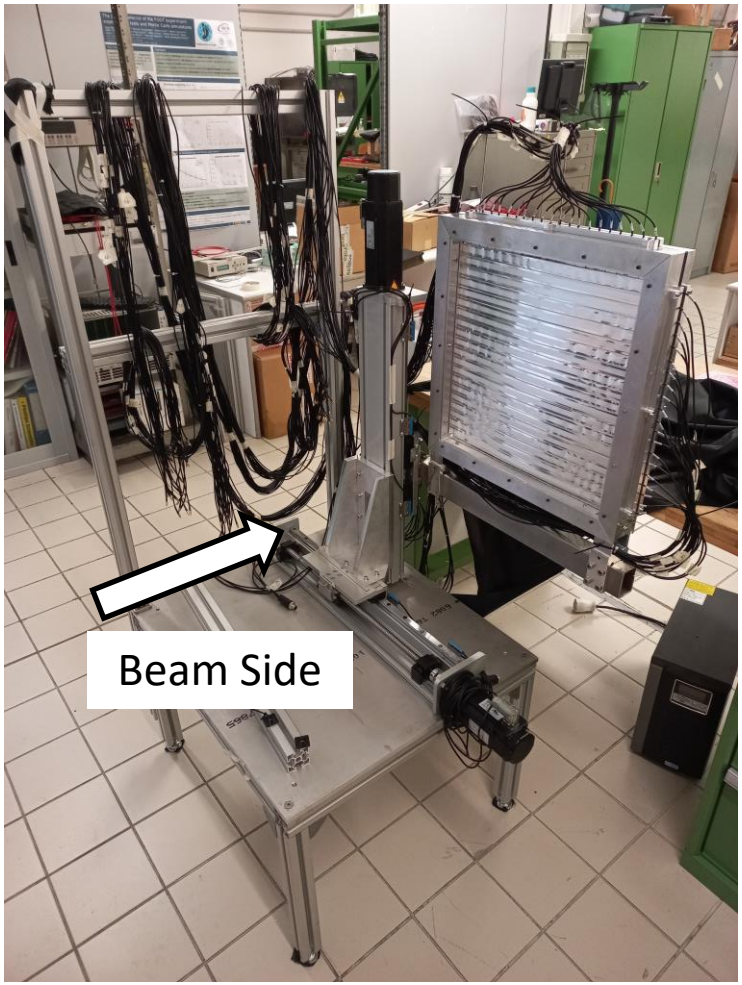
TOF wall status

X FOOT Collaboration Meeting

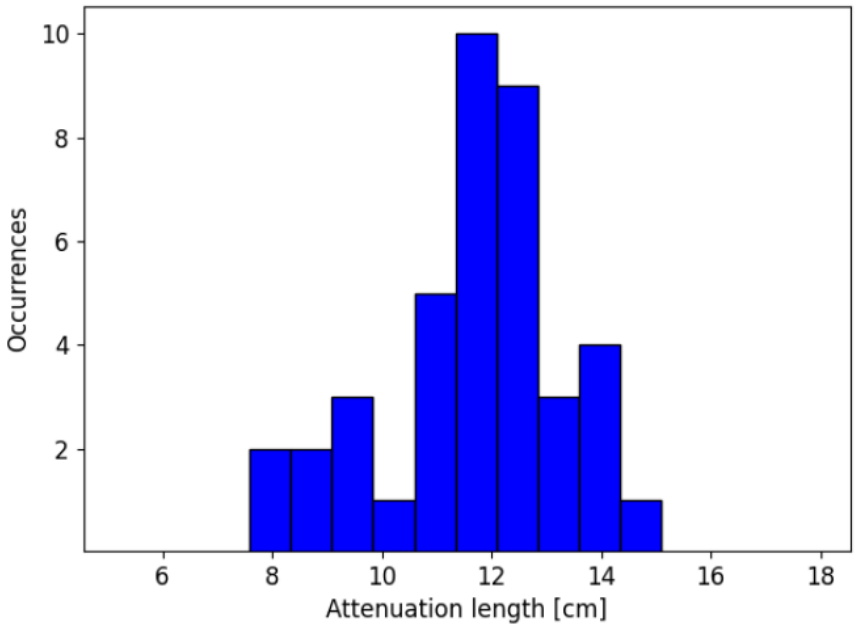
24-26 May 2021

Detector status



Tests with cosmic rays

- Attenuation length of the bars measured with cosmic rays highlights a disuniformity of the behavior of the bars in the detector
- This behavior in principle can be corrected, but the values measured with muons are not consistent with the values measured in the past with protons (a difference was already seen between protons and carbons)



	l (cm)			
	C 400 (MeV/u)	*C 260 (MeV/u)*	*C 115 (MeV/u)*	*p 60 (MeV/u)*
Left Front	17.9 ± 0.7	18.0 ± 0.6	19.2 ± 0.7	15.8 ± 0.6
Right Front	22.6 ± 0.8	23.2 ± 0.7	23.6 ± 0.8	20.0 ± 0.8
Top Rear	16.5 ± 0.6	17.9 ± 0.7	17.1 ± 0.6	14.2 ± 0.6
Bottom Rear	17.0 ± 0.6	18.2 ± 0.7	17.7 ± 0.7	14.7 ± 0.6

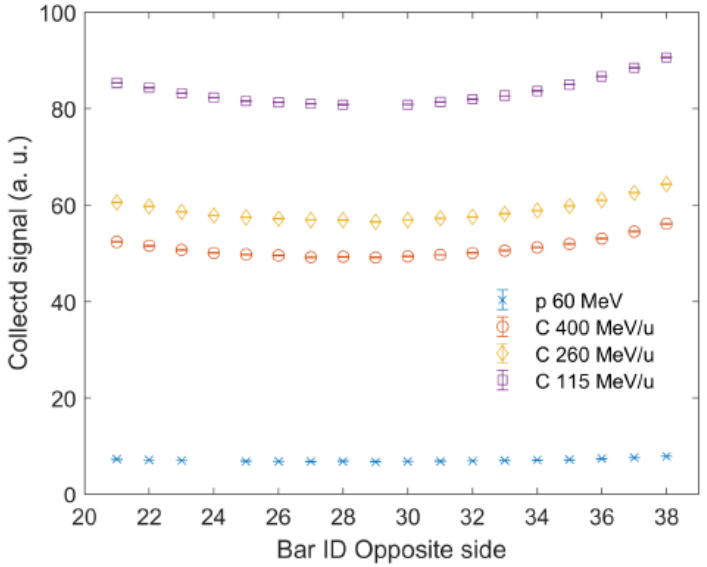
A good statistics in all the intersections can be obtained in few hours

A cosmic acquisition can be used once arrived at GSI to test detector integrity and to generate signals for preliminary DAQ tests.

Purpose for GSI calibration: Motivations

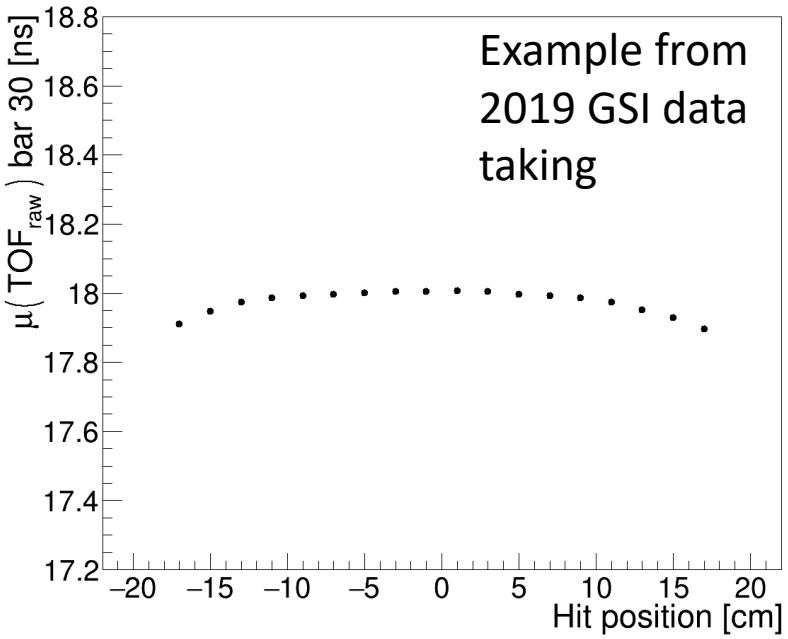
- It has been observed, both in the past with ions than in the present TW version with cosmic rays, that the **attenuation length** of the bars is not uniform.
  - Attenuation coefficients found with muons are not the same as the ones found with ions, so, at the moment, we are not sure that the calibration performed with cosmic rays can be used for GSI data

Attenuation can not be analitically corrected
(i. e. $\sqrt{Q_1 * Q_2}$)



Purpose for GSI calibration: Motivations (2)

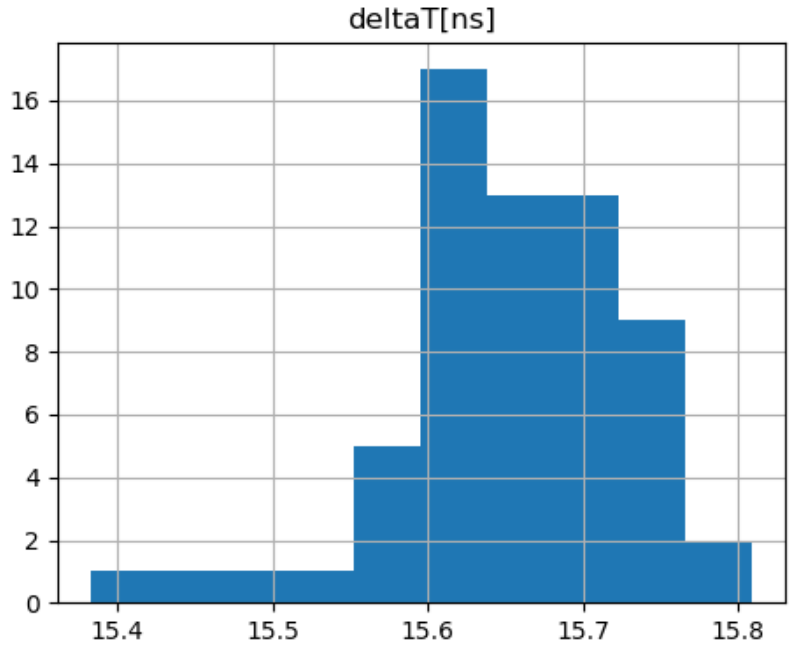
- In the past GSI data taking, it has been observed that the dependence on the position affects also the **time accuracy**:
  - different TW bars gave a time skew as large as 300 ps.
  - Also different positions in the same bar have different skews that are not negligible.



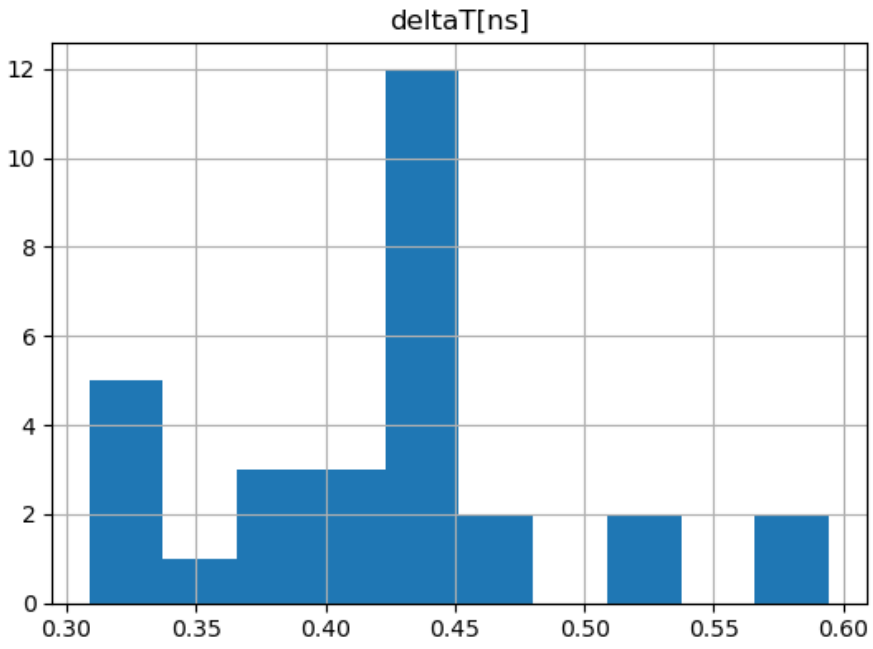
Purpose for GSI calibration: Motivations (2)

Example of time skew calibration obtained at CNAO and GSI in 2019 for one layer of the TOF Wall

CNAO (C 400 MeV/u)



GSI (O 400 MeV/u)



Purpose for GSI calibration: Motivations (2)

- Different approaches can be used to correct these effects
  - Detector scan
  - Fragment identification on each intersection

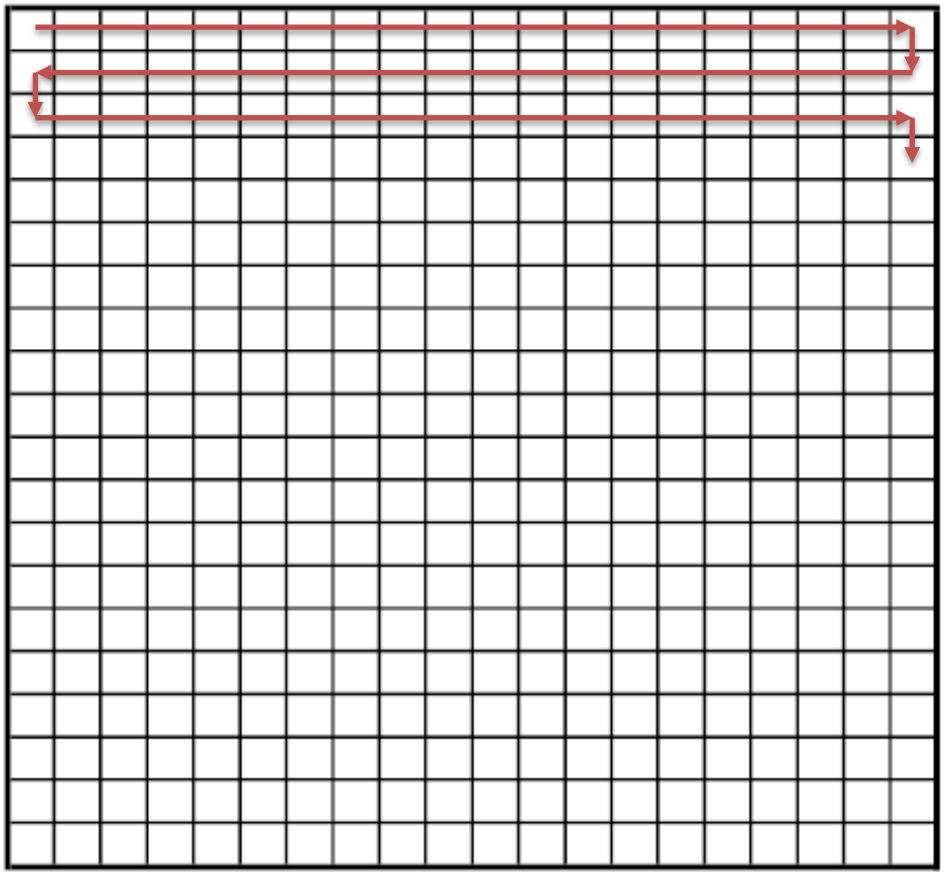
- The method based on the identification of the fragment on each intersection is very efficient since it does not require any kind of calibration, but a high enough statistics in each intersection is required to identify the ions peaks in the spectrum.

This may not be the case for the bars in the periphery of the detector, where only few events are collected.

Purpose for GSI calibration: Preliminary consideration

- Calibration can be performed with all the other detectors in place
- No actions are needed in the room to start the calibration and to go back to the standard position once the calibration is completed.
  - Calibration can be also performed with the target in place
- Calibration can be postponed after the physics data taking (before switching energy), so to be sure to already have enough statistics.
  - This may have also some drawbacks, since TW calibration time at the begin of the shift can be used by other detectors for fine tuning before data taking.

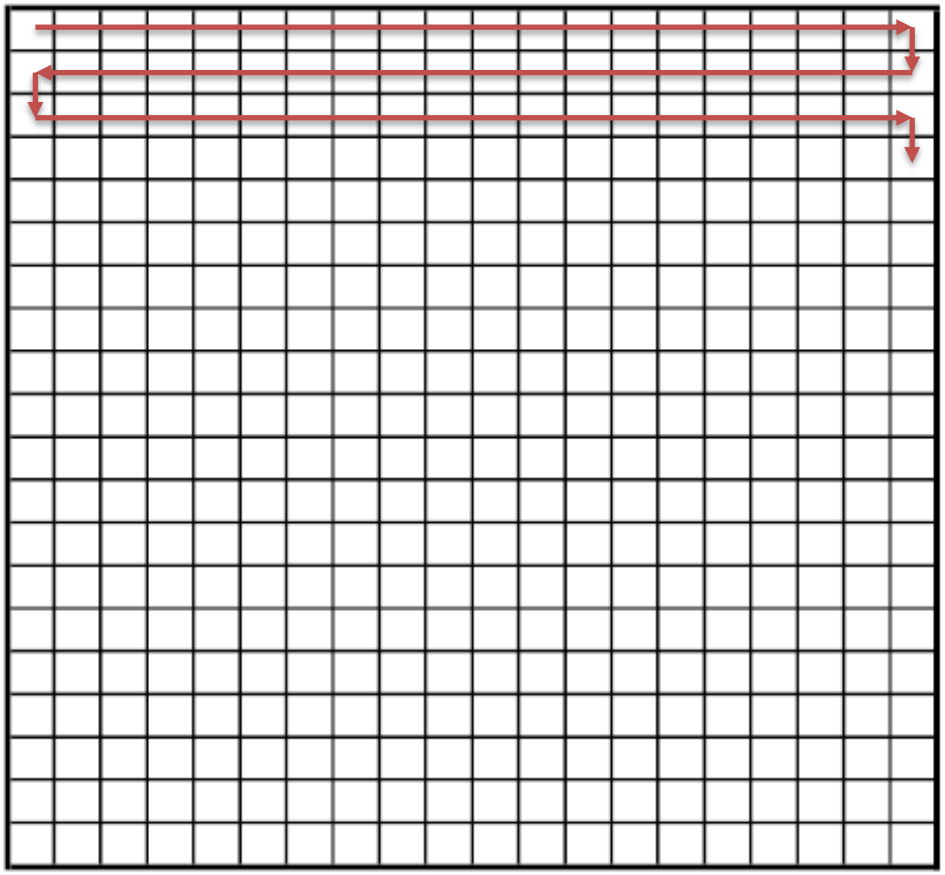
Purpose for GSI calibration: Scenario 1



Continuous motion

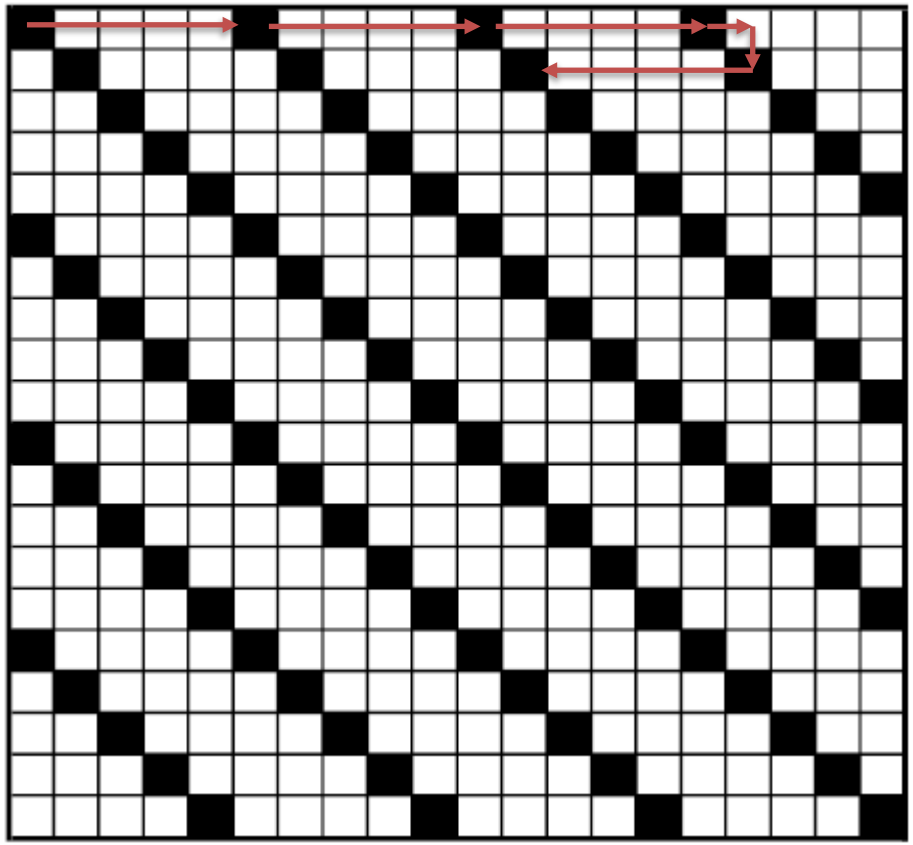
- No interruptions during the calibration
- Beam position can be reconstructed easily by checking intersection
- Speed can be adjusted according to the time we want to dedicate to each intersection, es:
  - 2 s X intersection: 13,3 min
  - 3 s X intersection: 20,0 min
  - 4 s X intersection: 26,7 min

Purpose for GSI calibration: Scenario 1



- Some intersections will be not irradiated, since there will be spill pauses, but a complete and uniform irradiation is not necessary for calibration.
- Even if this seems the most effective method, there is still a very unlike chance that some bars will be irradiated only in a very few set of points (depending on the detector speed and on the inter-spill time).

Purpose for GSI calibration: Scenario 2

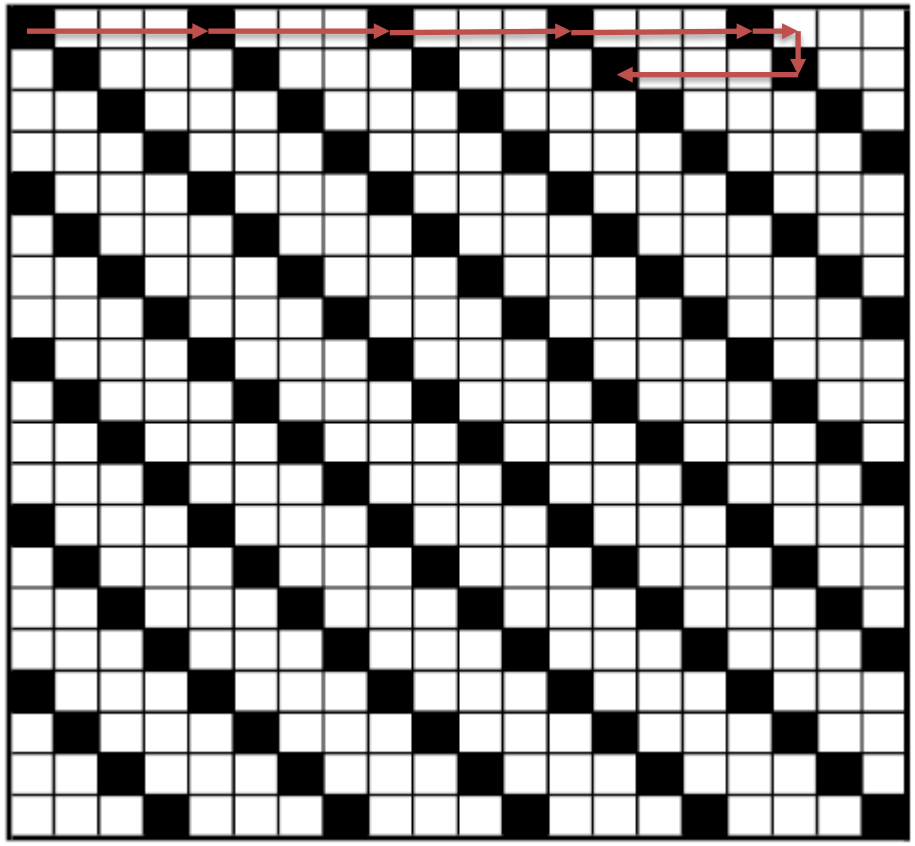


4 points for each bar

- No interruption in the acquisition during calibration
- Detector stays still in each black position for a fixed time before moving to the next one.

total points:	**80**	
total path:	**840**	**(over-estimated)**
events on each point:	**1000**	**(minimum value)**
time for each point (s):	**10**	
time for each movement:	**3**	**(estimated, could be less)**
total time (min):	**17.3**	

Purpose for GSI calibration: Scenario 3



5 points for each bar

- Same as before, 100 points inspected instead of 80.
- Time for each point can be reduced, as long as we are sure to acquire at least one spill on each black square.

total points:	**100**	
total path:	**840**	**(over-estimated)**
events on each point:	**1000**	**(minimum value)**
time for each point (s):	**10**	
time for each movement:	**3**	**(estimated, could be less)**
total time (min):	**21.7**	

Purpose for GSI calibration: Conclusions

- An effective and fast calibration can be performed to ensure the capability to correct for time skews and optical attenuation.
- The time required for the calibration spans form 15 to 30 minutes, according on the strategy we choose (1% to 2% of total beam time).
- Postpone the calibration after the physics data taking will minimize the risk for the data acquisition campaign.