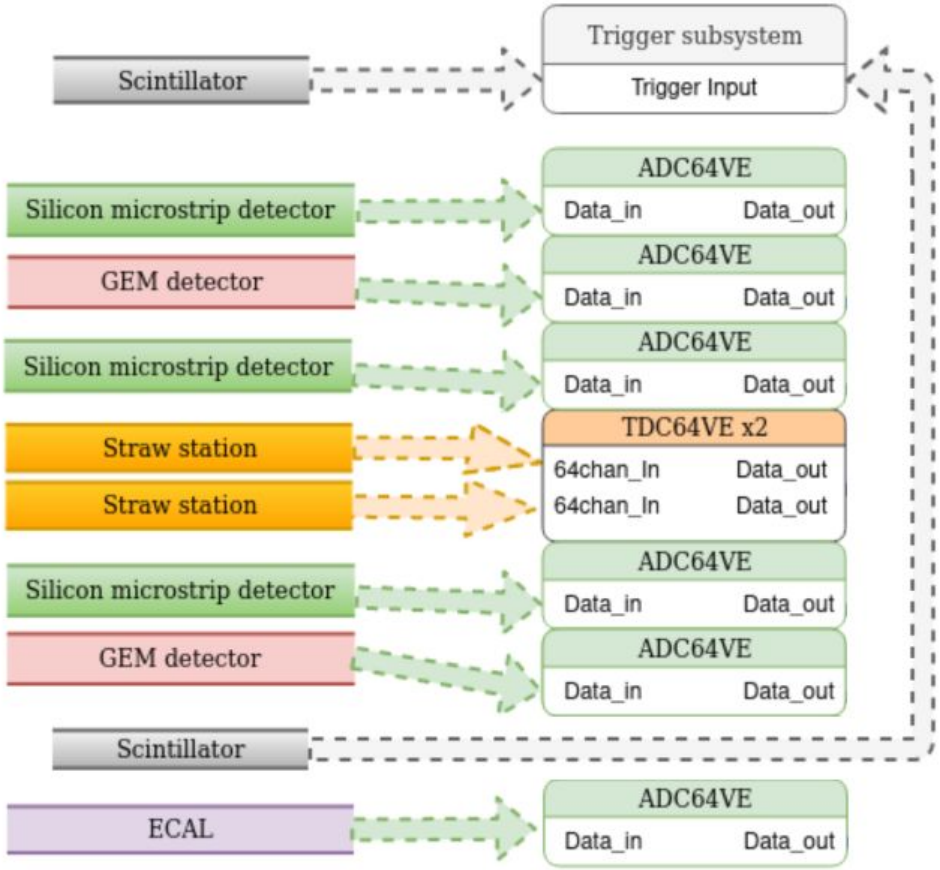
Preliminary results of straw tracker calibration at MiniSPD

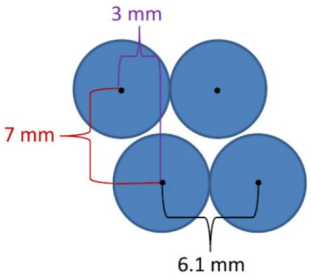
02.06.2021

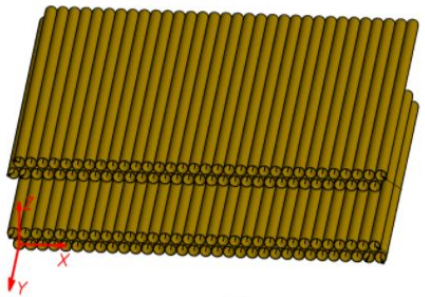
MiniSPD stand

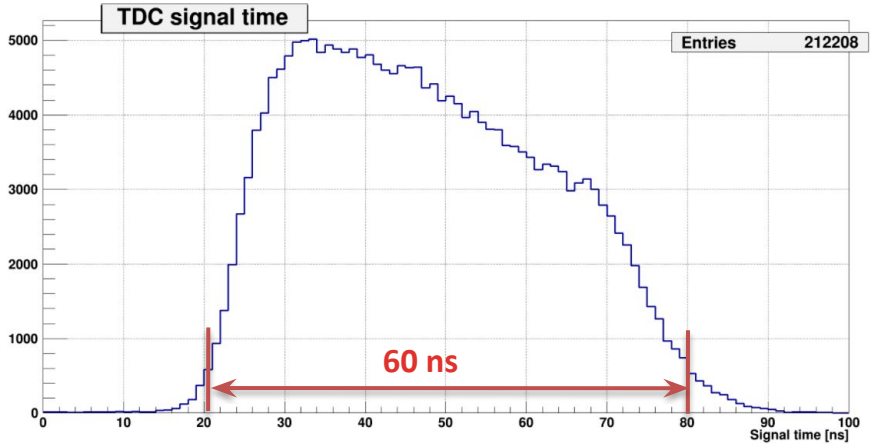


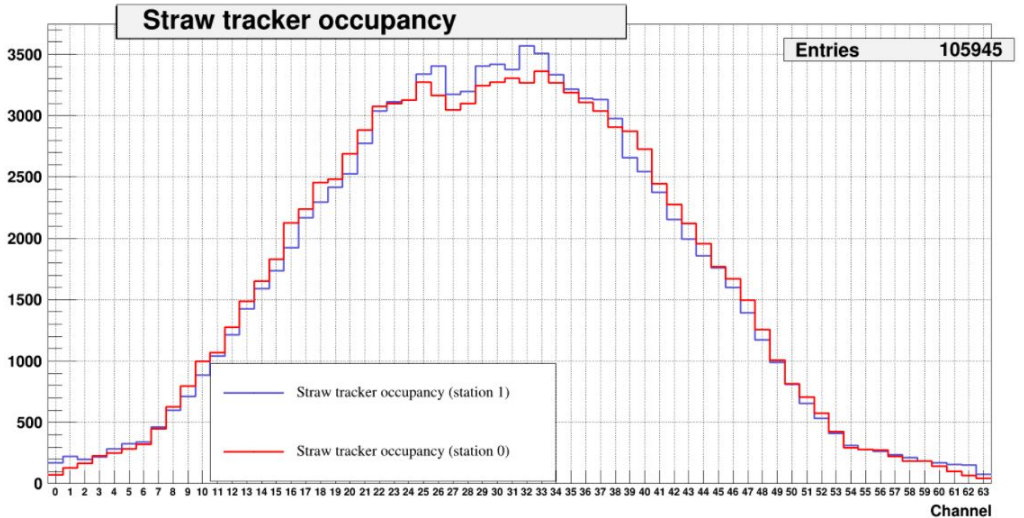
Straw tracker

- 20 cm straw tubes with inner diameter 6 mm.
- Gas: Ar 70%, CO2 30%, 20°C, 1 atm.
- Gold-plated tungsten wire: diameter 30 mkm, voltage 1625V.
- Used in NA64 experiment.



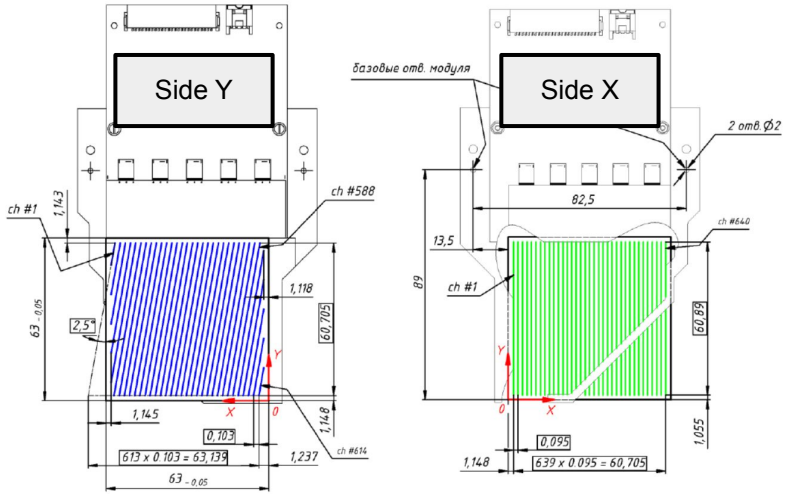


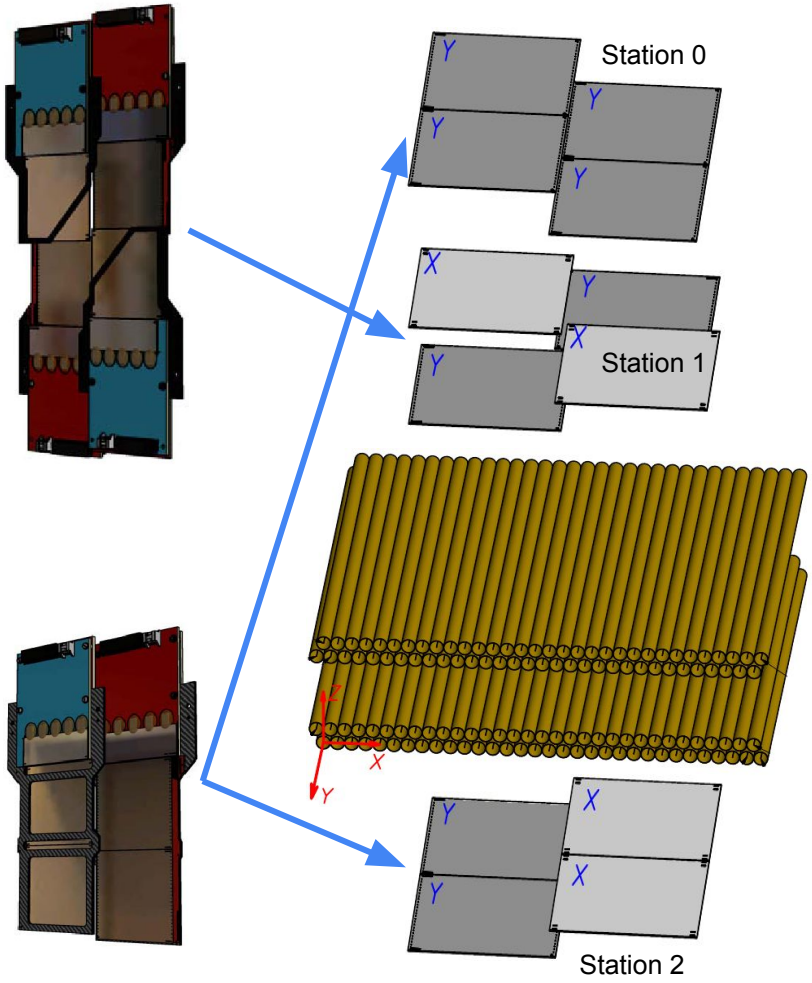




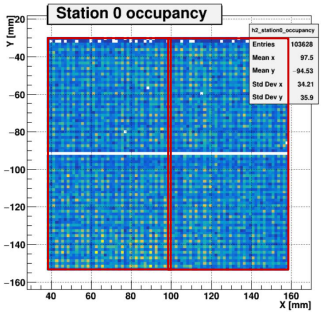
Silicon tracker

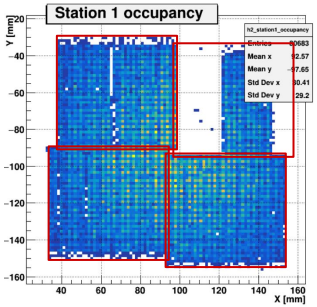
- Double-sided silicon strip detector with pitch 95 and 103 μm for X and Y sides, respectively.
- Y-side tilt 2.5°.
- Two types of modules short (63x63 mm) and long (two connected short modules).
- Similar modules were used in BM@N.

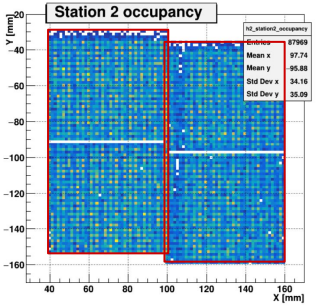


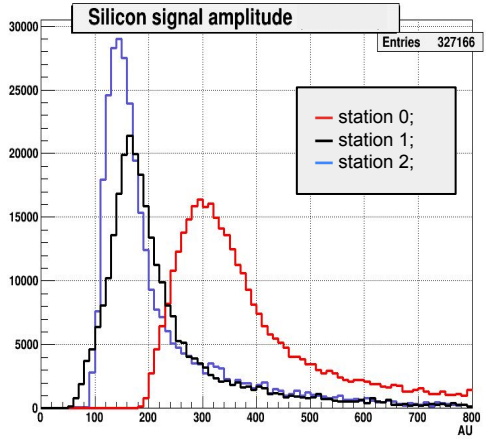


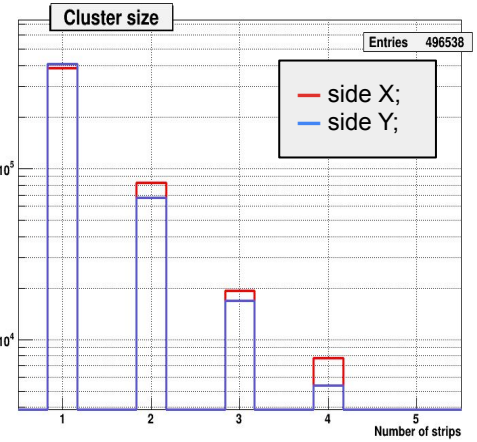
Silicon tracker data analysis

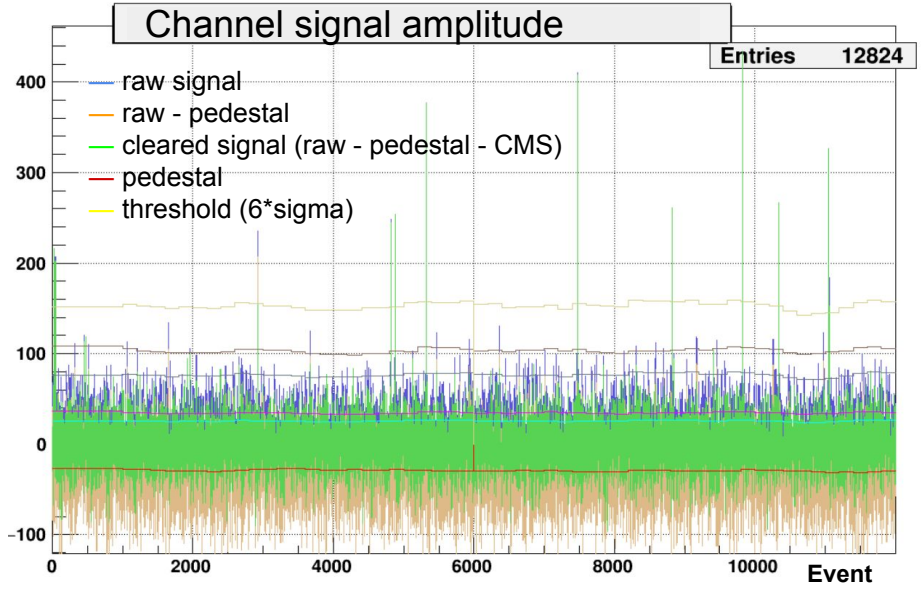






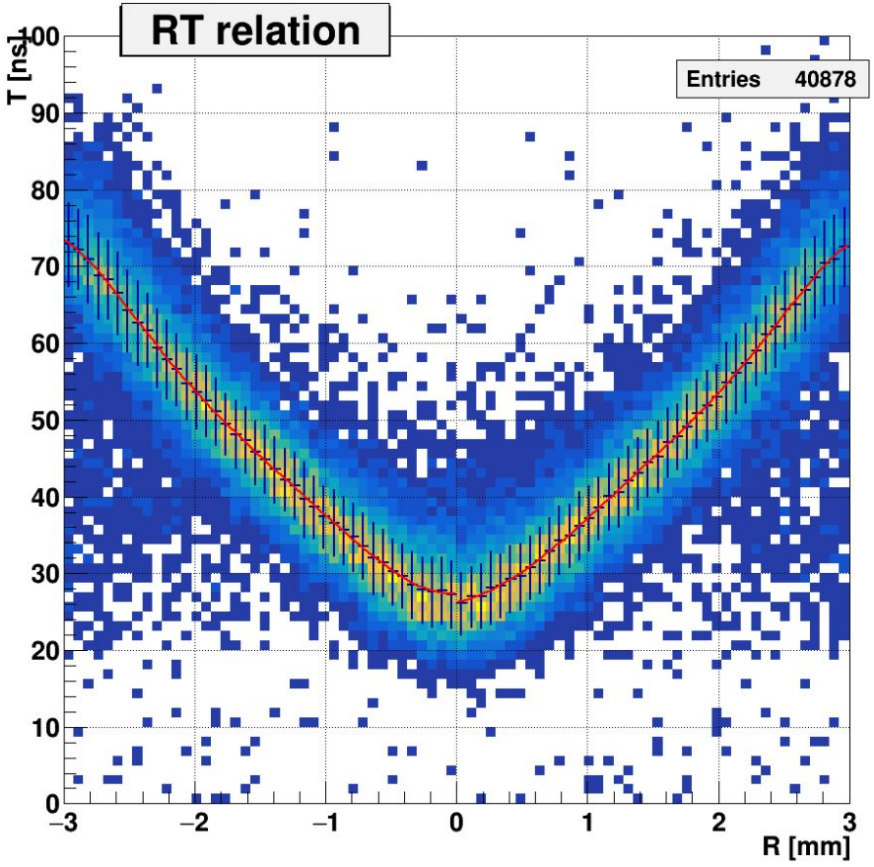






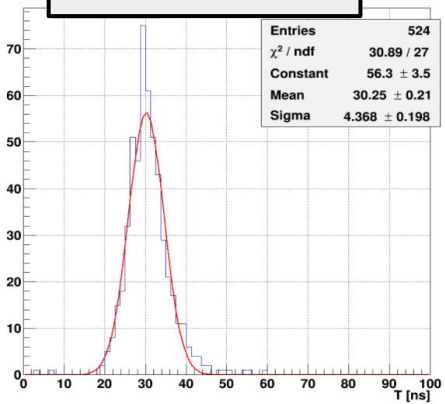
Residuals fit results		
Station - Module	Mean [mkm]	Sigma [mkm]
0-0	0.40	73.90
0-1	-2.49	70.81
1-0	3.76	87.79
1-1	1.20	98.03
1-2	-1.20	96.42
1-3	3.46	92.41
2-0	-2.77	51.88
2-1	-0.58	52.64

RT fit (all silicons active)

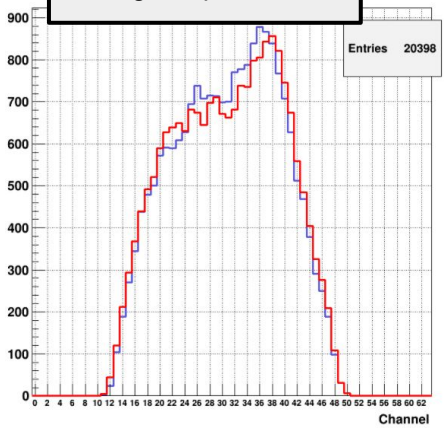


- Due to low number of entries one RT-shape is built for all straw tubes.
- For every R-bin time distribution is build and fitted in Gaussian.
- Straw time resolution σ_T ~ 5 ns.
- The V-shape can be saved as a “R vs mean T” table or as fit parameters.

One slice fit example



Signals per tube



Spatial resolution estimation

$$T = F(R)$$

Spatial resolution is estimated using error propagation formula:

$$\sigma_T^2 = \left(\frac{dF(R)}{dR}\right)^2 \sigma_R^2 \quad \rightarrow \quad \sigma_R = \frac{1}{|F'|}\sigma_T$$

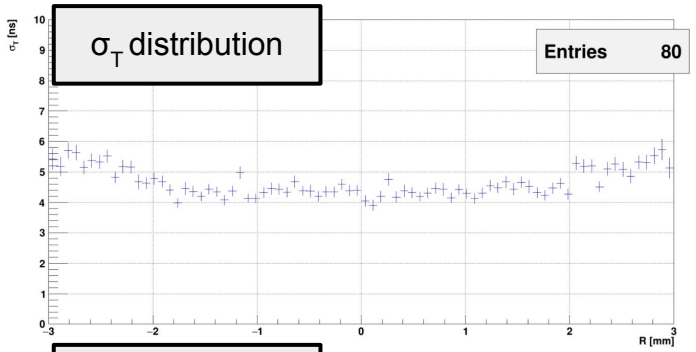
with error

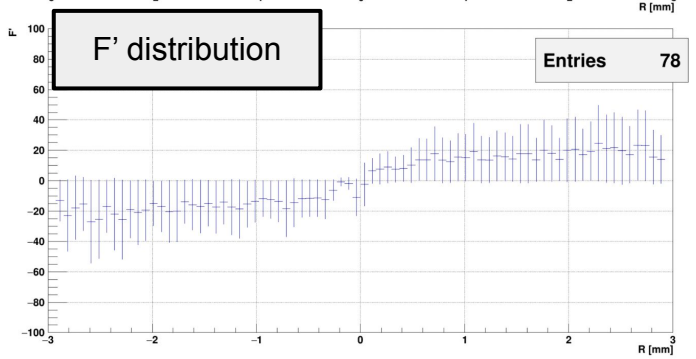
$$(\Delta\sigma_R)^2 = \left(\frac{\partial\sigma_R}{\partial\sigma_T}\right)^2 (\Delta\sigma_T)^2 + \left(\frac{\partial\sigma_R}{\partial F'}\right)^2 (\Delta F')^2$$

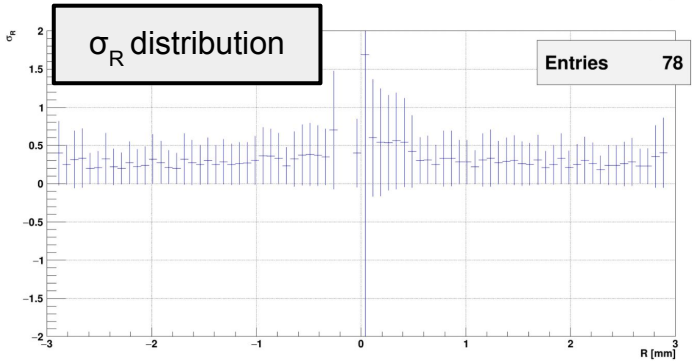
Spatial resolution then calculated as weighted mean of σ_R:

$$\mu_{\sigma_R} = \frac{\sum \frac{\sigma_R}{(\Delta\sigma_R)^2}}{\sum \frac{1}{(\Delta\sigma_R)^2}}$$

Estimated spatial resolution: 250μm



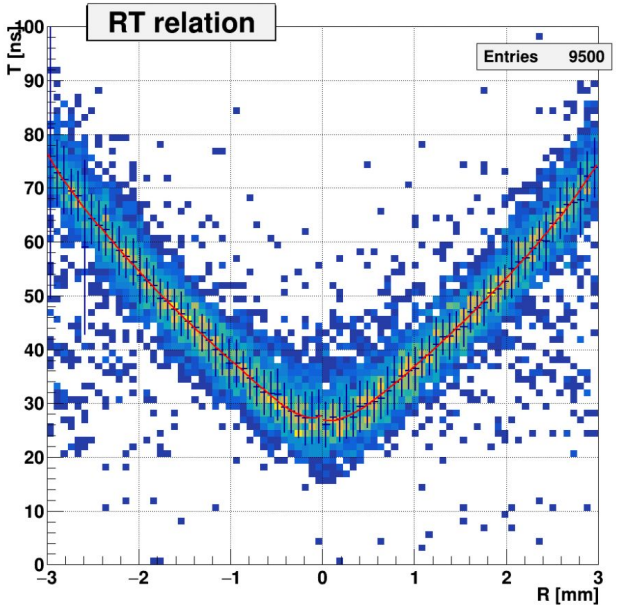


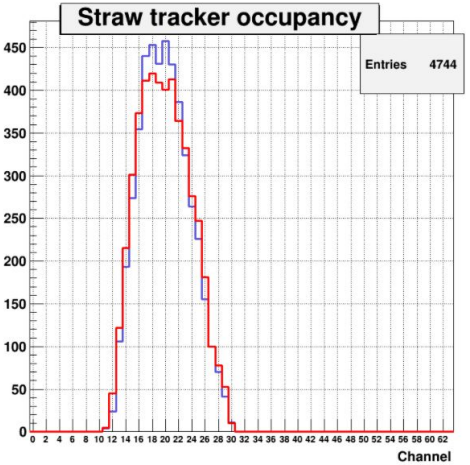


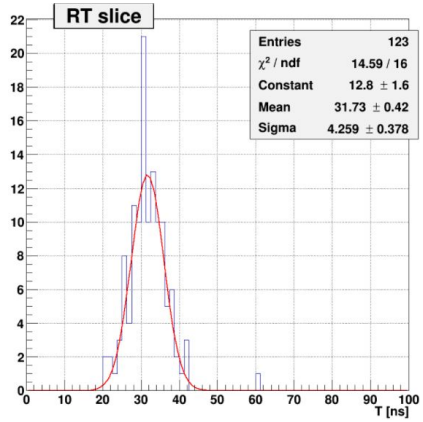
Ways to improve results

- better tracker alignment;
- add GEMs to tracking;
- algorithms and cuts optimisation to get more good tracks to work with;
- use single straw tube to get rid of misalignment and wire position uncertainty.

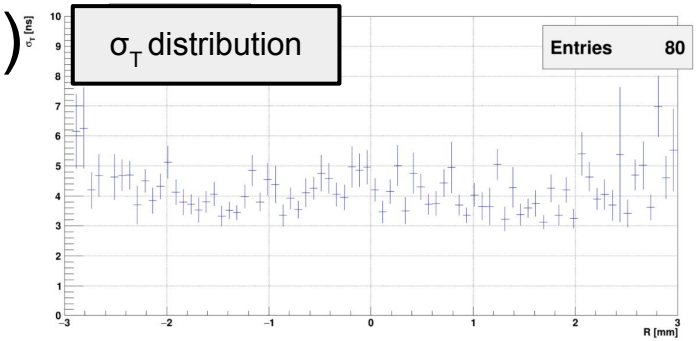
Spatial resolution (half of silicons active)

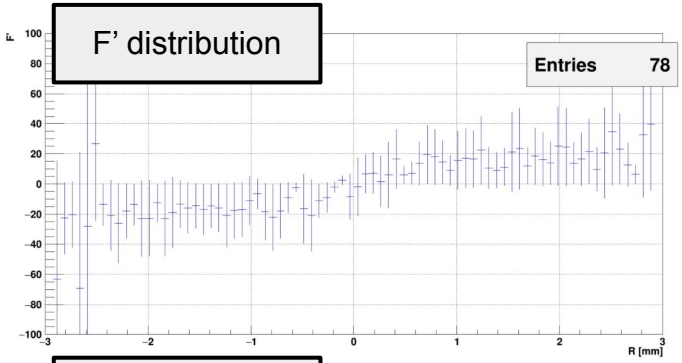


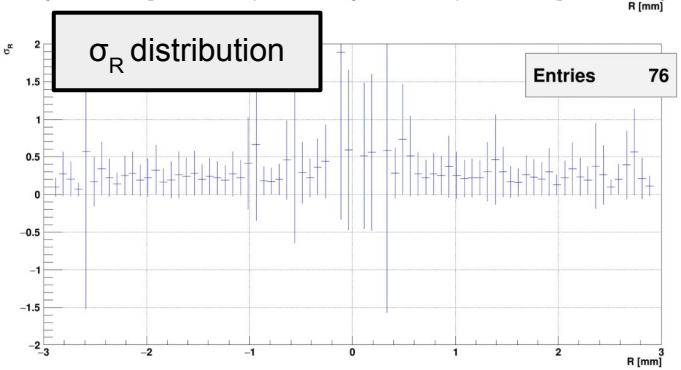




Estimated spatial resolution: 180μm







Backups