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NOVEL STRING BANANA TEMPLATE METHOD OF TRACK RECONSTRUCTION FOR HIGH MULTIPLICITY EVENTS WITH SIGNIFICANT MULTIPLE SCATTERING

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Novel String Banana Template Method (SBTM) for track reconstruction in high multiplicity events in non-uniform magnetic field spectrometer with emphasis on the lowest momenta tracks with significant Multiple Scattering (MS) is described. Two steps model of track with additional parameter/s which takes into account MS for this particular track is introduced. SBTM is time efficient and demonstrates better resolutions than another method equivalent to the Least Squares method (LSM).

Keywords: Track; Reconstruction; Multiple scattering.

1. SBTM description

Detailed Monte Carlo (MC) simulations (using GEANT [1], for example) could provide database of track's characteristics (templates) for later fast use.

The MS cone (as on Fig. 1*a*)) for an ensemble of particles with the same vector momentum $\vec{P}$ has a significant width (volume) at low momenta. At fitting stage in high multiplicity event it results in heavy computation with covariance matrices [2]. For pattern recognition in such difficult cases it's crucial to have narrow search windows (SW) what requires an a priori knowledge of momentum.

It was found that for another ensembles SWs are more narrow. The main idea of SBTM is in use of ensembles with 3 fixed points. Where the first point is initial vertex V_0. As two other points two strips (pixels) i, j in two reference planes (RP) close to the middle and end of the track are used. It results in 2-dimensional $\{i, j\}$ templates (see Fig. 1*b*)). For such ensemble which geometrical image in magnetic field has a *Banana*-like shape all necessary characteristics (centre of Bananas, their widths, angles, lengths ...) could be saved a priori to track reconstruction.

Two steps model of track is used: the first one – averaged over ensemble, gives rough estimations for SW (*Banana* center and width) and momentum of candidate. The second – per event dependent (takes into account MS for this particular track), permits to localize track in more narrow *String* SW and provides track parameters

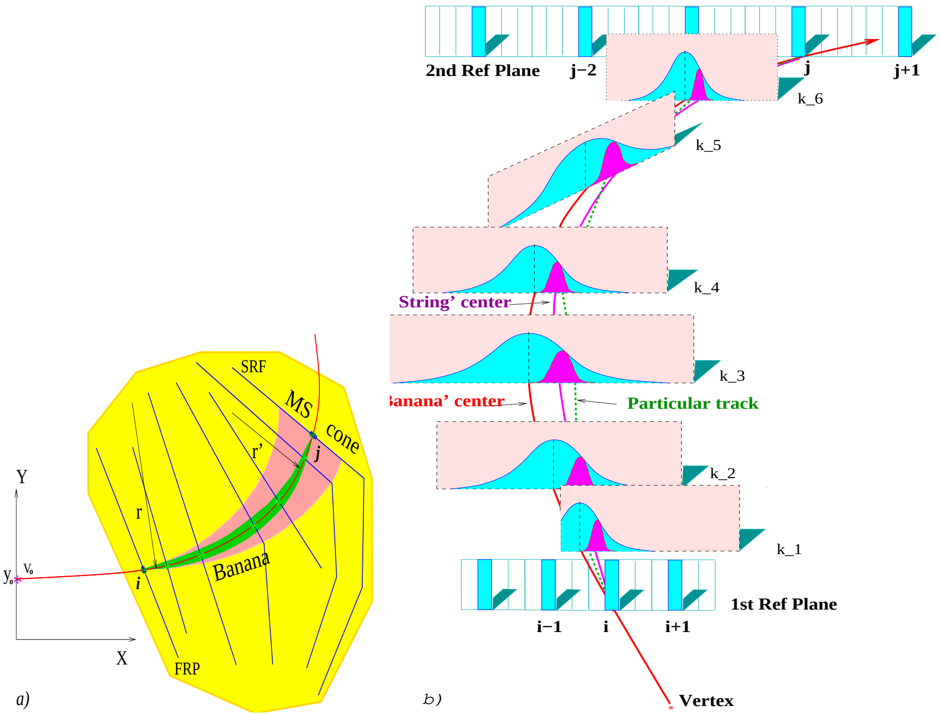

Fig. 1. *a*) MS cone for ensemble of particles with monochrome $\vec{P}$ and Banana for ensemble with the same average but narrow momentum distribution, which originated from V_0 and pass through the same pixel i in FRP. *b*) Banana (i, j) "bell road" and a particular String (more narrow "bells") inside.

corrections depending on relative deflection of a *String* inside a *Banana* window. So SBTM uses more parameters in its model space than usually and it provides additional corrections to track' parameters.

At first track recognition stage one check different combinations of (i, j) signals in RPs and select such which has proper number of signals inside of *Banana* road. At the second stage relative positions of signals inside *Banana* are checked and if they are inside of a more narrow window *String* – track candidate is recognized.

2. Comparison to another method and Conclusions

For demonstration and comparison the SBTM method is applied for the toy model spectrometer as in [3]. In this article optimal track fitting (OTF) which reproduces the results of the global fit [4] is described. Toy model spectrometer consists of four high resolution (5 μm) silicon detectors followed by thirteen gas detectors (200 μm resolution) in 1T magnetic field.

Main track reconstruction characteristics for this method and for OTF are shown

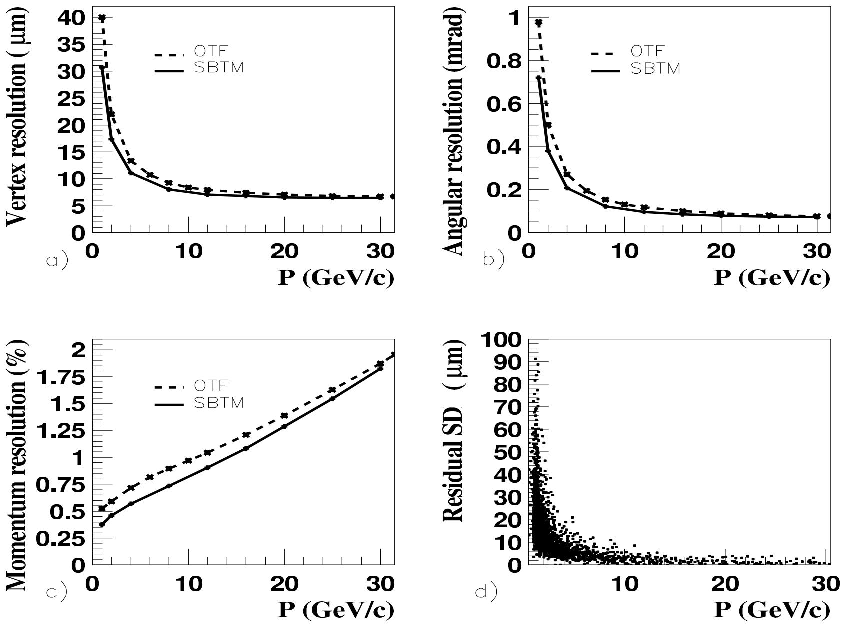

Fig. 2. Vertex *a*), angular *b*) and momentum *c*) resolutions as a function of particle momentum. Space precision of the SBTM model – residual standard deviation (for "ideal" space resolution case).

on Fig. 2. Points for OTF were taken from Fig. 10,11,12 in [3]. Fig. 2d) shows how close is track model to the actual hits.

This global method has internal robustness and can easily work with ambiguous measurements of different detectors. It exploits simple and fast access model of track and is time efficient. Its template based nature and close approach to the actual hits make it attractive for implementation in firmware.

Acknowledgments

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