recent GEM developments

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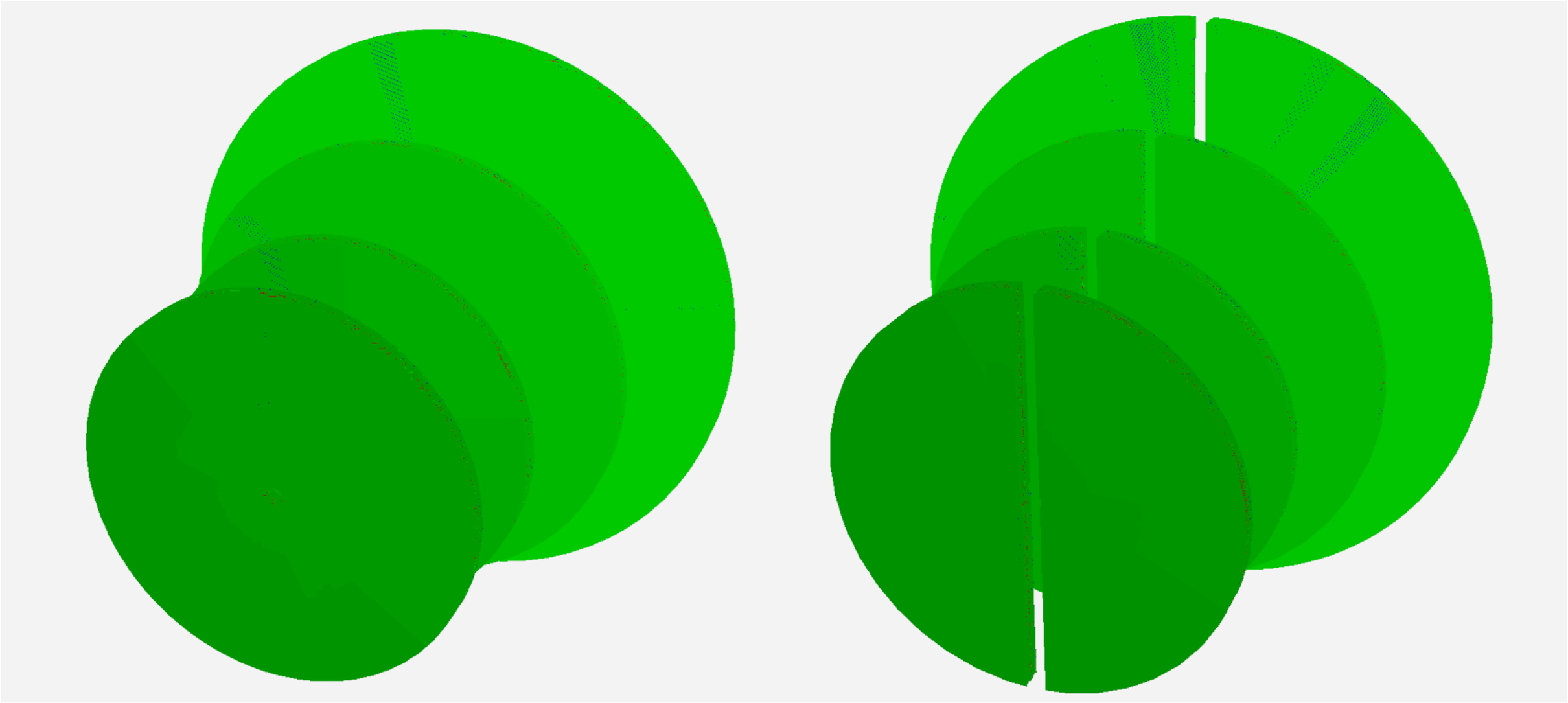
GEM geometry

Previous GEM version:

GEM stations were discs

New GEM version:

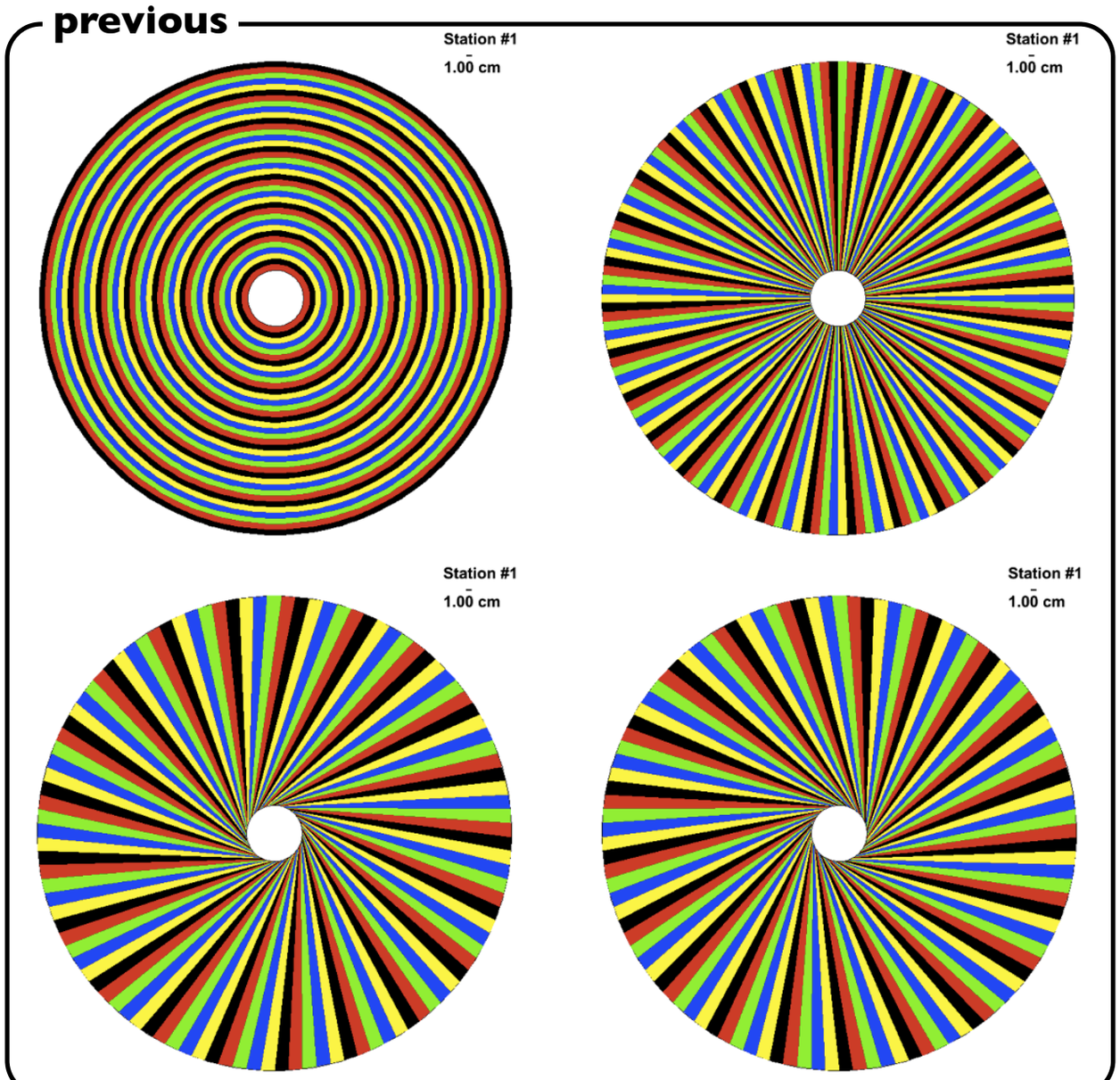
Introduced a vertical 4.3 cm gap

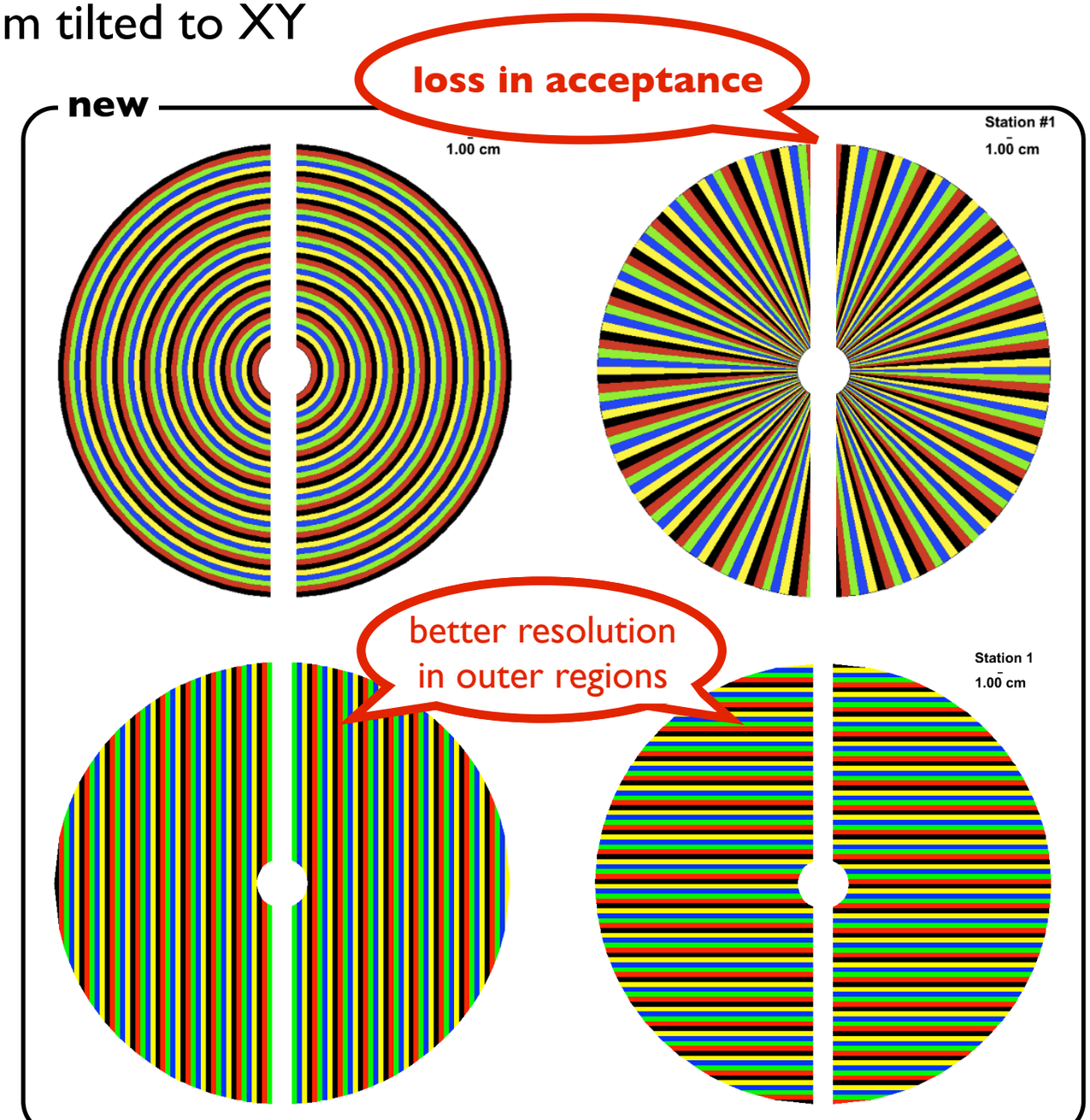


Digitization scheme

4 different views per station (as previously)

changed orientation in 2 back views from tilted to XY

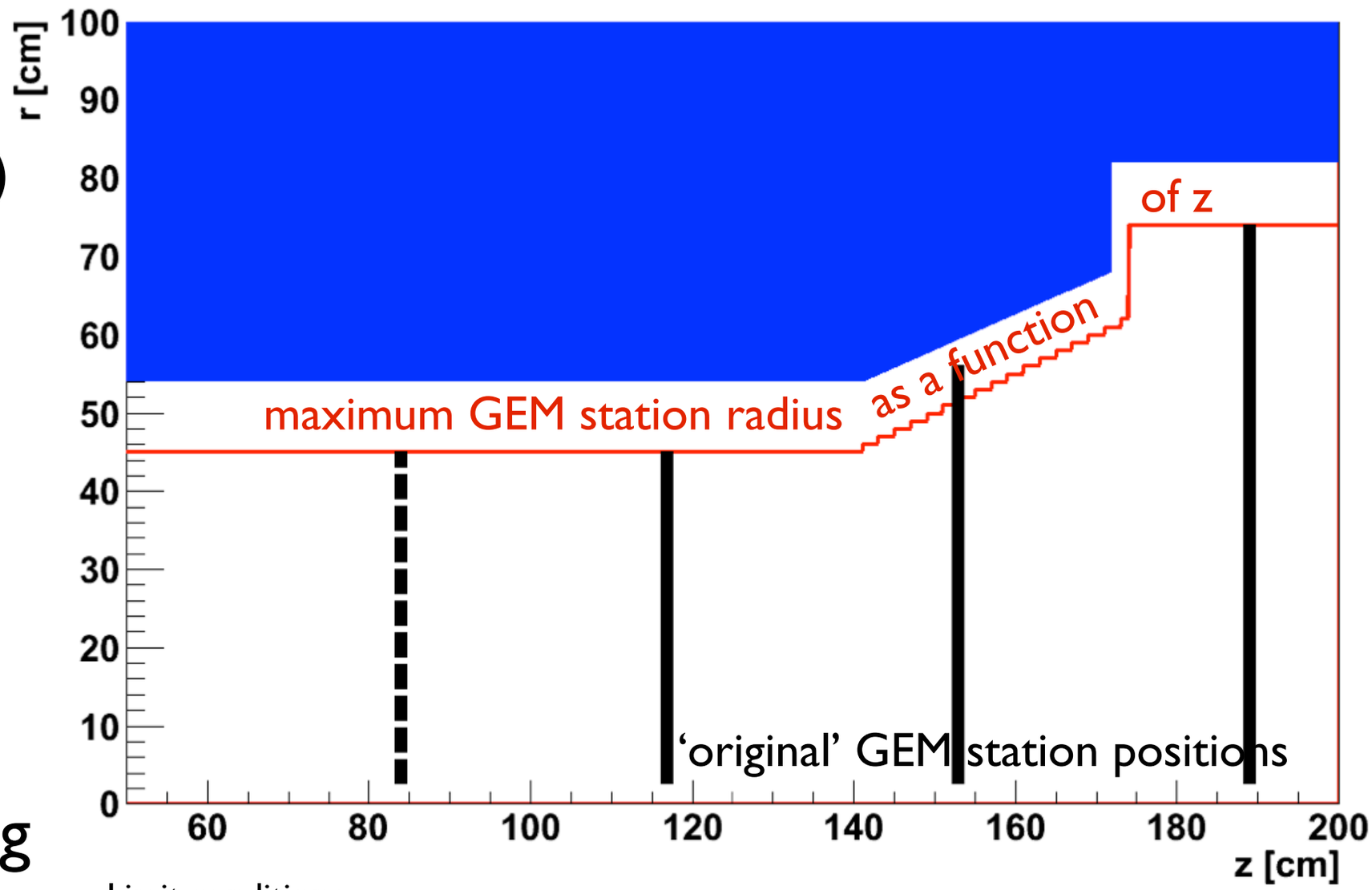




GEM layout study

GEM geometry:
3 stations (long CT)
4 stations (short CT)
at **z** with **r** :
(84cm 45cm)
117cm 45cm
153cm 56cm
189cm 74cm

How is the tracking performance changing when moving the stations?



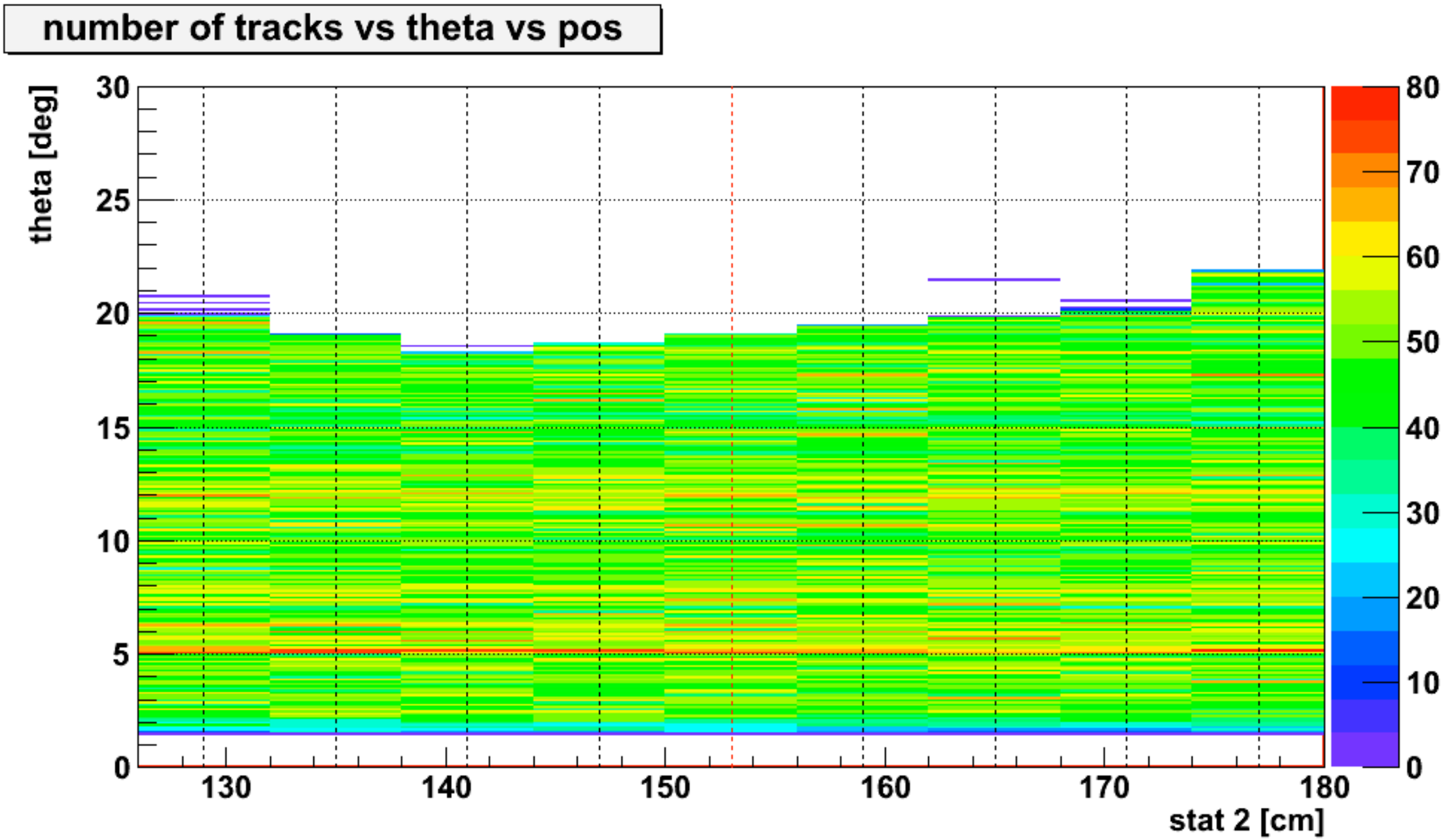
Limit conditions:
- first station cannot be moved forward (z_{min} = 84/117cm) because of CT
- last station cannot be moved back (z_{max} = 189cm) because of DIRC
- minimum distance between stations has to be bigger than 5cm

Long CT - 3 GEM Discs

- Change position of the middle station
- Following positions chosen (originally 153): 129,135,141,147,153,159,165,171,177
- Most sensitive observables:
  - minimum and maximum acceptance limits in theta
  - momentum resolution
  - tracking efficiency

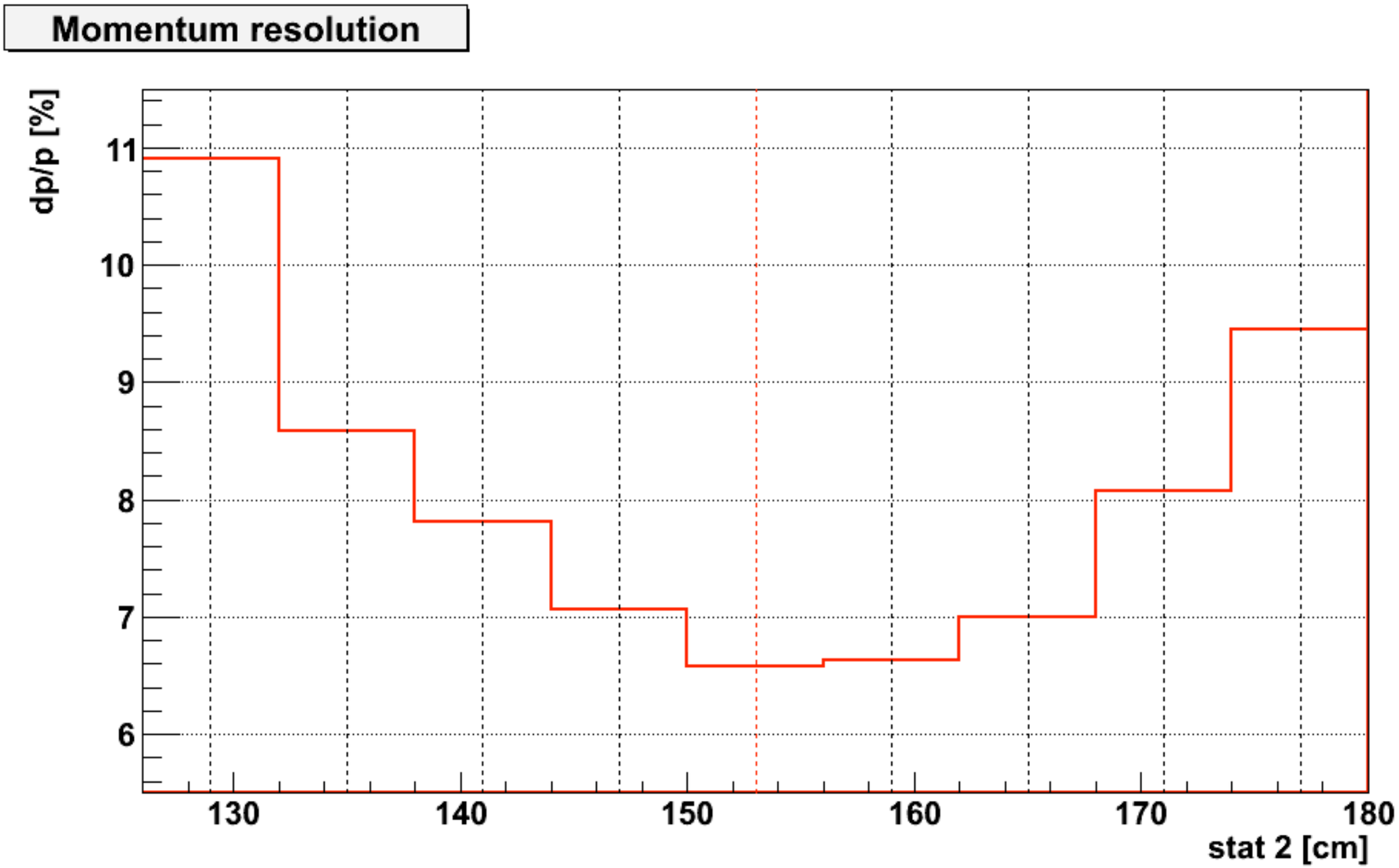
Results - 3 GEM Discs

Theta distribution of reconstructed tracks as function of middle station position



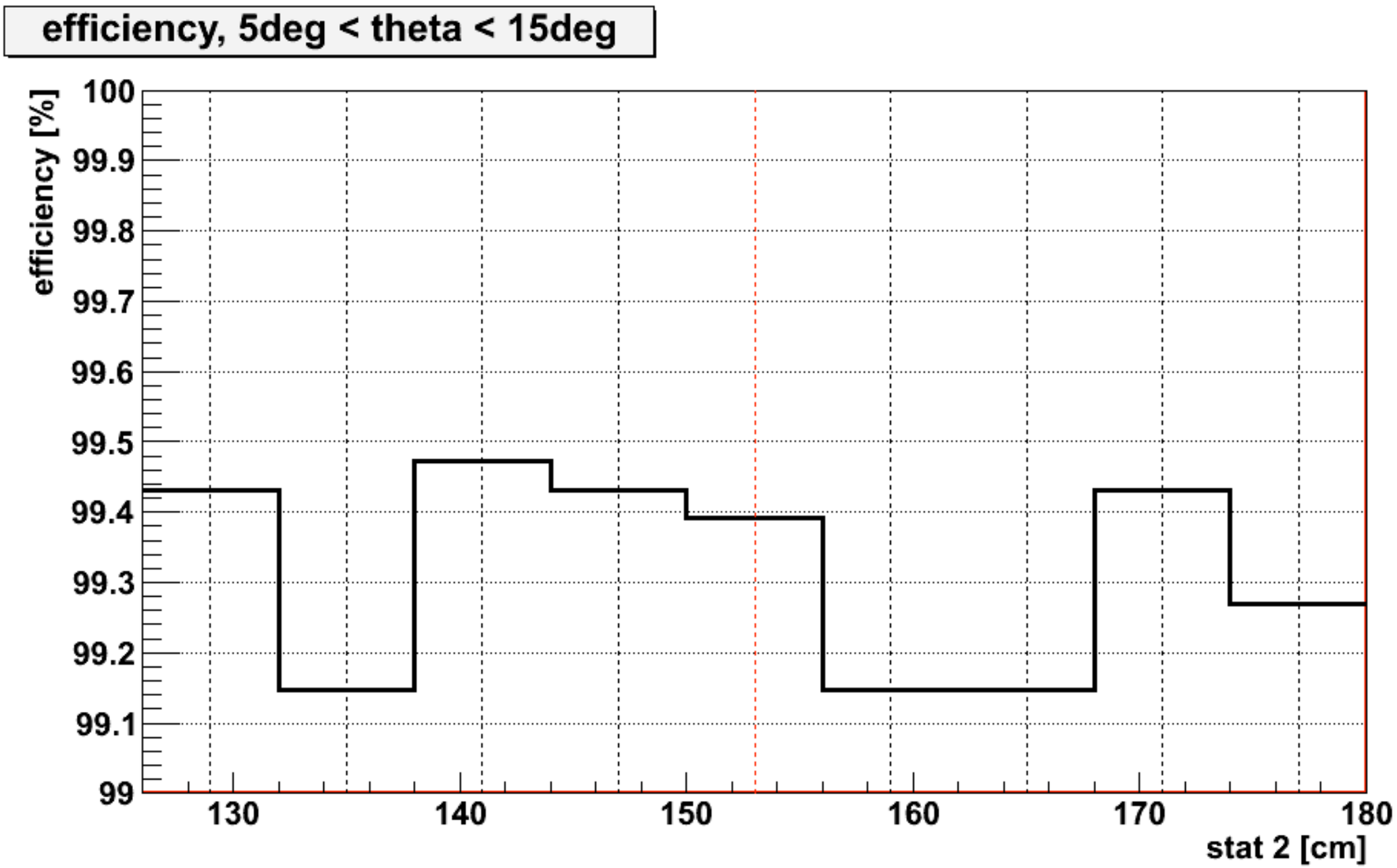
Results - 3 GEM Discs

Reconstructed tracks' momentum resolution as function of middle station position



Results - 3 GEM Discs

Tracking efficiency in the common acceptance region



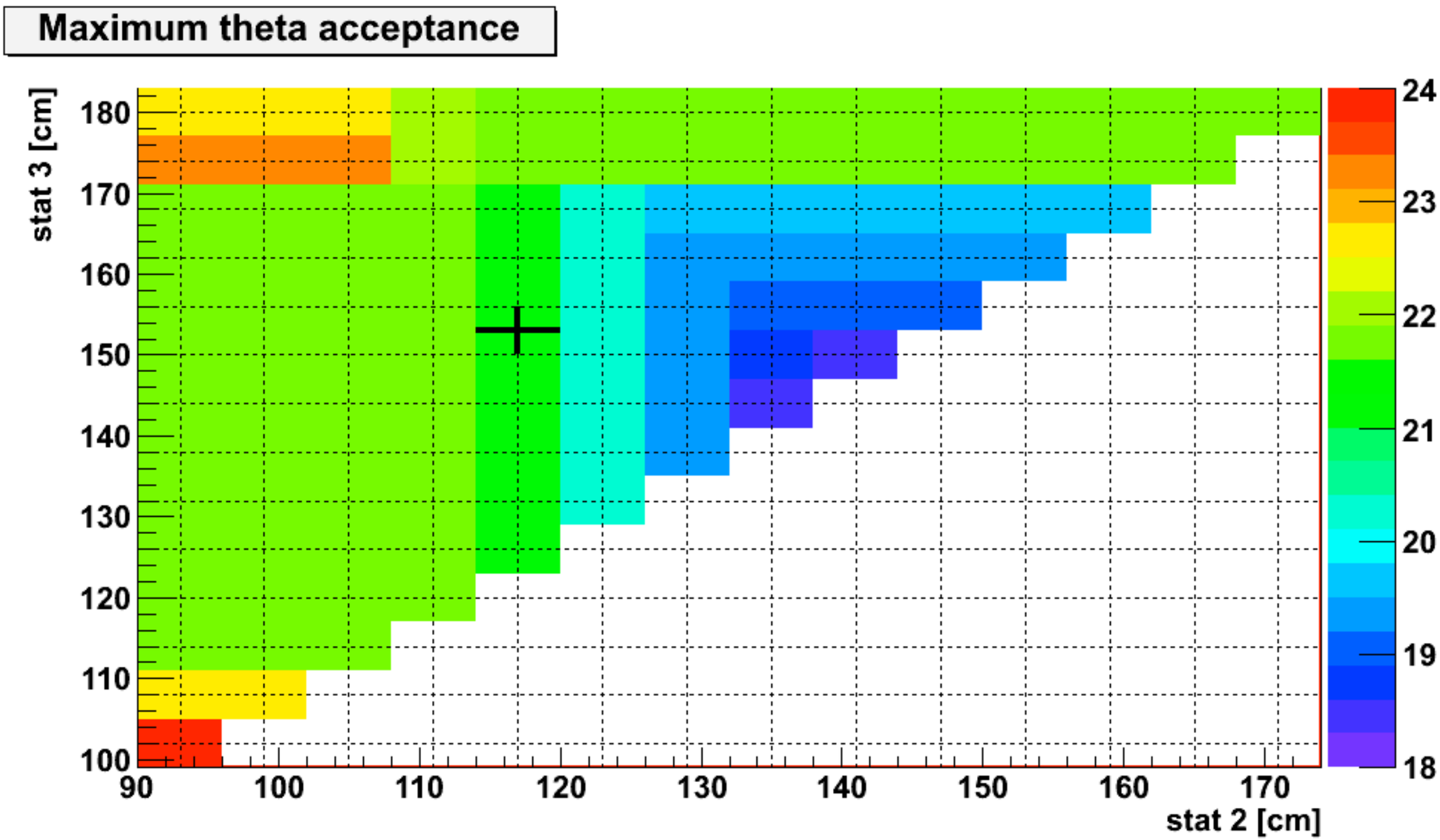
Short CT - 4 GEM Discs

- Change position of the middle stations
- Positions chosen according to the following criteria:
  - minimum distance between stations = 9cm
  - step set to 6cm

station 1	station 2	station 3	station 4
84	93	102, 108, 114, 120, 126, 132, 138, 144, ..., 174, 180	189
84	99	108, 114, 120, 126, 132, 138, 144, 150, ..., 174, 180	189
84	105	114, 120, 126, 132, 138, 144, 150, 156, ..., 174, 180	189
84	.....	.....	189
84	171	180	189

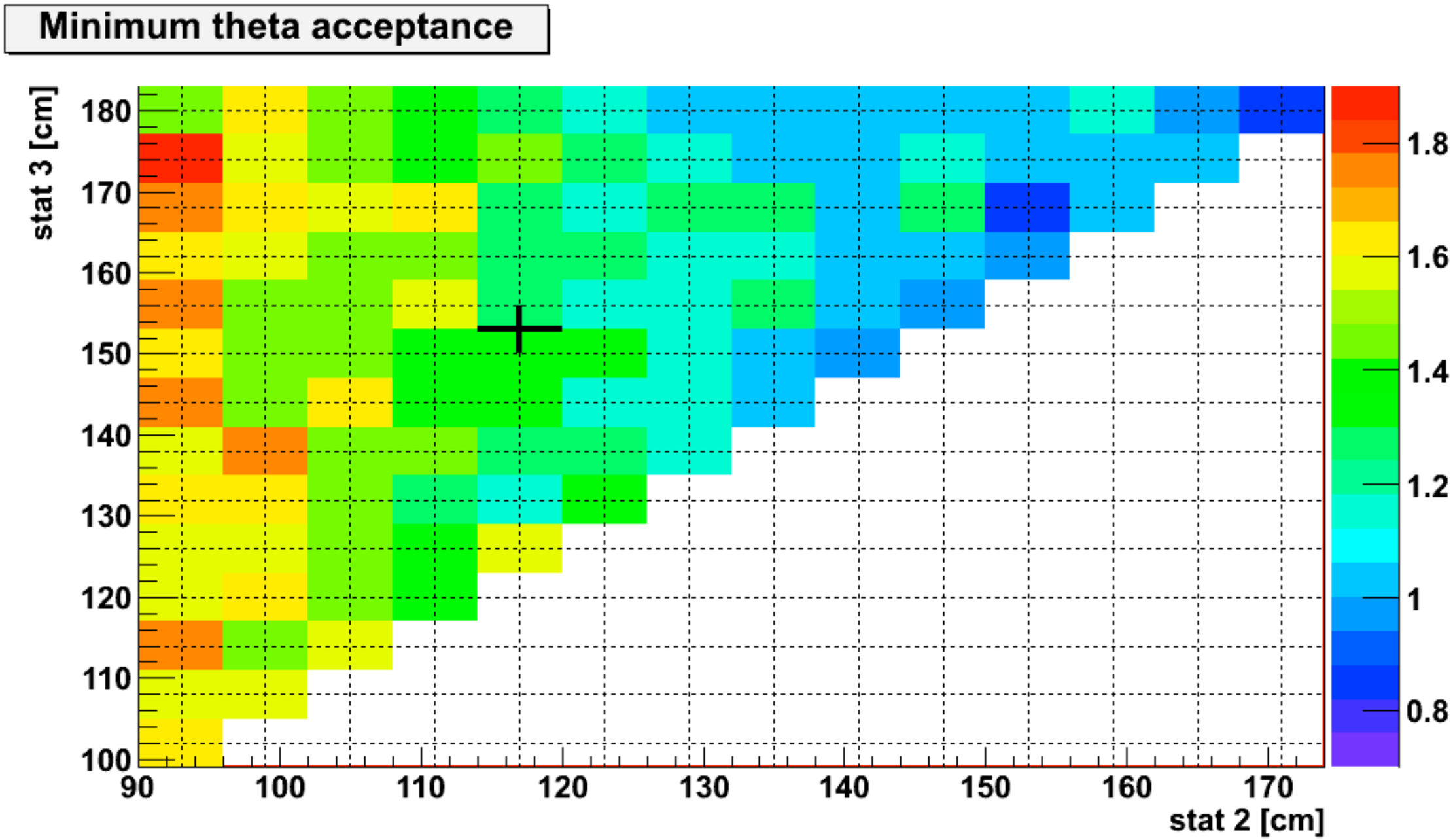
Results - 4 GEM Discs

Maximum theta acceptance as a function of middle stations' positions



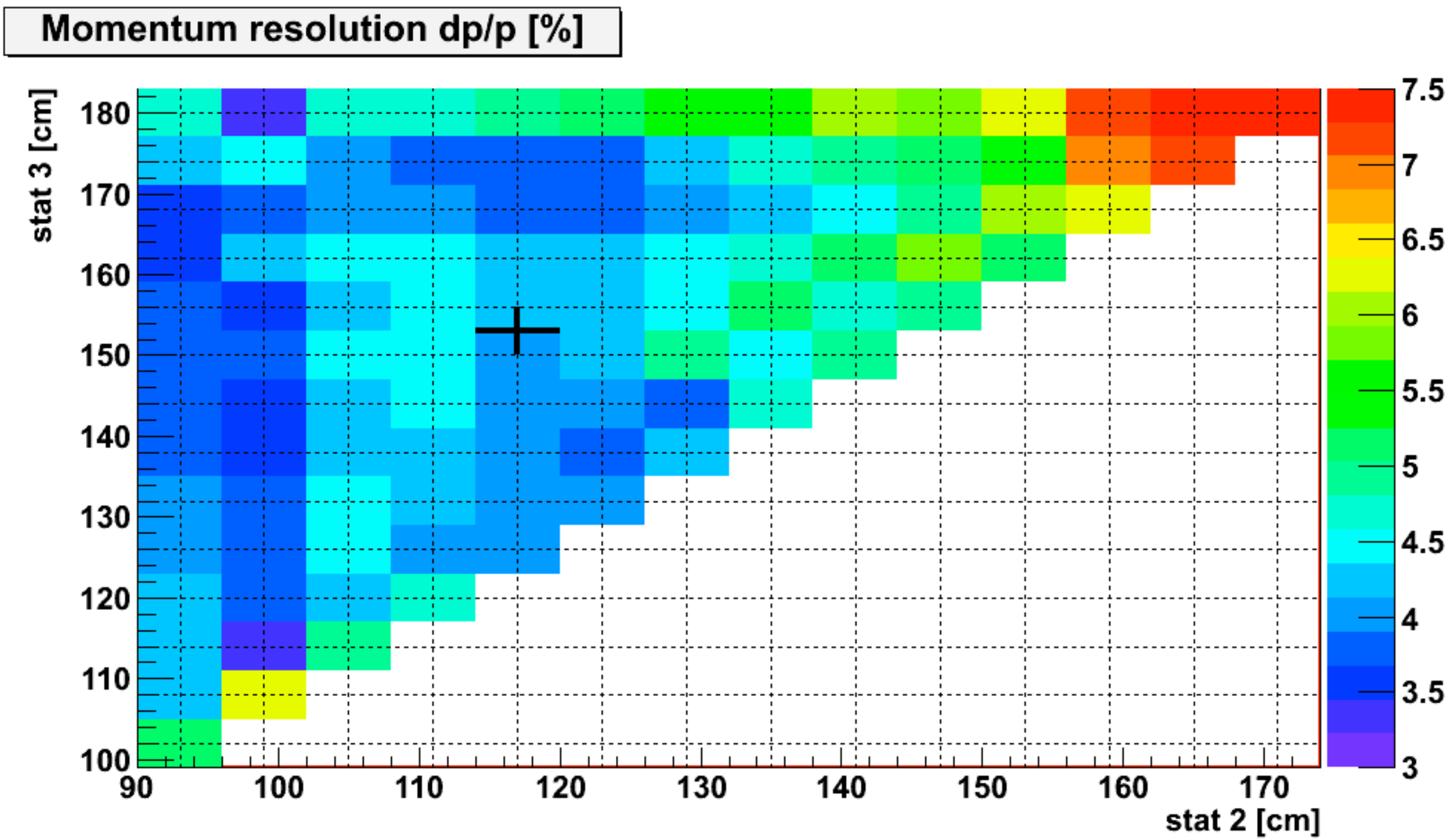
Results - 4 GEM Discs

Minimum theta acceptance as a function of middle stations' positions



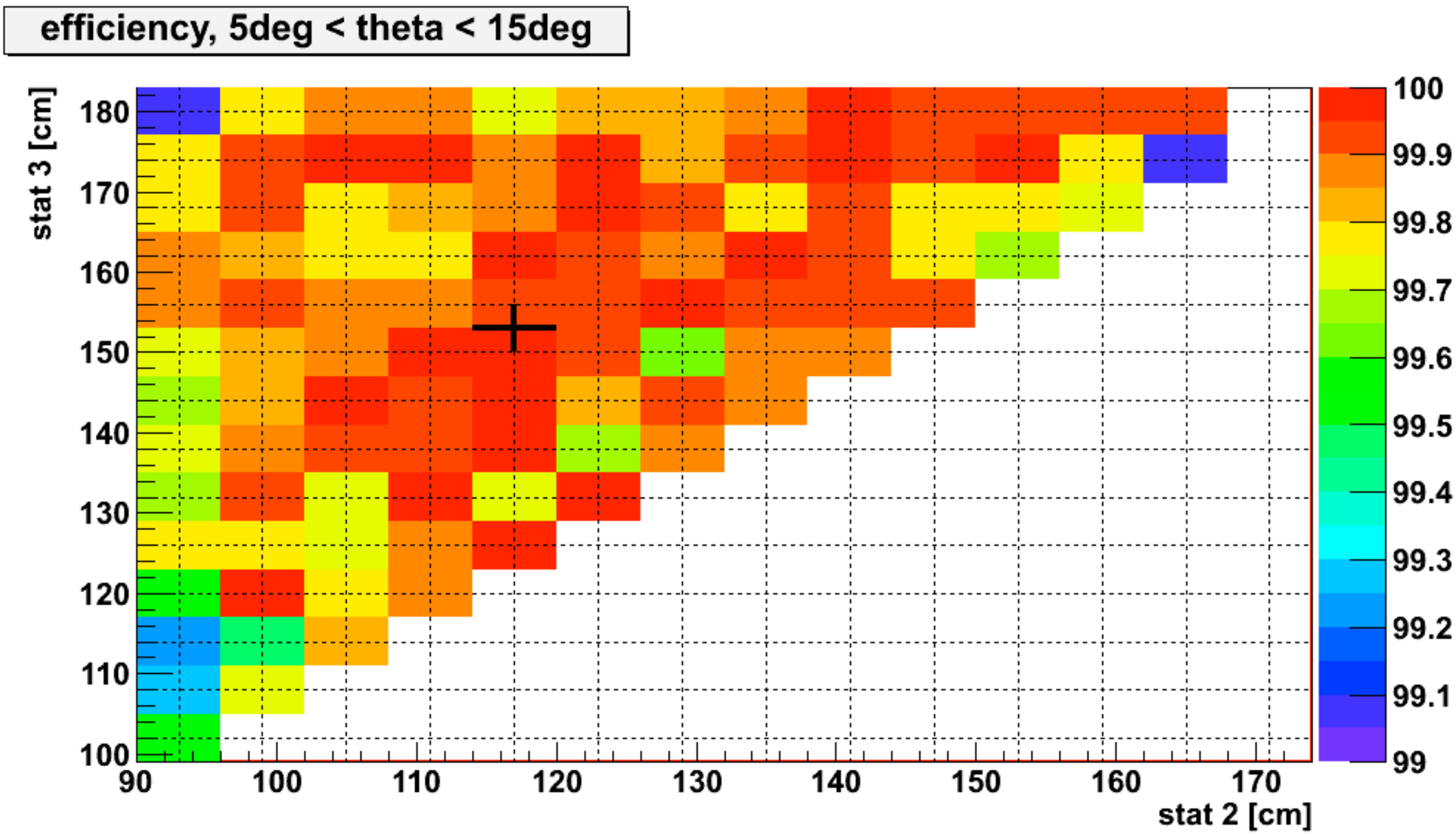
Results - 4 GEM Discs

Reconstructed tracks' momentum resolution as function of middle stations position



Results - 4 GEM Discs

Tracking efficiency in common acceptance region as function of middle stations pos's



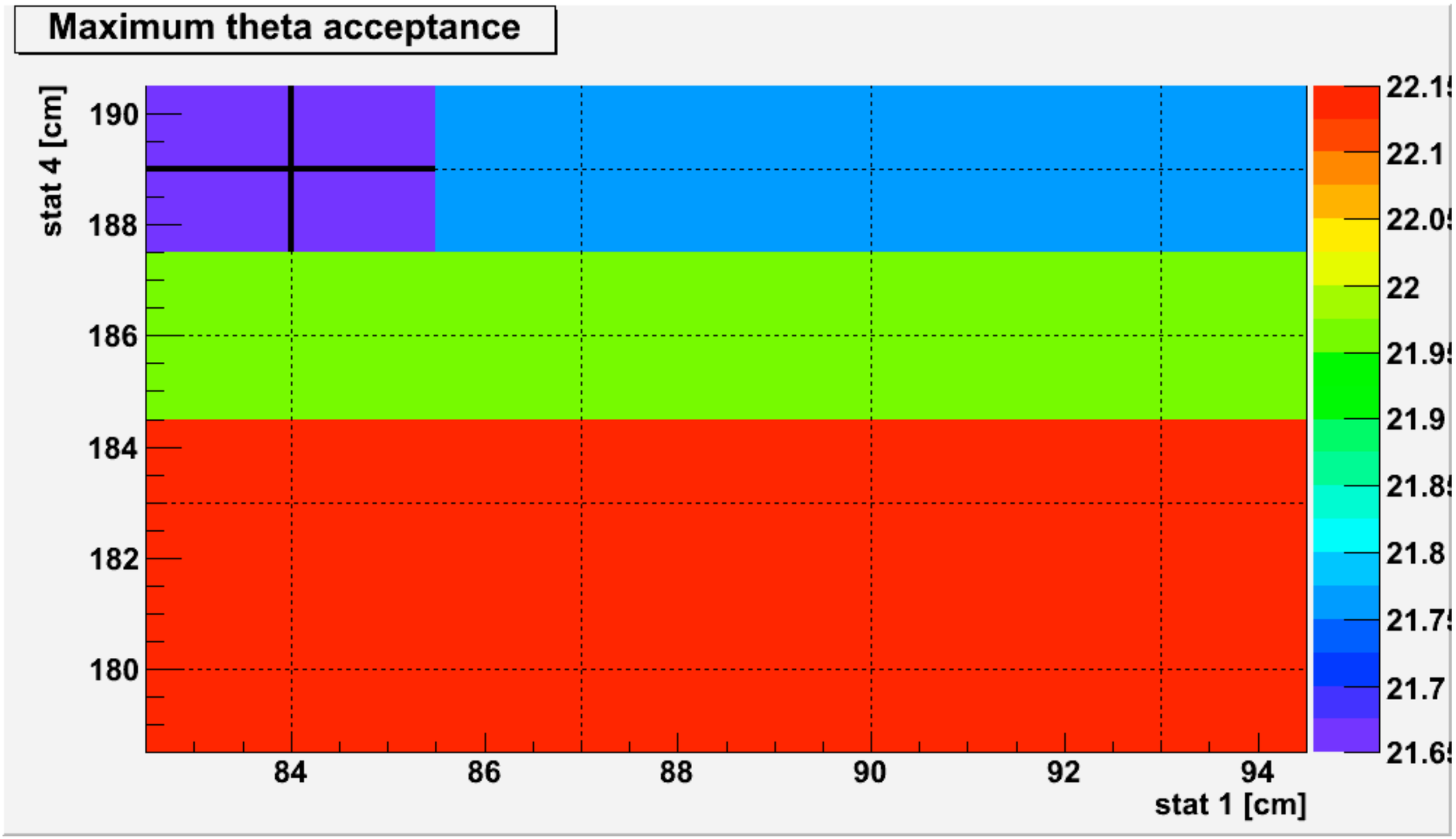
Short CT - 4 GEM Discs

- Vary positions of the first and last stations
- Fixed middle stations positions at: 111, 162 cm
- Parameter space summarized in table:

first/last				
	84/189	87/189	90/189	93/189
	84/186	87/186	90/186	93/186
	84/183	87/183	90/183	93/183
	84/180	87/180	90/180	93/180

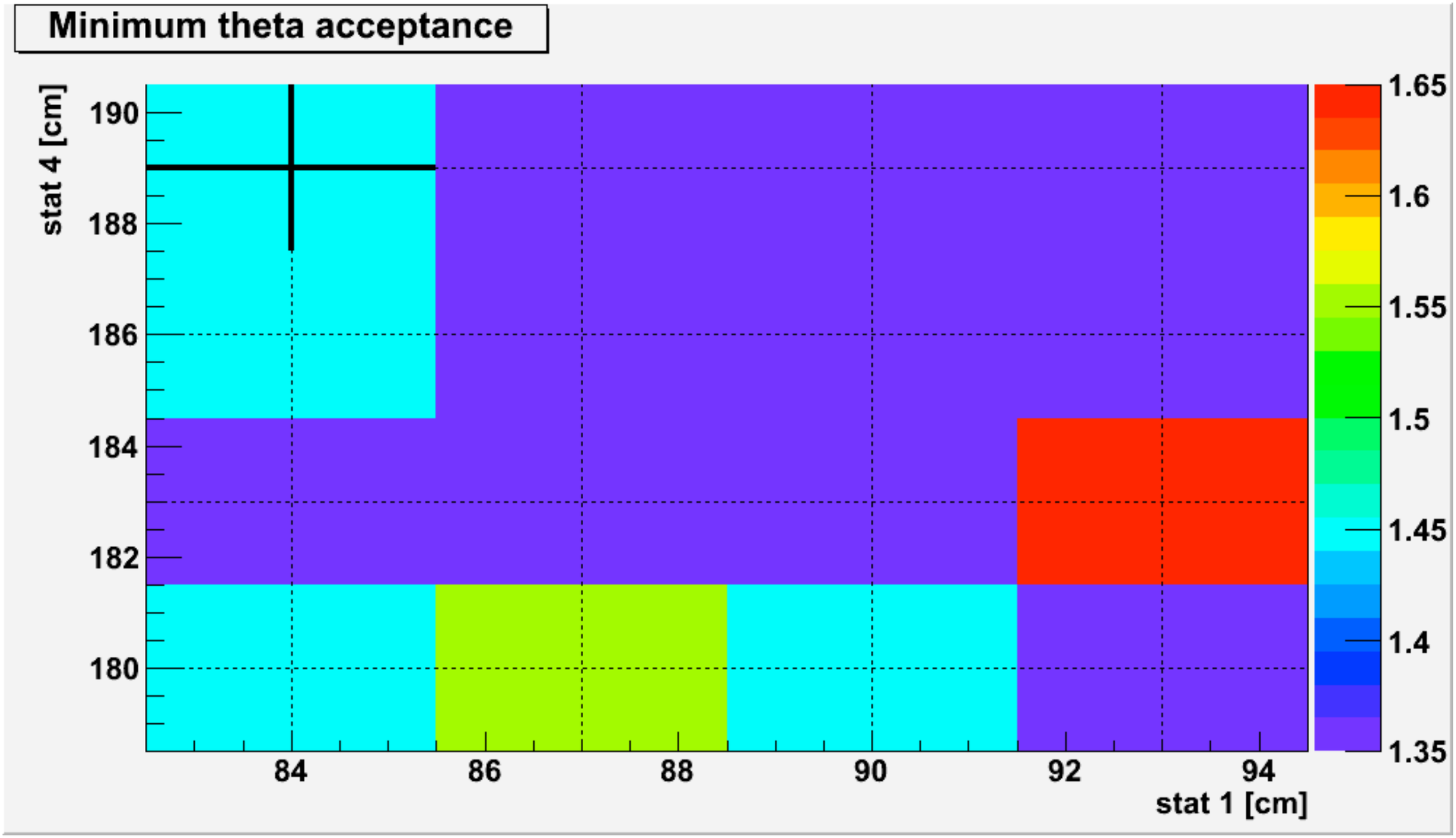
Results - 4 GEM Discs

Maximum theta acceptance as a function of outer stations' positions



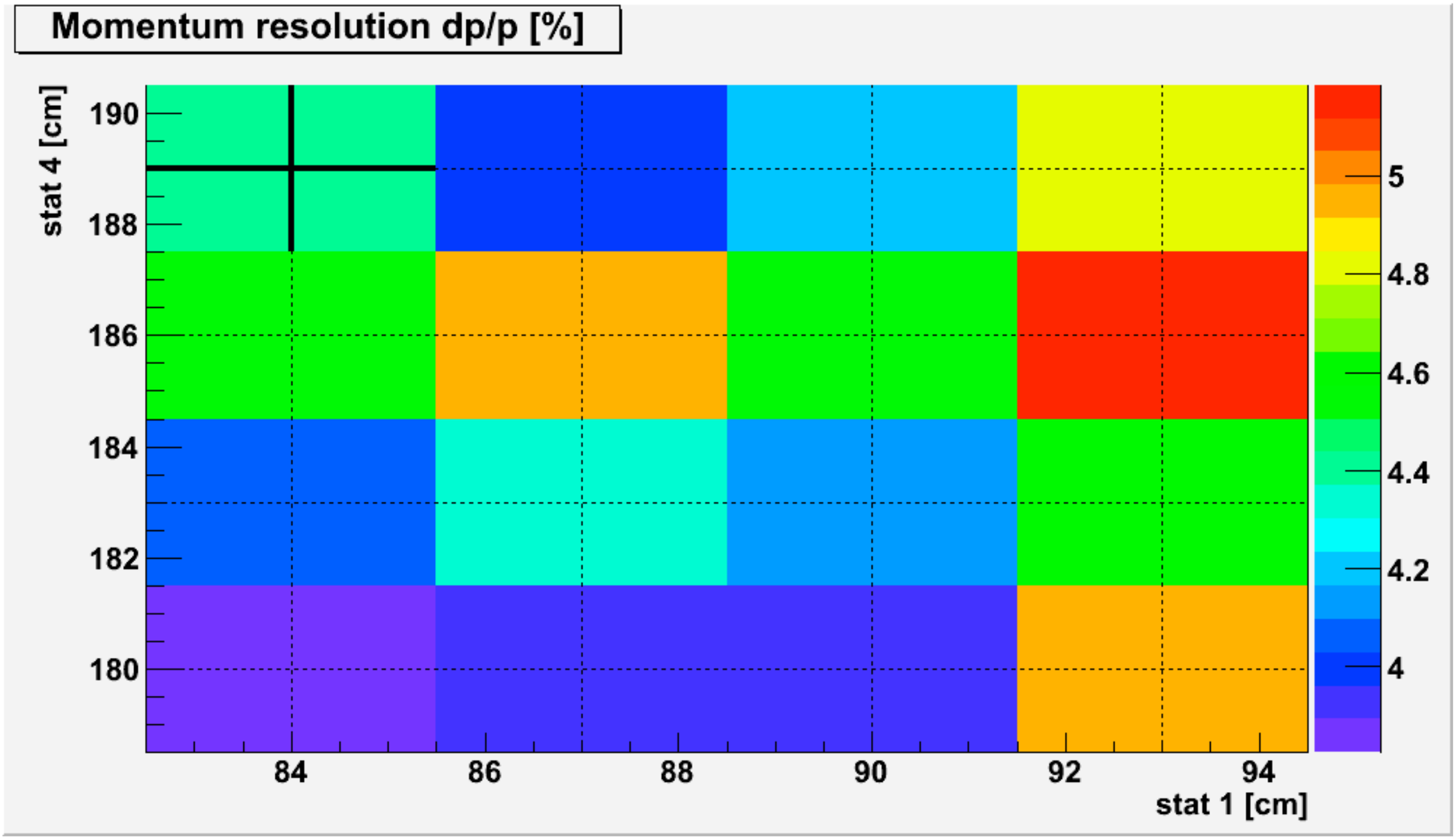
Results - 4 GEM Discs

Minimum theta acceptance as a function of outer stations' positions



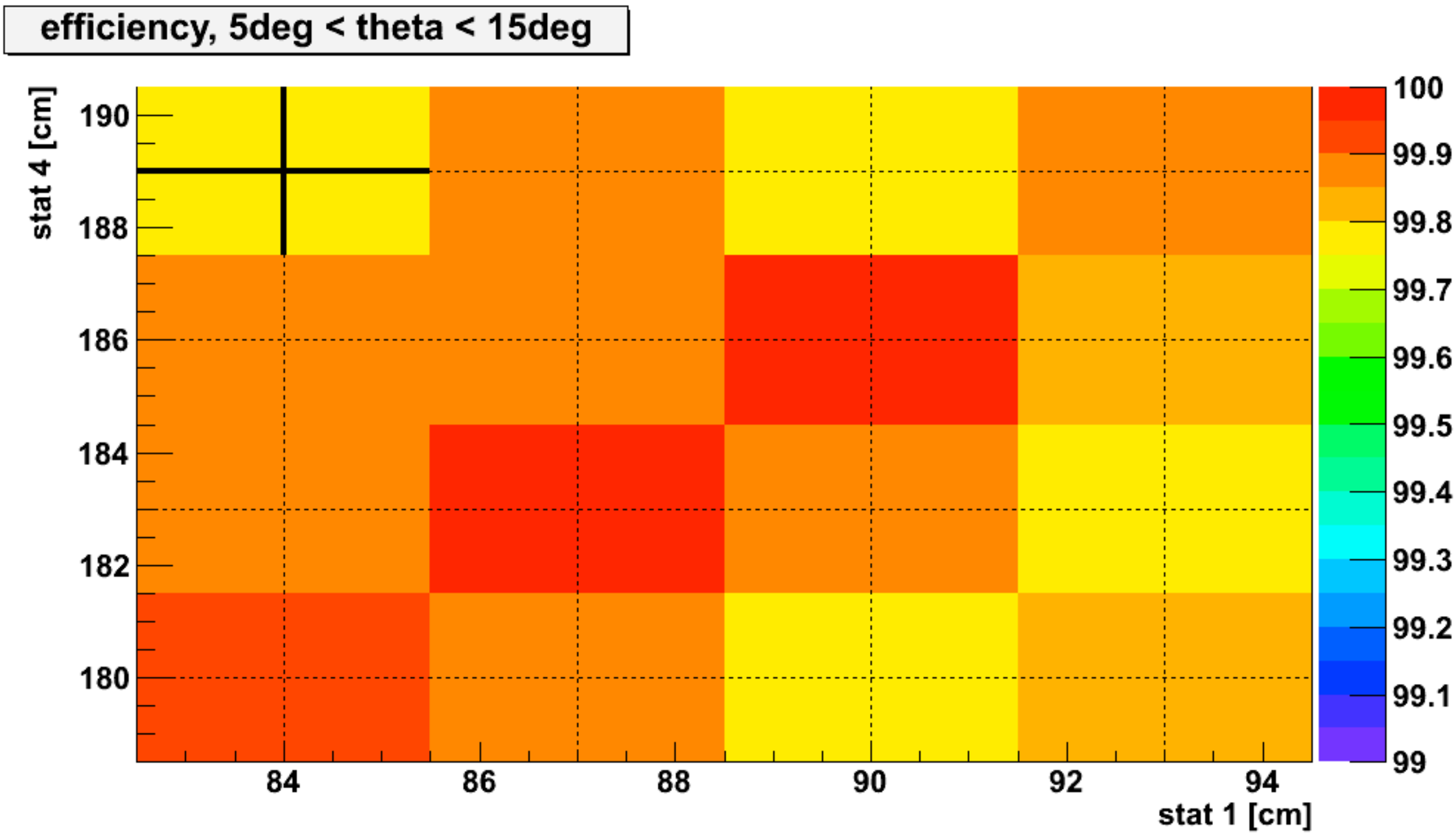
Results - 4 GEM Discs

Reconstructed tracks' momentum resolution as function of outer stations position



Results - 4 GEM Discs

Tracking efficiency in common acceptance region as function of outer stations pos's



GEM layout study - conclusions

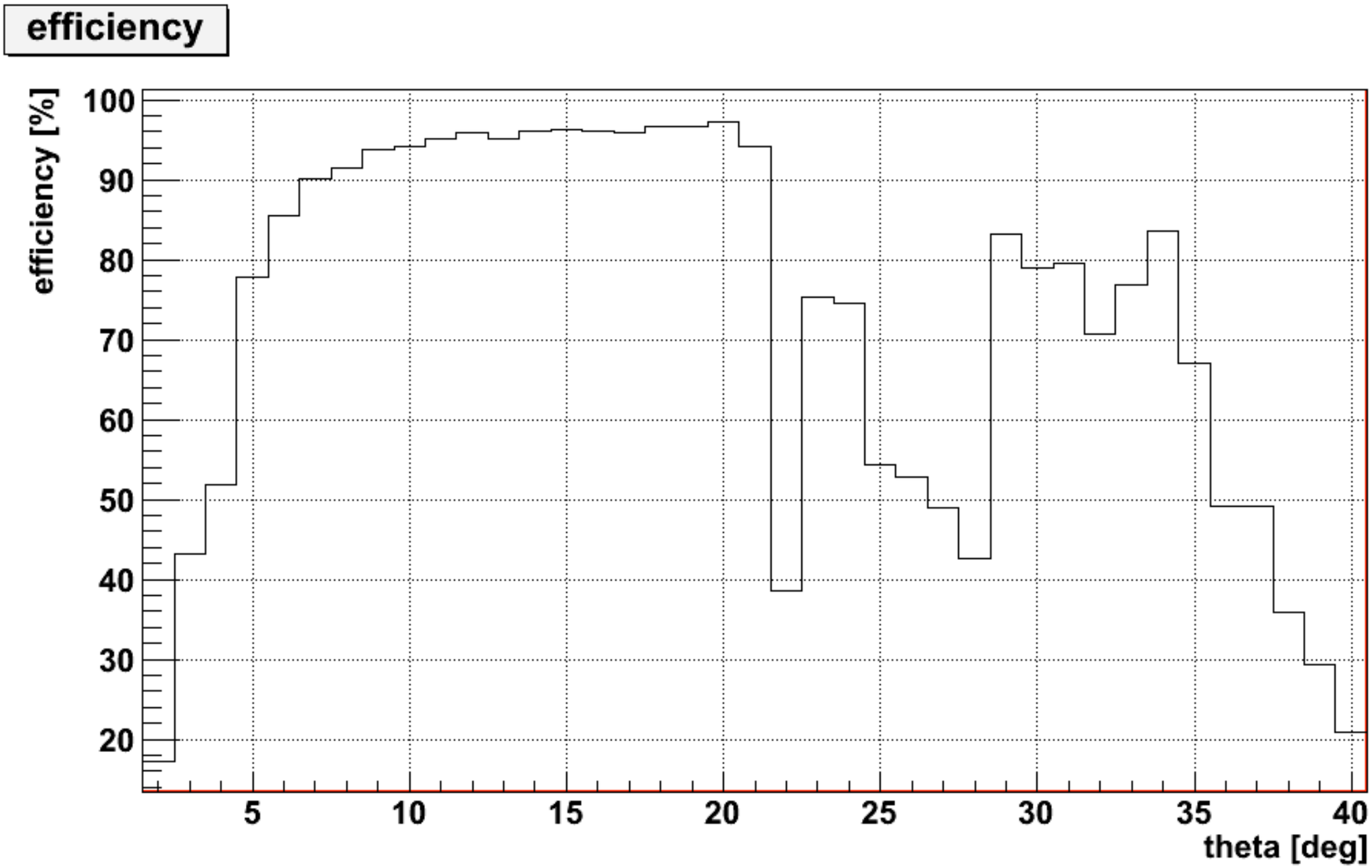
- Keep the first station as close to the target as possible (84/117cm for long/short CT)
- Move the last station closer to the target (probably to 183cm)
- Slightly shuffle the middle stations:
  - long CT: stat 2 from 153cm to 165cm
  - short CT: stat 2 from 117cm to 111cm

    stat 3 from 153cm to 162cm

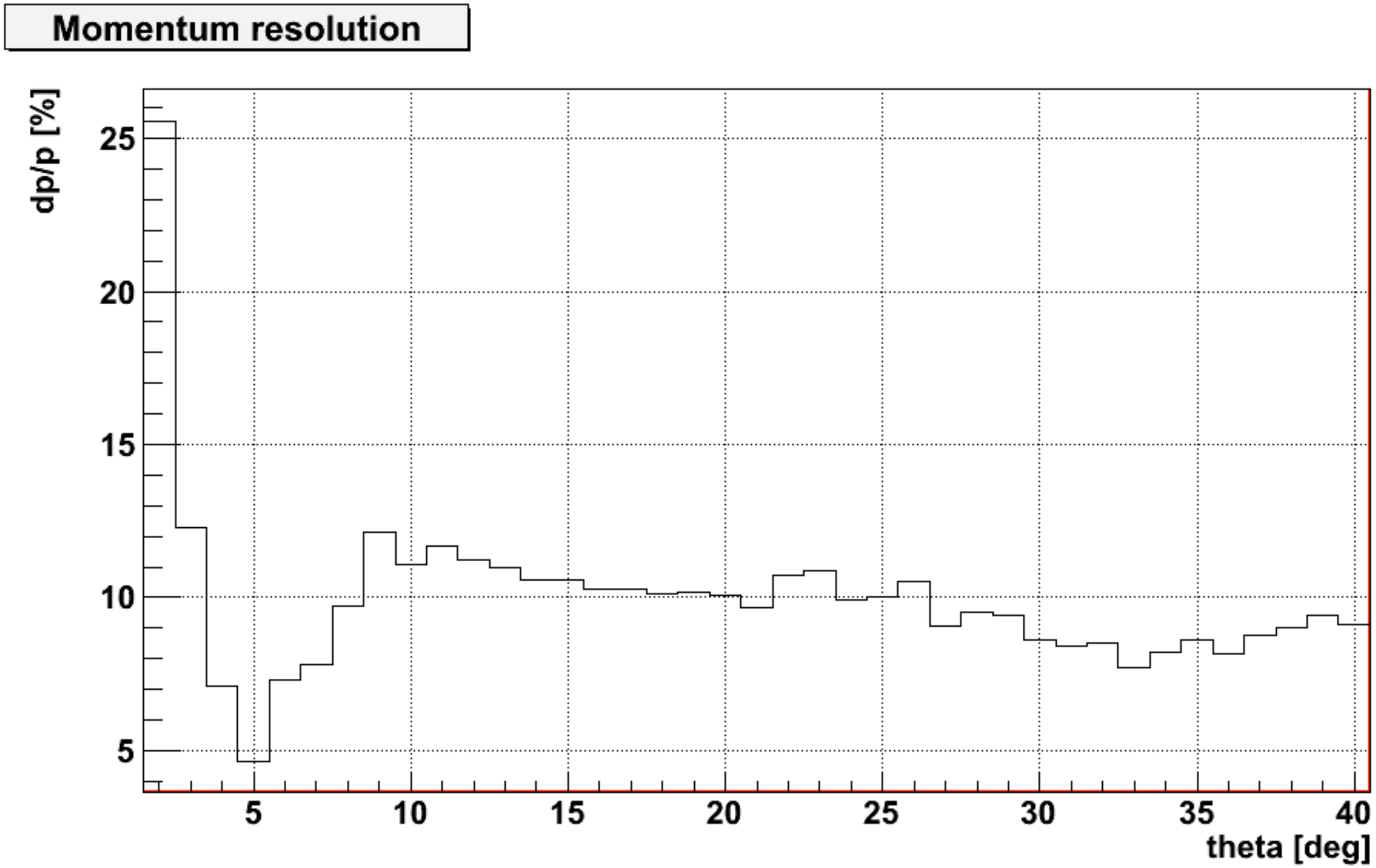
MVD-GEM track finder

- Simple extension of the existing GEM track finder:
  - create pairs of hits (MVD or GEM) with different z, close in radius and phi
  - calculate momentum assuming the track is primary
  - merge the pairs with momentum information into tracks
  - clean the array of tracks (remove ghost, merge clones)

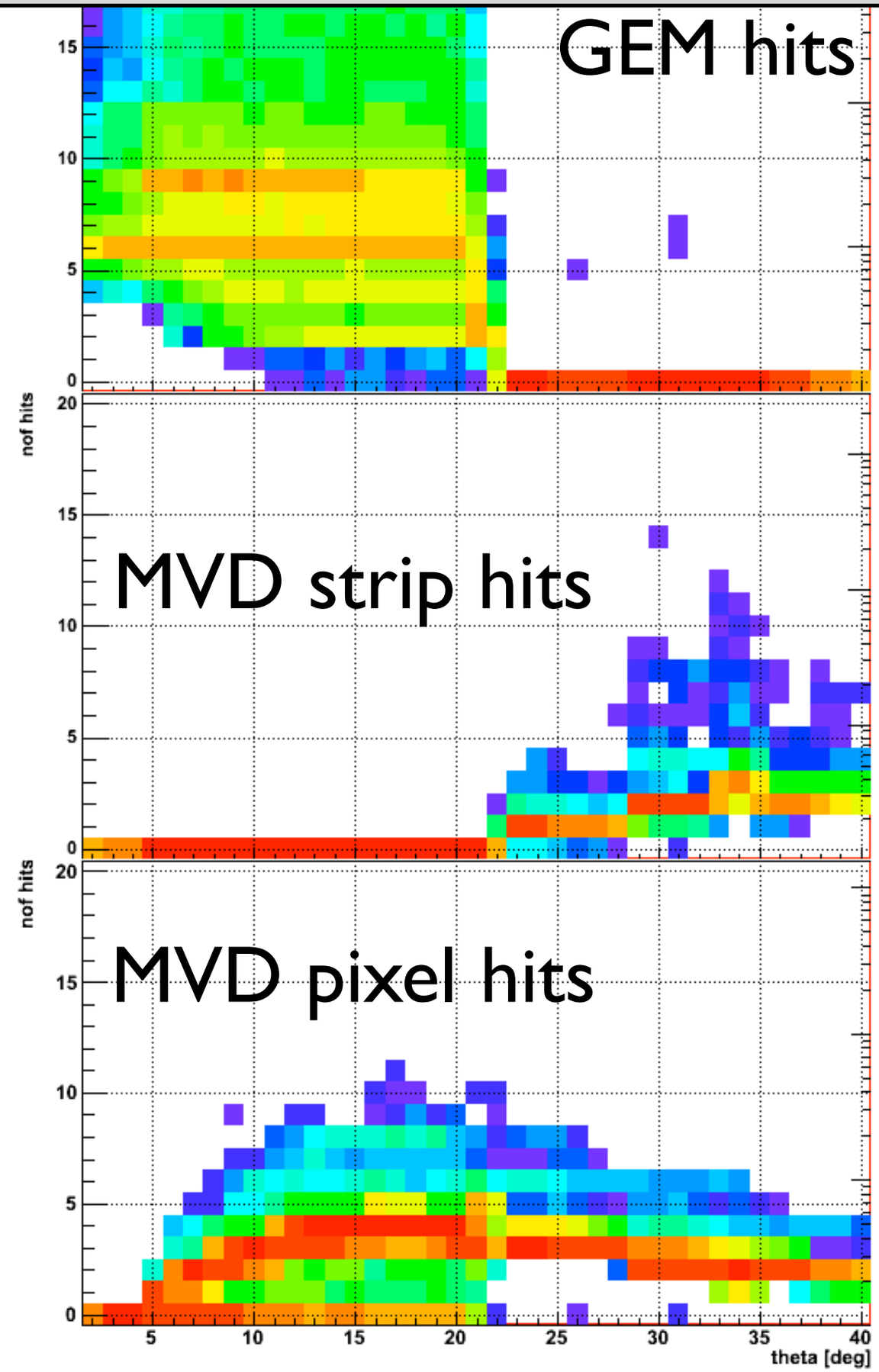
Results - efficiency



Results - resolution



Results - number of hits



back stage story

- How can one show such a piece a crap like the MVD-GEM track finder?
- Lia requested something comparable to Gianluigi's MVD-STT track finder
- The performance was even worse:

Lia: used the macros in macro/global: is it ok that it finds so many tracks (5,6,7) even if I generate only two tracks? Are there some ghost tracks to be recognized and deleted later or something like this? Moreover, I printed out the list of hits associated to each track with each detId and they are almost always GEM hits (I had only one pixel hit out of 10 events and no strip hits in my first test).

- the thing is I was working on something else...

barrel track finder

- Combine all the different central detectors: MVD, STT, TPC, GEM
- Imply some simple track model: helix (so the tracking assumes magnetic field to be constant)
- Focus on primary tracks

Pattern of action

```
loop over hits {
    loop over tracks
        if ( hit belongs to track )
            addHitToTrack;
    if ( hit belongs to any track ) continue;
    loop over unused hits
        if ( hit and unused hit match )
            createTrack;
    if ( hit matched with any unused hit ) continue;
    addHitToUnusedHits;
}
```

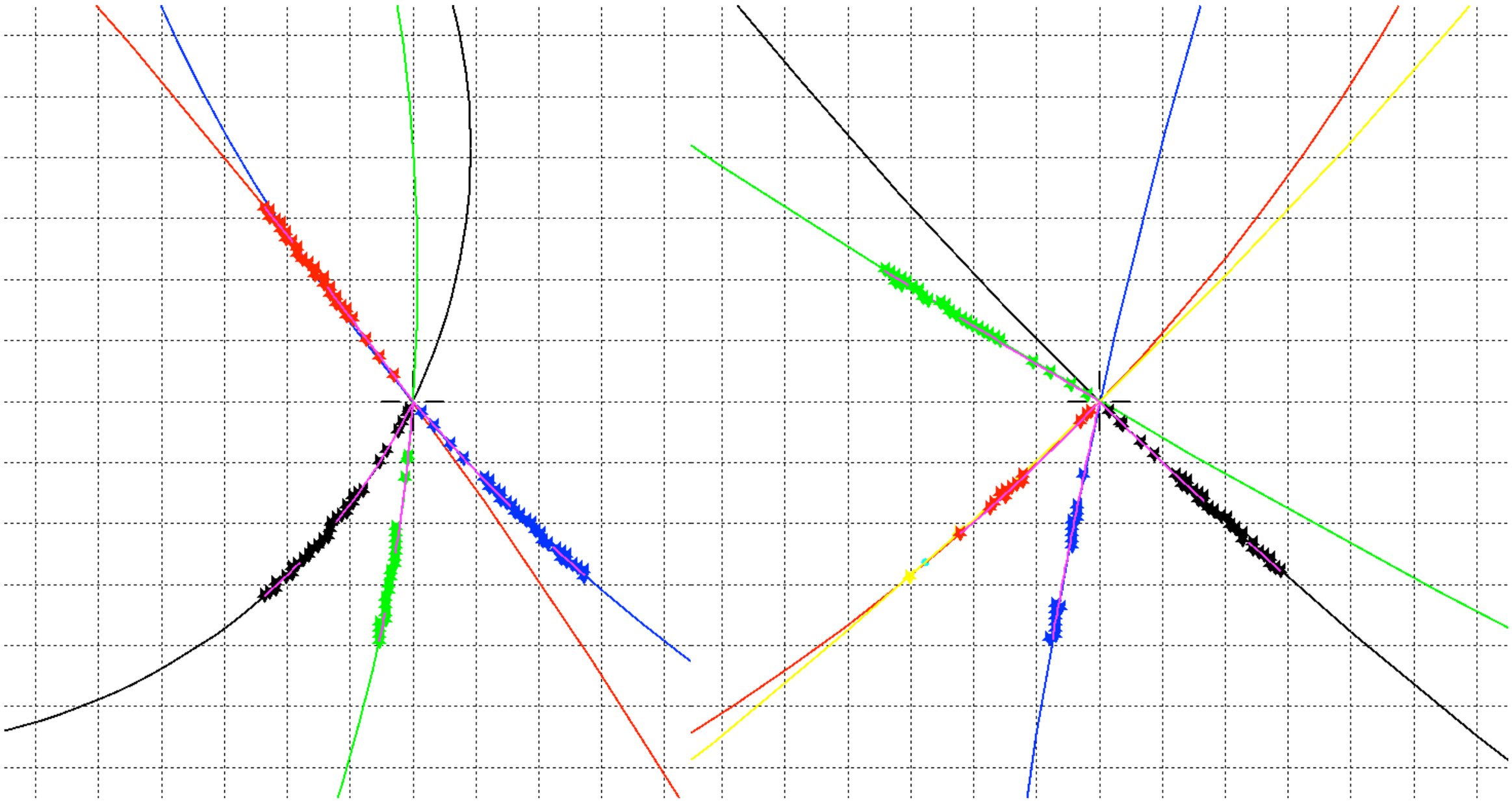
Simple extension

```
loop over hits {
    loop over tracks
        if ( hit belongs to track )
            addHitToTrack;
    if ( hit belongs to any track ) c
    loop over unused hits
        if ( hit and unused hit match )
            createTrack;
    if ( hit matched with any unused hit ) continue;
    addHitToUnusedHits;
}
```

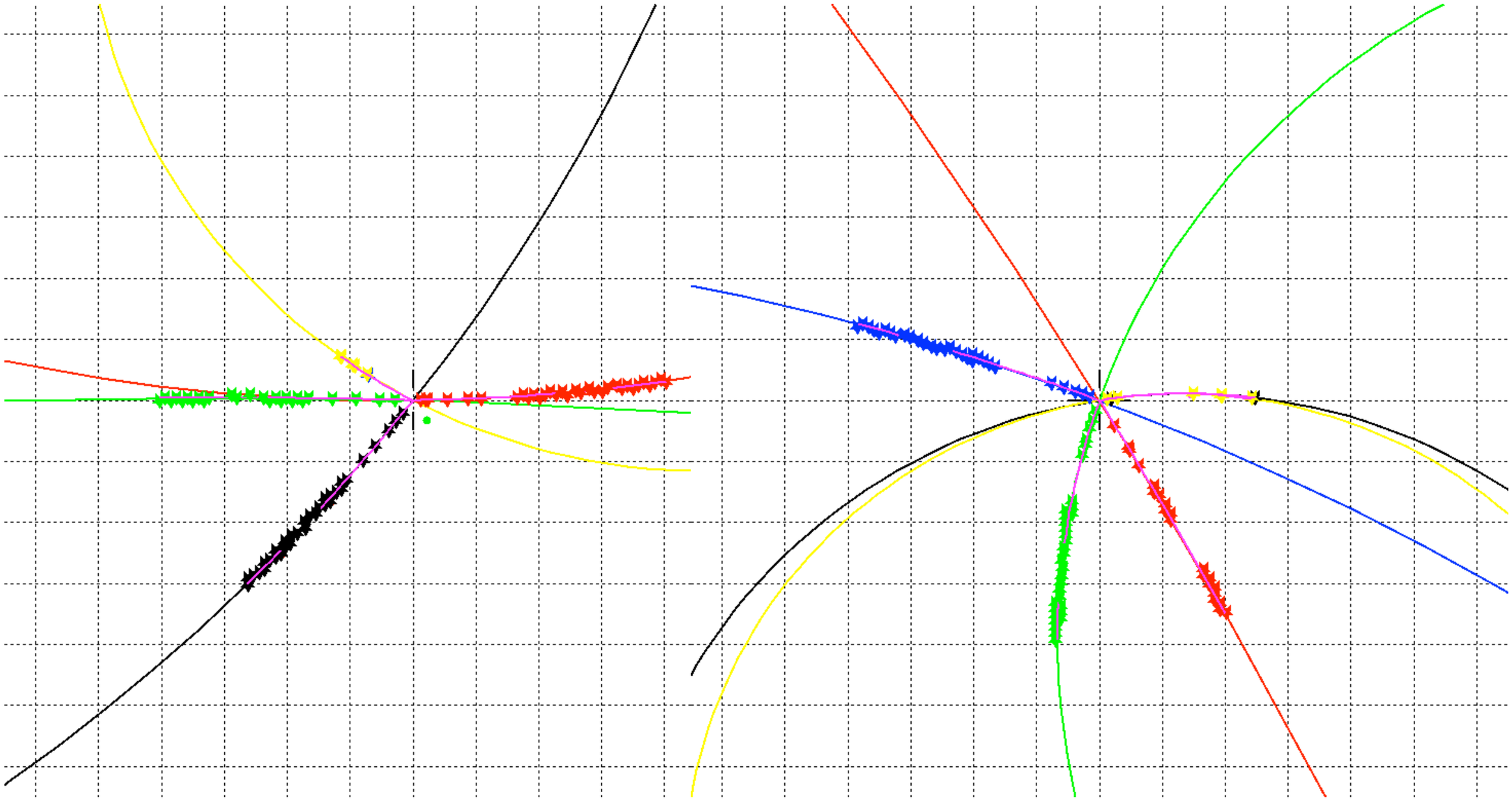
```
loop over tracks
    if ( track time ticket not valid ) {
        if ( checkTrackParameters )
            writeTrackToOutput;
        else
            removeTrack;
loop over unused hits
    if ( hit time ticket not valid ) {
        matchHitToTracks;
        removeHitFromUnusedHits;
    }
```

Life presentation?

Performance - examples



Performance - examples



Conclusions

- GEM geometry will be updated soon in svn/trunk: geometry, digitization scheme, station positions, dimentions
- Extended GEM track finder into somehow working MVD-GEM track finder
- Another global/barrel track finder "almost" ready to use: PndBarrelTrackFinder in trunk/global