Status of TOF systems: data reconstruction and preparation for future run

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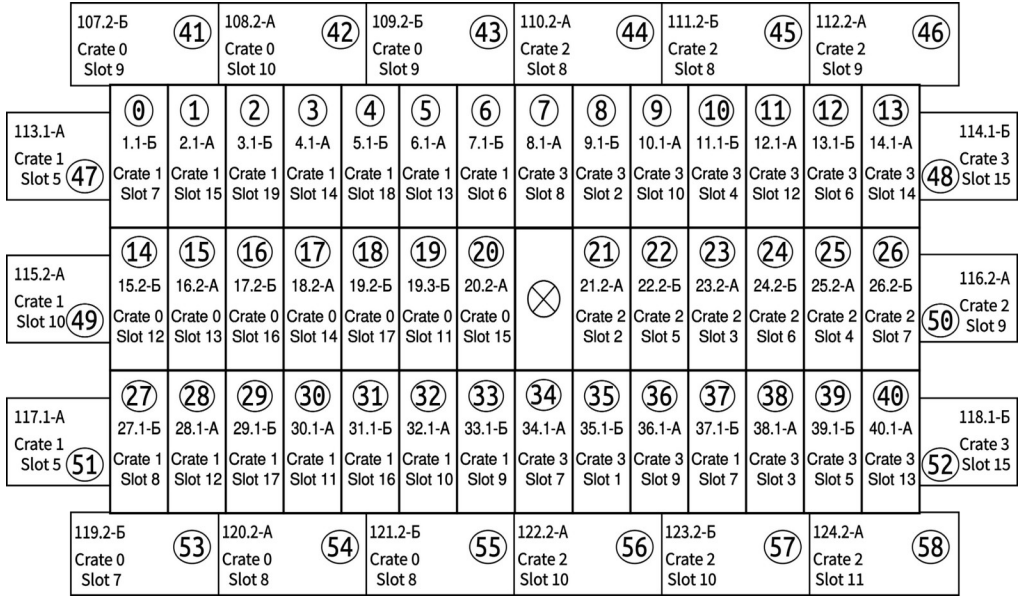
TOF systems overview

TOF400

#0	#5	⊗	#10	#15
#1	#6		#11	#16
#2	#7		#12	#17
#3	#8		#13	#18
#4	#9		#14	#19

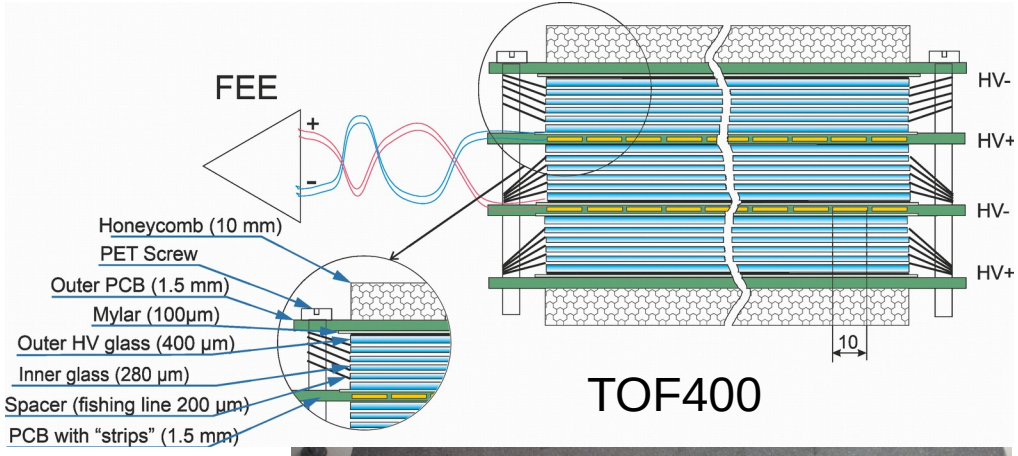
- 4.3 m from target
- 20 mRPCs
- 1.1 x 1.2 m^2 x 2 arms
- 1960 FEE channels

TOF700

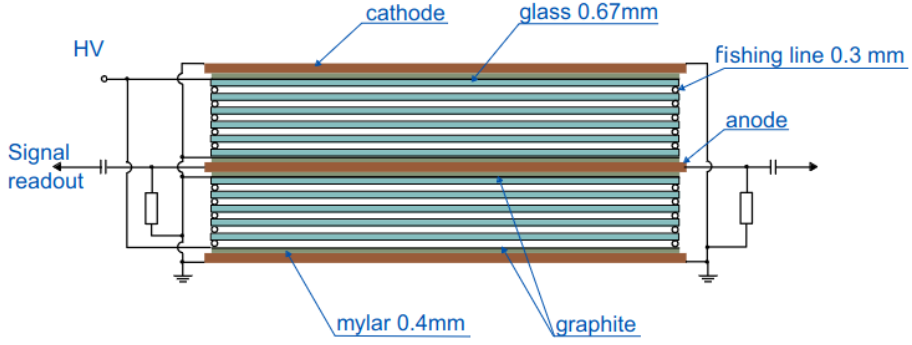


- 6.2 m from target
- 41 (small)+18(big) mRPCs
- 3.4 x 1.4 m^2 of active area
- 3200 FEE channels

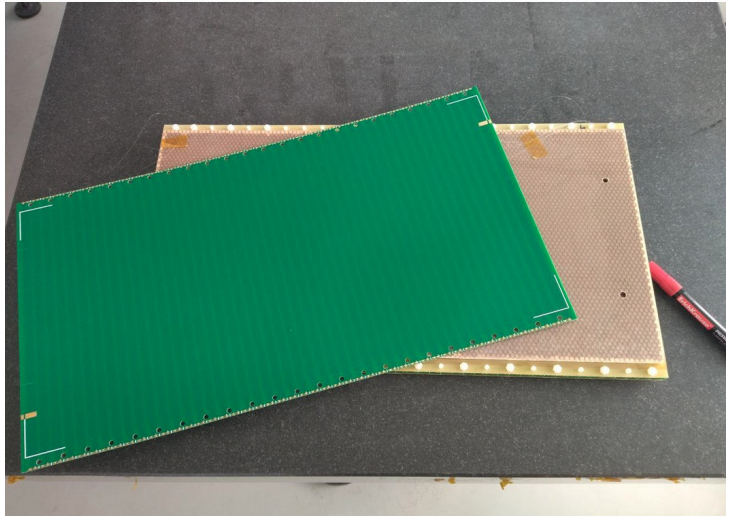
Detector scheme
Both systems use mRPC detectors with a strip readout.

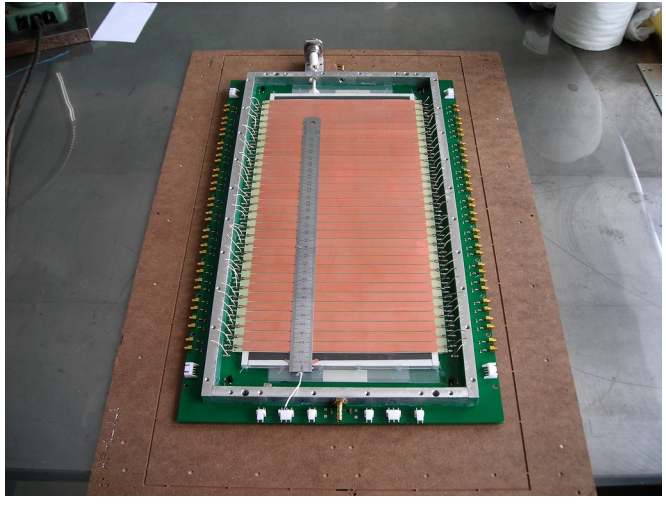


TOF400

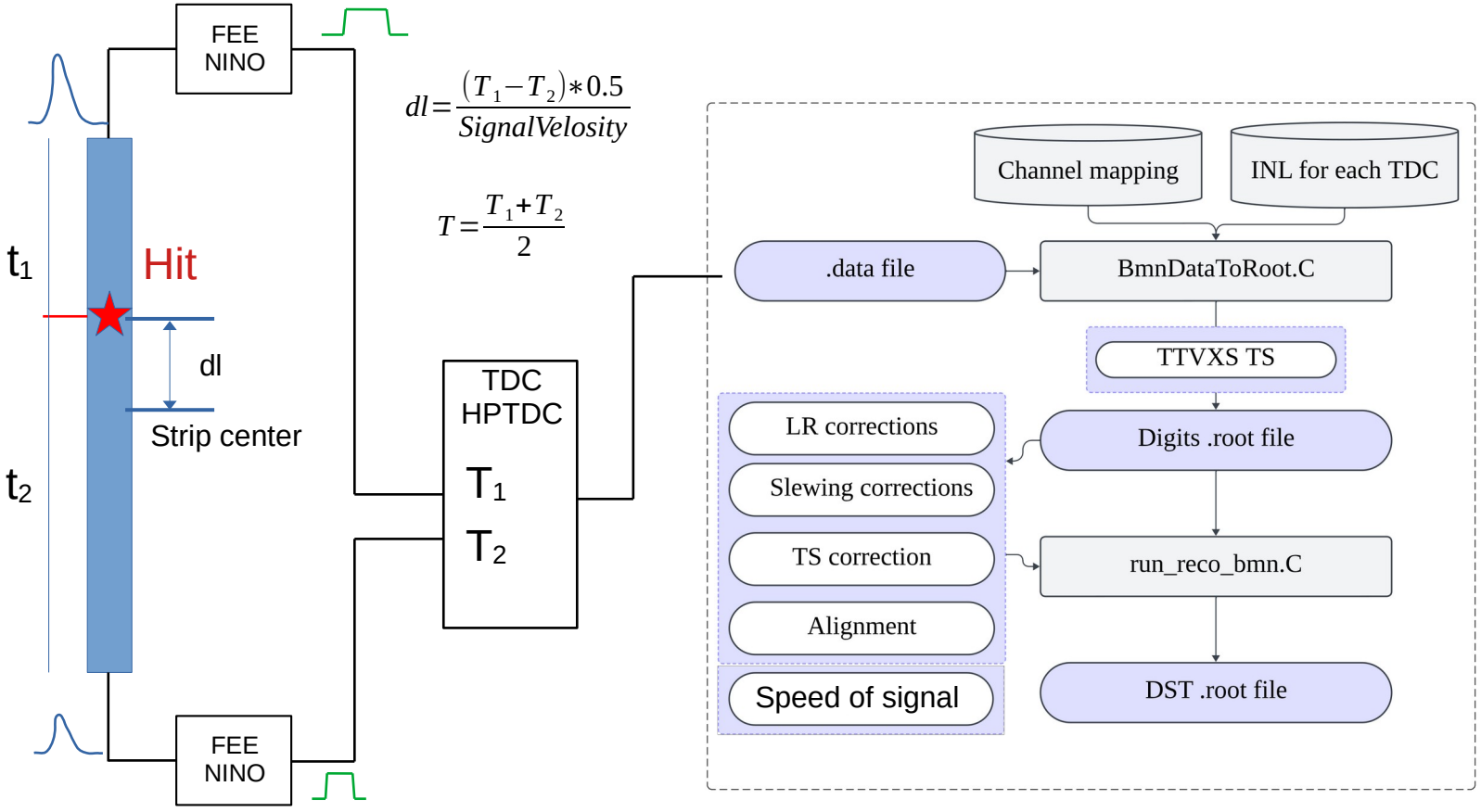


TOF700





Readout scheme



Both systems use a similar signal processing chain and data analysis pipeline.

Data analysis chain

bmnroot/decoder

- BmnSlewingTOF700.cxx
- BmnSlewingTOF700.h
- BmnThreadManager.cxx
- BmnThreadManager.h
- BmnTof1Raw2Digit.cxx
- BmnTof1Raw2Digit.h
- BmnTof2Raw2DigitNew.cxx
- BmnTof2Raw2DigitNew.h
- BmnTof701Raw2Digit.cxx
- BmnTof701Raw2Digit.h

It should to be done.

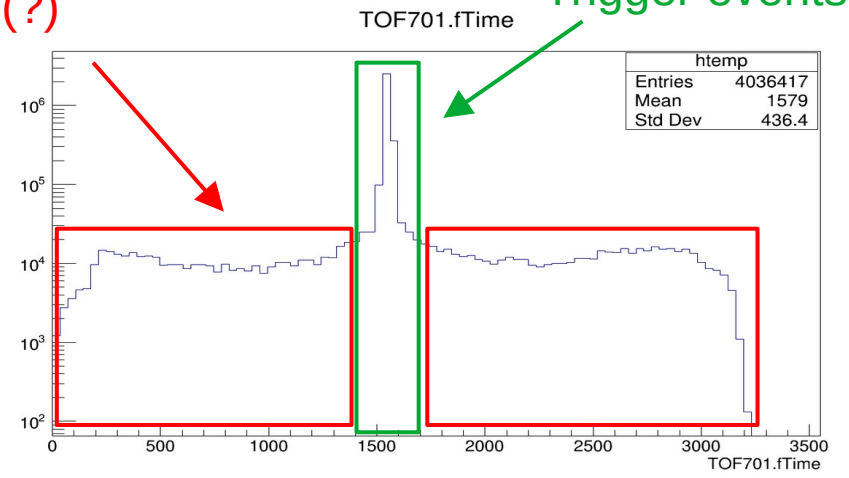
bmnroot/detectors

- tof
- tof1
- tof701

In progress

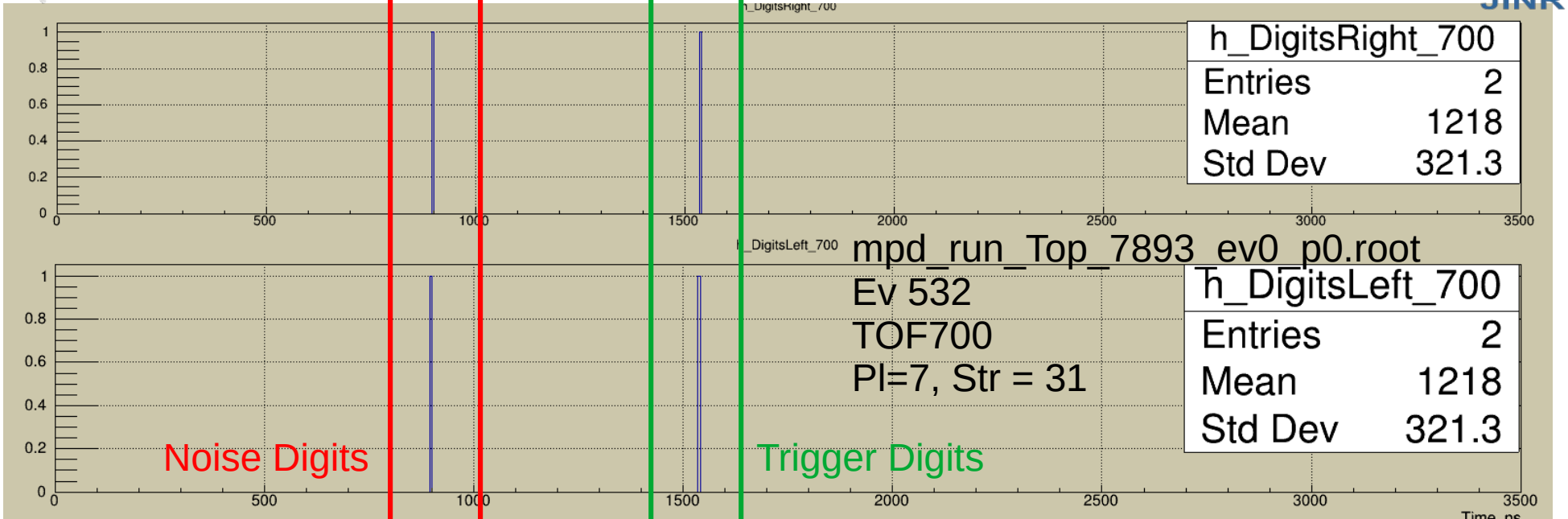
Noise (?)

Trigger events



Since the mRPC detector has been shown to have low noise, **only one hit (the first one in time) was reconstructed on each strip.** However due to the large reading window (~ 3μs), there may be situations when more than one “particle” gets into the strip, from trigger event and from a noise.

“New” HitProducer procedure



A hit is “possible” if there are digits on both sides of the strip and the reconstructed coordinate is located within the length of the strip:

$$\frac{(T_1 - T_2) * 0.5}{SignalVelosity} \leq \frac{StripLength}{2}$$

In the old version of the software, only the first “noise” hit would be reconstructed, as it was the first in time. In the updated version, both hits will be reconstructed.

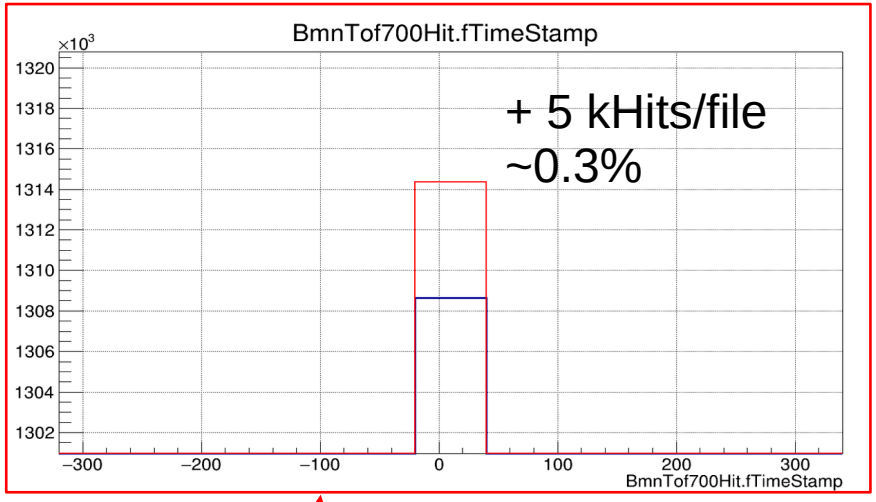
“New” HitProducer procedure

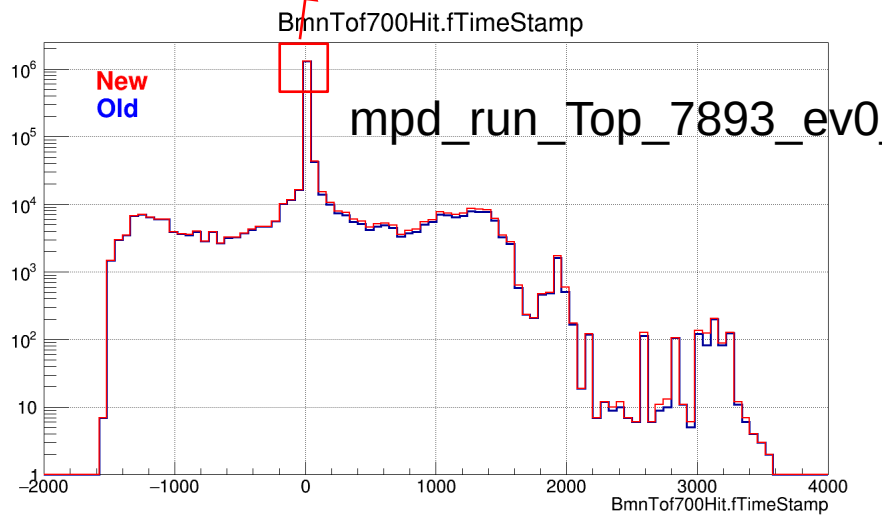
A hit is called “possible” if its reconstructed coordinate is within the length of the strip.

“Old” procedure: only one possible hit (the first one in time) is reconstructed on the strip.

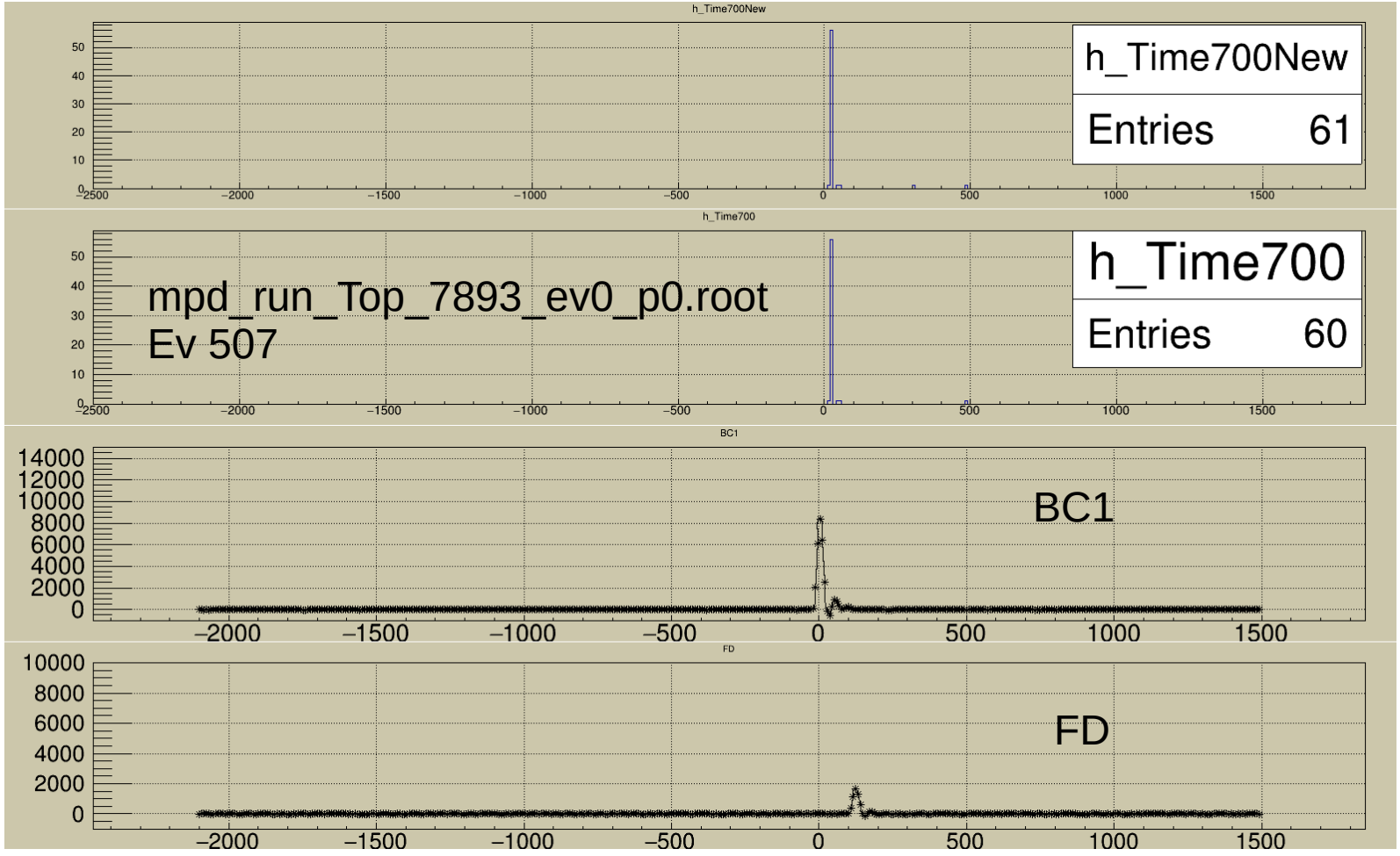
“New” procedure: all possible hits are reconstructed on the strip.

All the "old" hits have been reconstructed by the new algorithm!

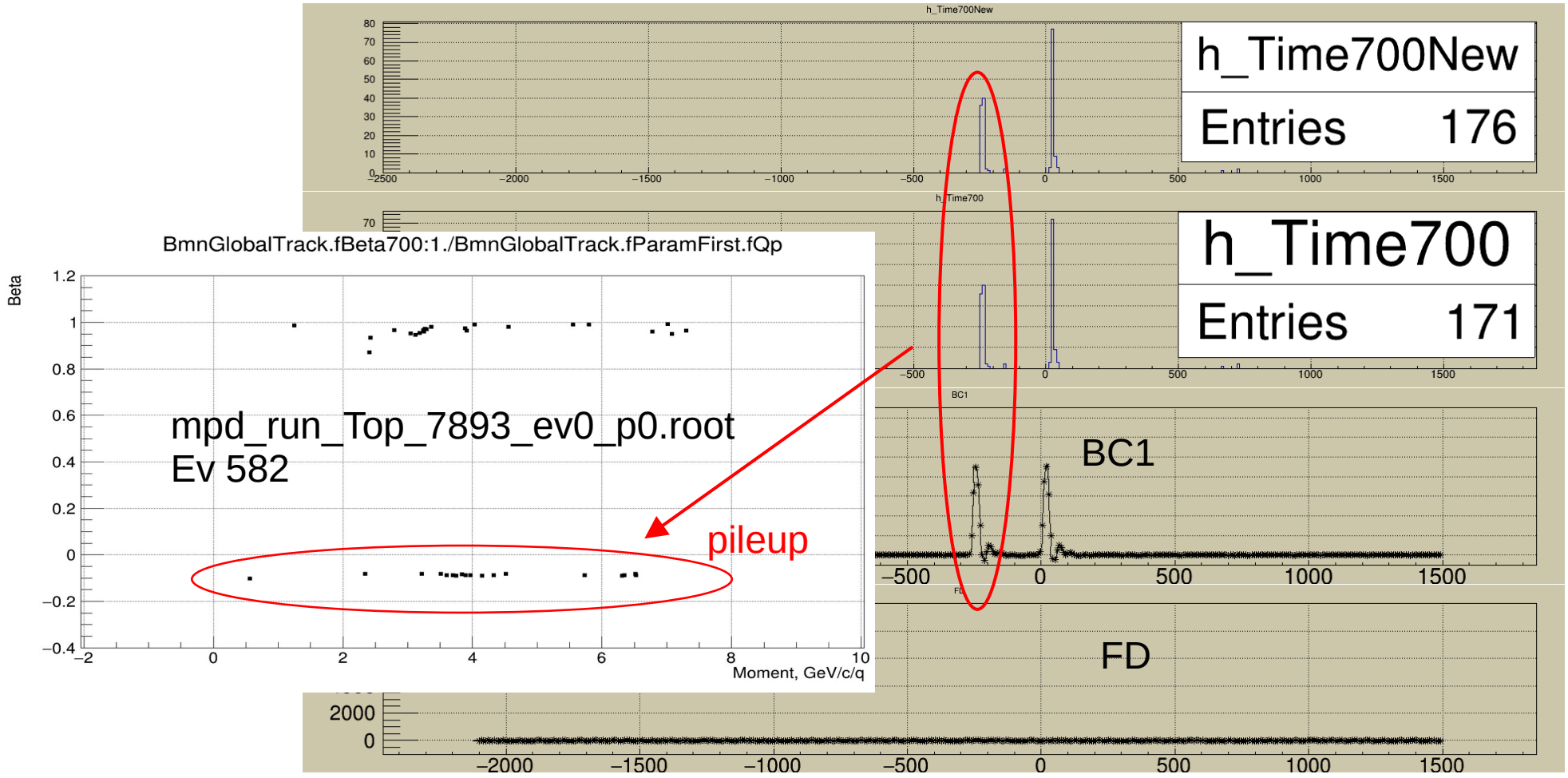




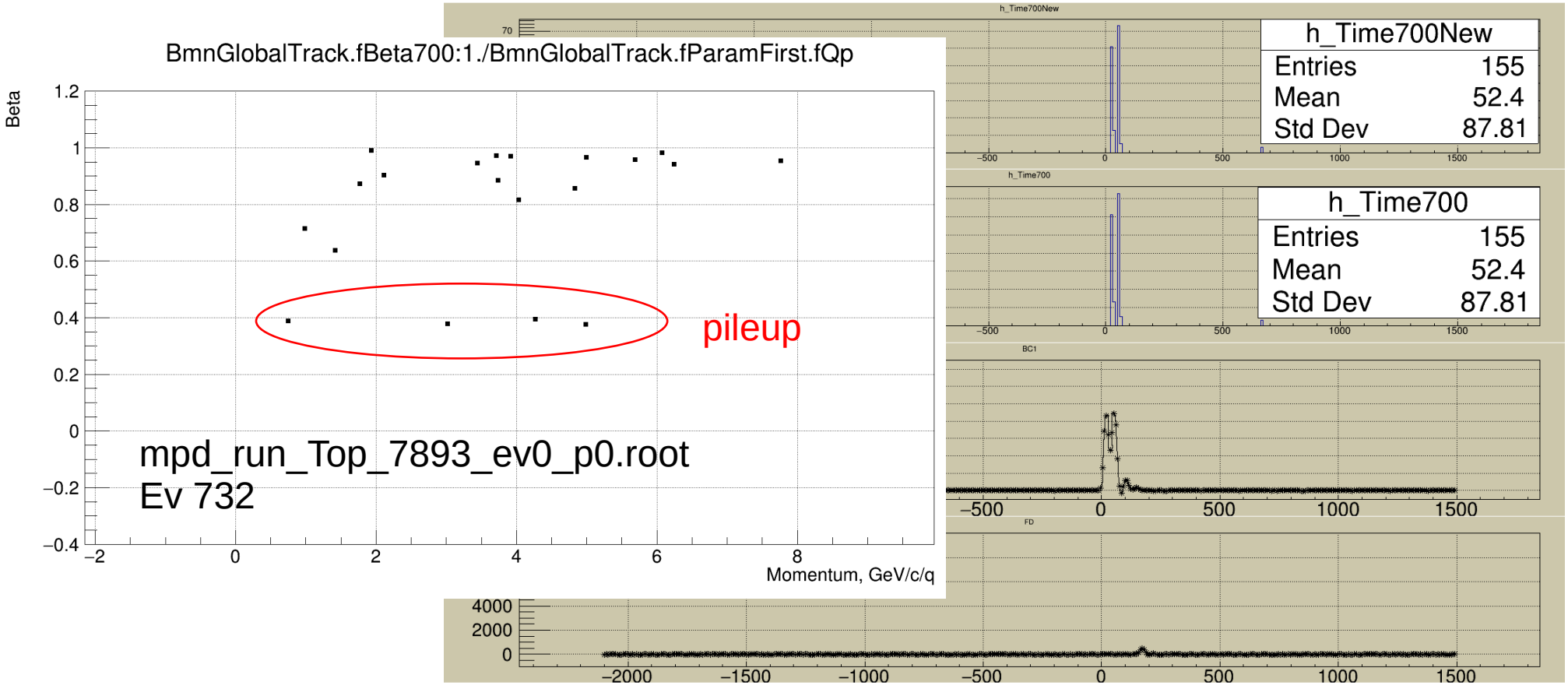
“New” HitProducer procedure



“New” HitProducer procedure



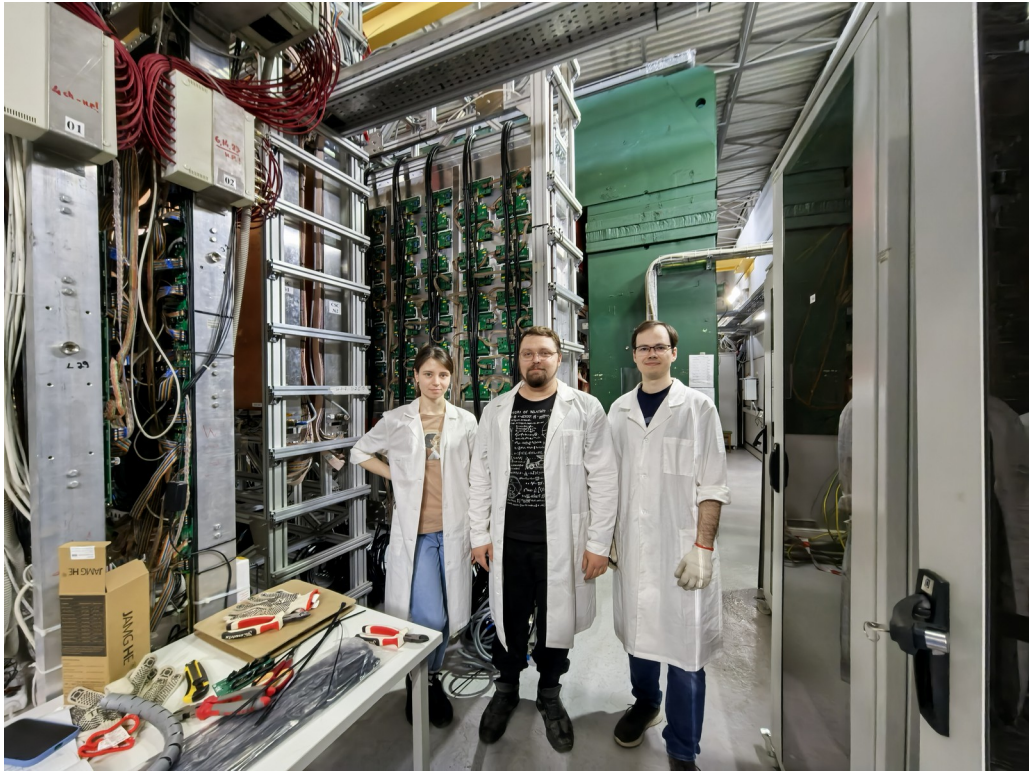
“New” HitProducer procedure



Conclusion

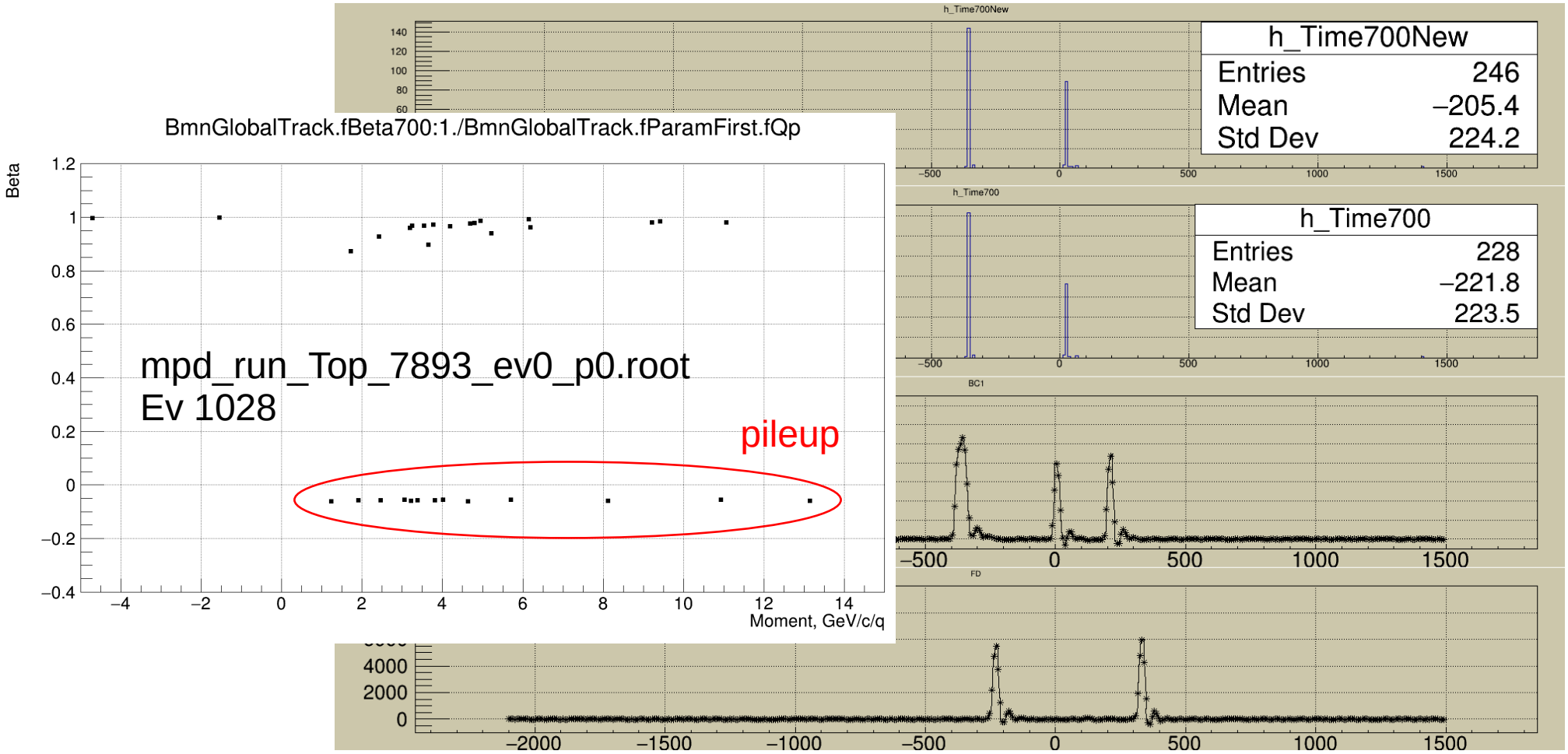
- A new advanced procedure for hits reconstruction is being prepared for the commit.
- There is an possibility to untangle pileup events using time information from trigger counters and TOFs(or mark pileup tracks/hits).

- All TOF400 new boxes are installed in the BM@N area (thanks to MEPhi group).
- The boxes are checked for gas leak.
- All service cables (HL, LV, SlowControl) are connected.
- The signal cables should be connect this week.
- TOF700 system does not have any changes compared to the previous run.



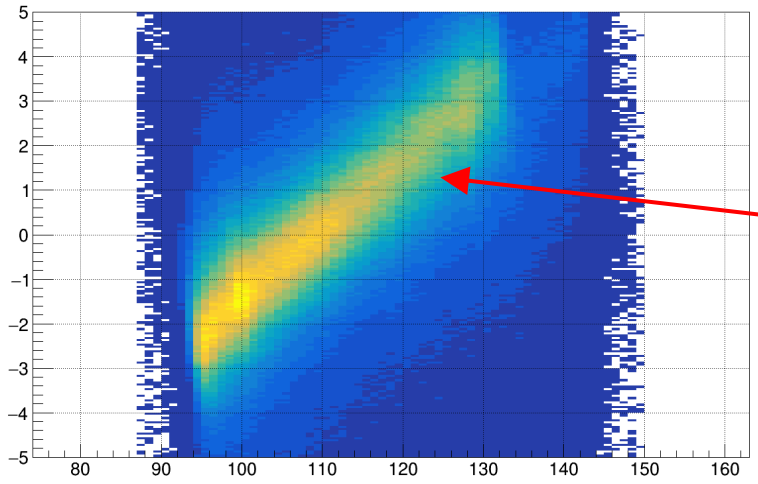
Backup

“New” HitProducer procedure

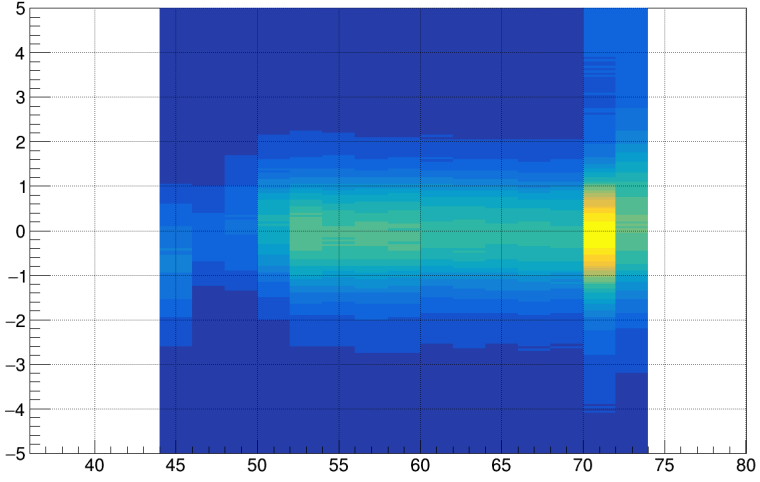


Matching problem along a strip (x coordinate)

dx_vs_x_Plane42

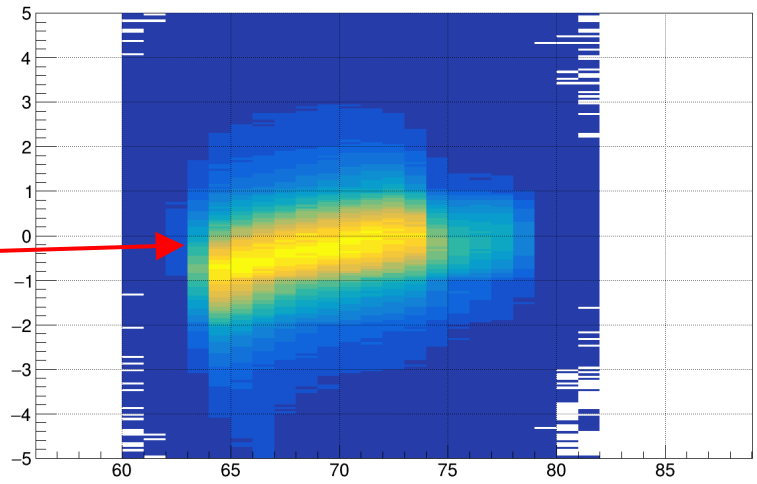


dy_vs_y_Plane42

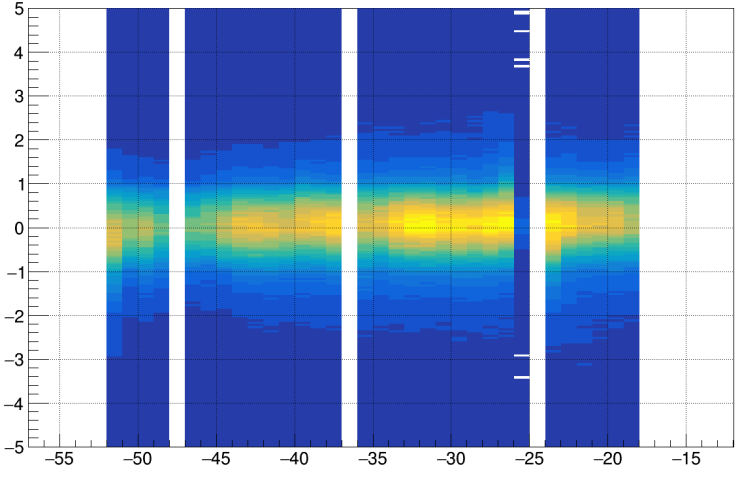


Slope is observed only for dx_vs_x distribution

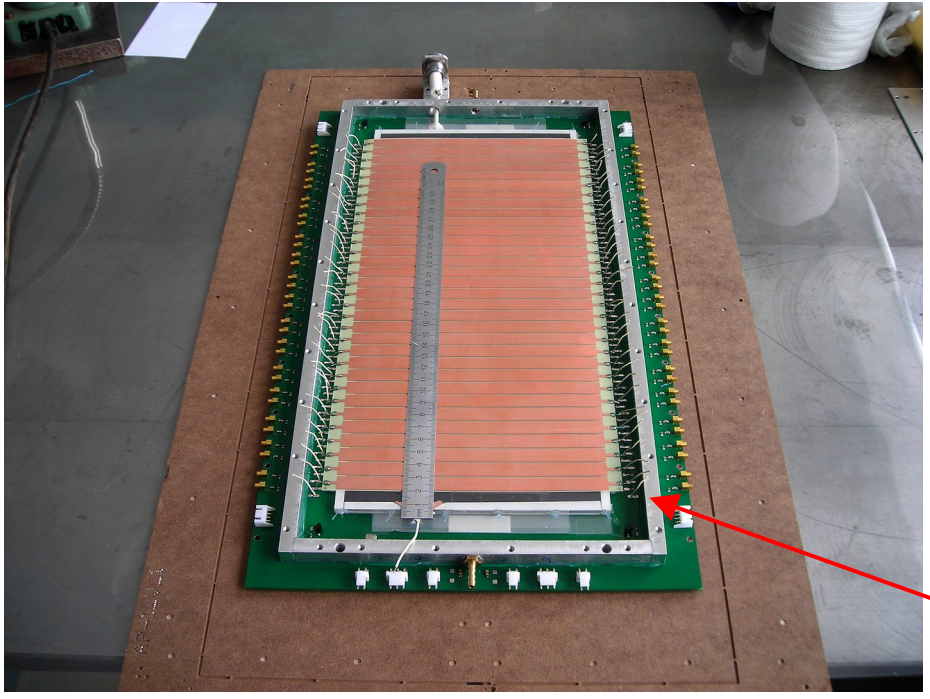
dx_vs_x_Plane32

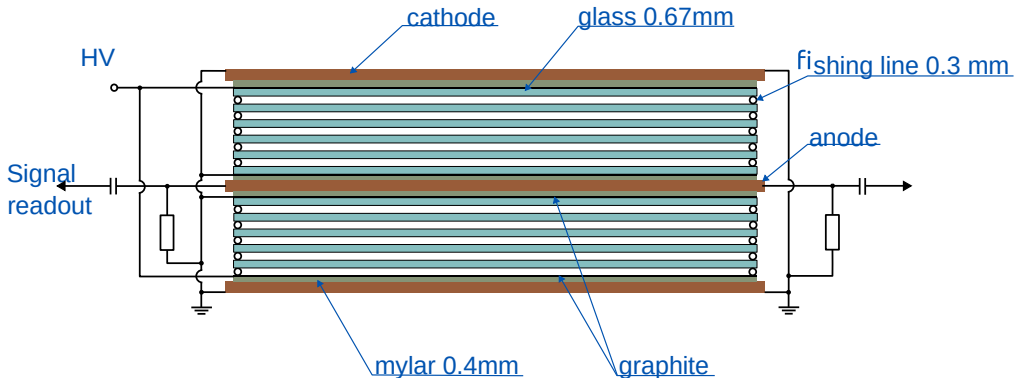


dy_vs_y_Plane32



Matching problem along a strip (x coordinate)

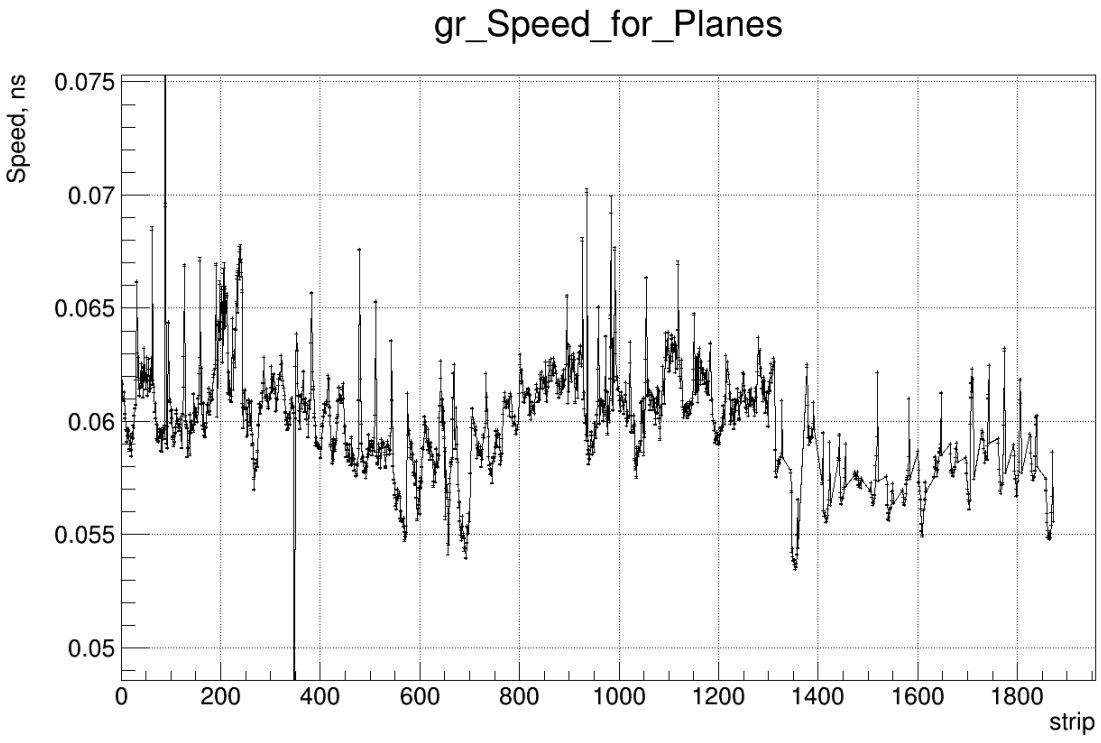


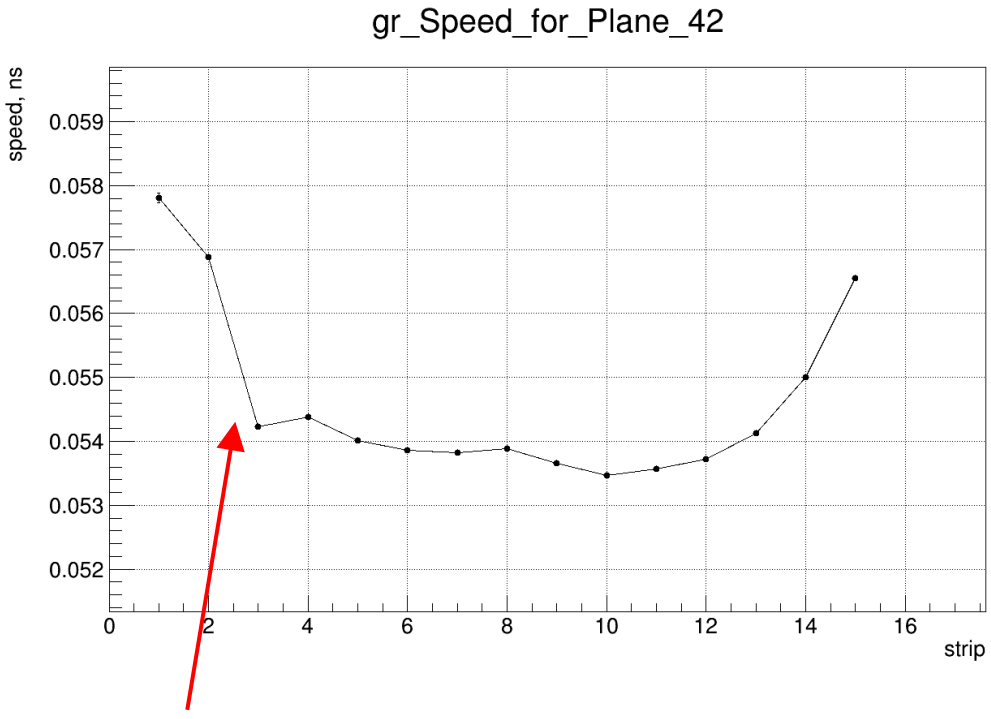


The robust frame prevent capacitance changes at the edges of the detector

For coordinate reconstruction the "speed of signal" constant is used. It depends on the dielectric environment and the capacitance between the strip and ground. Our assumption is that when voltage is applied, the capacitance between the ground and the strip in the center of the detector changes. So we need to **calculate the “speed of signal” for each strip**, instead of using a single constant.

Matching problem along a strip (x coordinate)

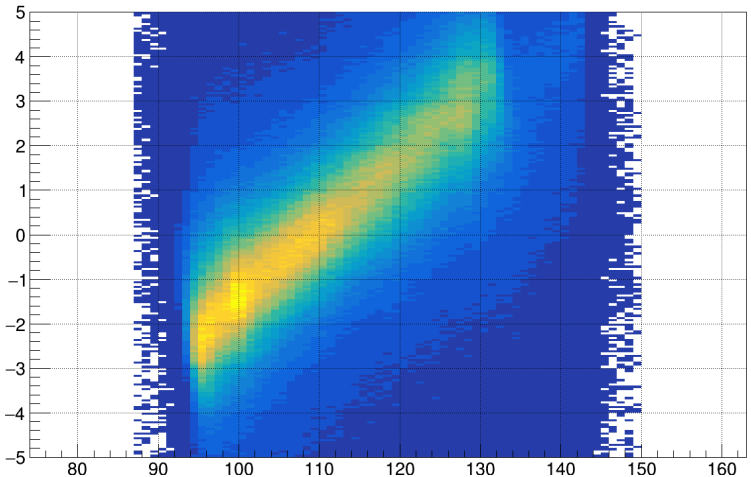




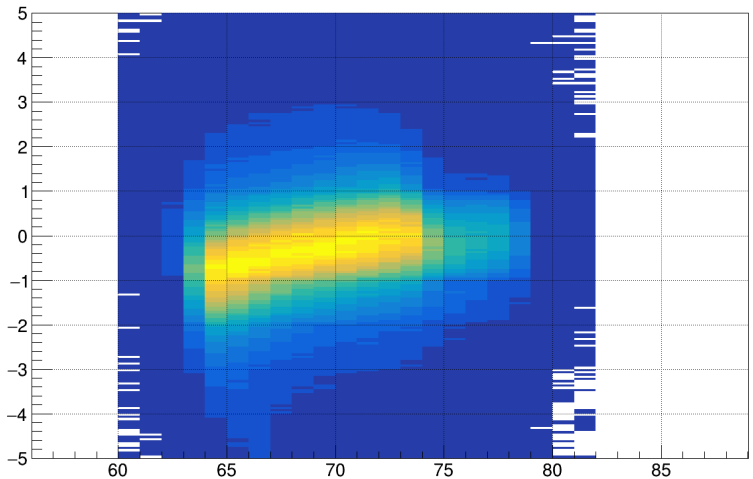
A speed difference of 4 ps/cm results in a coordinate error of about 4 cm on a 56 cm long strip. The shape of the curve confirms the assumption that the speed changes due to the change in capacity in central region of the detector.

Matching problem along a strip (x coordinate)

dx_vs_x_Plane42



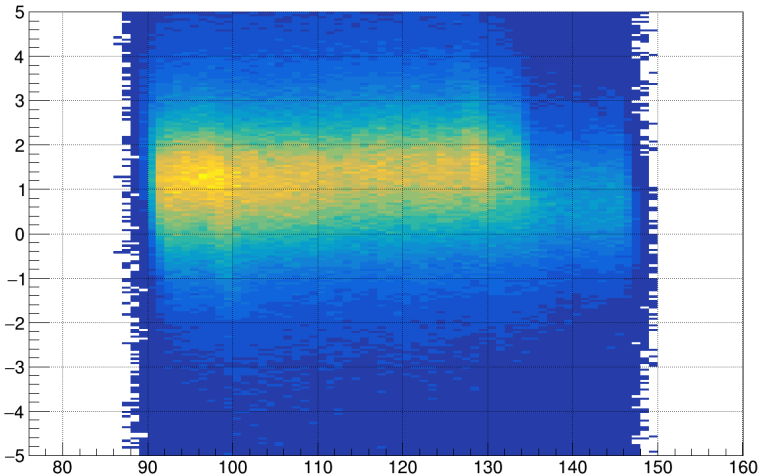
dx_vs_x_Plane32



before

After “speed of signal” correction the distribution looks better. But we need to align detectors again.

dx_vs_x_Plane42_16



after