CA-based track finder with STS detector inefficiency

I. Kisel[1], *I. Kulakov*[2,3], *I. Rostovtseva*[4], *and M. Zyzak*[2,3]

[1]GSI, Darmstadt, Germany; [2]Goethe University, Frankfurt, Germany; [3]University of Kyiv, Ukraine; [4]ITEP, Moscow, Russia

The CBM experiment at FAIR is being designed to study heavy-ion collisions at high track densities up to 1000 tracks per central collision in the Silicon Tracking System (STS). Double-sided strip detector modules will be used in STS, that leads to up to 85% additional combinatorial space points. The Cellular Automaton (CA) based algorithm [1] is used for track reconstruction in the STS detector of the CBM experiment. The algorithm creates short track segments (triplets) in each three neighboring stations, then links into track-candidates and selects according to the maximum length and minimum χ^2 criteria.

To handle real experimental conditions the track reconstruction algorithm has to cope with detector inefficiencies. Therefore the stability of the algorithm has been investigated with respect to detector inefficiencies. In order to improve the stability new features have been added to the algorithm: (i) triplets can skip one station with a missing hit, (ii) gathering individual hits by track-candidates and (iii) merging separate parts of the same track.

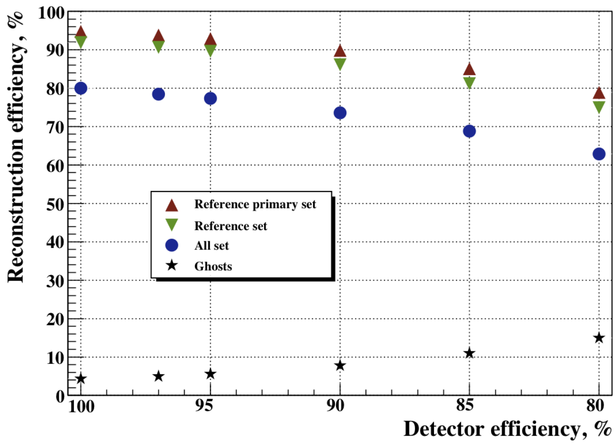

Figure 1: Reconstruction efficiencies and ghost rate versus the detector strip efficiency

For tests 100 central Au+Au UrQMD events at 25 AGeV have been simulated. The track reconstruction with the detector strip efficiencies of 100, 97, 95, 90, 85 and 80 per cent has been investigated. The track reconstruction efficiency and track fitting quality were monitored.

Track reconstruction efficiency is defined as the number of reconstructed tracks assigned to generated particles divided by the number of all reconstructible tracks. Reconstructible tracks are those, which have momentum greater than 0.1 GeV/c and intersect the sensitive regions of at least four consecutive stations. A reconstructed track is assigned to a particle, if at least 70% of its hits have been caused by this particle. A reference track should have a momentum greater than 1 GeV/c in addition. The reference set of tracks can also include tracks of particular physics interest: secondary tracks from interesting decays or primary tracks coming from the target region. If a reconstructed track is not assigned to any particle it is called a ghost.

The dependence of the track reconstruction efficiency on the detector strip efficiency is shown in Figure 1. The efficiencies for all reconstructible tracks, reference tracks and primary reference tracks and ghost rate are presented. As one can see, the algorithm is robust and shows a slight reconstruction efficiency degradation with respect to the detector inefficiency. In particular, decreasing of the detector efficiency from 100% to 95% leads to decreasing of the track reconstruction efficiency only by 3%.

Table 1: Residuals of track parameters versus the detector strip efficiency

Detector strip efficiency, %	100	97	95	90	85	80
x, μm	12	13	13	14	14	15
y, μm	57	60	61	65	69	73
t_x, mrad	0.35	0.36	0.37	0.38	0.40	0.42
t_y, mrad	0.60	0.61	0.61	0.63	0.64	0.66
p, %	1.22	1.25	1.28	1.34	1.41	1.48

Track fit quality at the first track point has been investigated with respect to the detector inefficiency as well. Resolutions become slightly worse due to the smaller number of hits in a track (see Table). Resolutions and pulls (resolutions normalized on estimated errors) of all track parameters are unbiased.

Summarizing, the algorithm of track reconstruction has been improved and shows stability with respect to the STS detector inefficiency.

References

[1] I. Kisel, Nucl. Instrum. Meth. **A 566** (2006) 85