The status of time slice simulation in the SPD straw tracker

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Collaboration assignment

- Development of methods and creation of software for modelling the response of SPD tracker in the trigger-free regime.
- Studying the temporal structure of signals.
- Development of algorithms for reconstruction of events in the trigger-free regime.
- Investigation of reconstruction efficiency and purity on MC simulation data.
- Development of prototype software for event reconstruction at the stage of online data filtering.

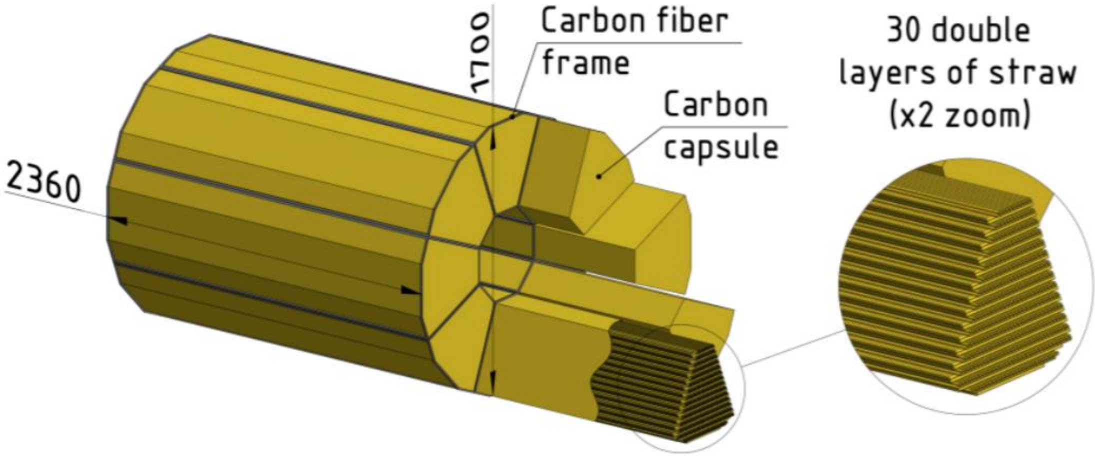
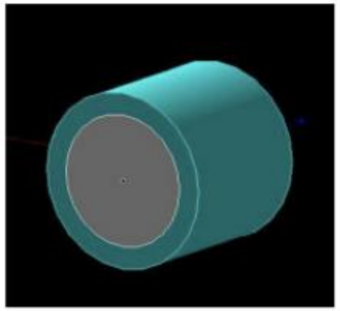


Fig.1. Schematic representation of the straw tracker

Blue layer – PET
R = 0.036 mm
White layer – gas
CO_2 (30%) + Ar (70%)
R = 4.964 mm



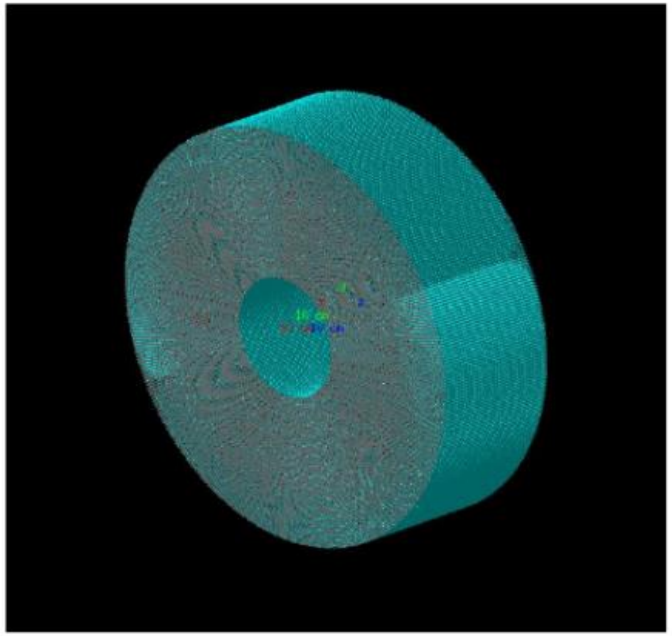


Fig.2. Straw-tube segment model(left), full detector model (64 layers) (right)

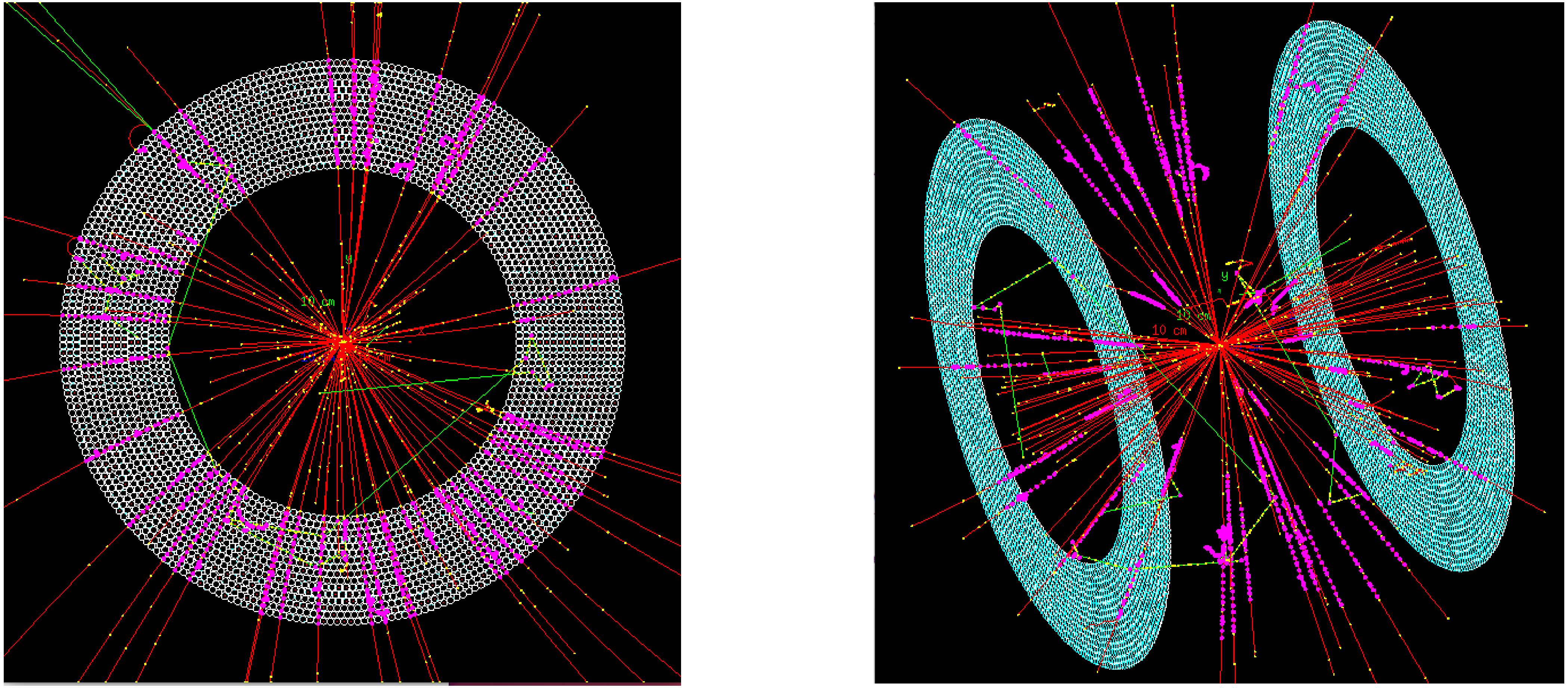


Fig.3. Launch of 100 muons. View of the detector in the Oxy plane (left), at an angle (right). Pink dots are points of energy loss in the sensitive volume.

$$r = \frac{|(x_2 - x_1)y_2 - (y_2 - y_1)x_2|}{\sqrt{(y_2 - y_1)^2 + (x_2 - x_1)^2}},$$

(x_1, y_1) – local (relative to the centre of the tube) coordinates of the first point of energy loss, (x_2, y_2) – of the last one.

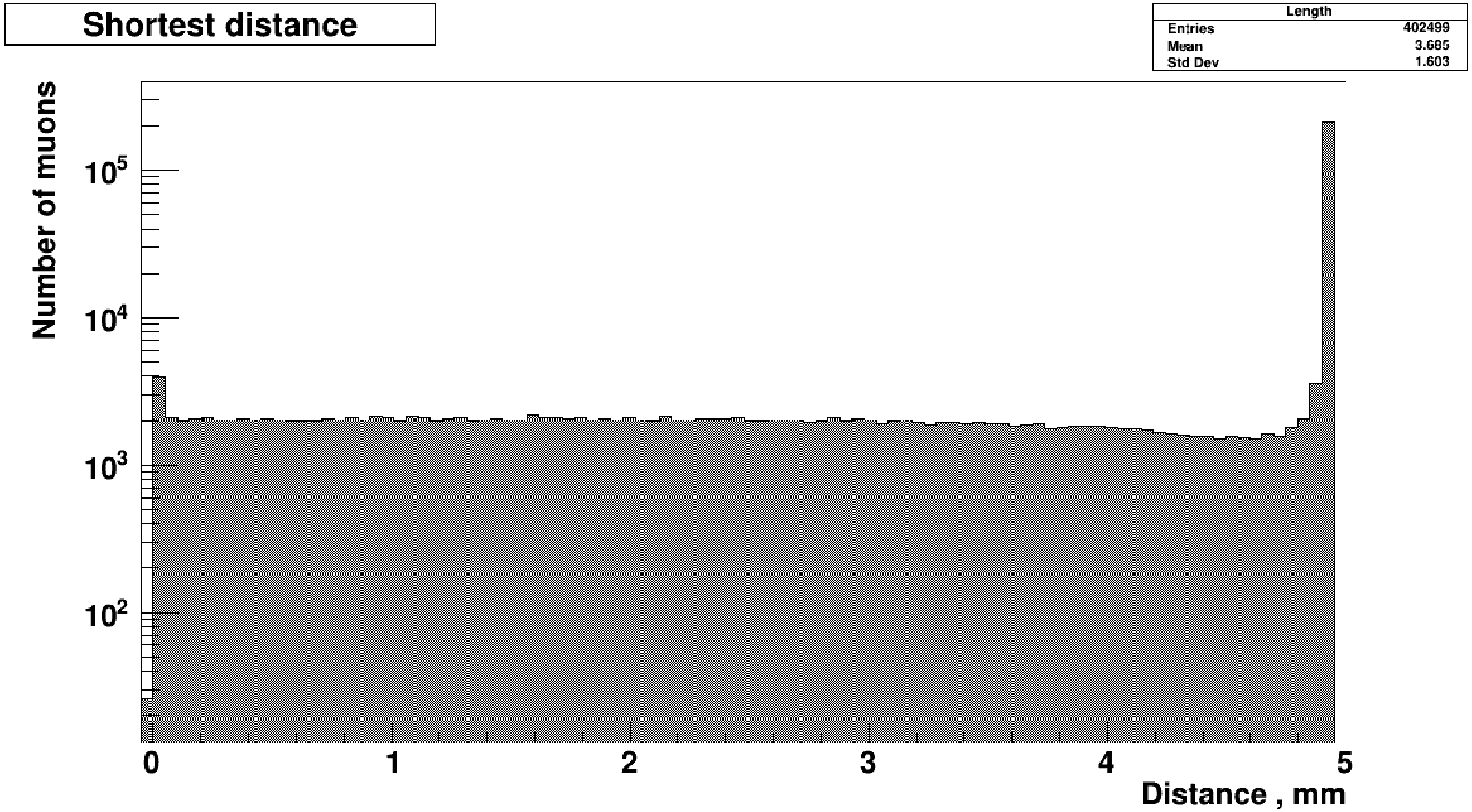


Fig.4. Distribution of the distance from the point of energy loss to the tube axis.

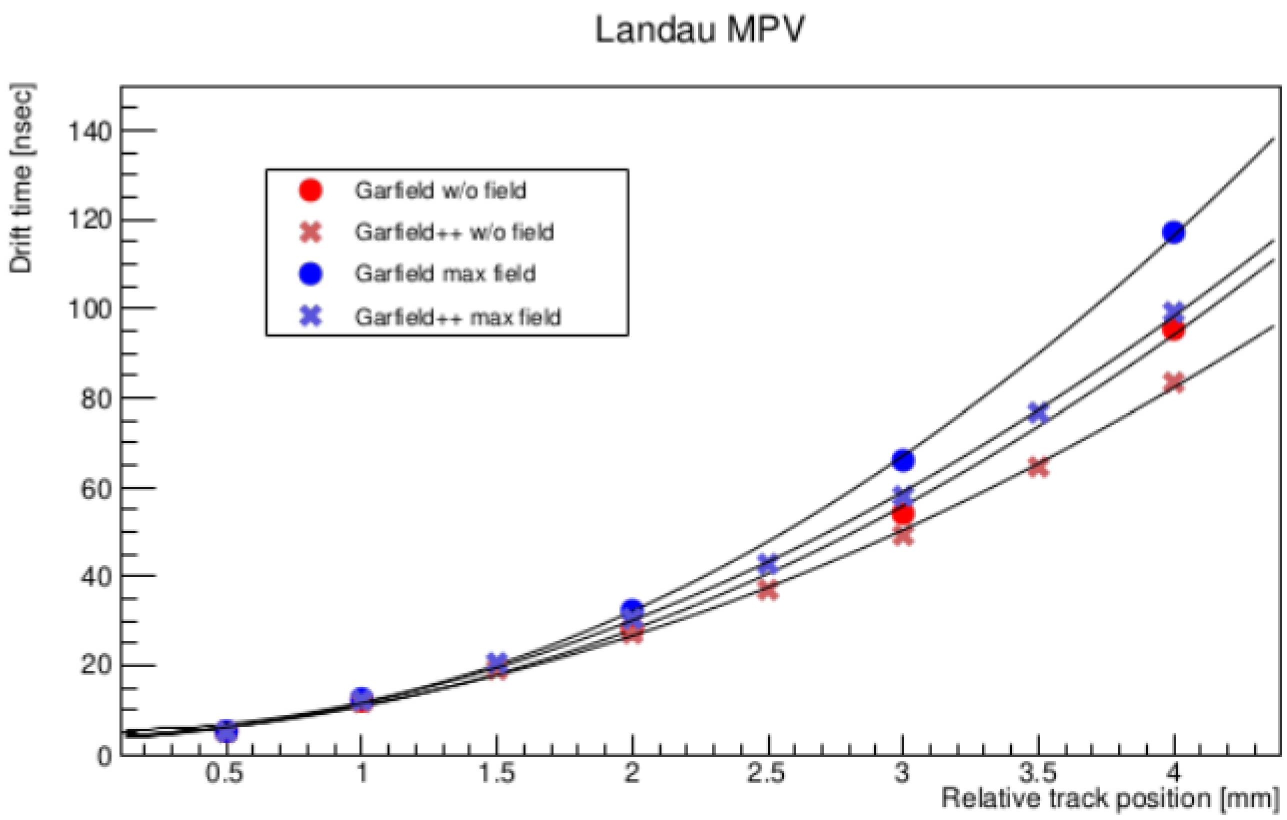


Fig.5. Time dependence on distance from the tube axis. Garfield generation.

$$T_{Real} = t + 2.71012 + 1.21564x + 6.82868x^2,$$

x – distance to the tube axis,
t – time of energy loss by the particle from the beginning of the experiment modelling,
T_{Real} - time taking into account electron drift.

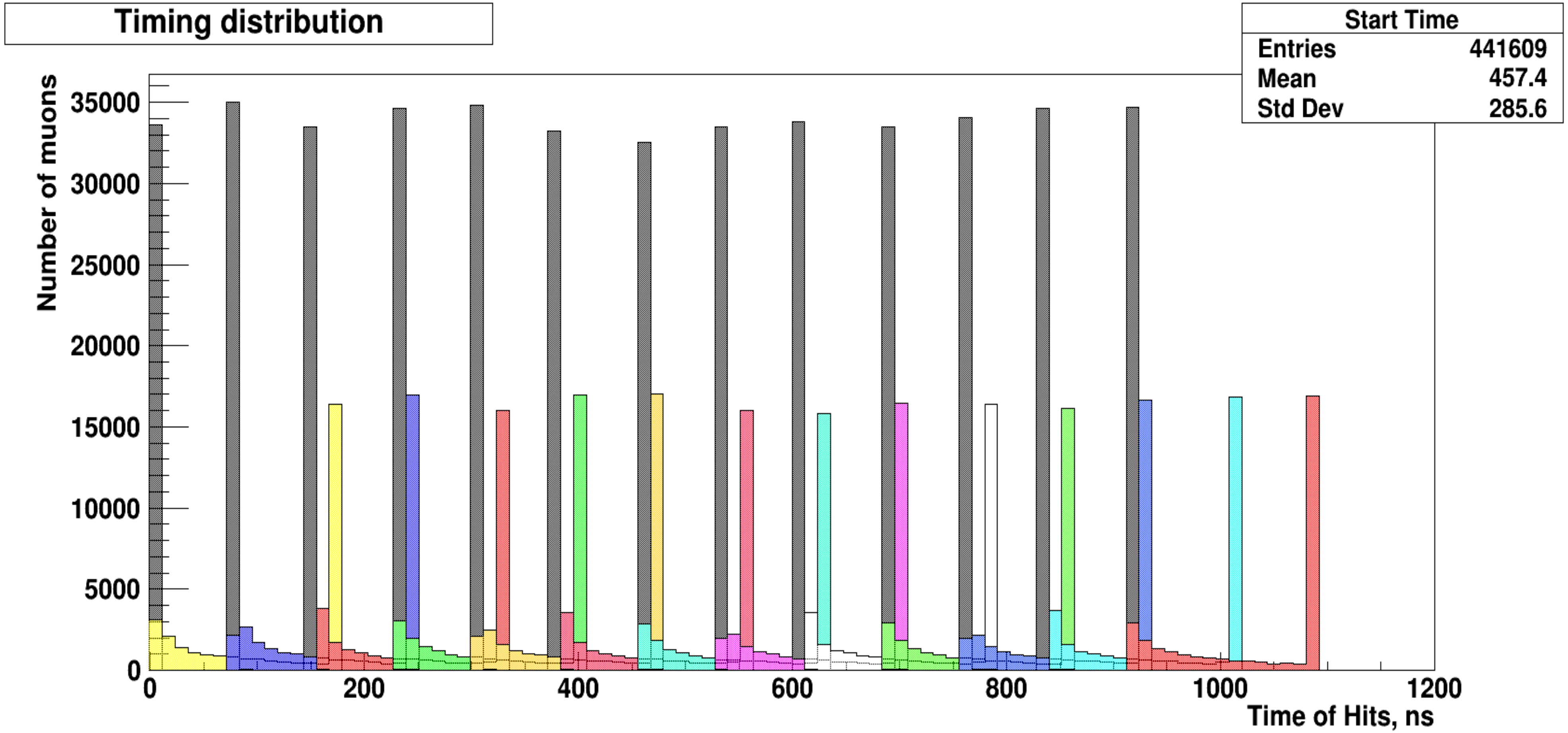
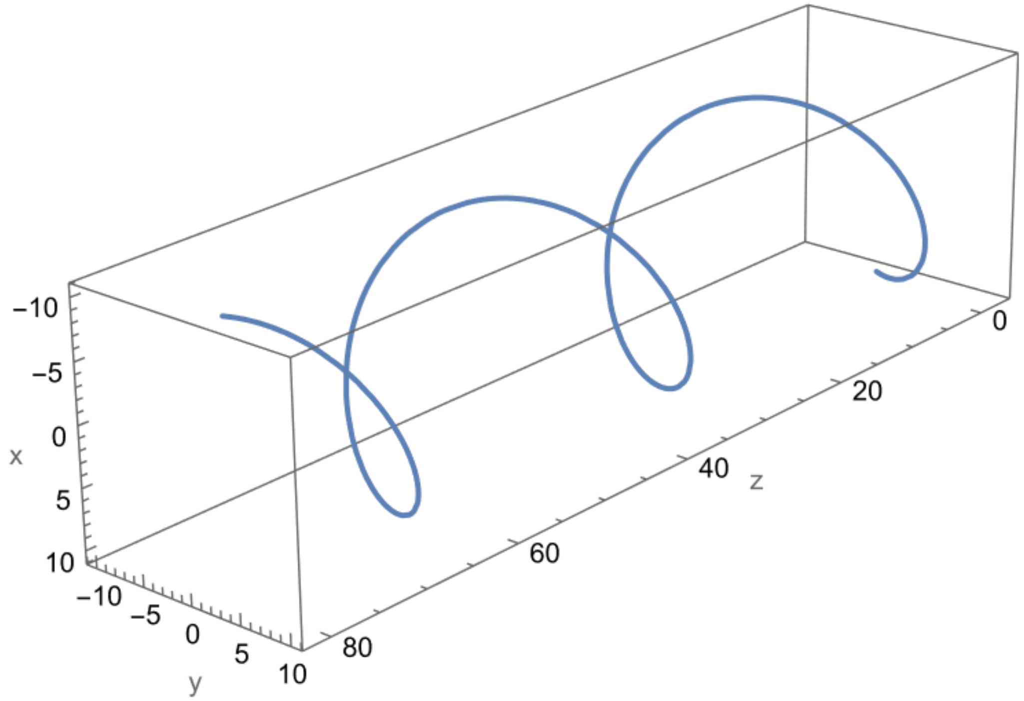


Fig.6. Histogram of the distribution of straw response times.



$$x = a_1 \cos a_2 t$$
$$y = b_1 \sin b_2 t$$
$$z = c_1 t + c_2$$

$$\sin x = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n+1}}{(2n+1)!}$$

$$\cos x = \sum_{n=0}^{\infty} (-1)^n \frac{x^{2n}}{(2n)!}$$

Approximation functions:

$$y(z) = a_1 z^2 + b_1 z + c_1$$

$$x(z) = a_2 z^2 + b_2 z + c_2$$

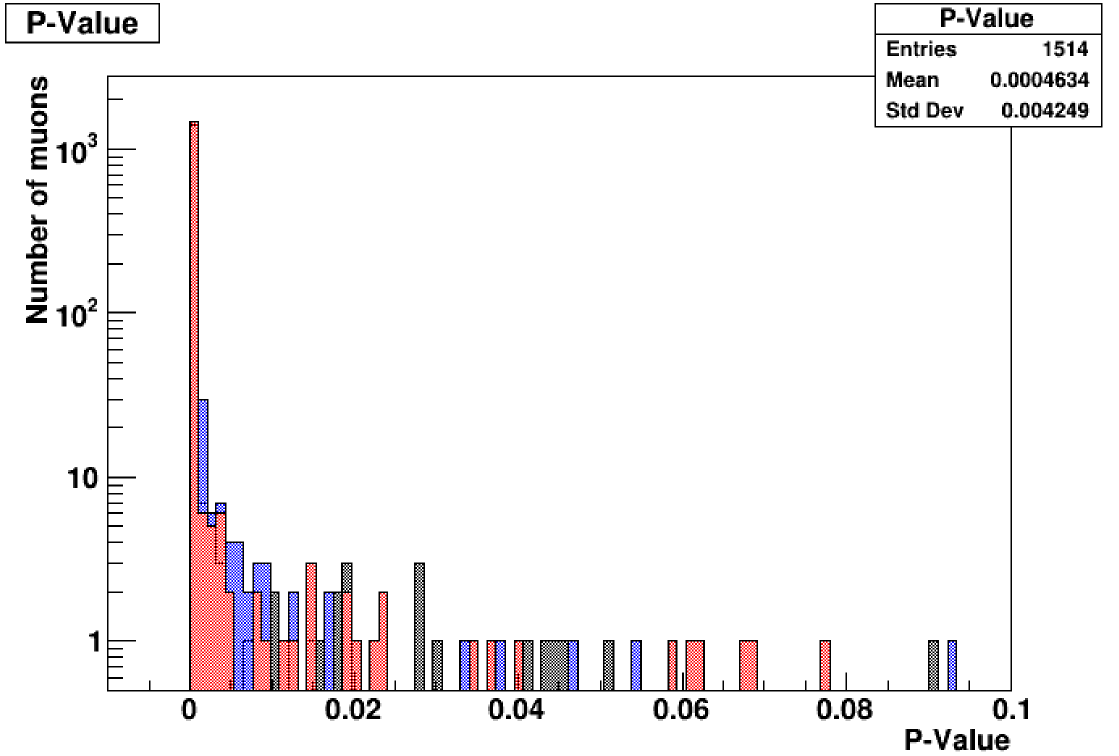


Fig.7. P-value of z(t) approximation. red - linear, black - quadratic, blue - cube

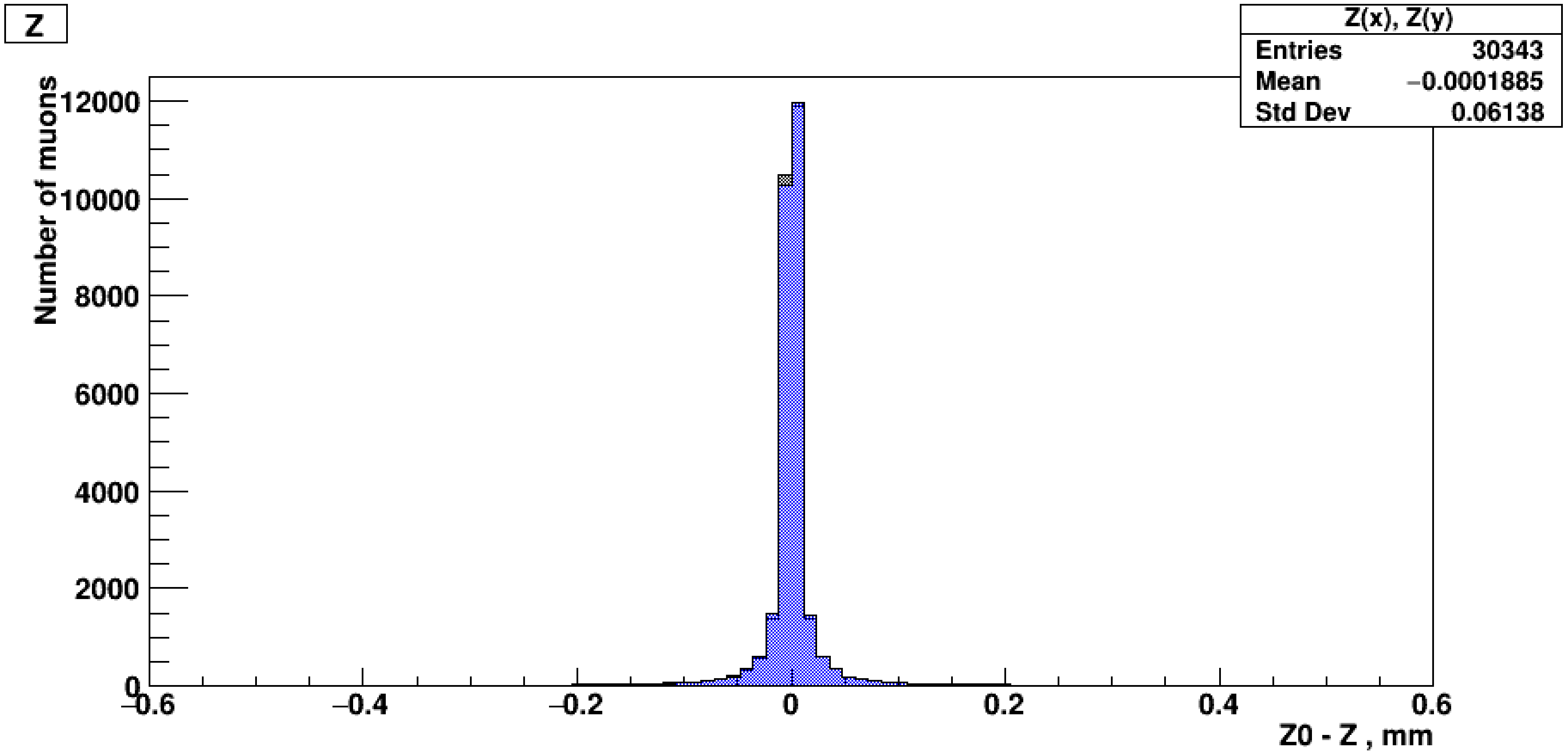


Fig.8. Histogram of deviation of the found z from the true value

Conclusion and TODO

- Time distributions of the simulated hits in sensitive volumes were obtained.

- Algorithm for primary vertices reconstruction was developed.

- The next step is to improve algorithm.