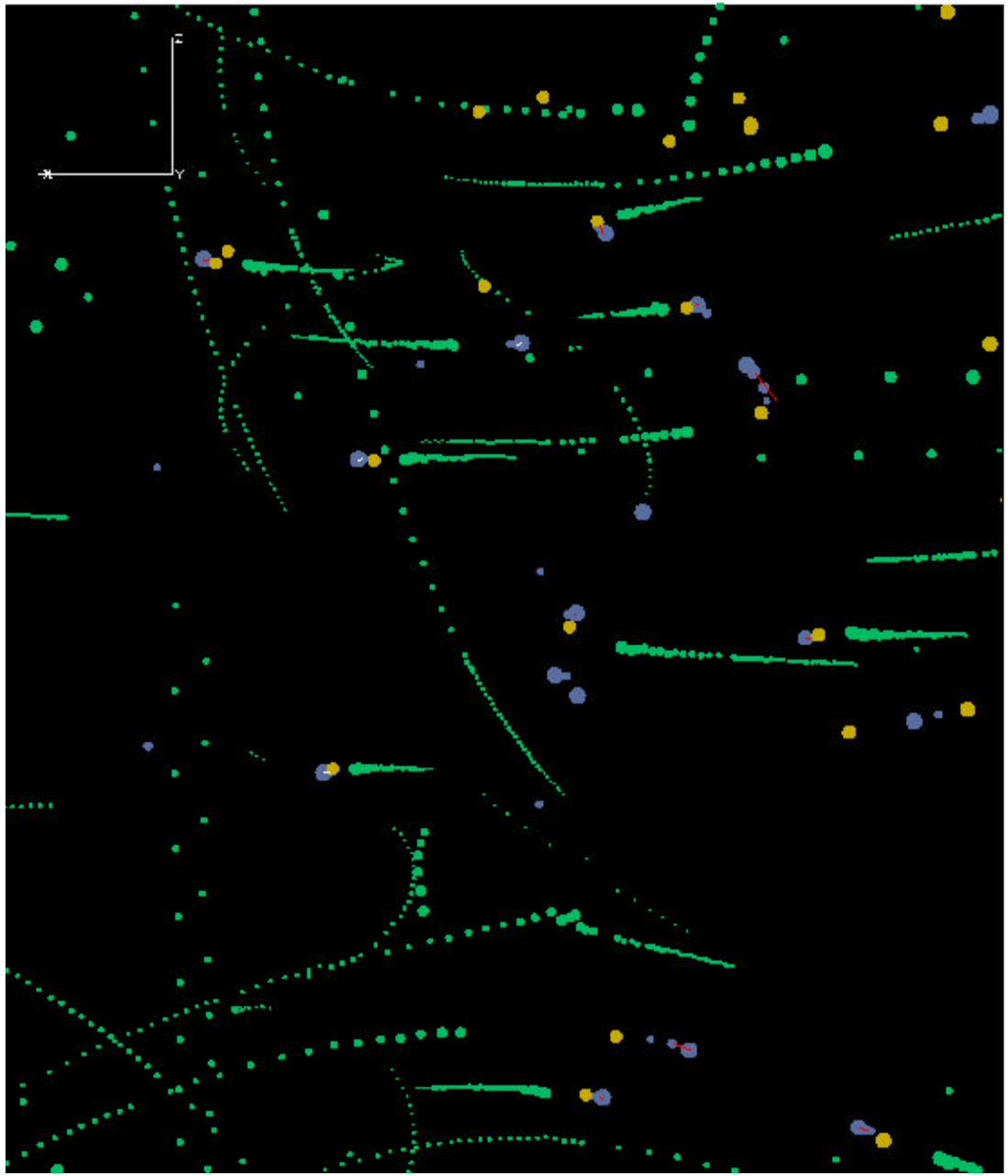
If you iterate increasing the binning for hits you move

to lower and lower pt (or larger radii of curvature).

Advantage:this method is fast.

Tracking via grouping

For primaries this technique has been shown to be over 94% efficient, and for pt >200MeV/c the efficiency 97% when using the SVT alone.



Tracking with the Year 2 Method 1

Disadvantage of the grouping technique is you can only find primaries, or tracks appearing to originate from the primary vertex.

So we have a standard “follow your nose” tracker which tries to identify secondary tracks and those tracks with too low a pt to be successfully identified by the grouping technique.

It starts at the primary vertex.

- Takes a point on the first barrel
- Using straight line projections it projects to the second barrel, finds closest hit within a search cones
- Projects to next barrel, finds closest hit etc to 4^{th} barrel

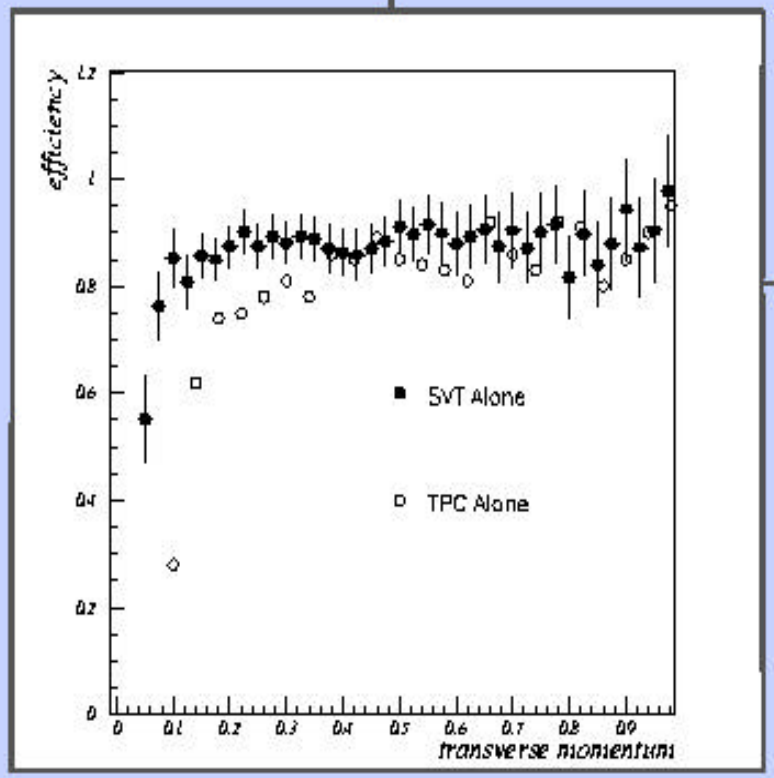
All 3 hit candidates for that hit are identified. A helix fit is done for each “track”. Best fit is selected as the track

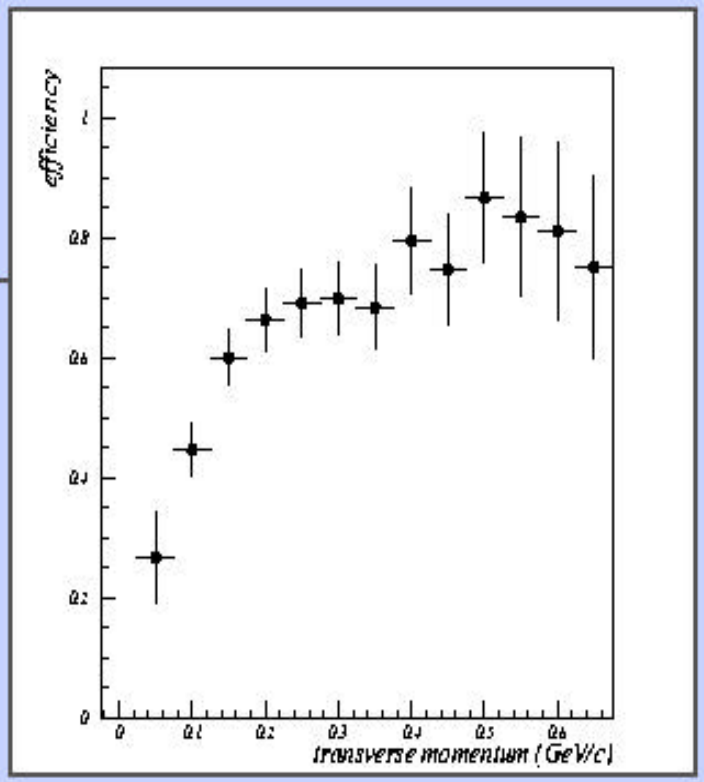
Hits are removed from pool and iteration starts with next hit

Tracking with the Year 2 detectors

Primaries

Secondaries





0 1 GeV 0 1GeV

Tracking Matching between Vertex detectors and TPC

We then take all tracks from SVT+SSD and tracks from TPC.

Project tracks to a common radius. Form a footprint of each track at that radius, size of footprint dependant on errors from track fit and a gross estimate of the material the track as passed through.

Match best pairs of tracks.

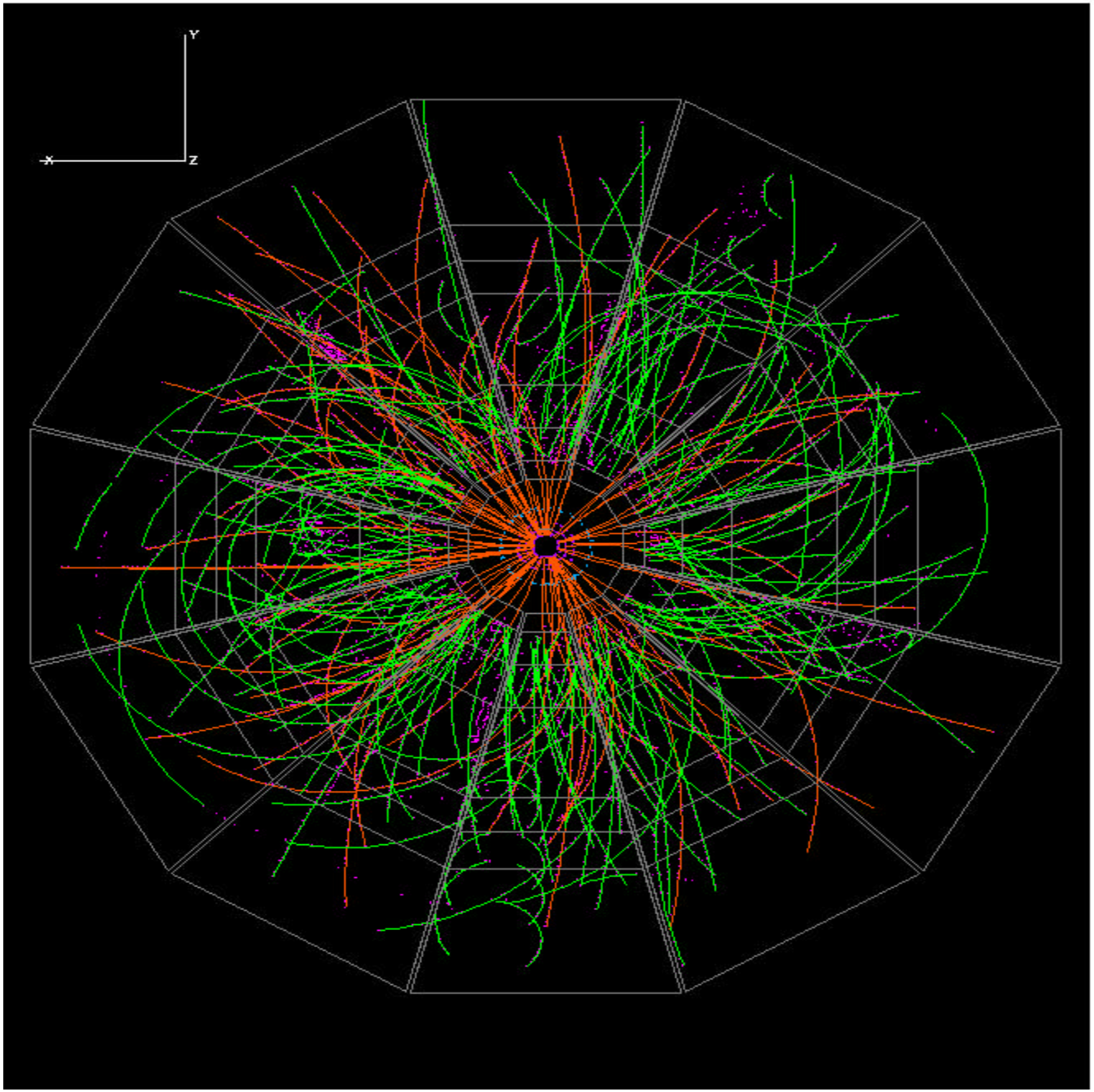
We take advantage of the this step and have VERY loose cuts in the SVT+SSD tracking. This means we pass many fake tracks to the matcher. The matcher then weeds these bad tracks out. i.e the SVT tracking tries to get a high efficiency at the expense of purity.

Tracking with the Year 2 Method 1

Track-Track matching

SVT+SSD+TPC:

Primary			Secondary		
Findable	1743		Findable	252	
Correct	1366	- 78%	Correct	71	- 28%
Ghost	158	- 10%	Ghost	31	- 30%


Y
X
Z

Space Point – Track Matching

Takes 5 passes:

At least 1 hit in each layer

At least one hit in each layer with larger search cone

At least one is in 3 different layers

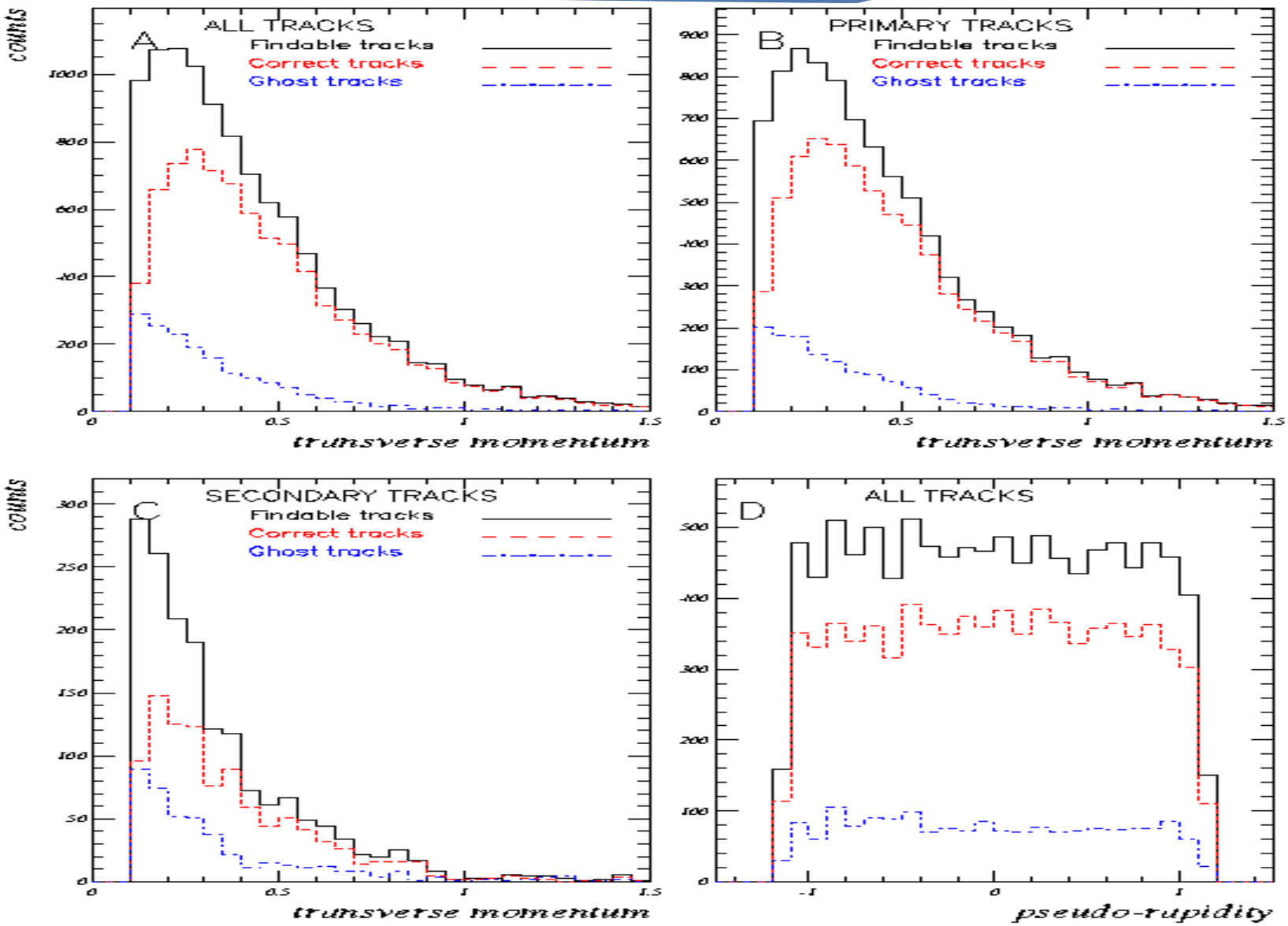
At least one hit in 2 different layers

At least one hit in the SSD

In each pass there are 7 iterations over pt thresholds (high pt first)

Project to SSD, find hit, refit track, mover to next barrel

Track-Hit Matching Efficiency



0 1.5 -1 1

Tracking with the Year 2 detectors Method 2

Track-Space point matching

Note there are now more findable hits as allow as few as 1 hit per track

Primary		
Findable	1778 (1743)	
Correct	1399 (1366)	- 78%
Ghost	263 (158)	- 16%

Secondary		
Findable	333 (252)	
Correct	202 (71)	- 61%
Ghost	90 (31)	- 31%

Upgrades/ Future work

Speed!!!!

Integrate space point to track matching with grouper technique

Take out the easy to find high mtm tracks using a fast method then apply track-hit matching

The improvement of the secondary reconstruction is counterbalanced by the increase in ghost contamination

Integrate dE/dx into the hit matching from SVT and SSD

Take into account the material passed through by the track.

Take advantage of kalman /propagation (Geane/other?) work being done for year 1.