Drift Chamber Simulations for BRAHMS Experiment

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As a part of our contribution to the BRAHMS experiment at RHIC we are preparing software for data analysis. We are focusing particularly on tracking routines for drift chambers which are currently under construction in Krakow, Poland. Our goal is to prepare a reliable analysis tool and also to investigate influence of different geometrical configurations of the detectors on their performance. The analysis program is a SONATA code which has been translated from FORTRAN to C++ language and works in integrated environment BRAT [1].

Some details of the current designs of all three drift chambers that will be used in the experiment are presented in Table 1. Detector T3 is positioned closest to the collision vertex so it has to fulfill the highest requirements.

We have concentrated on simulated clean events, i.e. only tracks passing through the whole active volume of detector are present and there are neither secondary particles nor background. In the ideal case with perfect position resolution and detection efficiency all single tracks passing through the detectors are reconstructed. In the subsequent more realistic analysis we assumed detection efficiency 0.97 and position resolution 0.025 cm. These numbers are soon to be verified with the test run of the prototype chamber with proton beam.

In Figure 1 (detector T3) and Figure 2 (detector T4) we present an example of the comparison between two geometrical configurations with different staggering distances (i.e. the distances by which prime planes are moved). Solid line corresponds to the staggering distance equal to 0.25 of the sense wire distance (option A). Dotted line shows another configuration with staggering distance equal to 0.5 of the wire distance (option B).

Table 1.

Detector (number of modules)	**Planes** (in each module)	**View type**	**View angle** (deg.)	**Sense wire spacing** (cm)	**Staggering distance** Option A (Option B) (cm)	**Plane distance** (cm)	**Active module dimensions** (cm)	**Distance between modules** (cm)
T3	1, 2, 3	x x' x''	0.		0., 0.25, 0. (0., 0.5, 0.)		x = 40.0	
(3)	4, 5	v v'	-18.	1.0	0., 0.25 (0., 0.5)	1.5	y = 30.0	25.5
	6, 7, 8	y y' y''	90.		0., 0.25, 0. (0., 0.5, 0.)		z = 15.5	
	9, 10	u u'	18.		0., 0.25 (0., 0.5)			
T4	1, 2	x x'	0.		0., 0.5 (0., 1.)		x = 50.0	
(3)	3, 4	v v'	-18.	2.0	0., 0.5 (0., 1.)	1.5	y = 35.0	22.5
	5, 6	y y'	90.		0., 0.5 (0., 1.)		z = 12.5	
	7, 8	u u'	18.		0., 0.5 (0., 1.)			
T5	1, 2	x x'	0.		0., 0.5 (0., 1.)		x = 50.0	
(3)	3, 4	v v'	-18.	2.0	0., 0.5 (0., 1.)	1.5	y = 35.0	22.5
	5, 6	y y'	90.		0., 0.5 (0., 1.)		z = 12.5	
	7, 8	u u'	18.		0., 0.5 (0., 1.)			

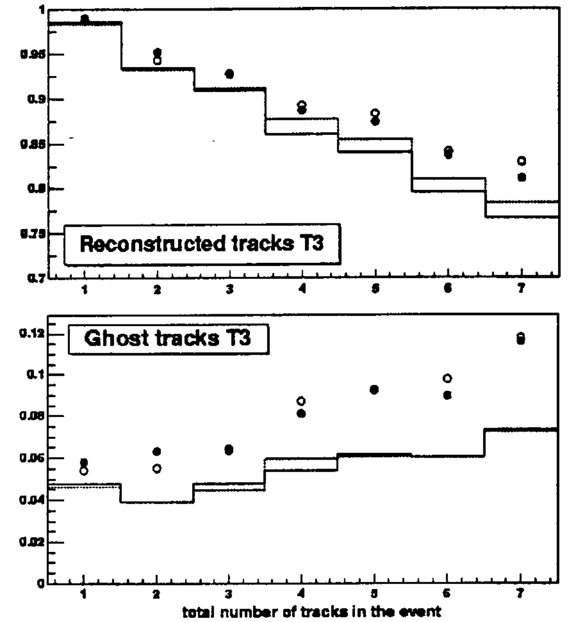

Figure 1. Number of reconstructed tracks and created ghost tracks shown as a function of the total number of tracks passing through the detector T3 (see text).

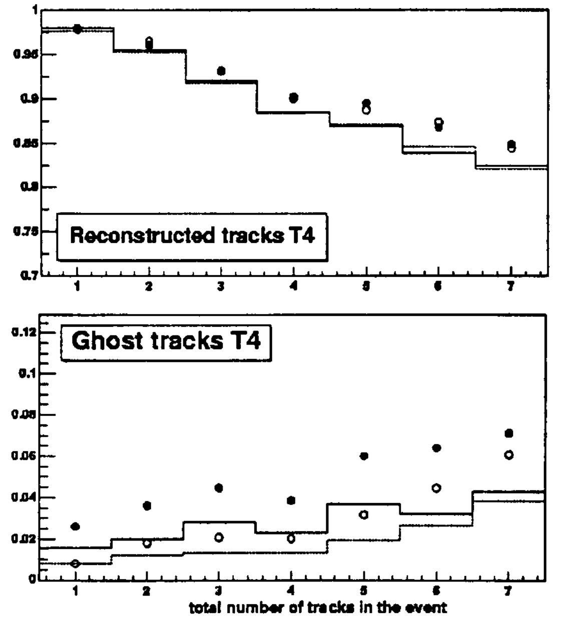

Figure 2. Number of reconstructed tracks and created ghost tracks shown as a function of the total number of tracks passing through the detector T4 (see text).

The upper panels show efficiency for reconstructing tracks per one track, the lower panels show number of generated ghost tracks per one track (ghost tracks are tracks created in addition to reconstructed real tracks). These numbers are shown as a function of total number of tracks in the detector in one event. The fraction of reconstructed tracks decreases and generated ghosts increases with the total number of tracks in the detector.

The absolute number of reconstructed tracks depends to some extent on parameters used in the tracking routine. Solid and hollow points represent simulations for options A and B, respectively, with different sets of parameters, allowing more candidate tracks to be accepted during the tracking procedure. It can be seen that one can achieve higher efficiency, but at the same time one creates significantly more ghost tracks. While it is possible to reject most of these ghost tracks later in the analysis by taking into account information from all detectors, it is desirable to keep the number of ghosts as low as possible. Thus one has to decide on the optimal set of parameters.

In this particular comparison our findings favor slightly option B. Further simulations including simulated 'real' events for forward spectrometer setting are under way.

References

[1] K. Hagel, Progress in Research 1997-1998, Cyclotron Institute, TAMU, p. II41.