Si beam tracker efficiency and vertex resolution in the Xe run

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SPbU

Outline

1. Evaluation of difference between tracks and hits (Residuals)
2. Results of alignment procedure
3. Analysis of SiBT Vertex
4. Efficiency calculations

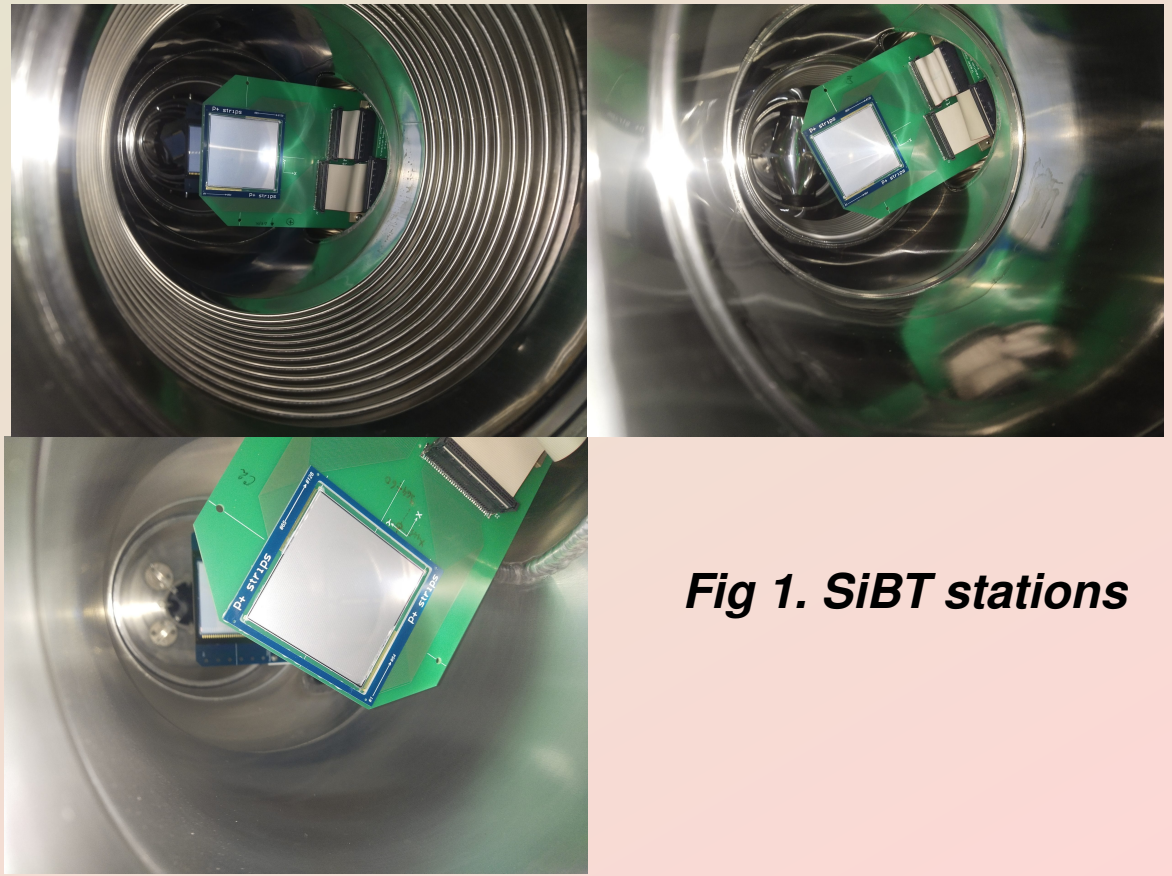


Fig 1. SiBT stations

Background Information

The goals of Silicon Beam Trackers usage:

1. Online beam monitoring

2. Improvement vertex resolution

3. Determine the beam angle in the event for further physical analysis

Fig 2. SiBT stations positions

Alignment Procedure (without Magnetic Field)

1. A straight line connects the hits from the first and last station.
2. The difference between the position of the hit at the middle station and the straight line is determined
3. A shift is made to the position of the central station when creating hits.

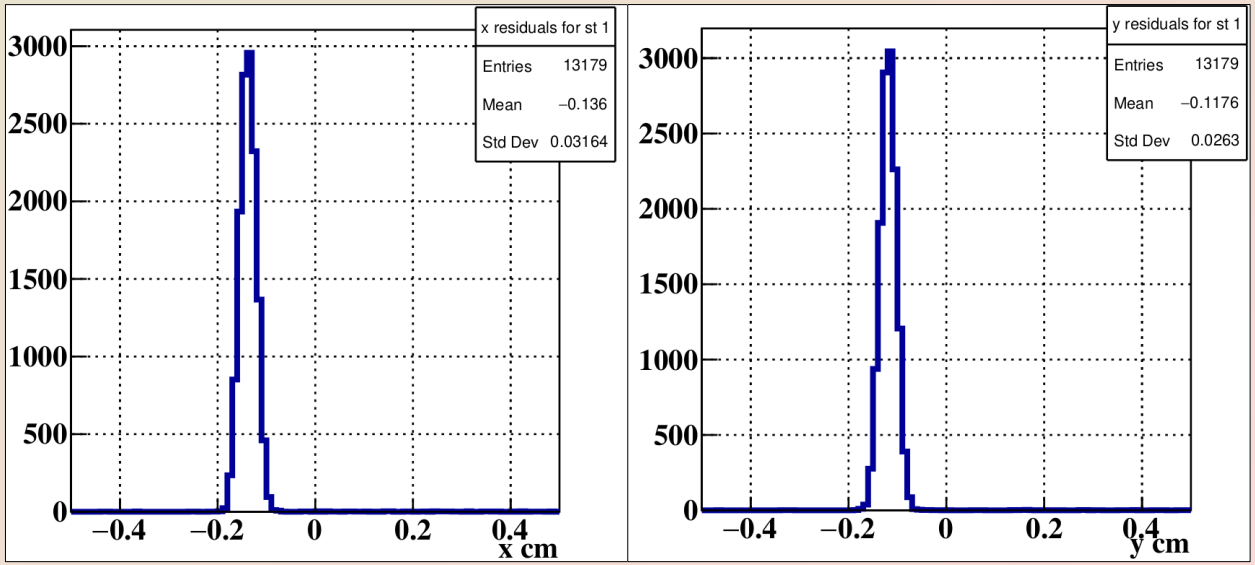


Fig. 3 Residuals in middle (1) station before corrections

Alignment Procedure (without Magnetic Field)

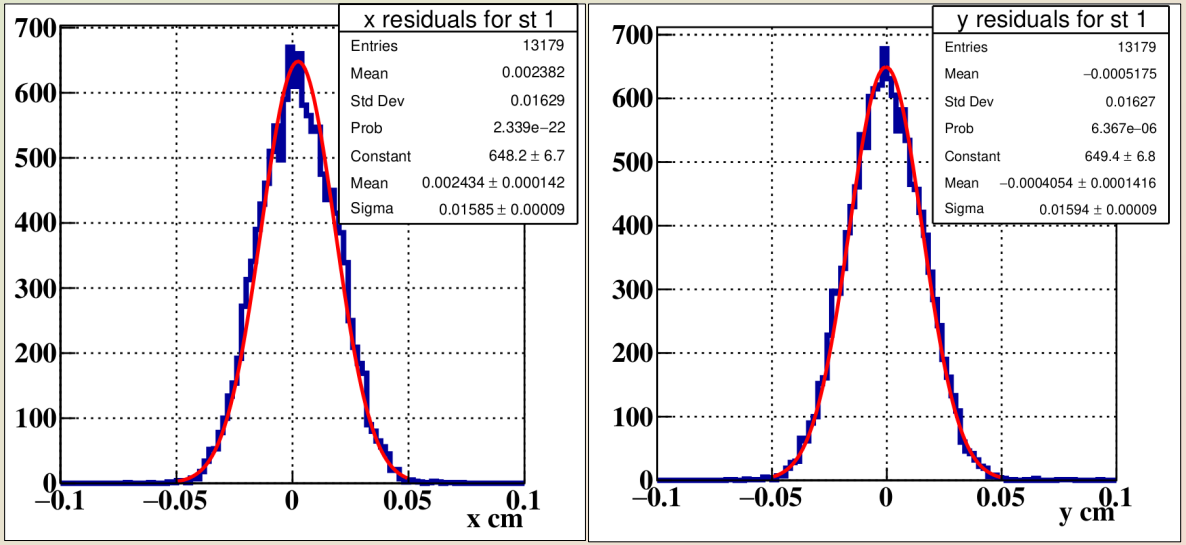


Fig. 4 Central station residuals <u>after</u> corrections

Station	mean X mm	σ mm
0	-0.05	0.35
1	0.024	0.16
2	-0.05	0.35

a)

Station	mean Y mm	σ Y mm
0	0.014	0.34
1	-0.004	0.16
2	0.012	0.34

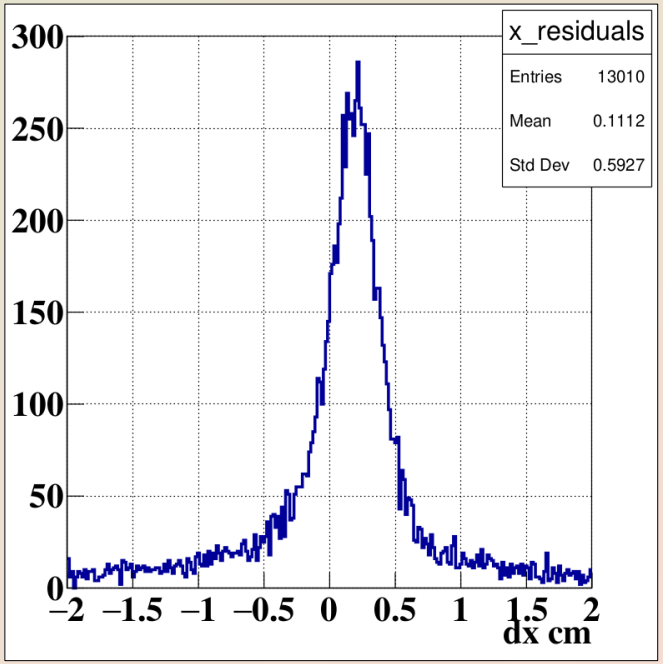
b)

Table 1. a) X residual parameters

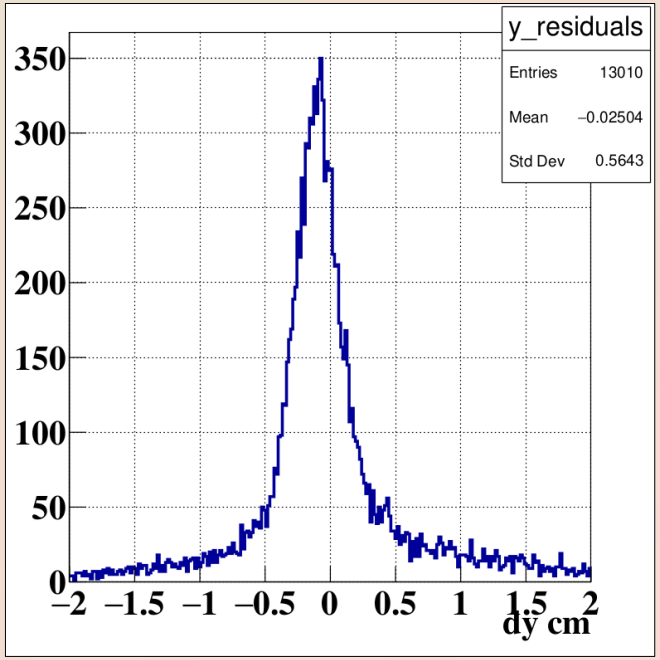
b) Y residual parameters

Alignment Procedure (with Magnetic Field)

1. Momentum was fixed
2. The beam tracks were extrapolated using the Kalman filter to the target position
3. The difference between beam tracks and hits was added to the hit positions in all stations



a)

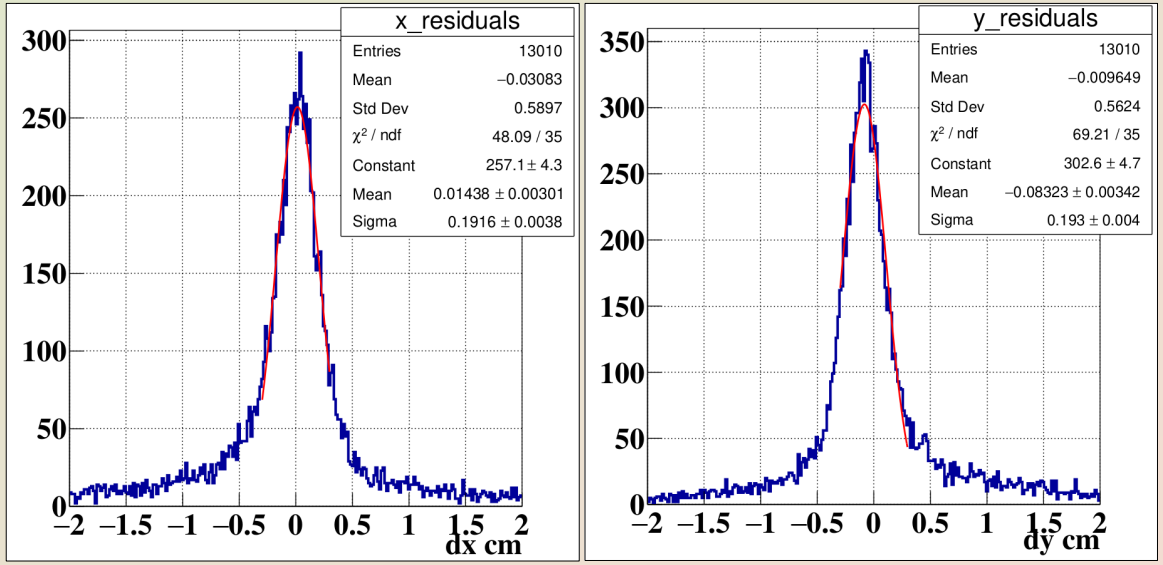


b)

Fig. 5 Vertex – Beam tracks residuals <u>before</u> corrections

a)x coordinate b) y coordinate

Alignment Procedure (with Magnetic Field)

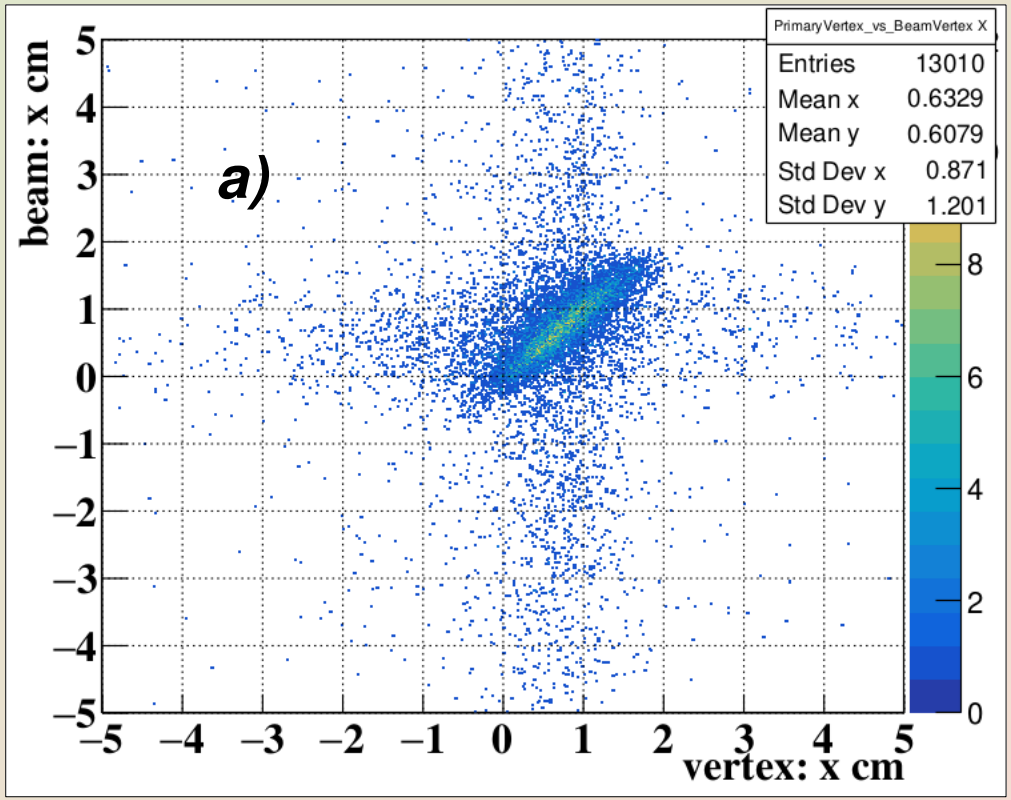


residuals	mean	σ cm
dX cm	0.0143	0.192
dY cm	-0.0832	0.193

Fig. 6 Vertex – Beam tracks residuals <u>after</u> corrections a)x coordinate b) y coordinate

Table 2. Mean value and variance for Vertex – Beam tracks residuals

Vertex Correlation (old version of tracking)



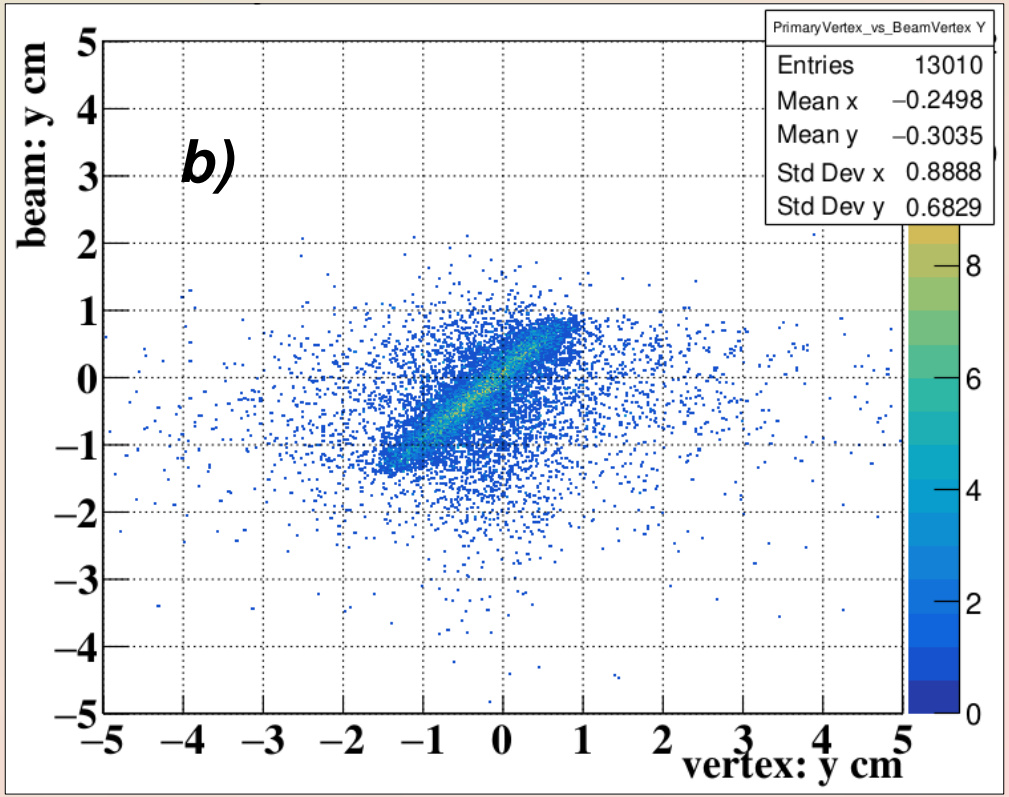
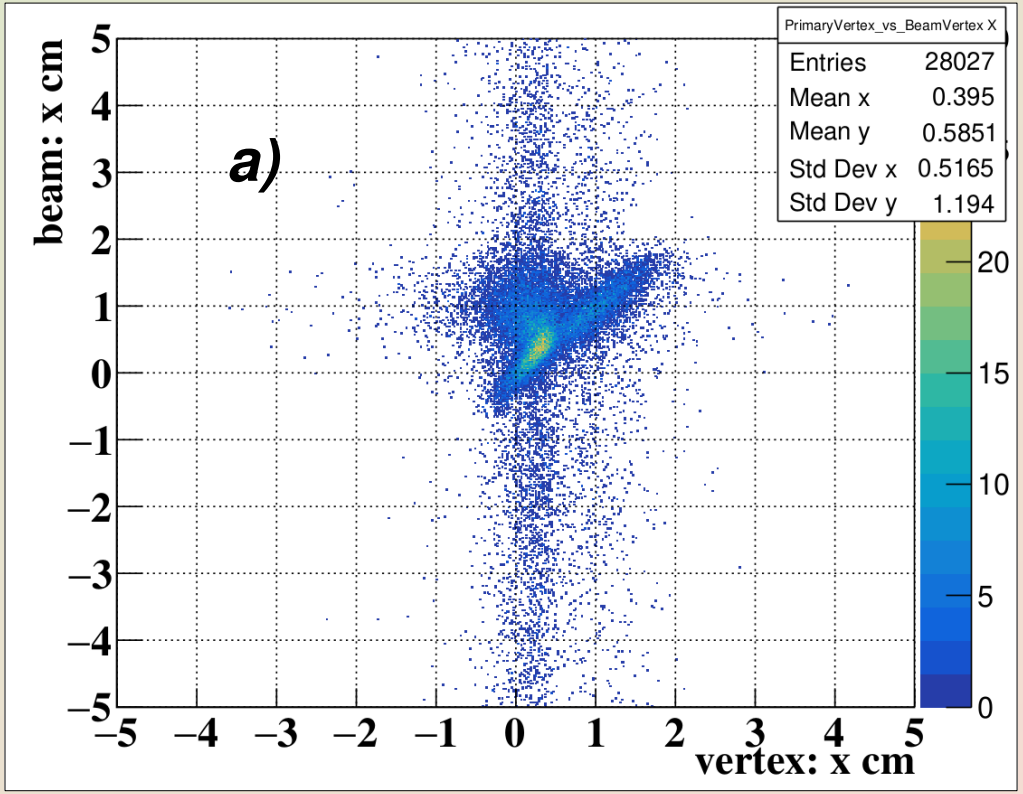


Fig. 7 Vertex – Beam tracks correlations a) x coordinate b) y coordinate

Vertex Correlation (new version of tracking)



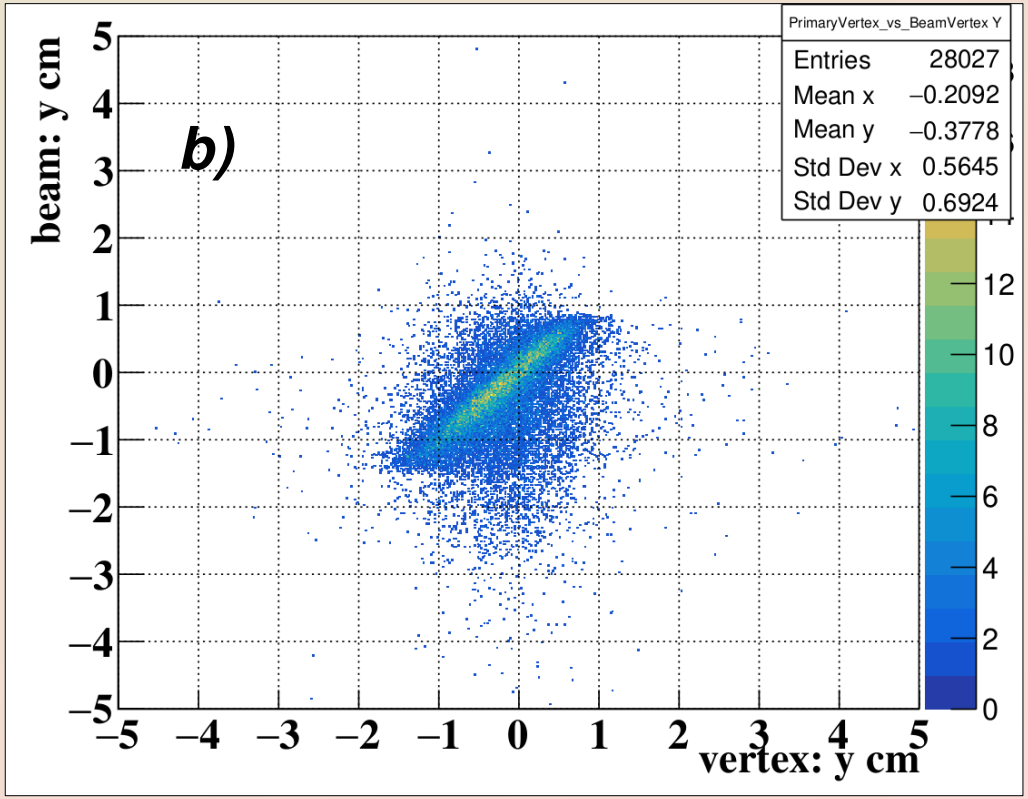


Fig. 8 Vertex – Beam tracks correlations a) x coordinate b) y coordinate

Efficiency (without Magnetic Field)

1. To evaluate the efficiency of station “i”, events are considered in which two other stations worked.

2. For all hits from two stations, straight lines were built, which were extrapolated to station “i”

3. If the line crosses the station “I” in acceptance, the denominator N^{i}_{all} is increased

4. If the hit of station “i” is in acceptance and the hit is near of the line, the numerator $N^{i}_{accepted}$ is increased

5. Hit matching efficiency for station “i”:

$$\eta_i = \frac{N^{i}_{accepted}}{N^{i}_{all}}$$

Efficiency (without Magnetic Field)

Station	N_all	N_accepted	Efficiency %
0	102494	98096	95.7
1	112183	99451	88.6
2	105106	98252	93.5

Table 3. Efficiency calculations for 150000 events Run 8307

Efficiency (with Magnetic Field)

1. The hits distribution were estimated by Gaussian function. The peaks of the Gaussian function were approximated by a quadratic function for the x coordinate and a linear function for the y coordinate

2. The approximation is used to extrapolate track to other stations

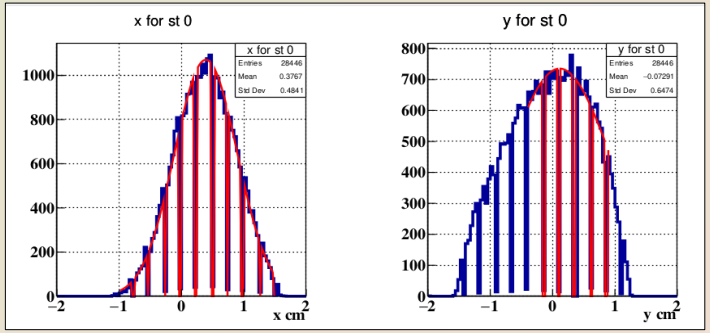
3. If the line crosses the station "i" in acceptance, the denominator N^{i}_{all} is increased

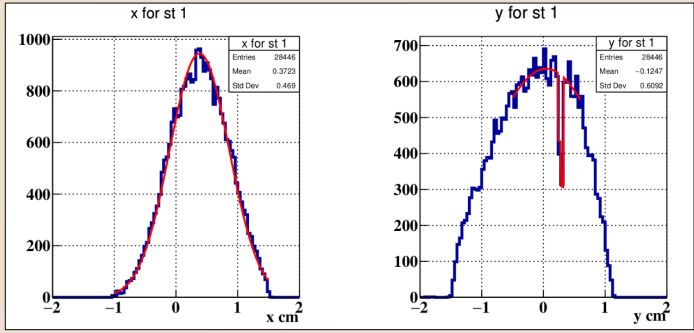
4. If the hit of station "i" is near of the line, the numerator $N^{i}_{accepted}$ is increased.

5. Efficiency: $$\eta_i = \frac{N^{i}_{accepted}}{N^{i}_{all}}$$

Estimation of mean coordinates

1. Due to strips structure in hits distribution for the first station there is problem for correct approximation.
2. The coordinates of hits in each stations were approximated by modified Gaussian function.





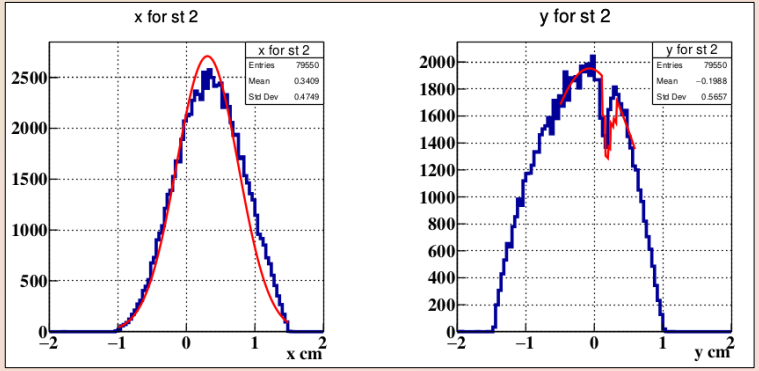


Fig. 9 Fitting of hits distributions

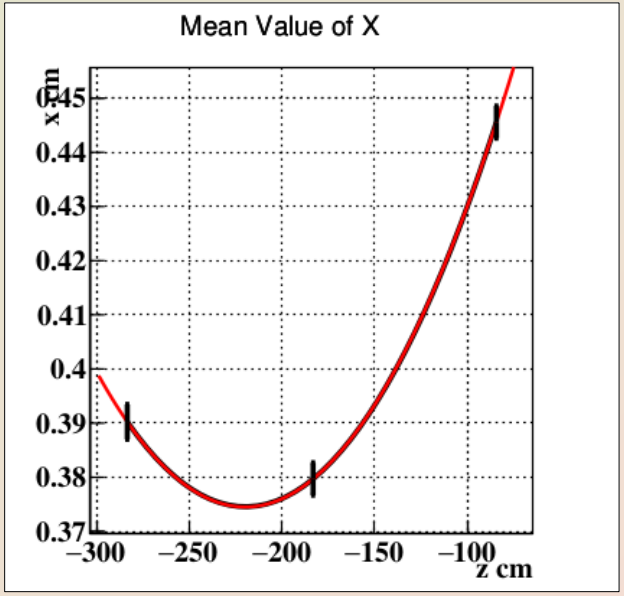
Estimation of mean coordinates

1. **Mean values of "x" gaus approximation were estimated by quadratic function:**

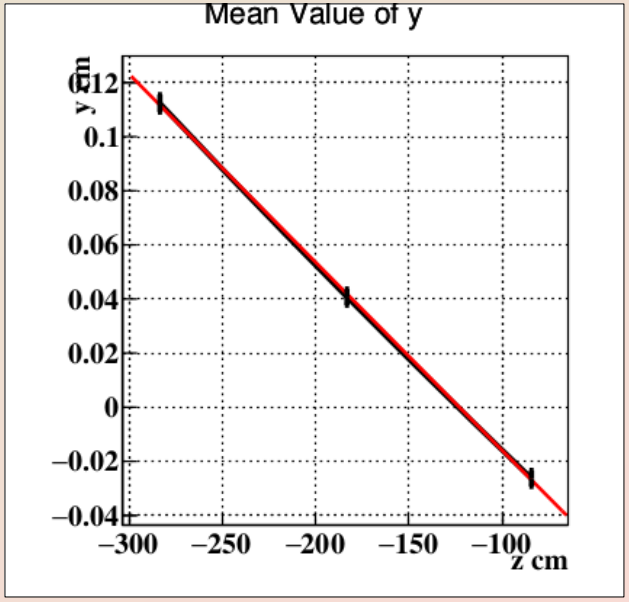
$$x = az^2 + bz + c$$

2. **Mean values of "x" gaus approximation were estimated by linear function:**

$$y = az + b$$



Coefficient	value	error
a 10^(-6)	3.90	0.40
b 10^(-3)	-1.70	0.10
c	0.560	0.010



Coefficient	value	error
a 10^(-4)	-6.90	0.20
b 10^(-2)	8.60	0.40

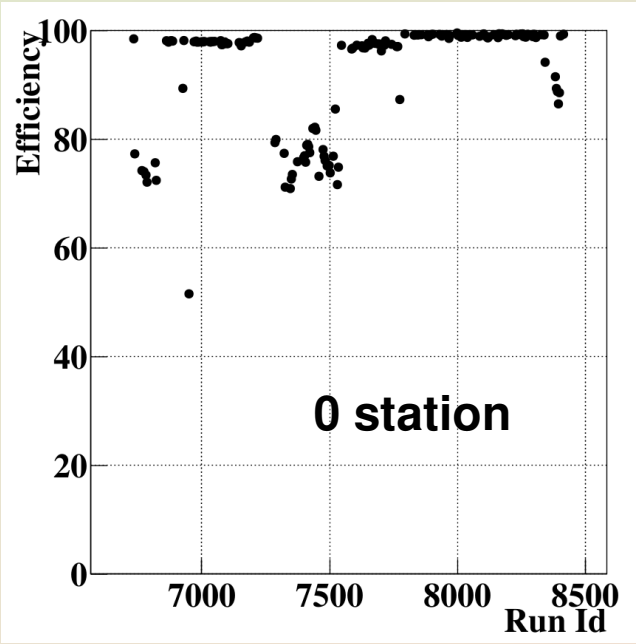
Efficiency

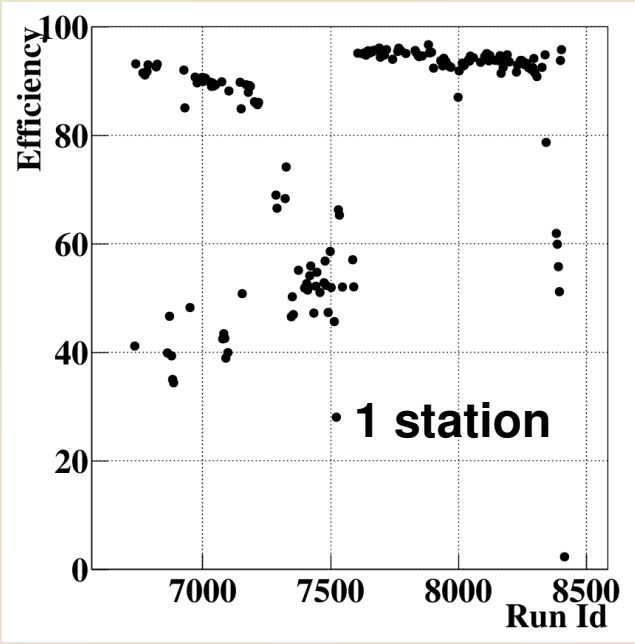
1. Linear and quadratic function can extrapolate track from a station to other stations. So, two values of efficiency can be calculated.
2. Taking into account a shift of hits from approximated line.

Station	according station	Efficiency %	Mean Efficiency %
0	1	99.95	99.27
	2	98.60	
1	0	93.97	94.03
	2	94.09	
2	0	93.47	93.55
	1	93.63	

Table 4. Example of efficiency calculation for Run 7891

Efficiency estimation of hit matching





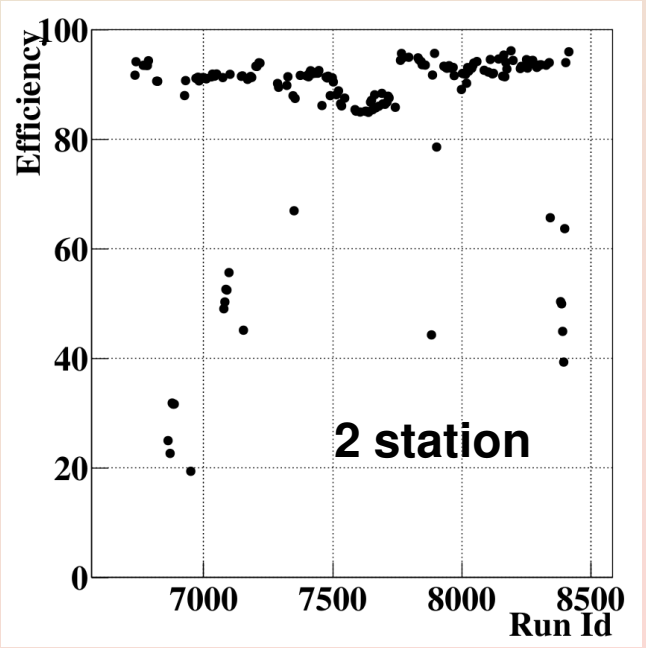


Fig. 10 Efficiency during the experiment. There runs with parameters: a)Magnetic Field, b) CsI Target, c) Mixed Trigger

Efficiency

1. There are several areas where the effectiveness of hit combining is declining.
2. The effect of reducing efficiency is being studied. One of the reasons may be non-working strips for these runs
3. Mean values and standard deviation for all runs are presented in table.

station	Efficiency %	std
0	90	10
1	79	21
2	86	14

Table 5 . Mean values of efficiency and standard deviation

Summary

1. The station alignment procedure was carried out in two stages. At the first stage, the stations were aligned for data without a field, at the second stage, for data with a magnetic field.
2. The vertex resolution has been estimated and is about 0.19 cm.
3. The efficiency was evaluated throughout the experiment. The mean results are 90% for the first station, 79 % for the second station and 86 % for the last station. There are areas where efficiency decreases. This is currently being researched. One of the possible reasons is non-working strips in events.

Backstage

Vertex SiBT

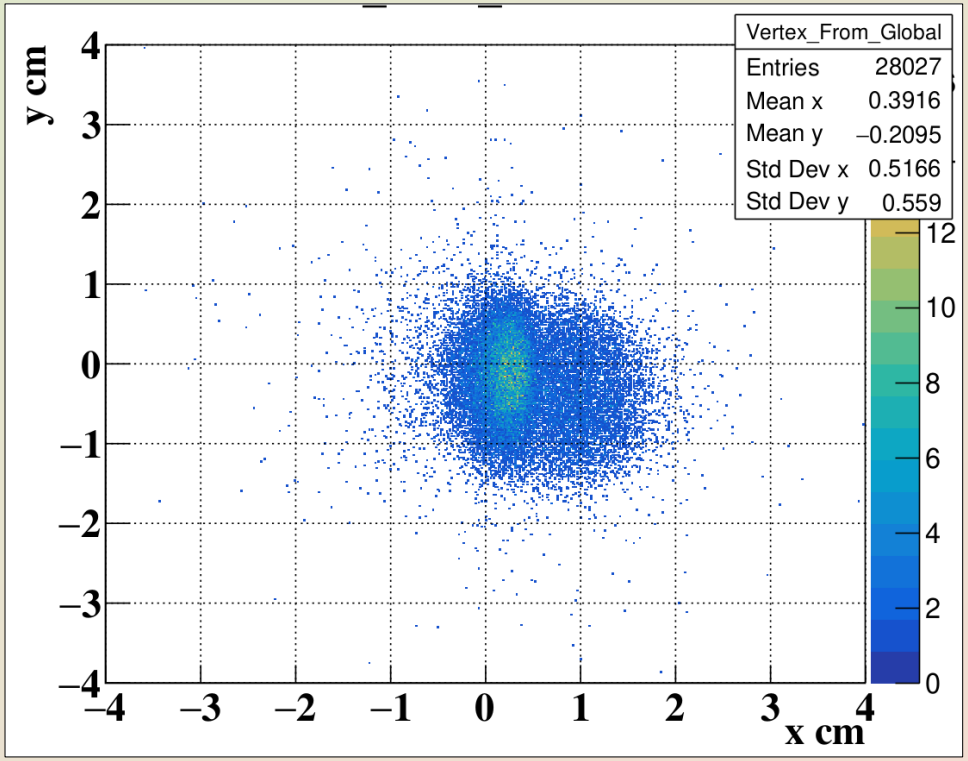


Fig. 11 Primary Vertex x-y coordinates

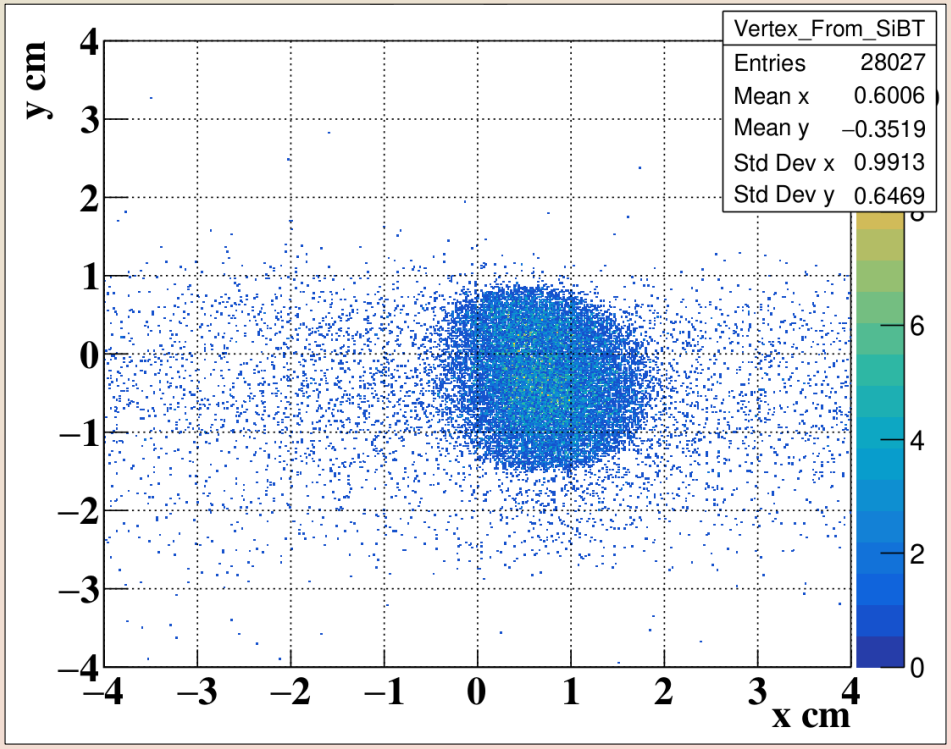


Fig.12 Beam Vertex x-y coordinates

Hits distribution for SiBT station

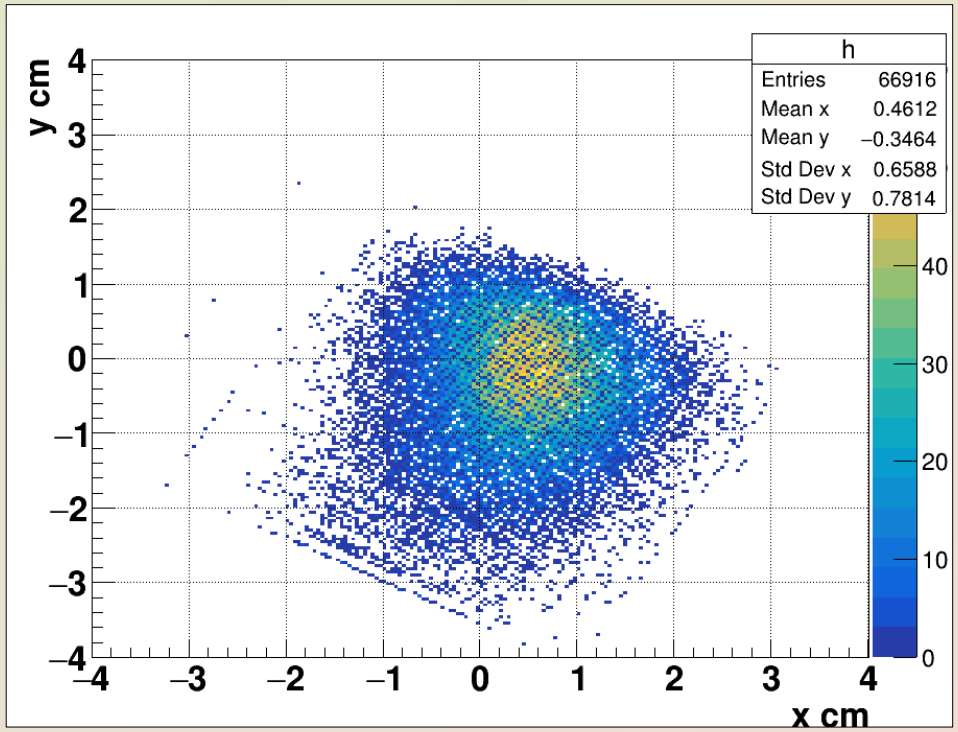


Fig. 13 x-y coordinates for middle station (high efficiency)

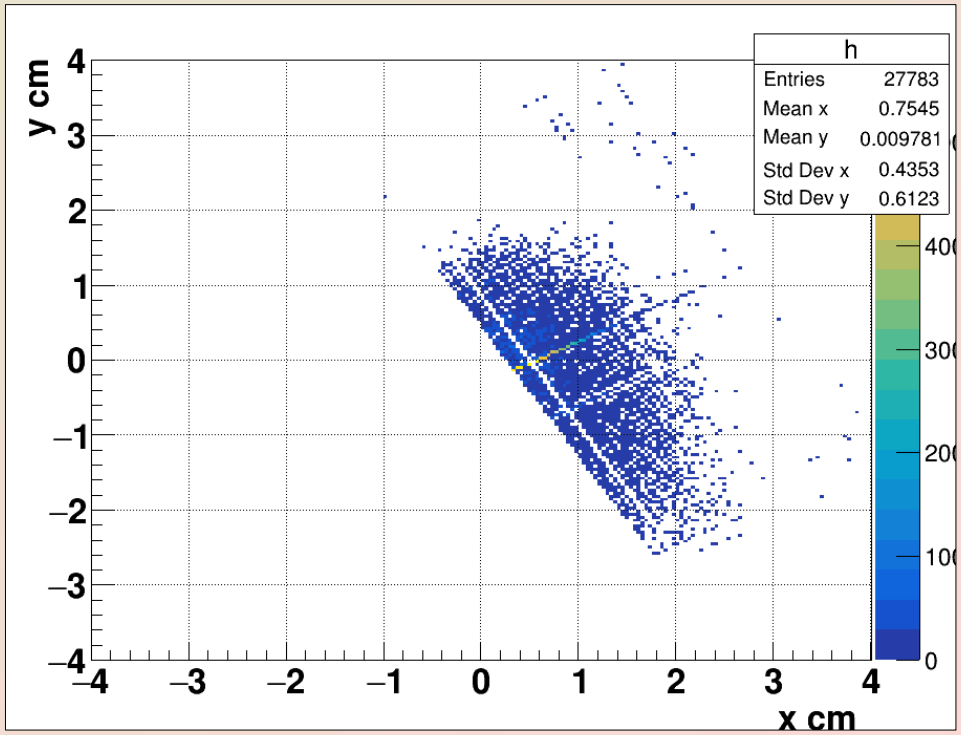


Fig. 14 x-y coordinates for last station (low efficiency)