ATLAS experiment

Tracking trajectories in ATLAS curved by magnetic field

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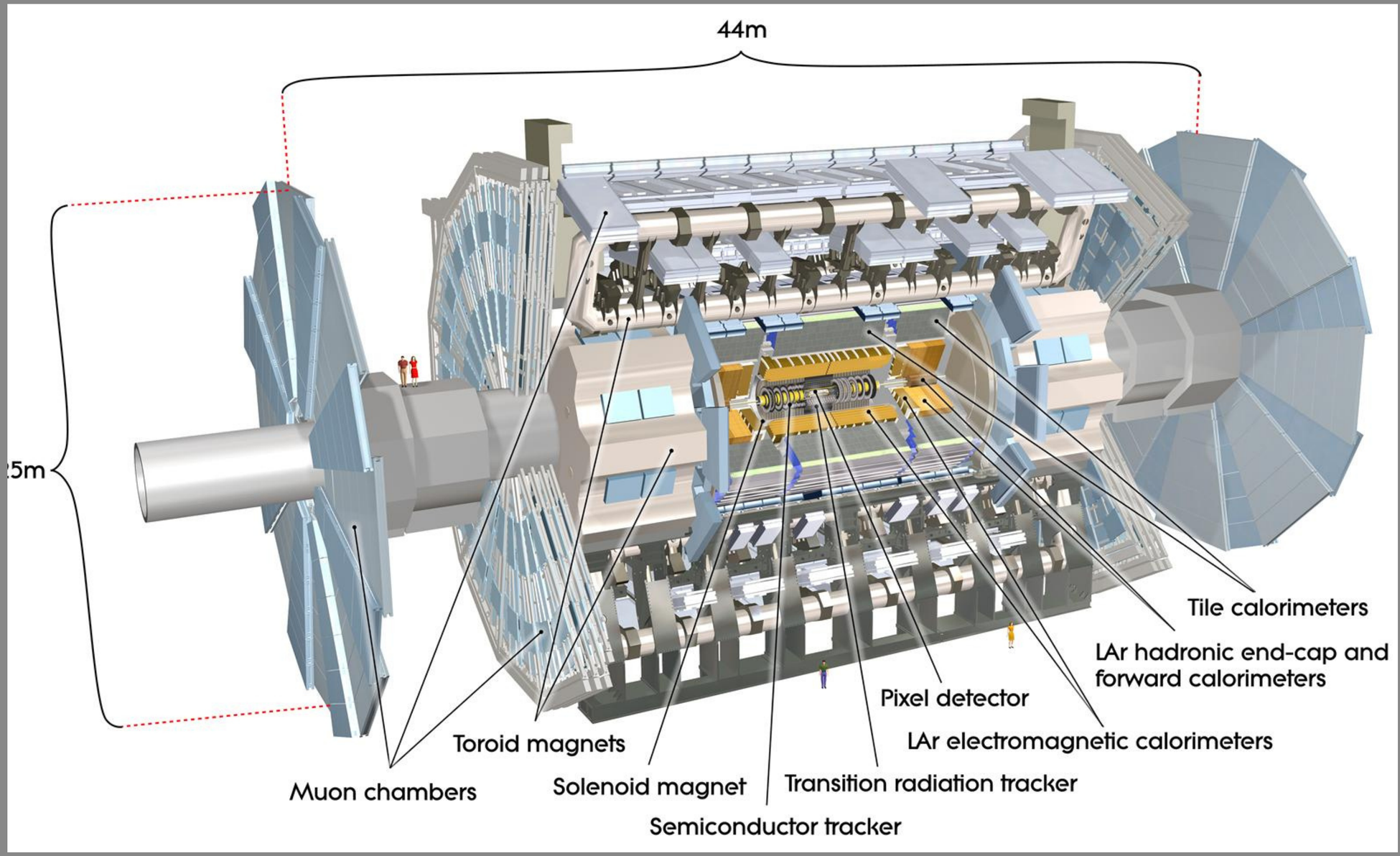
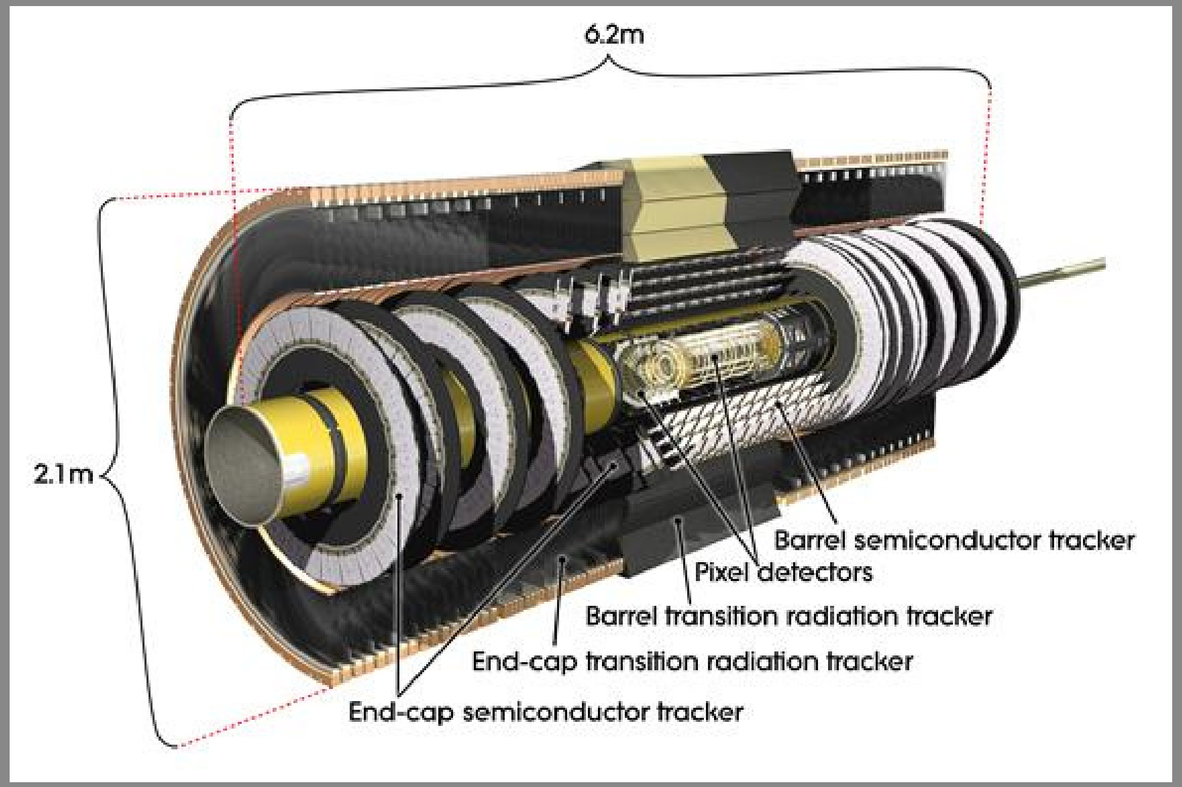
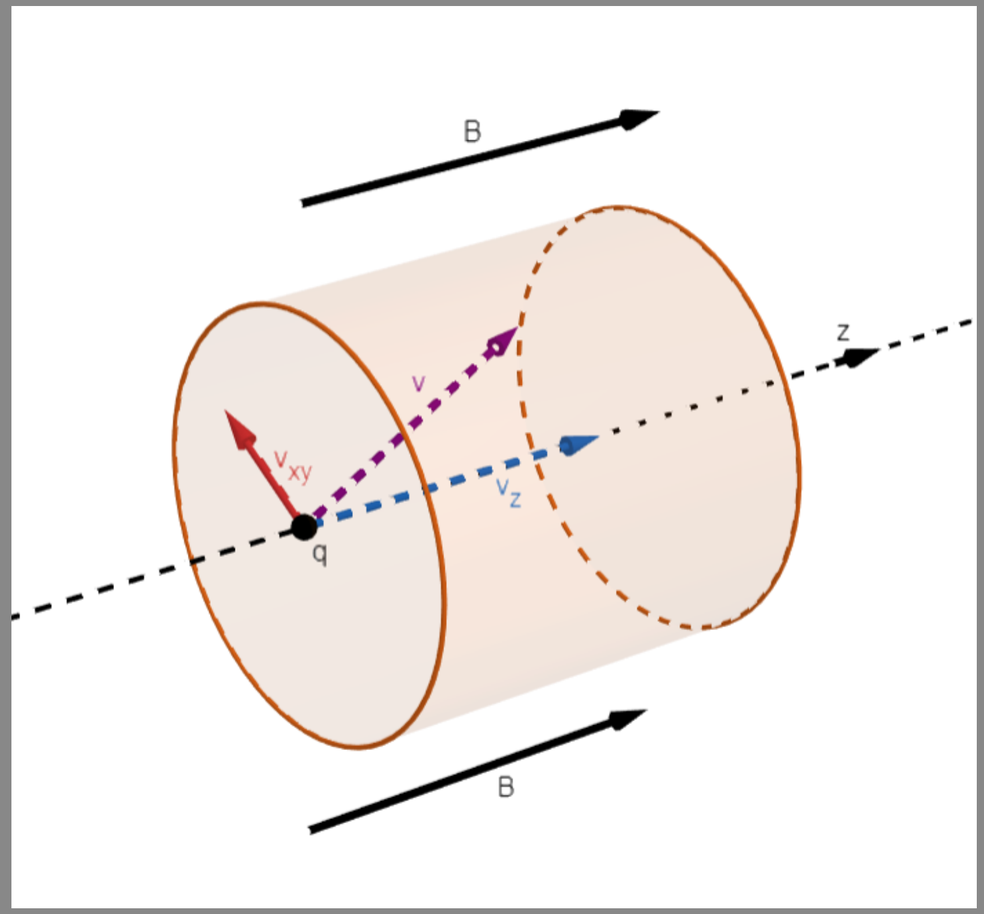
ATLAS Detector



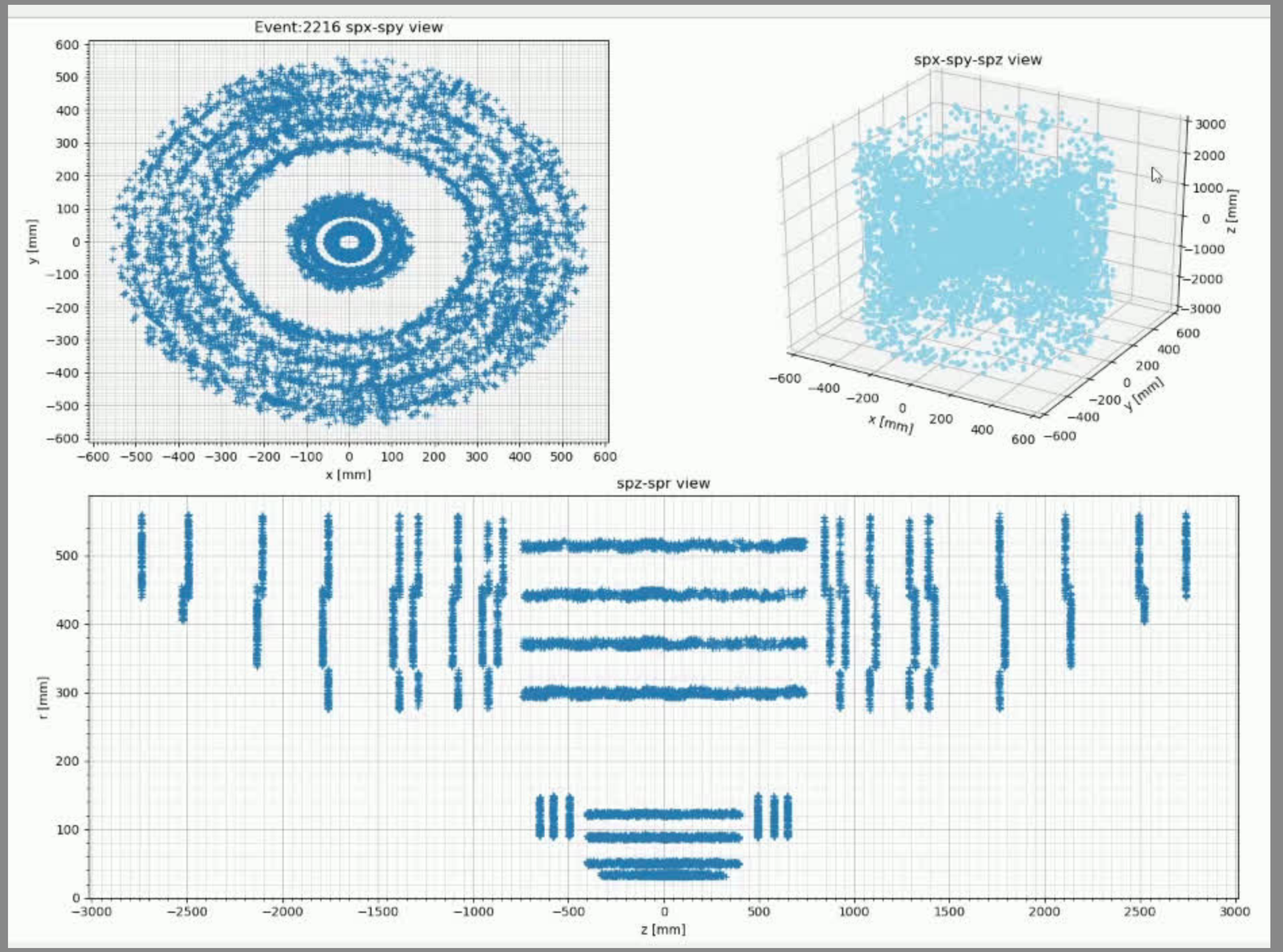
ATLAS Inner Detector

In the inner detector direction, momentum and charge of charged particles can be measured. These particles are produced in proton-proton collisions.

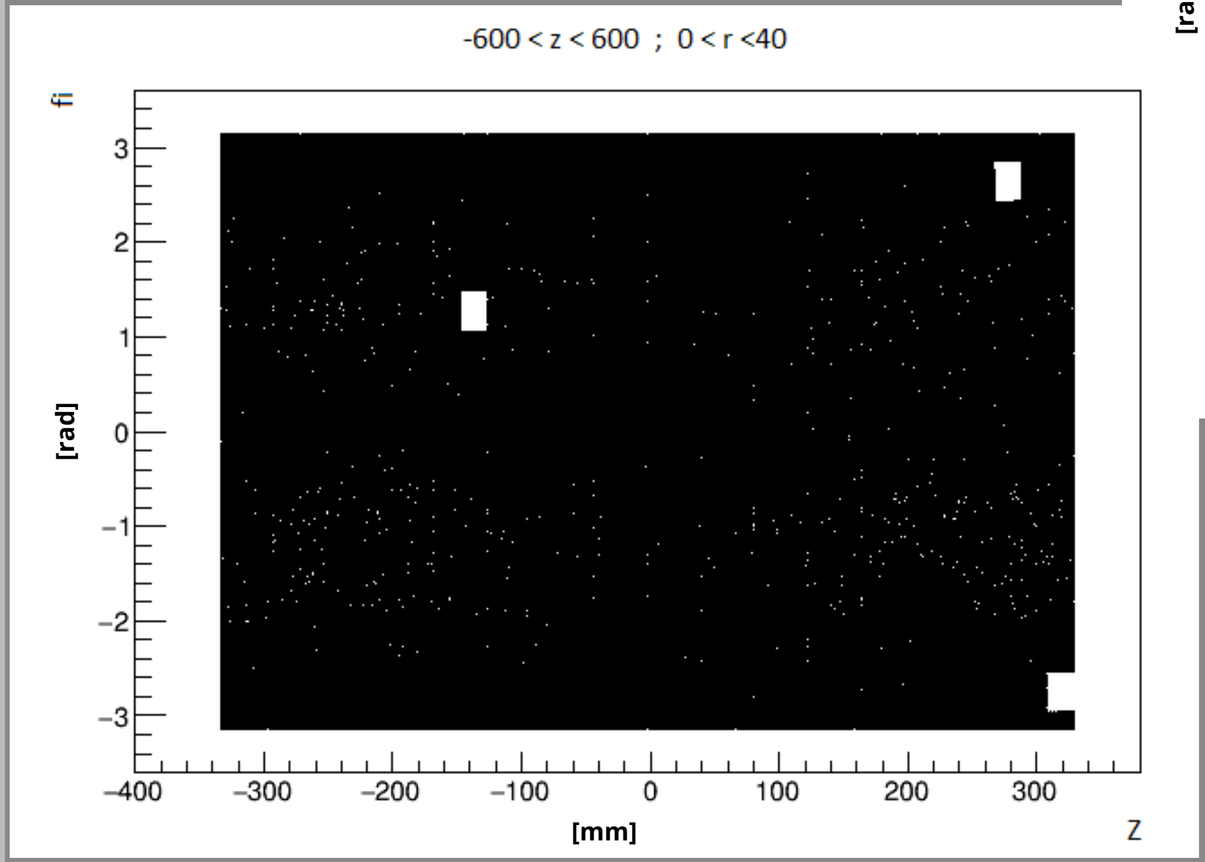


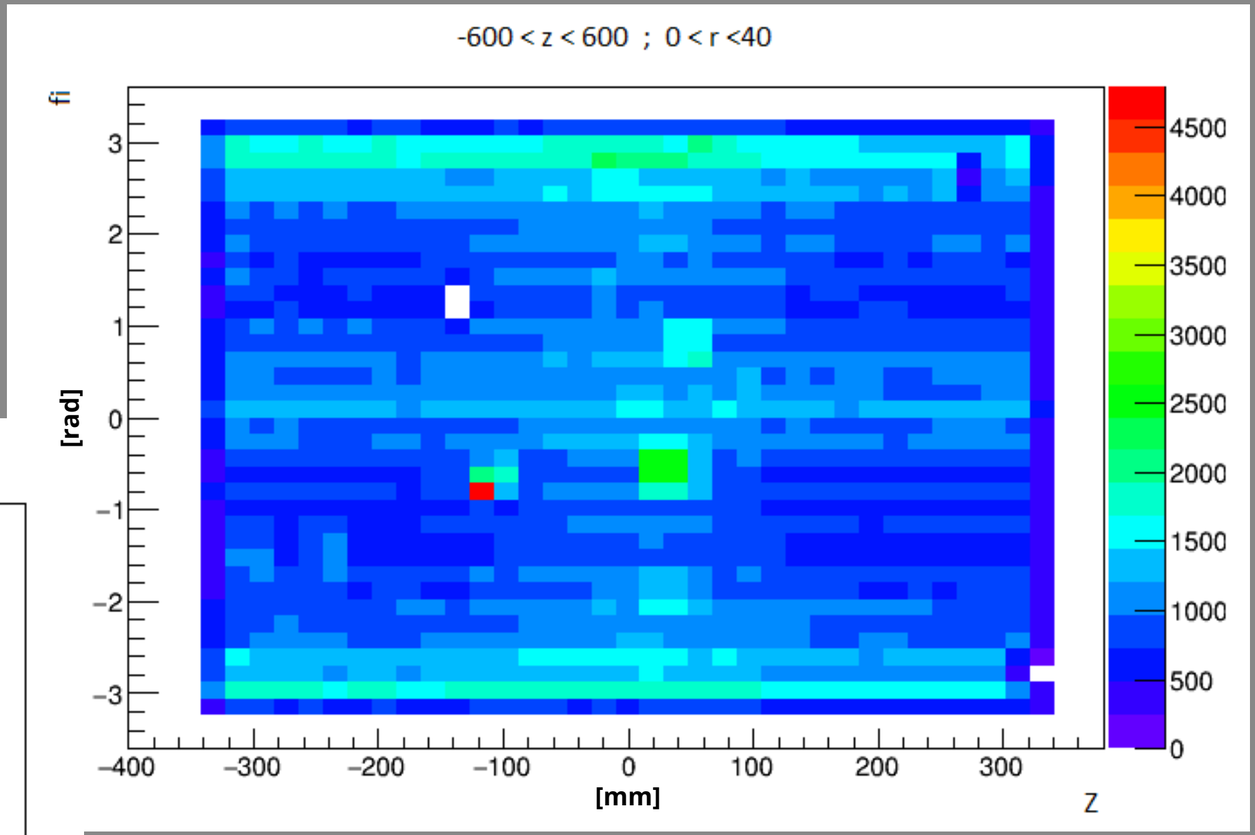


Hits from >1000 events of peripheral HI collisions



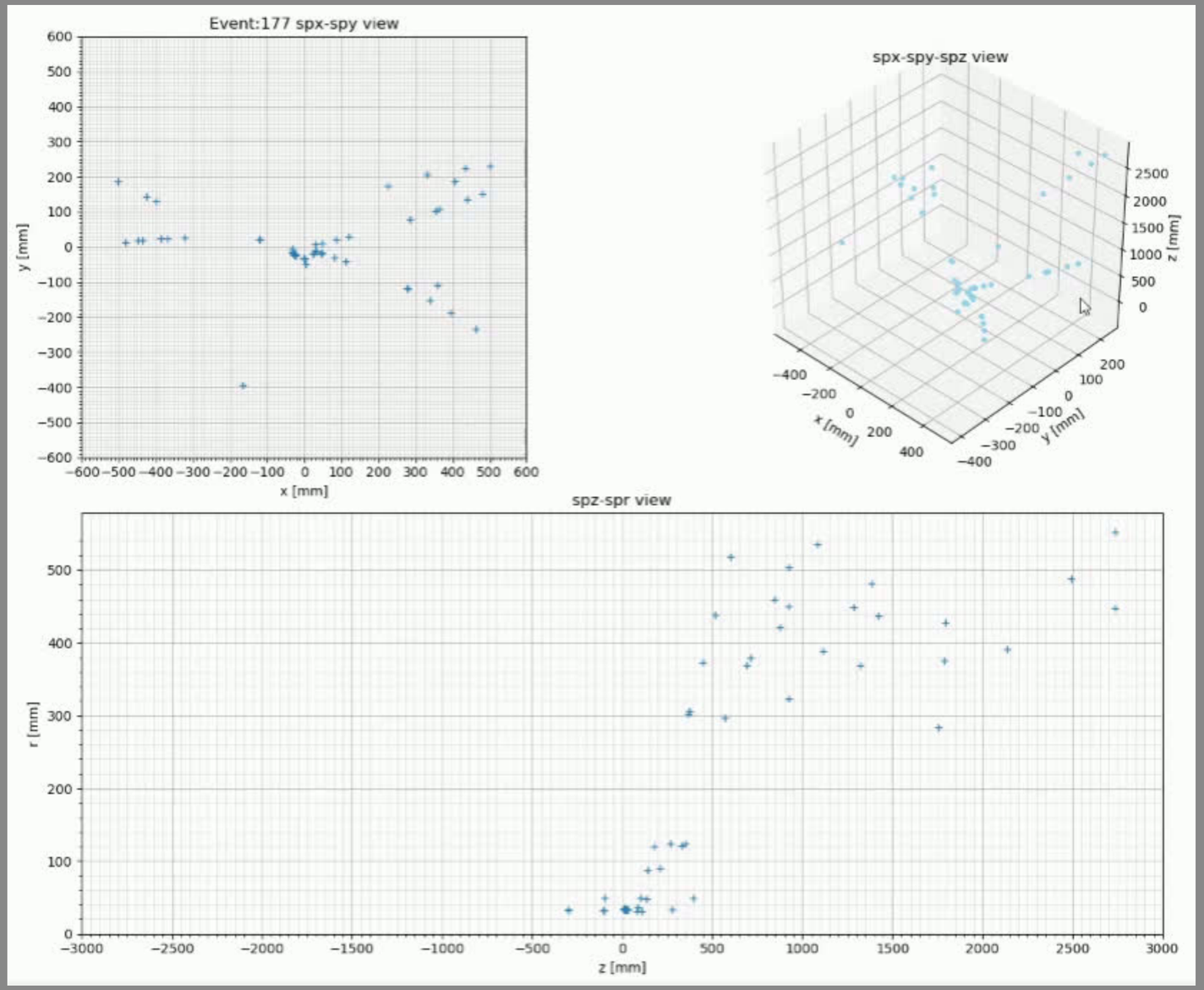
Detector map





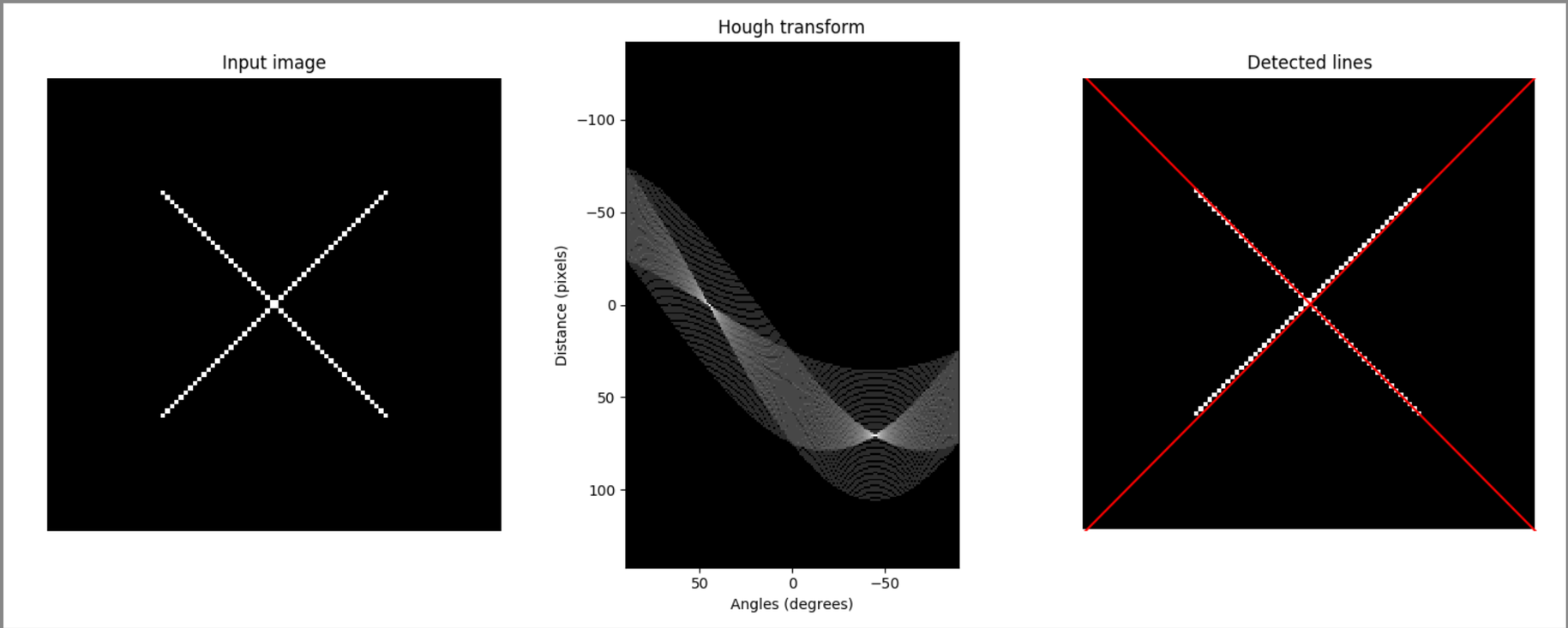
They are not always active!

Individual events



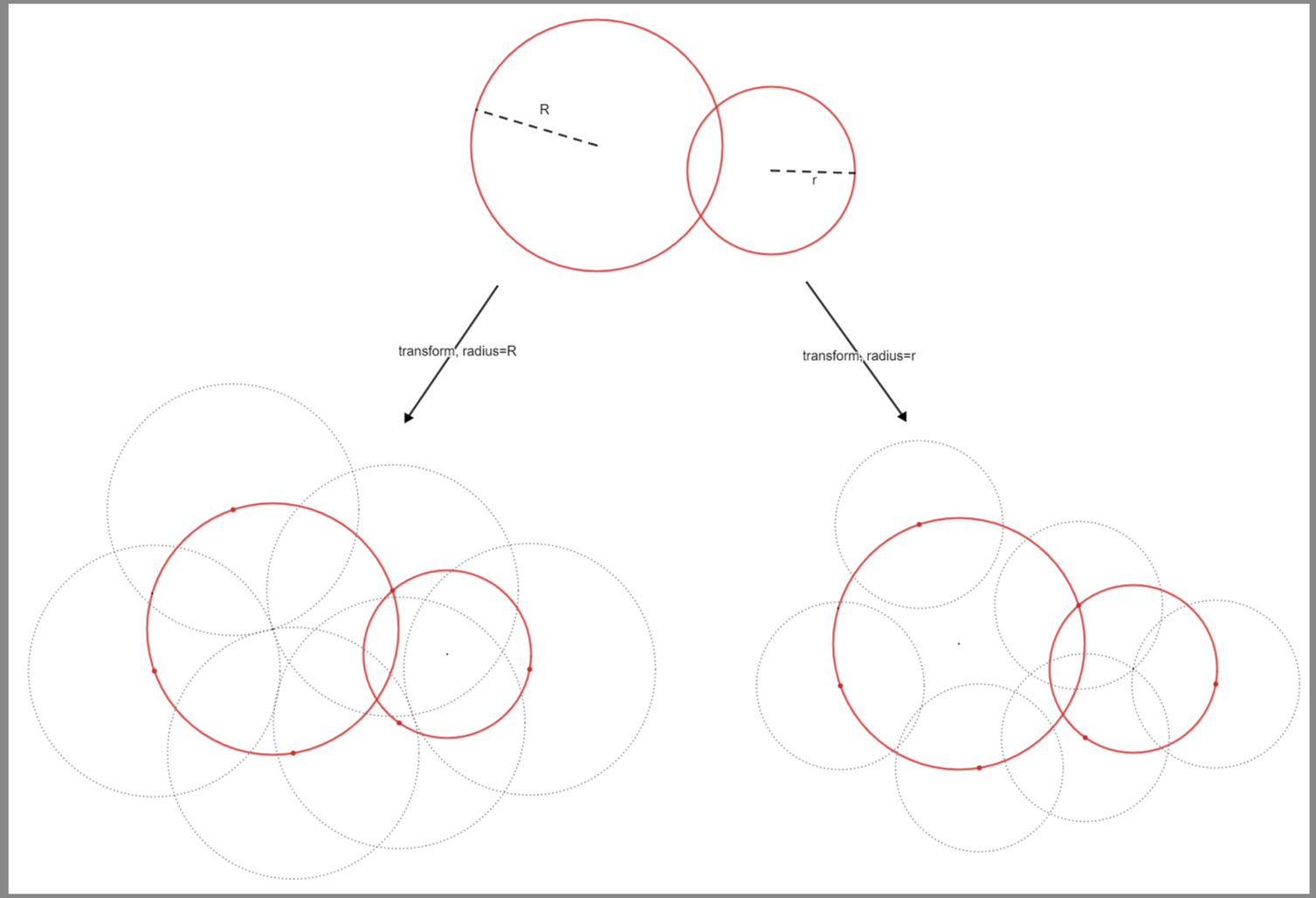
Hough Transform

Allows to find linear shapes using voting system in the paramiter space and selecting local maxima. This version iterate through lines with different slope and Y-axis cross (in terms of linear function).



Circular Hough Transform

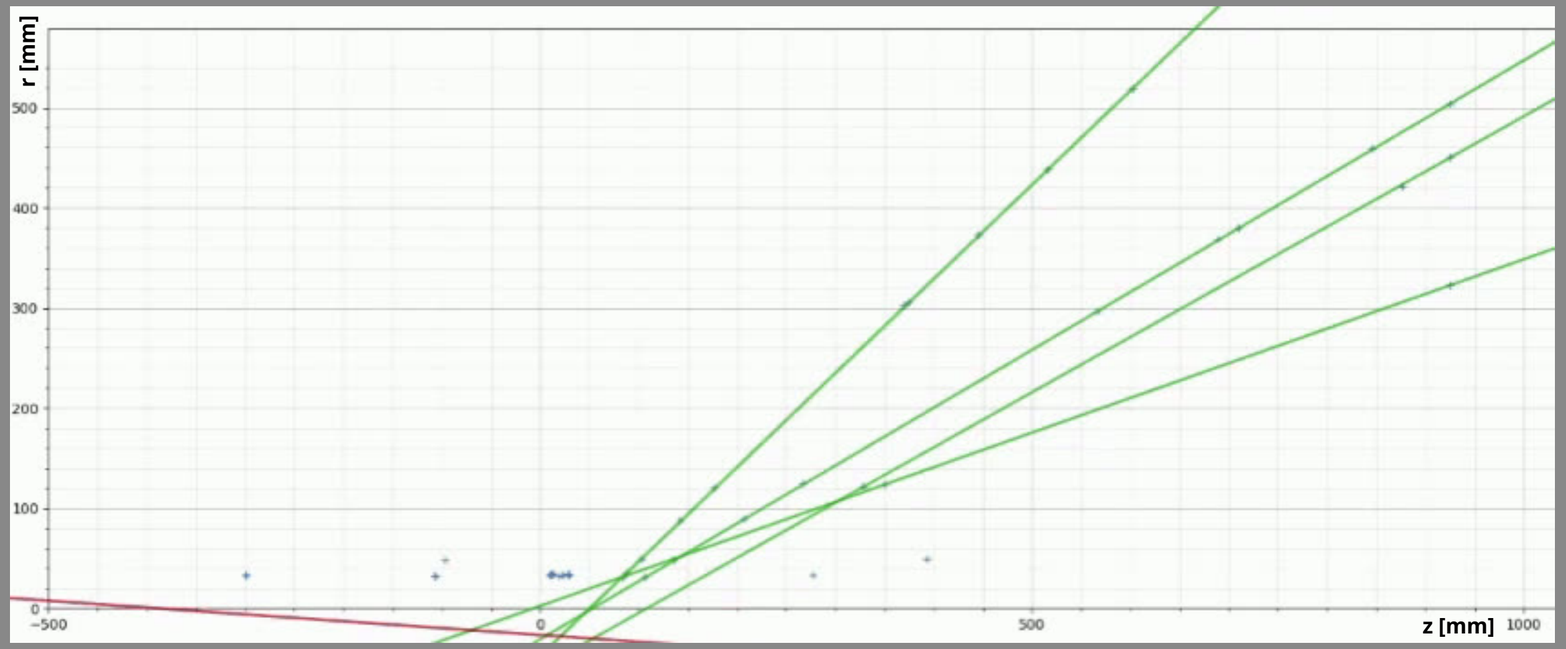
Allows to find circular shapes using voting system in the paramiter space and selecting local maxima. This algorithm iterate through different radiuses and circles' centers.

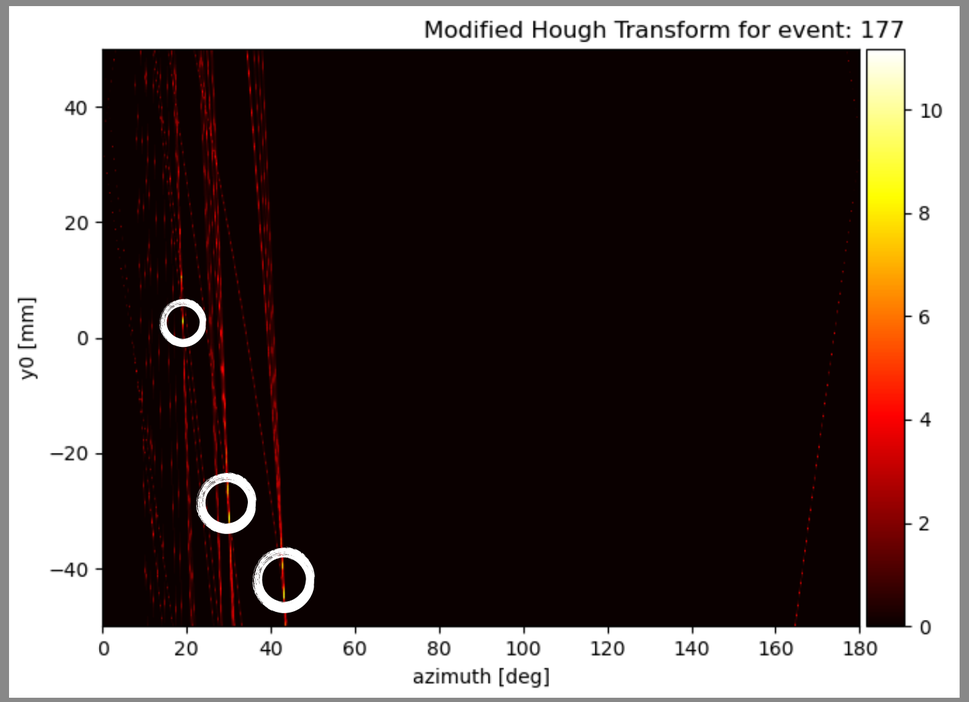


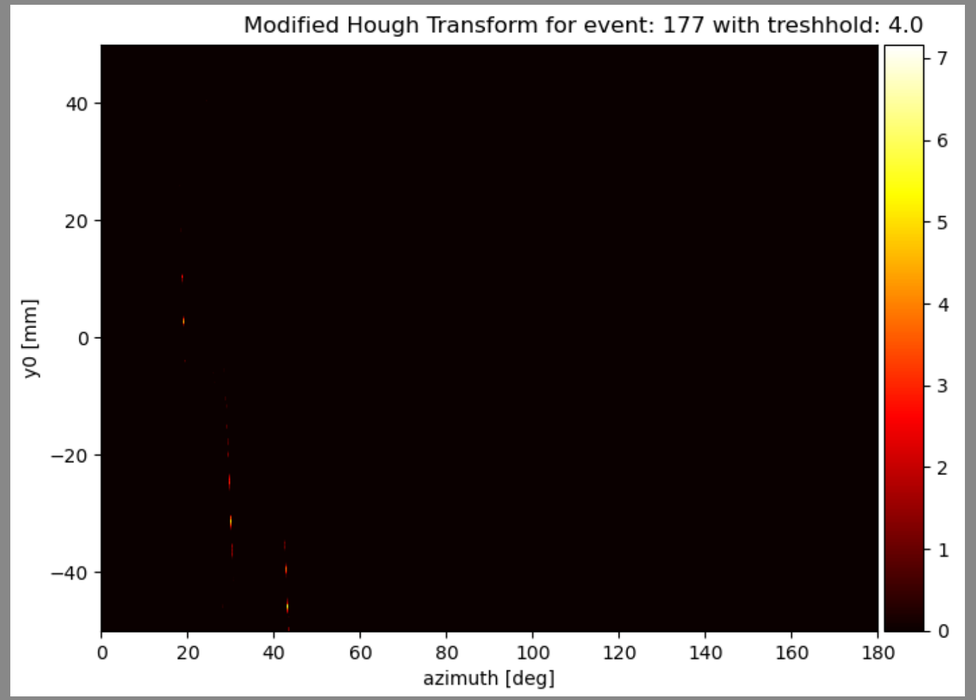
Algorithms:

- Linear Hough Transform (for Z-R view):
  - Iteration through "y" around (0;0) and slope
  - Iteration through points awarding voting array for line with 1/(distance from center)
- Receiving maxima from voting array:
  - segmenting array
  - finding exact segment maximum
- Filtering wrong classified maxima:
  - maxima with overlapping points
  - too few points
  - too many points around the center of collision
- Filtered maxima X-Y view circle fit:
  - minimalisation points' error for different radiuses

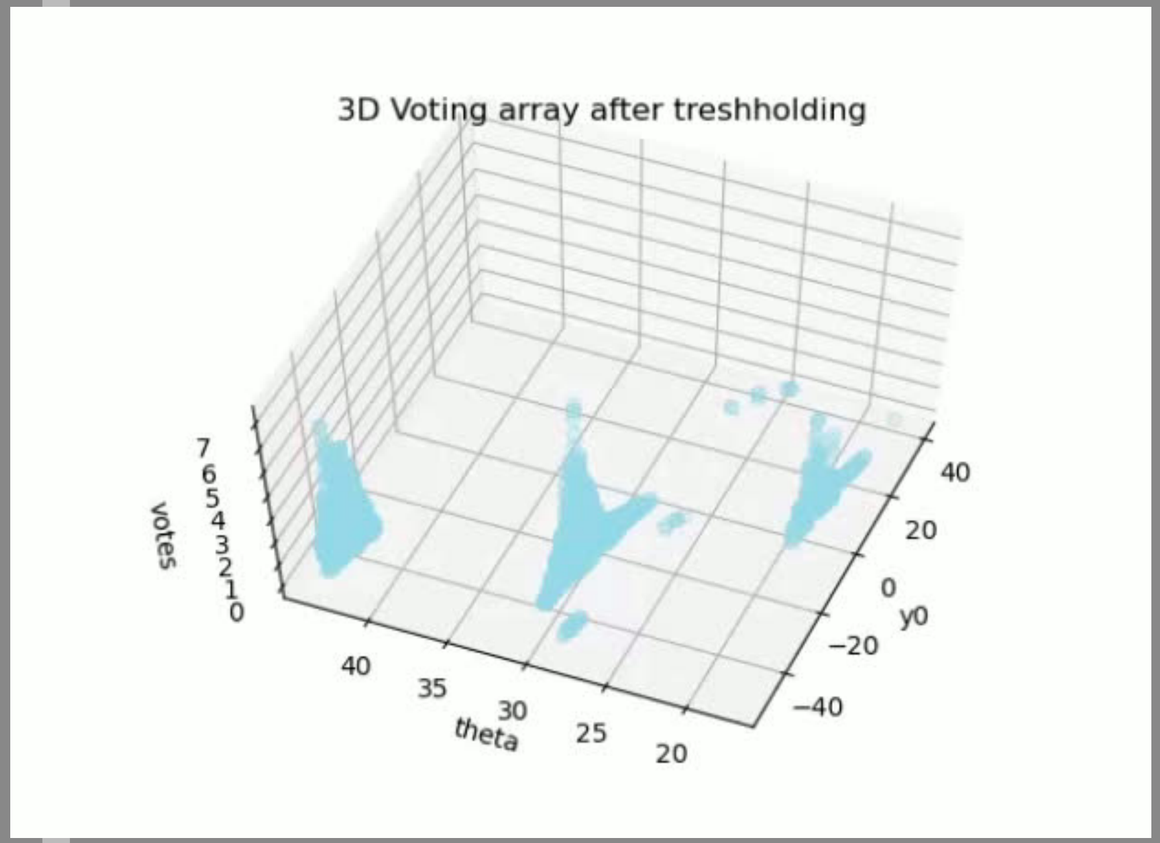
Linear Hough transform result

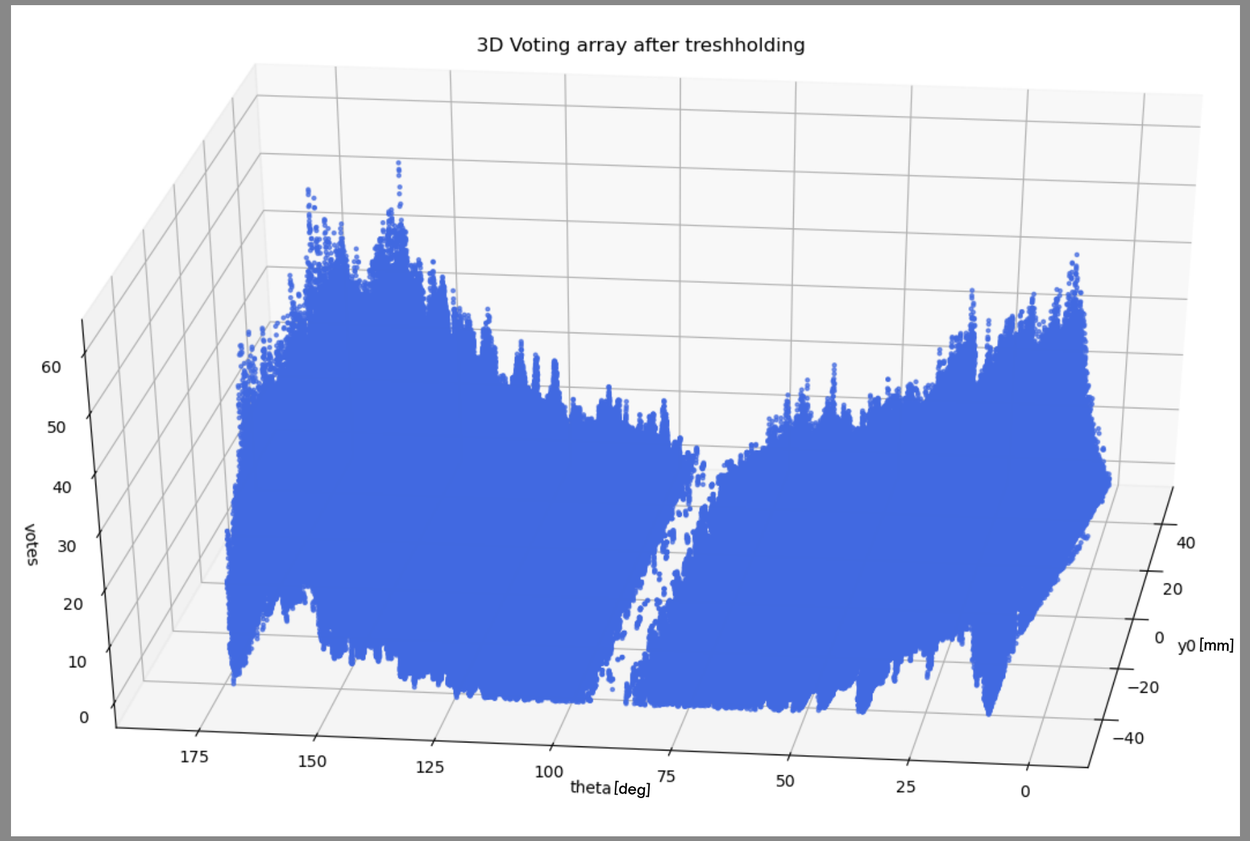






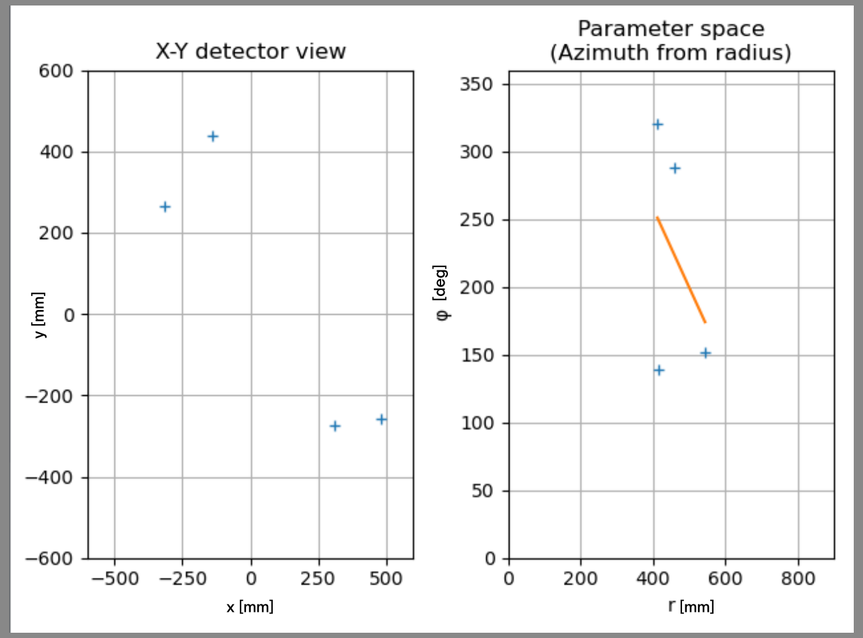
Segmenting voting array
Finding local maxima



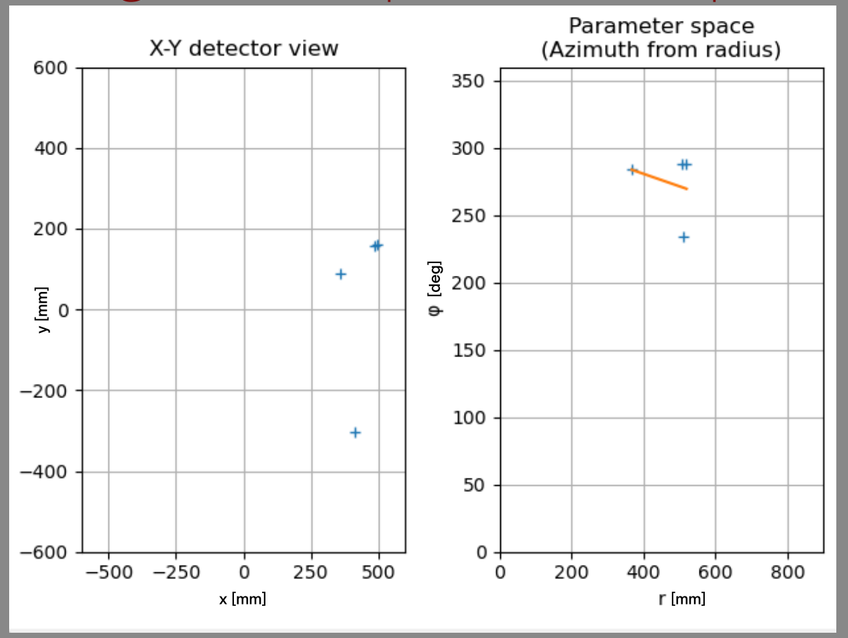


Removal points (or maxima) scattered in x-y view

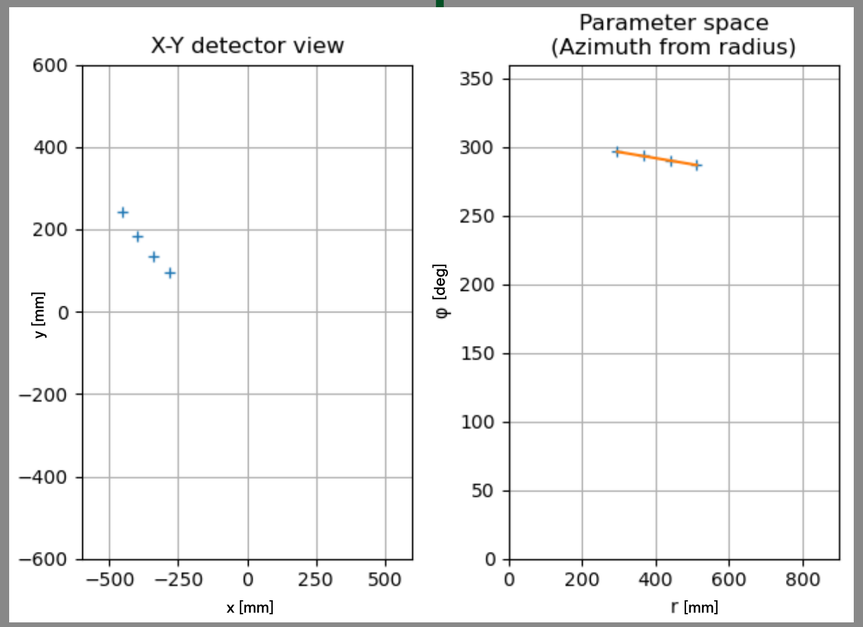
Unfitable



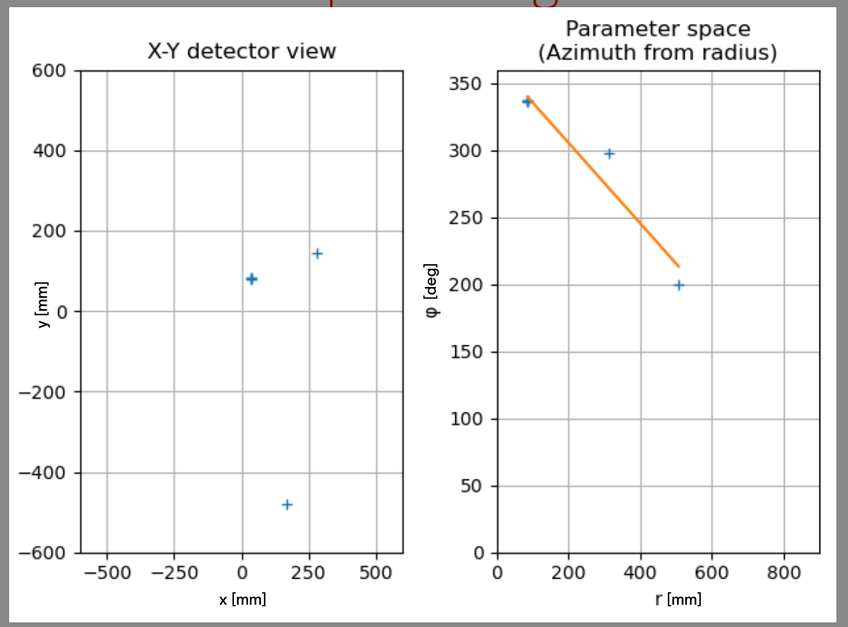
Wrong classified point/too few points



Accepted



Slope too high



Event lifecycle

MODIFIED LINEAR HOUGH TRANSORM FOR Z-R VIEW

SEGMENTING VOTING ARRAY AND FINDING LOCAL MAXIMA

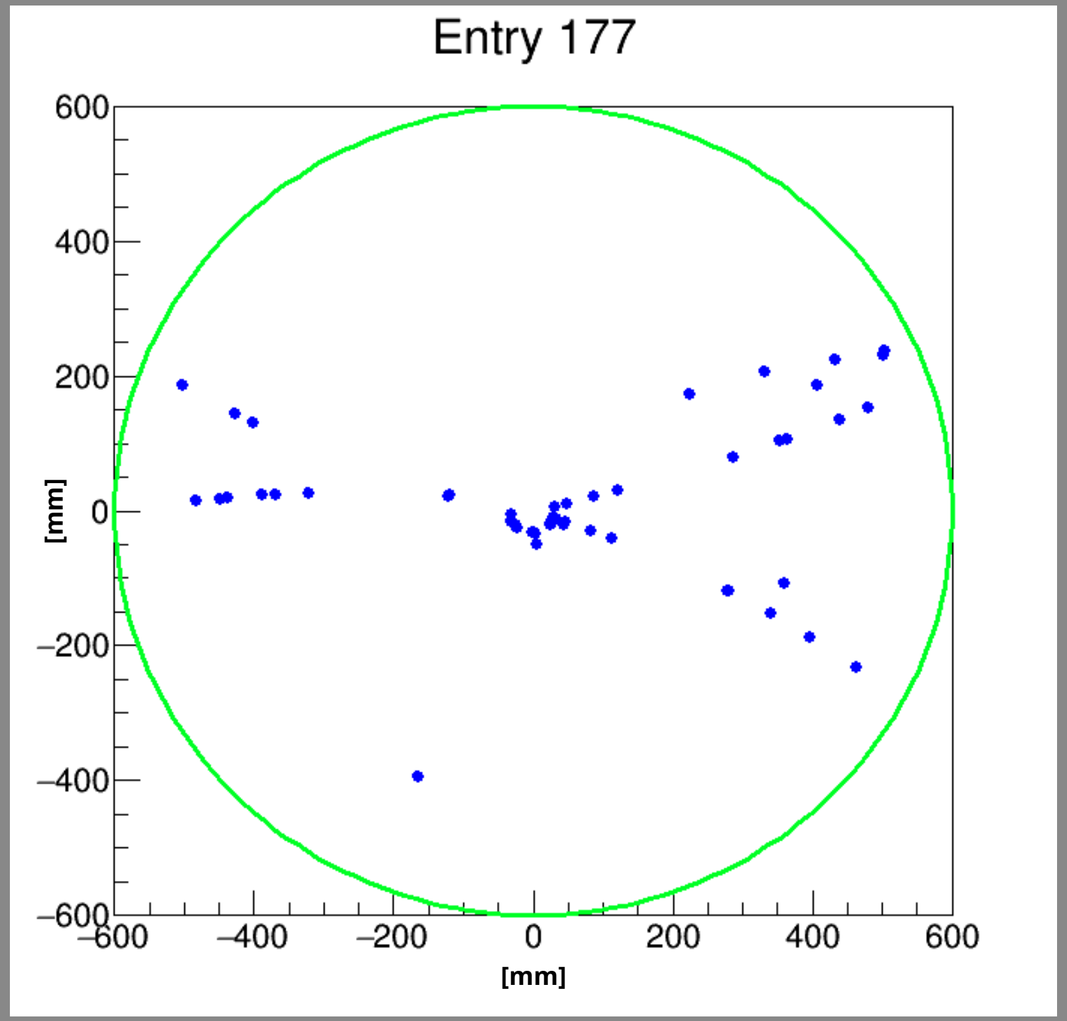
EJECTING POINTS (OR MAXIMA) SCATTERED IN X-Y VIEW

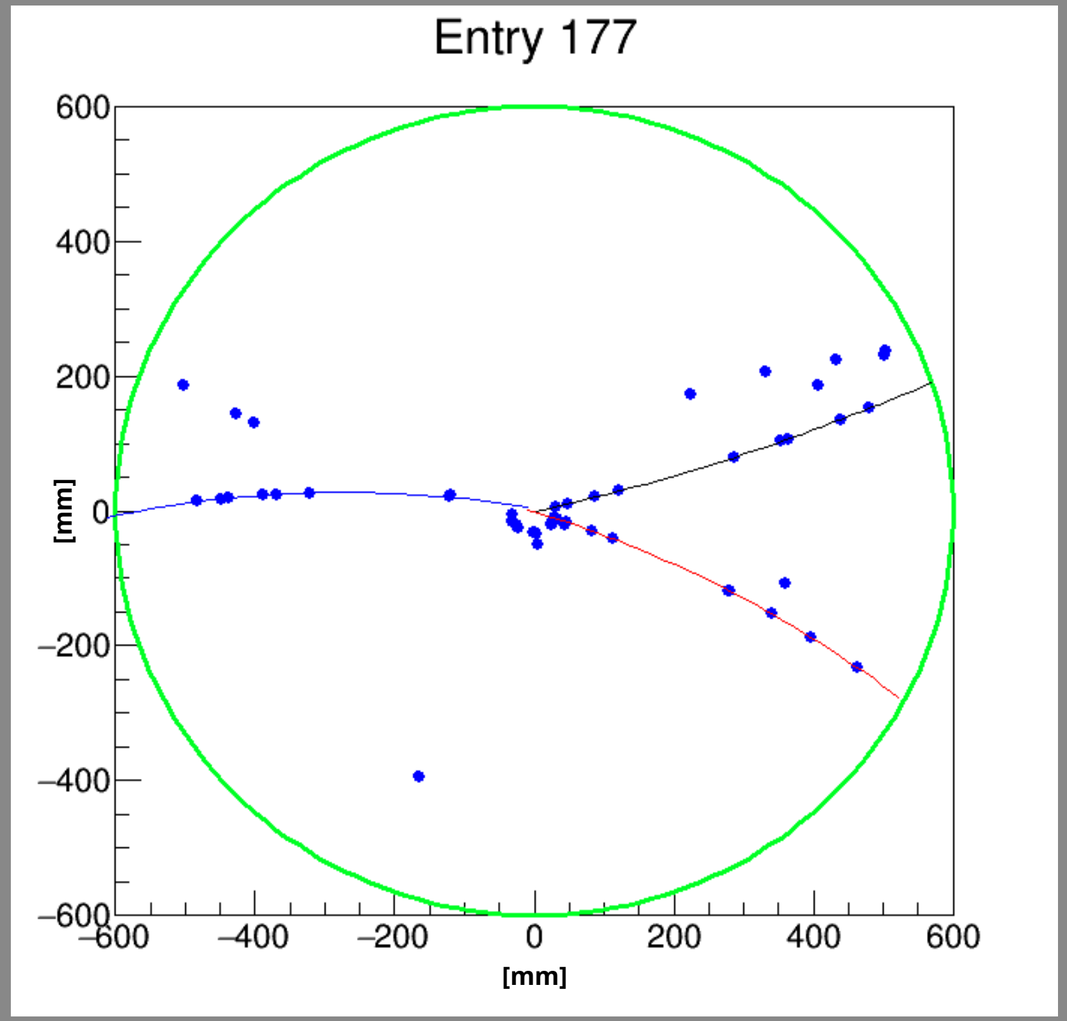
REDUCING MAXIMA WITH OVERLAPPING POINTS

CIRCLE (ARC) FIT FOR CLEARED MAXIMA

Results:

Radius and center coordinates of the particle's path, that may be used for caculating momentum.

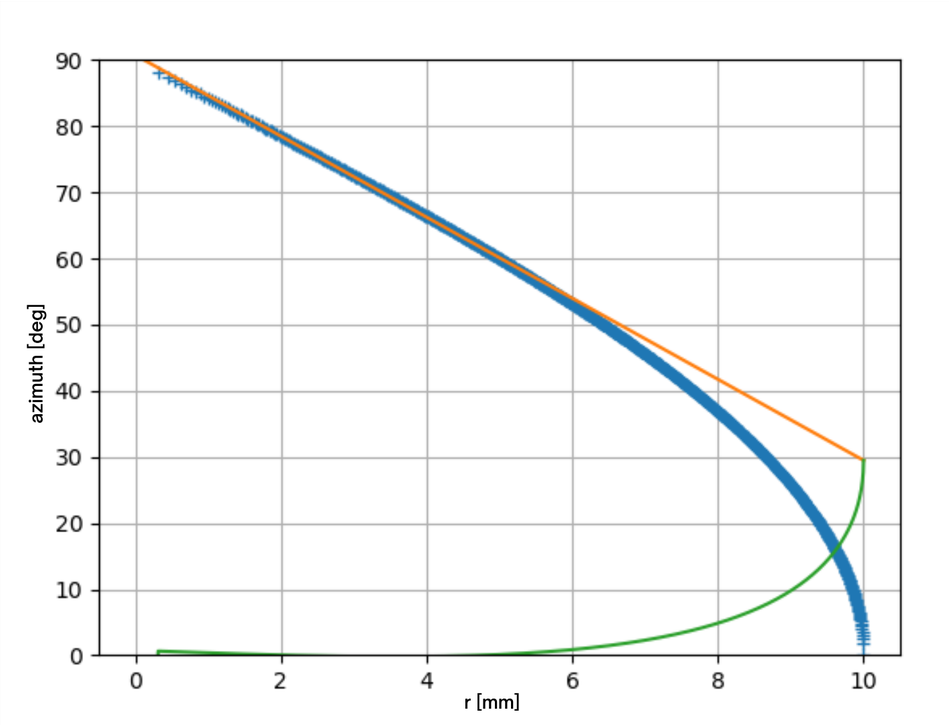




Questions?

Backup:
Explanation

Linear fit for angle dependency

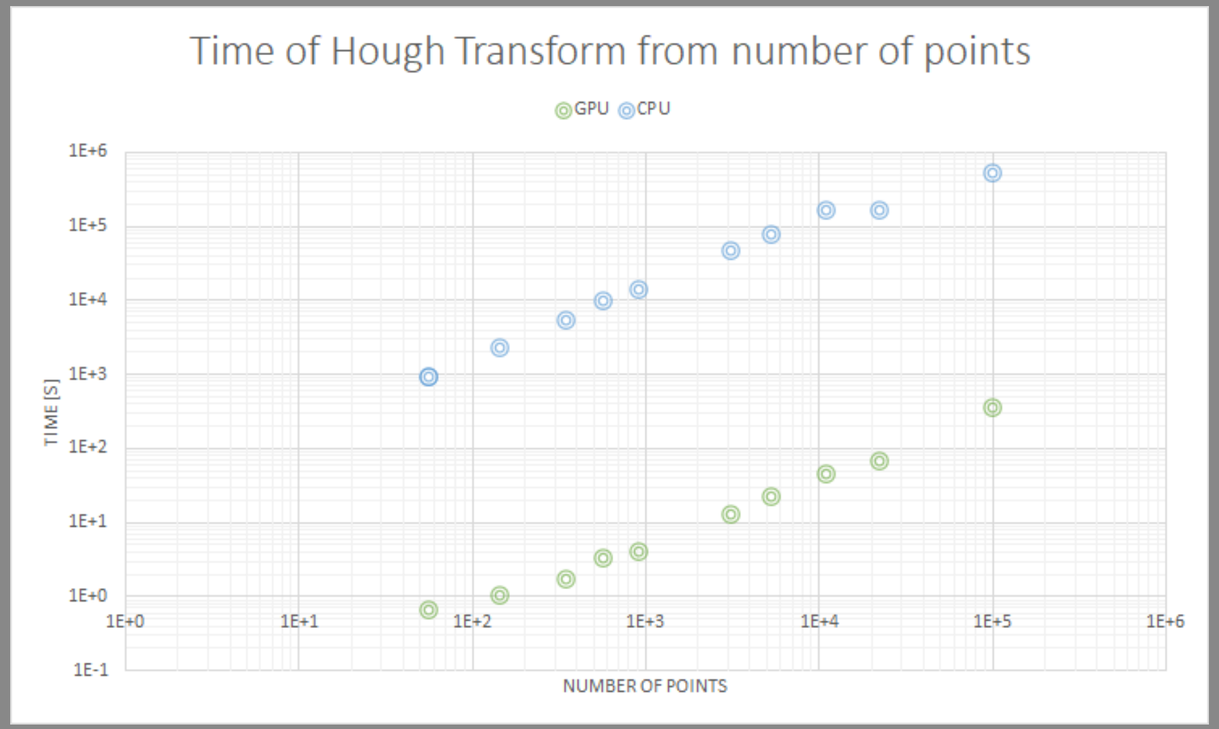


Circle fit publication:

http://www.dtcenter.org/sites/default/files/community-code/met/docs/write-ups/circle_fit.pdf

Backup:
Paralellisation

GPU Parallelisation results:



Perspectives:

- All sub-algorithms paralelisation
- Reformat code to scalable form and choosing optimal parameter precisely
- Deeper Hough transform parallelisation
  calculating every point weight and combining results using i. e. shared memory