Status report of the Start Counter

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FOOT general meeting
11 June 2020

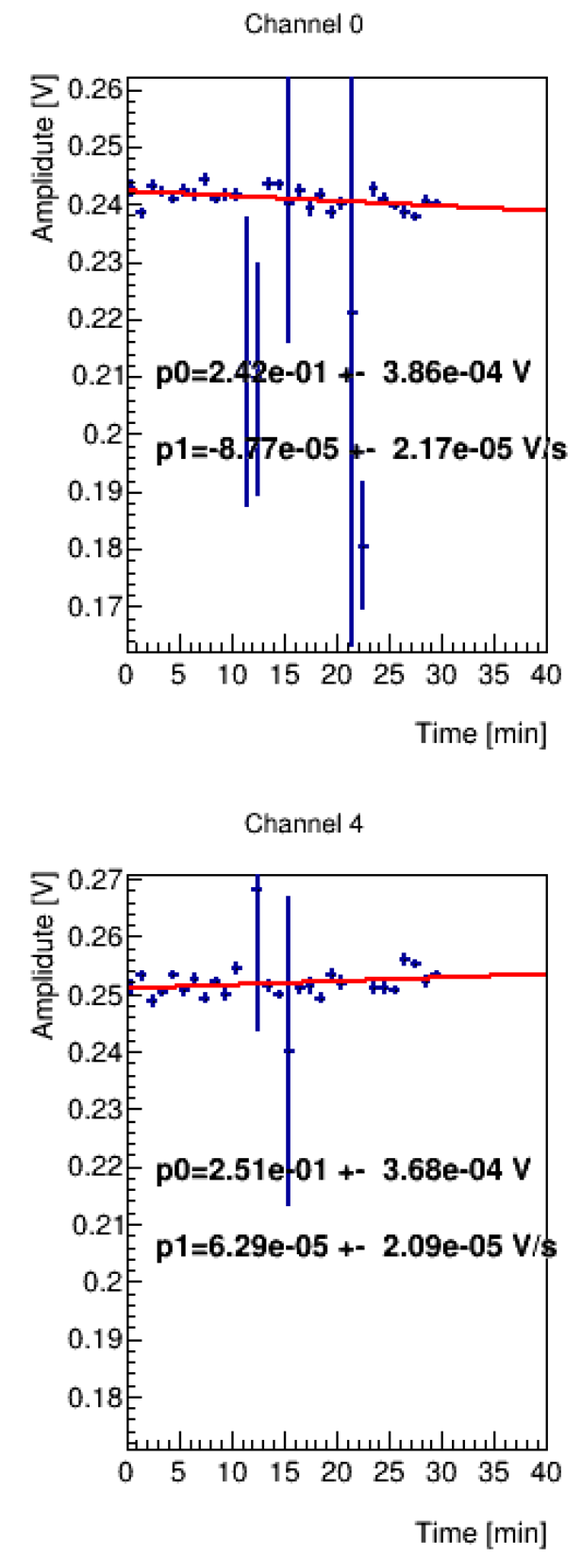
Summary

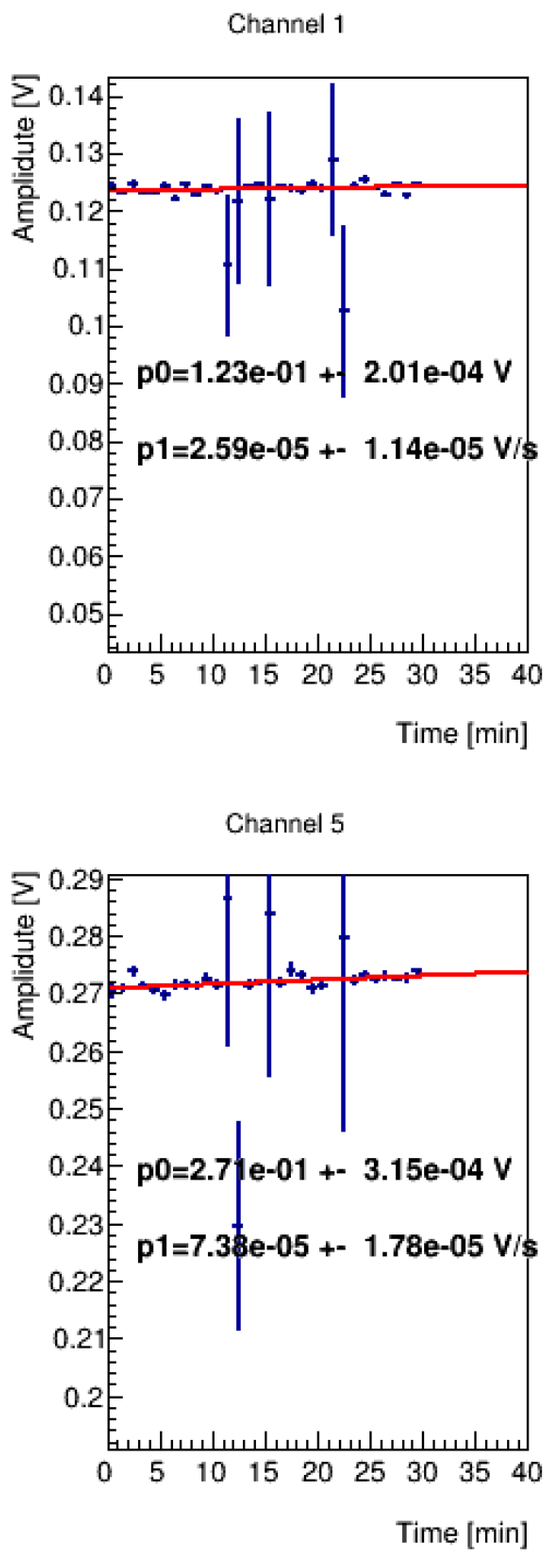
- ST signal stability

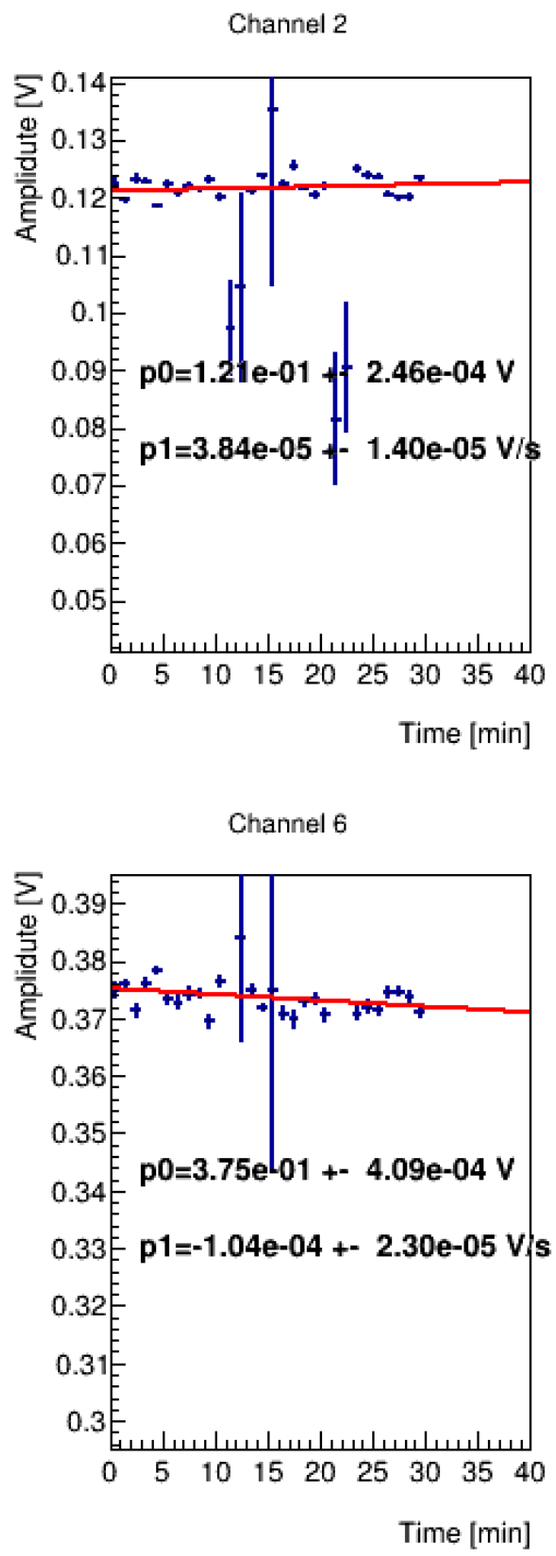
- Performance at GSI

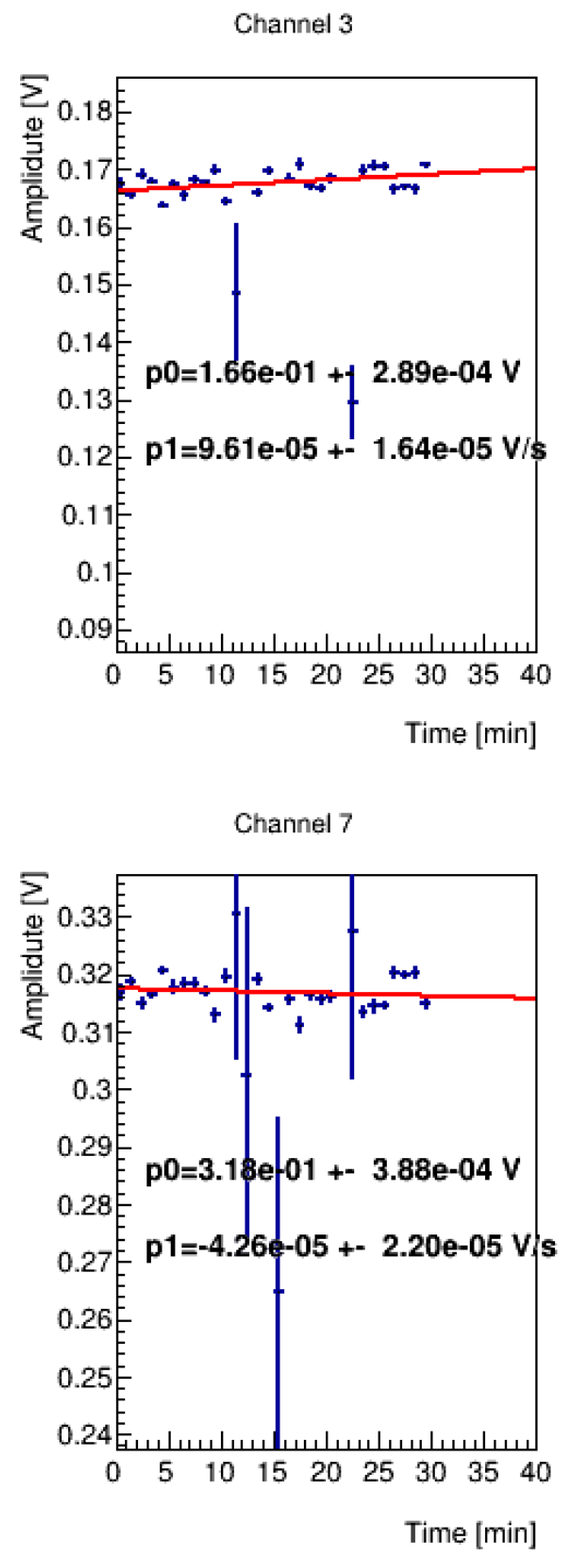
- Test beam @GSI2020

ST stability @ CNAO (^{12}C 400 MeV/u)

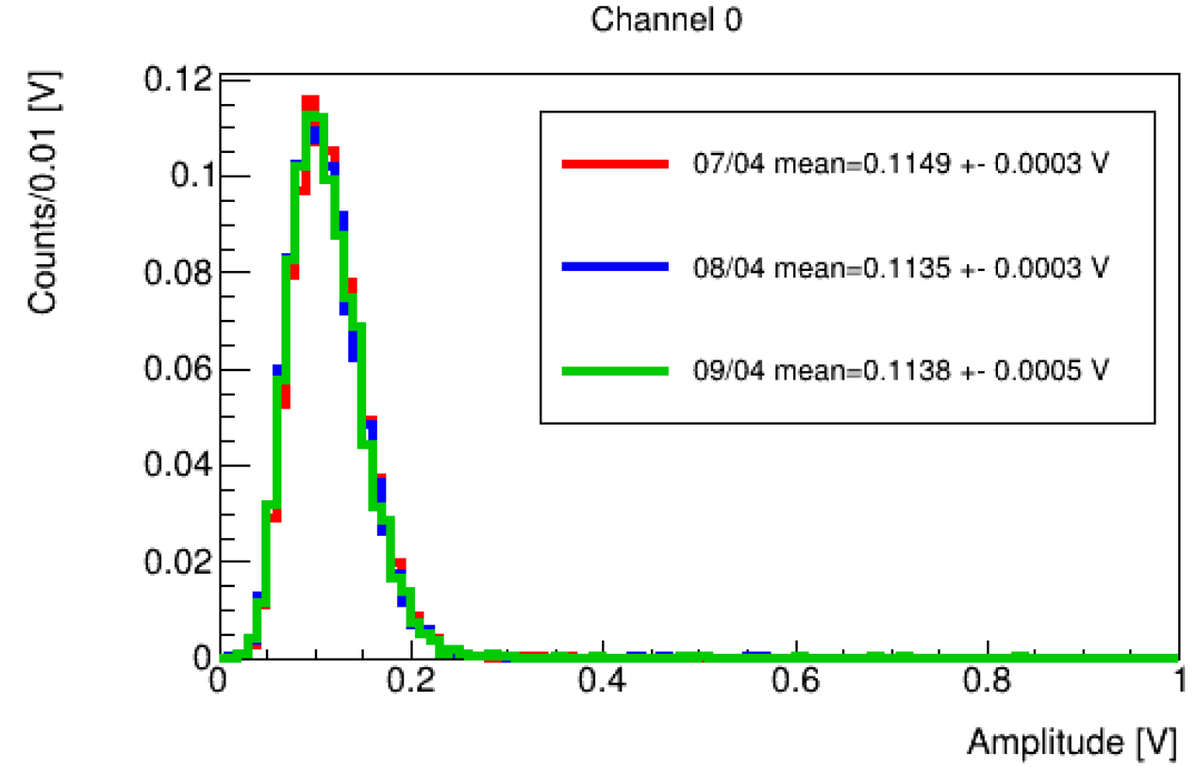


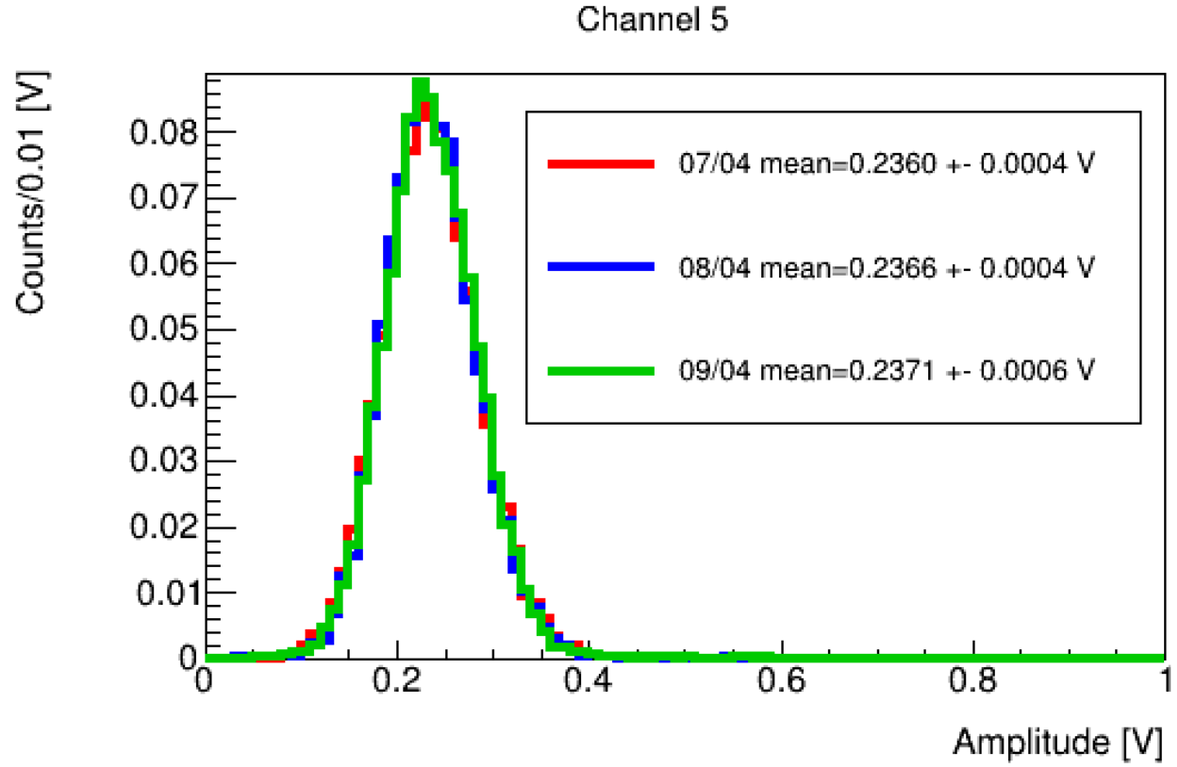


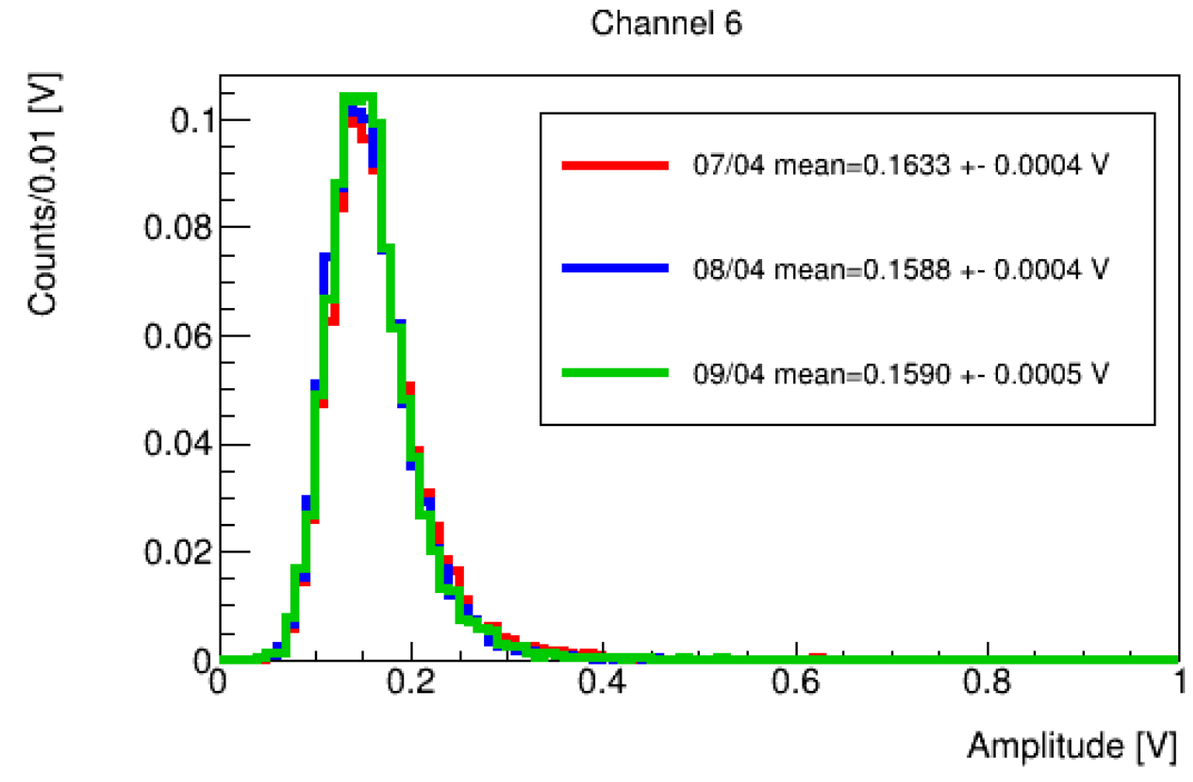


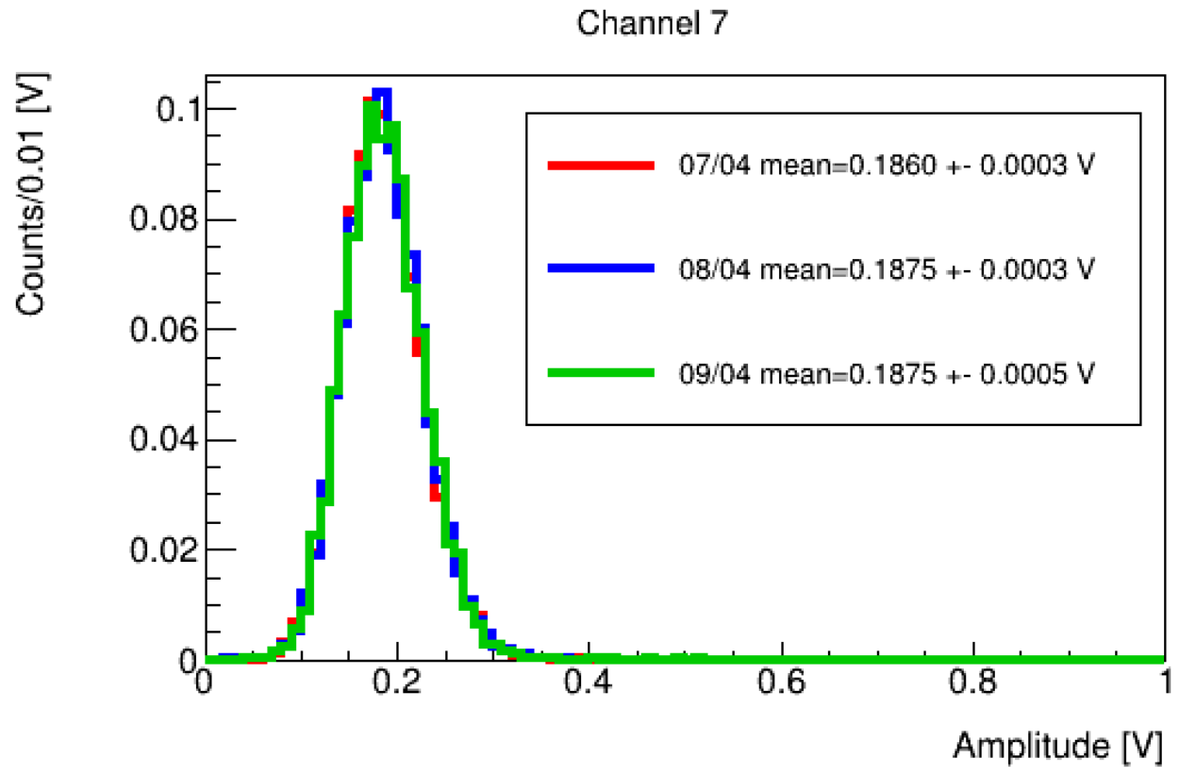


ST stability @ GSI2019 (^{16}O 400 MeV/u)









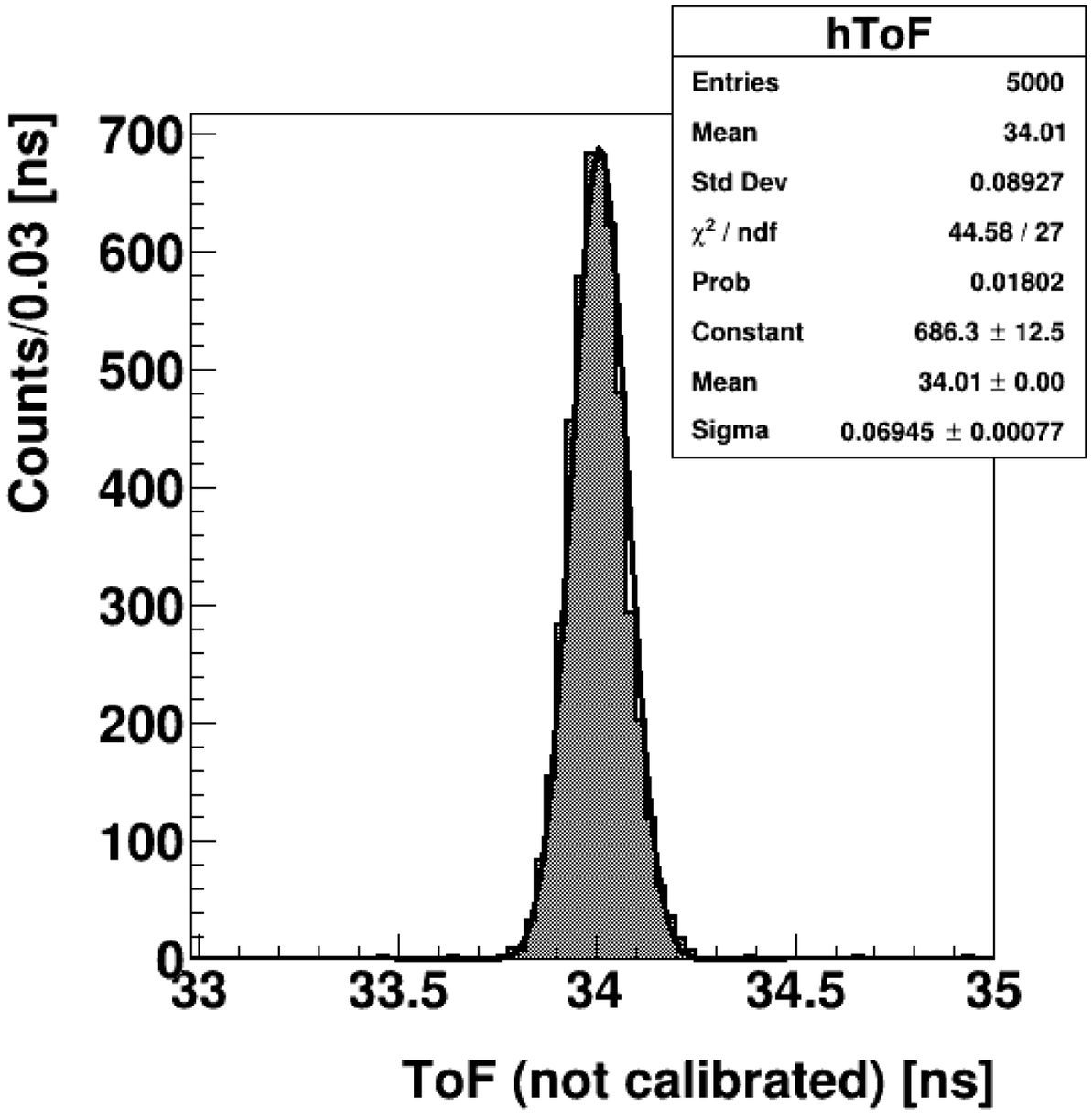
Some considerations

- From the available data, it seems that “small” environmental changes (i.e. temperature) **do not have a strong impact on the signal response**. However, this have to be checked with dedicated measurements
- Moreover, even assuming a small difference in the response, I do not expect a significative impact of the arrival time, as it is computed with a **CF algorithm**.

Time resolution @ GSI2019

run 2210(11,12)

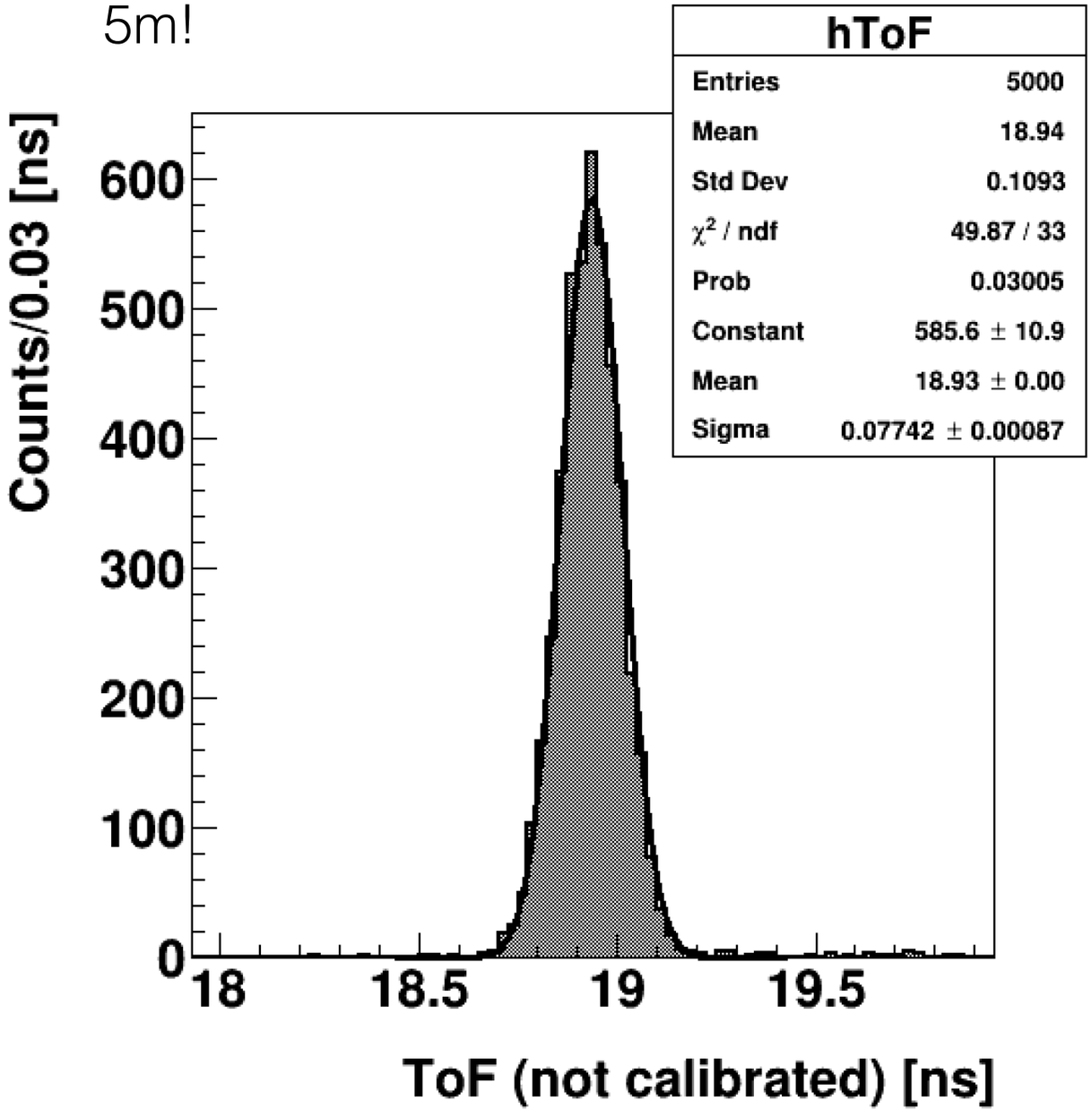
σ~70ps



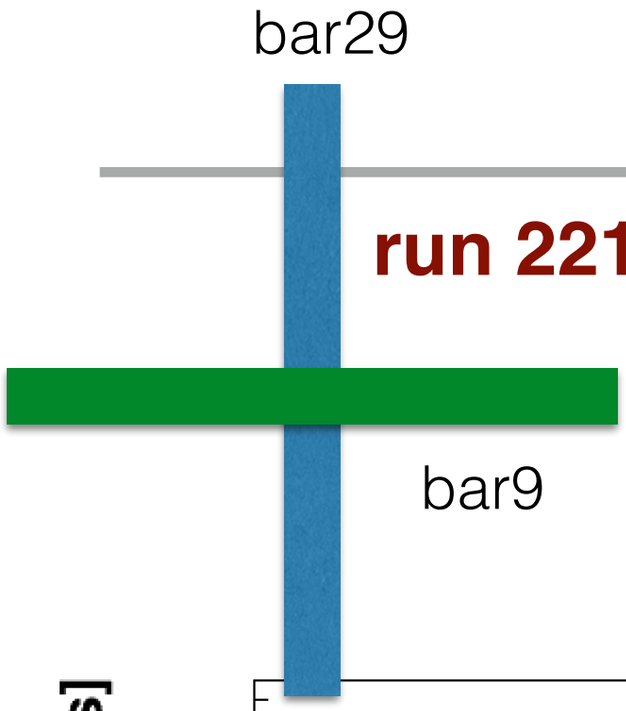
run 2239(40,41,42)

σ~78ps

- Cables from 2m to 5m!



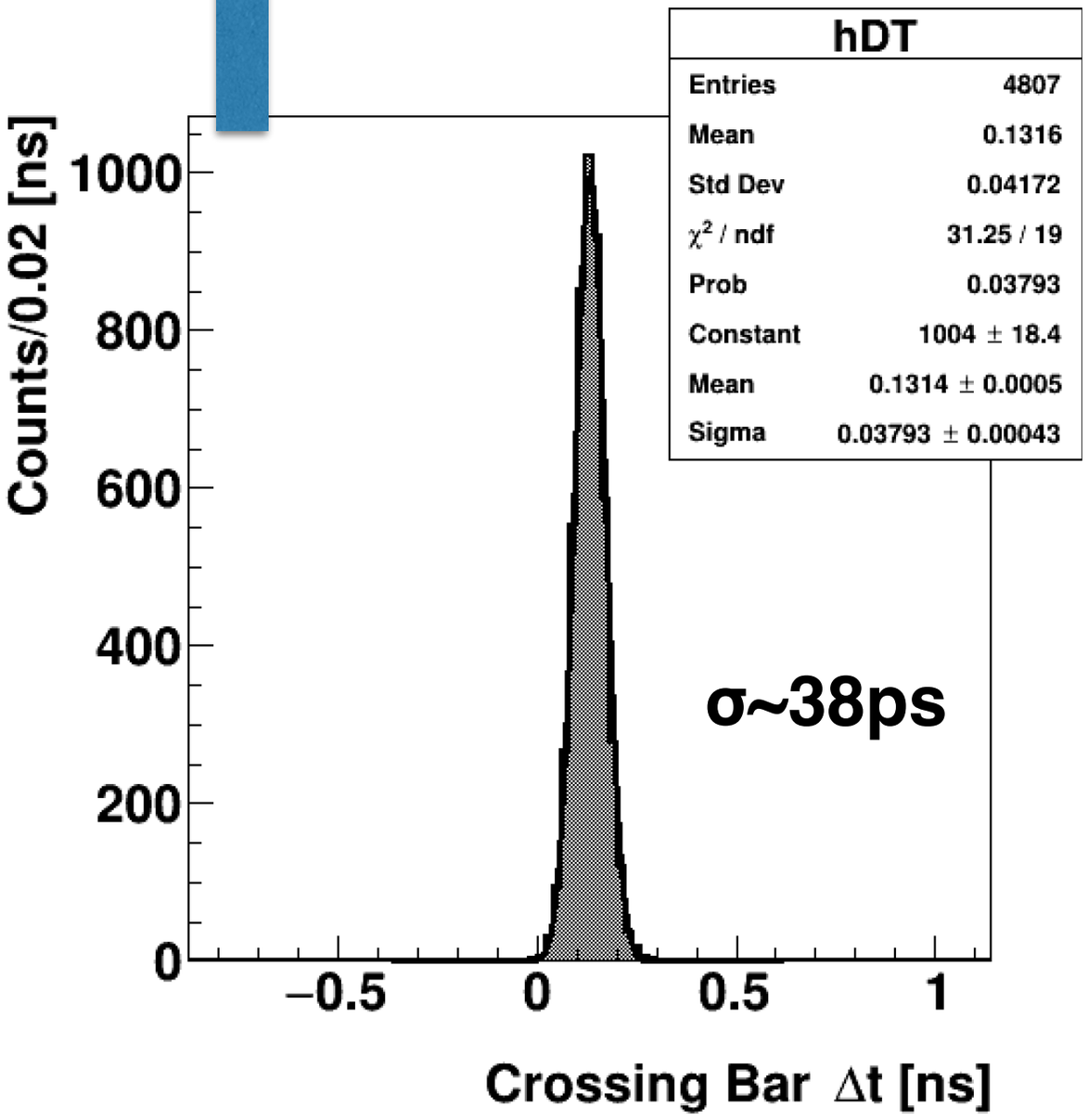
Check on the TW

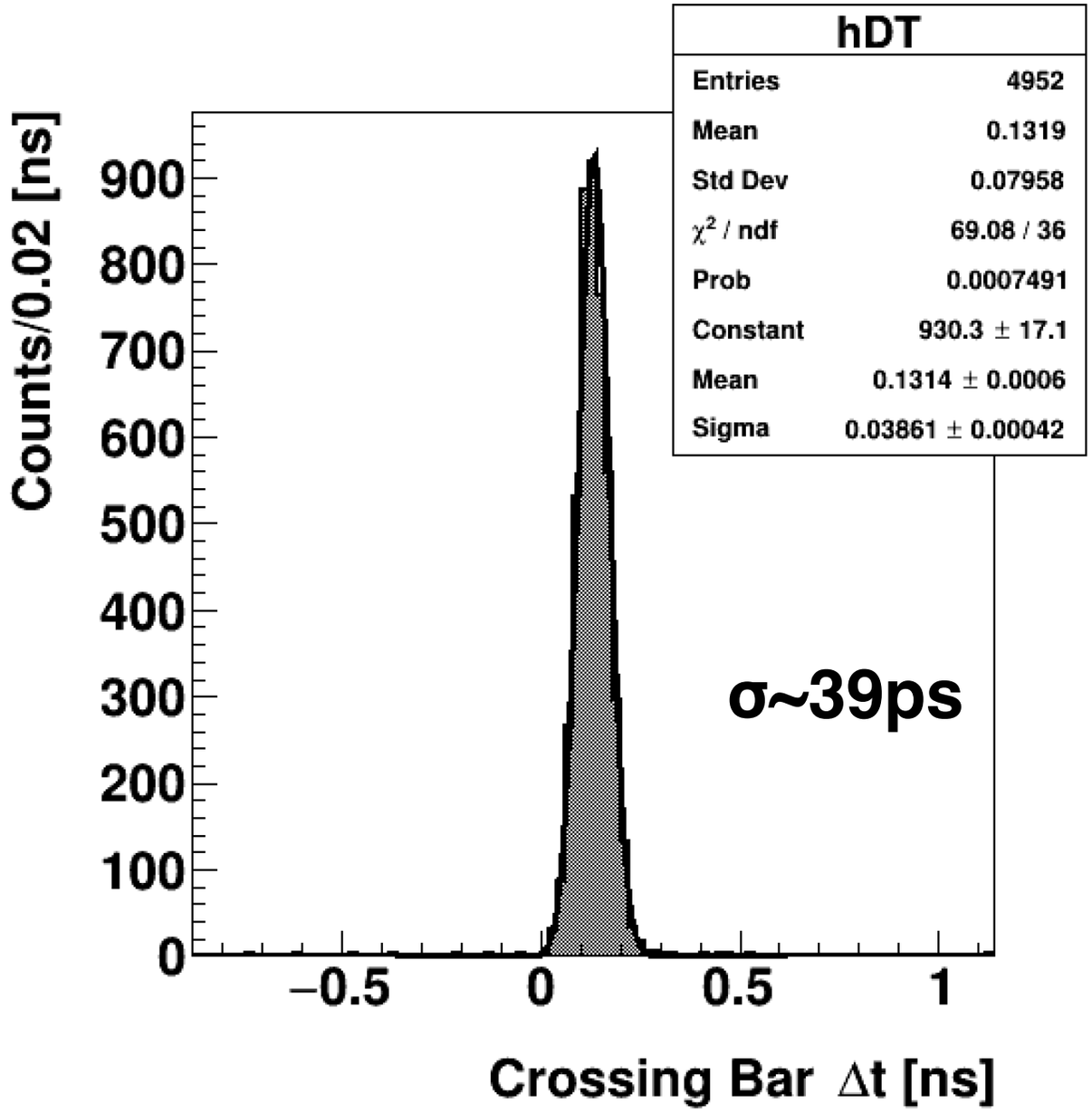


run 2210(11,12)

run 2239(40,41,42)

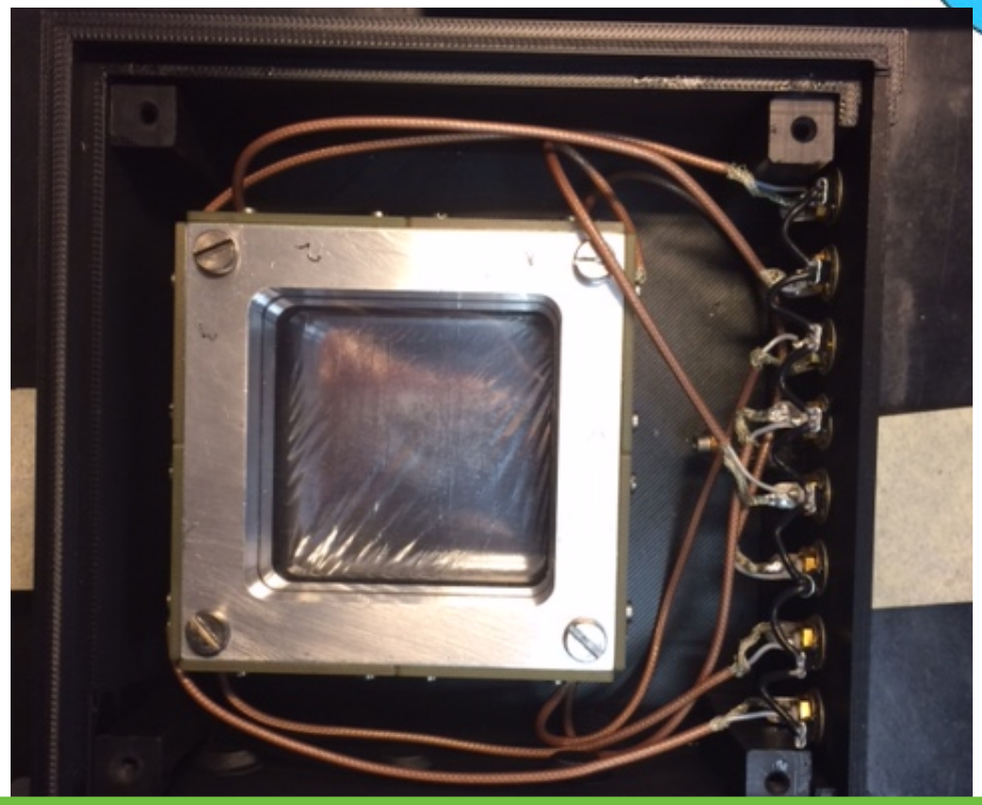
- It seems that the resolution difference is due to the ST



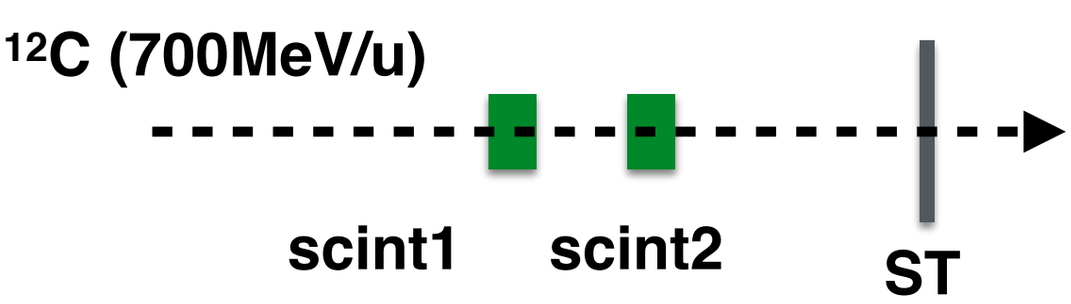


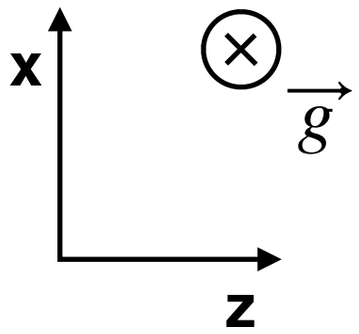
Update of the hardware

- Before the GSI2020 data-taking:
  - **Scintillator layer replacement.** We realised that the scintillator was cracked in the center… a new study of the response was needed
  - **The ground of the single channels have been shorten (detector side)** to reduce the impact of noise picked-up within GSI environment.

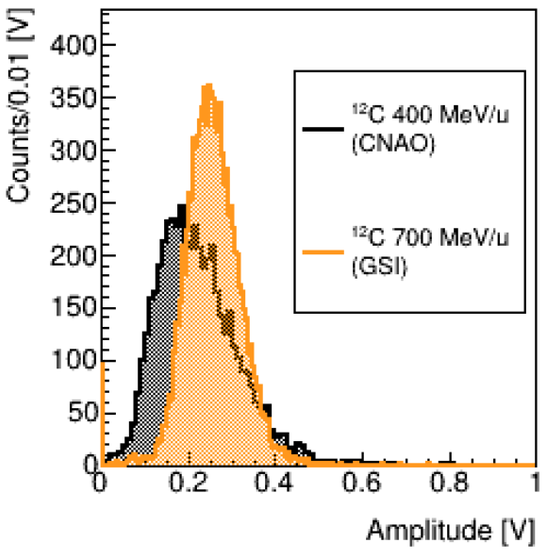


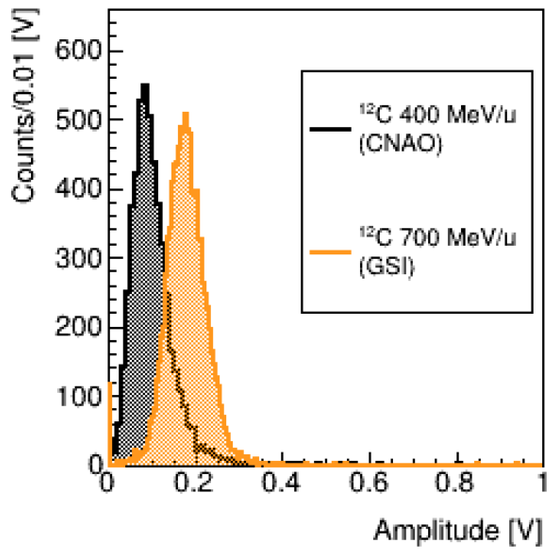
Setup

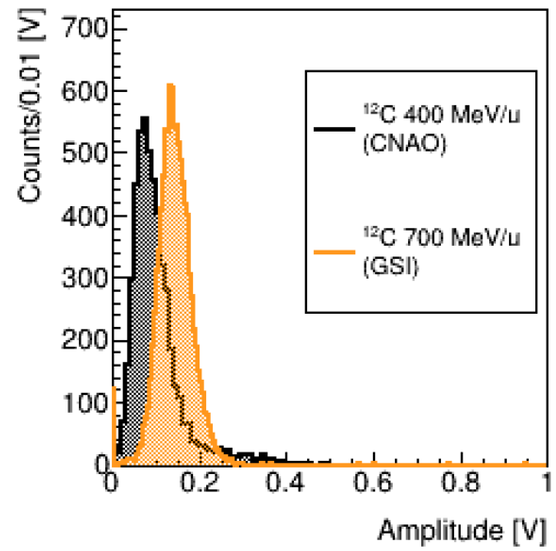


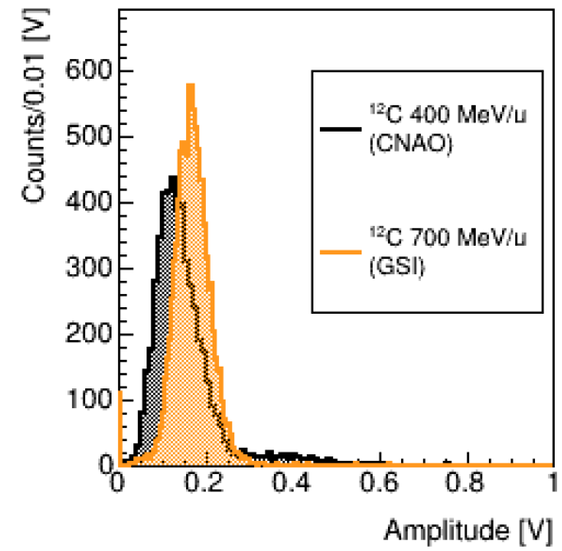


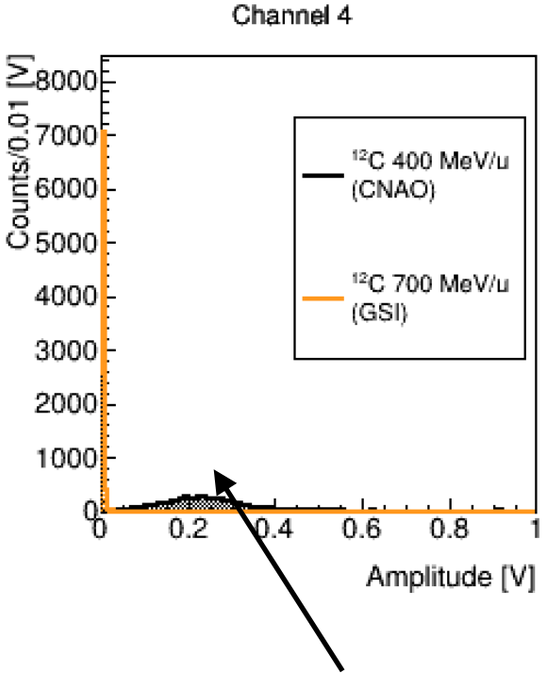
ST signal amplitudes

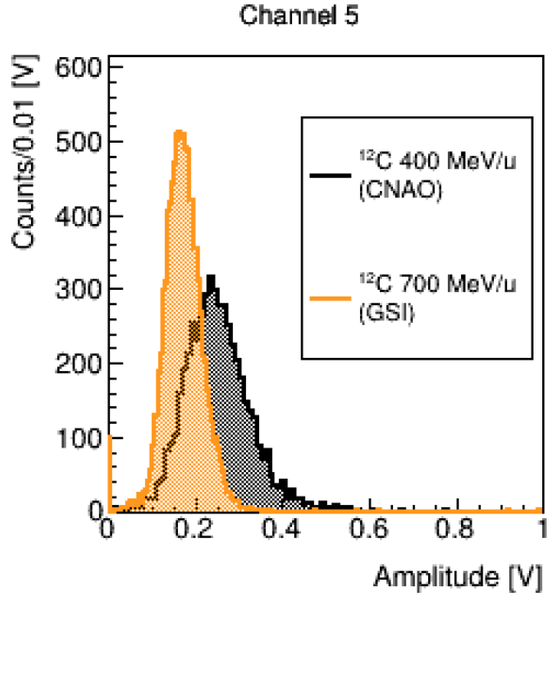


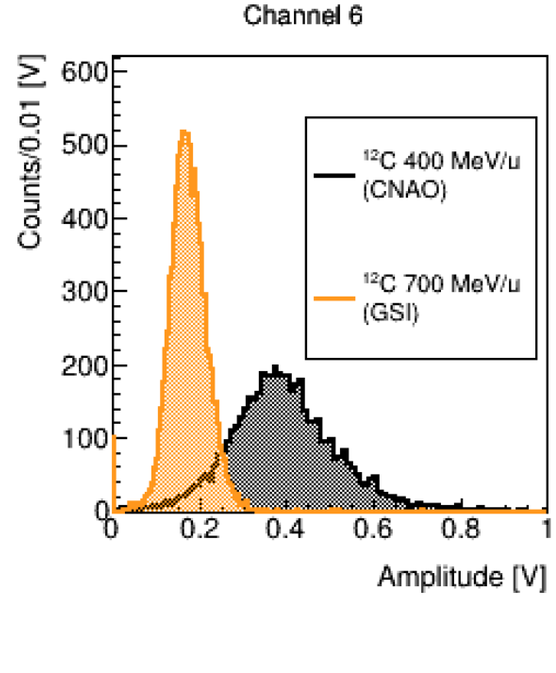


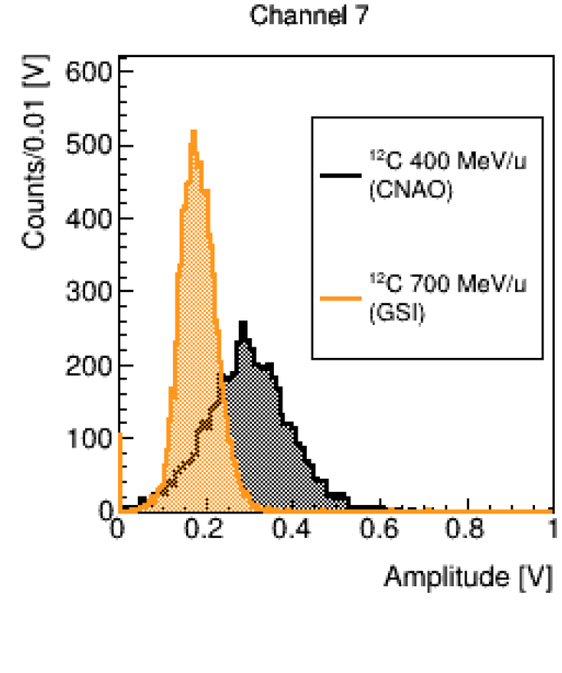






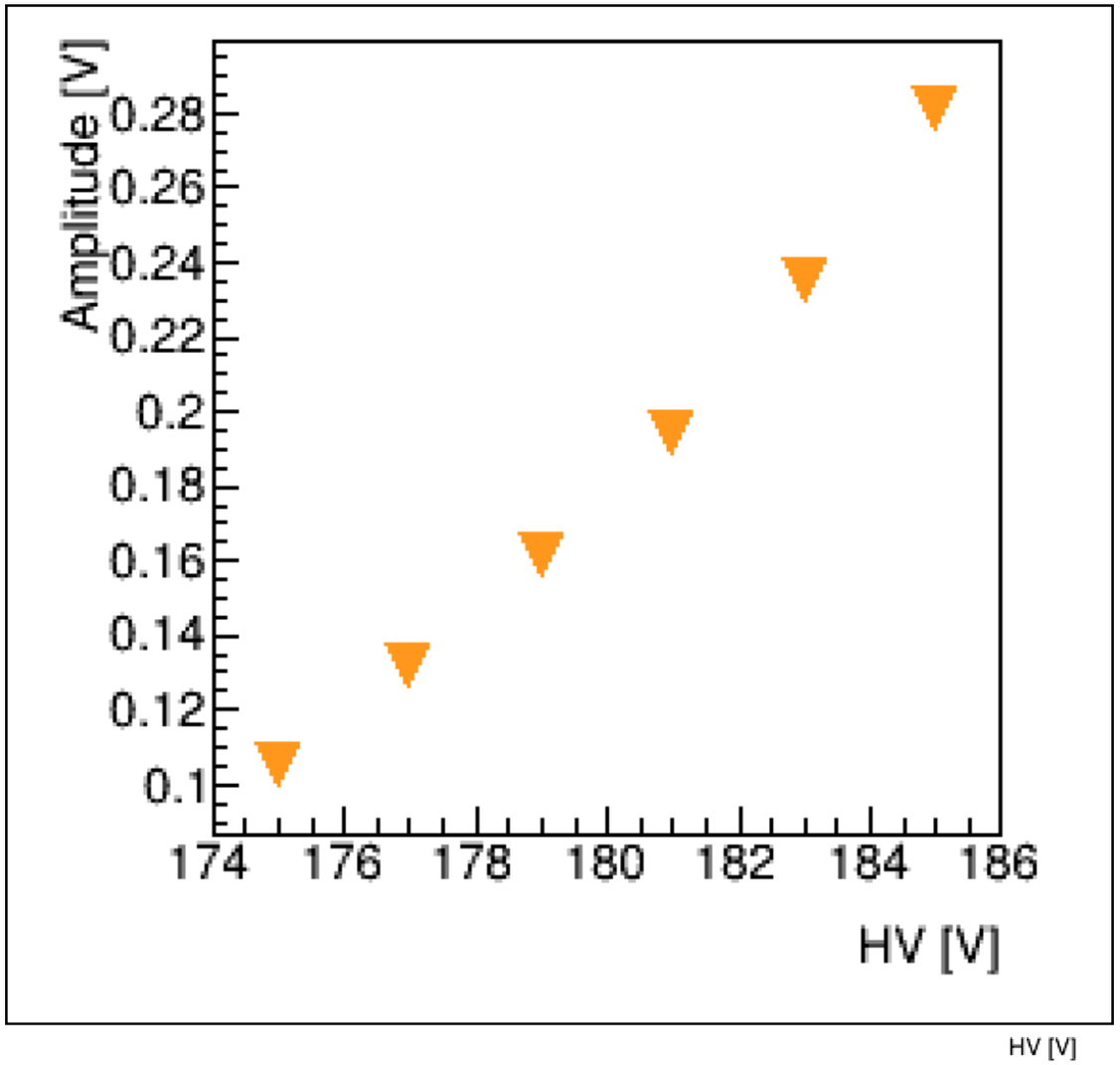




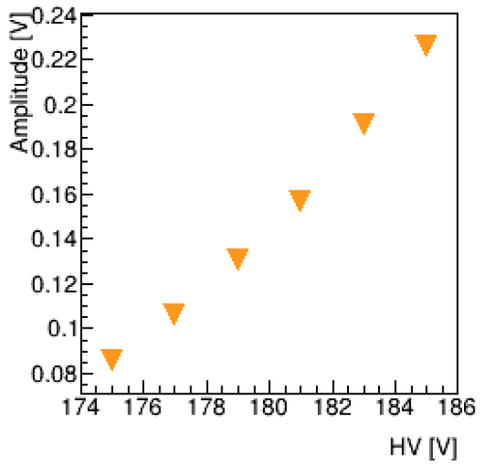


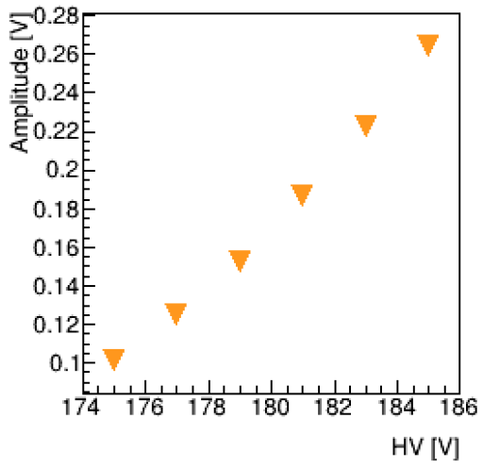
Broken channel: from preliminary tests it seems a **single SiPM fault**

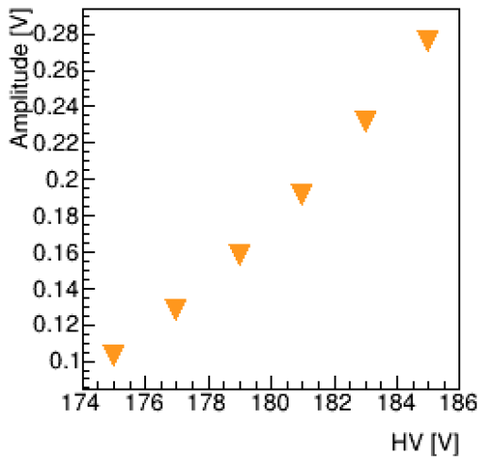
Channel gain equalization

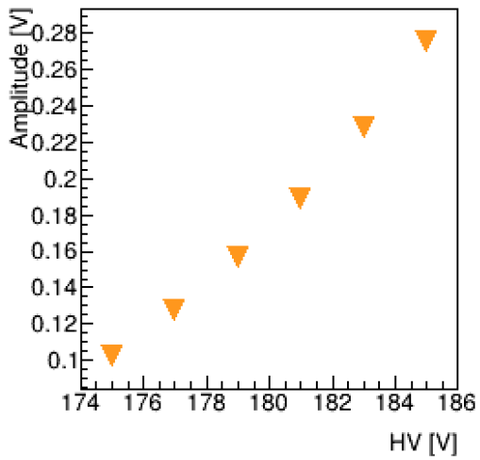


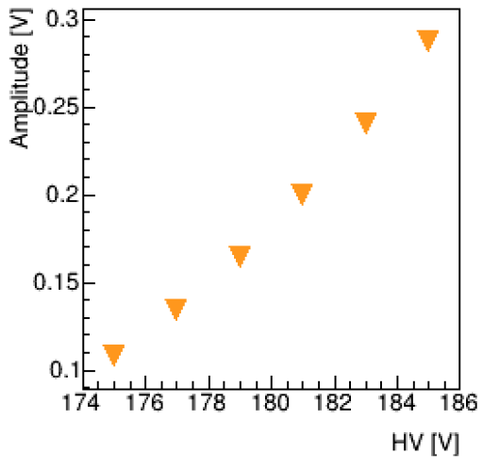
- The different response of channels can be equalised properly tuning the HV
- The gain in the BD region of the SiPMs vary of a factor ~2-3





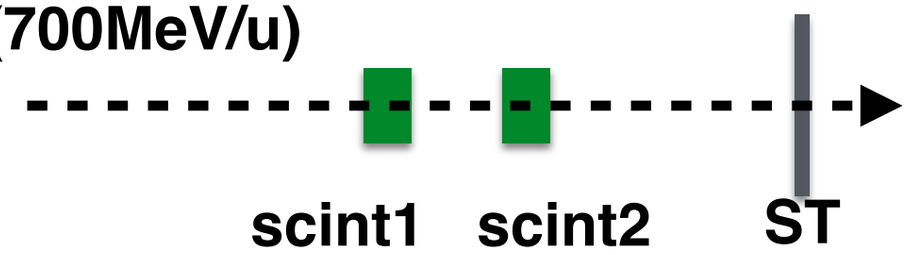


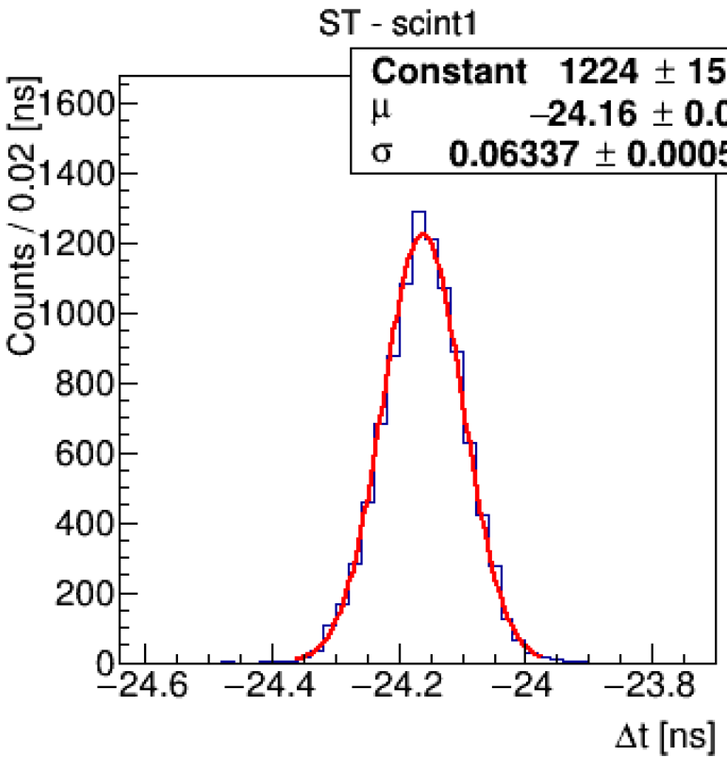


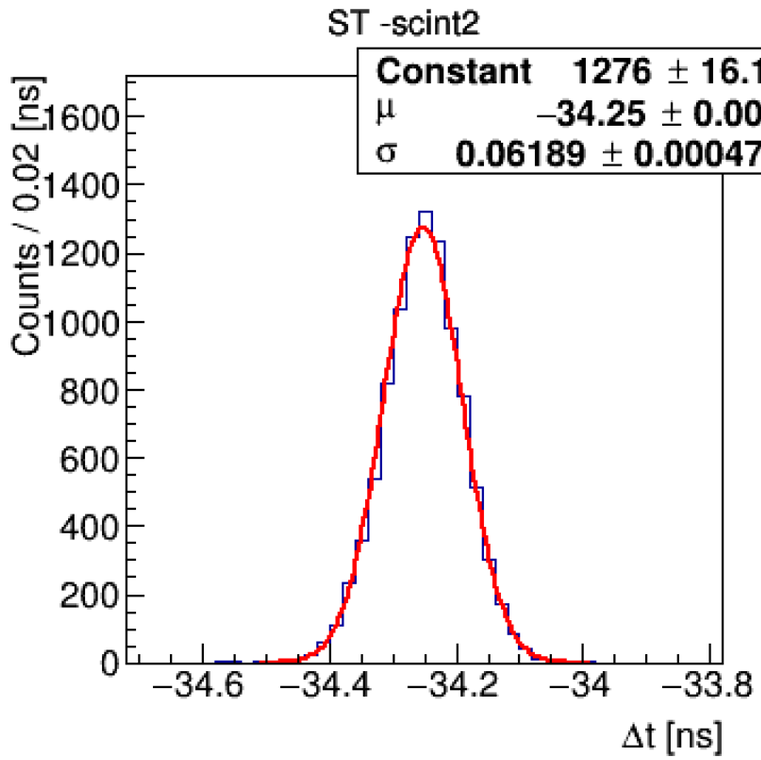


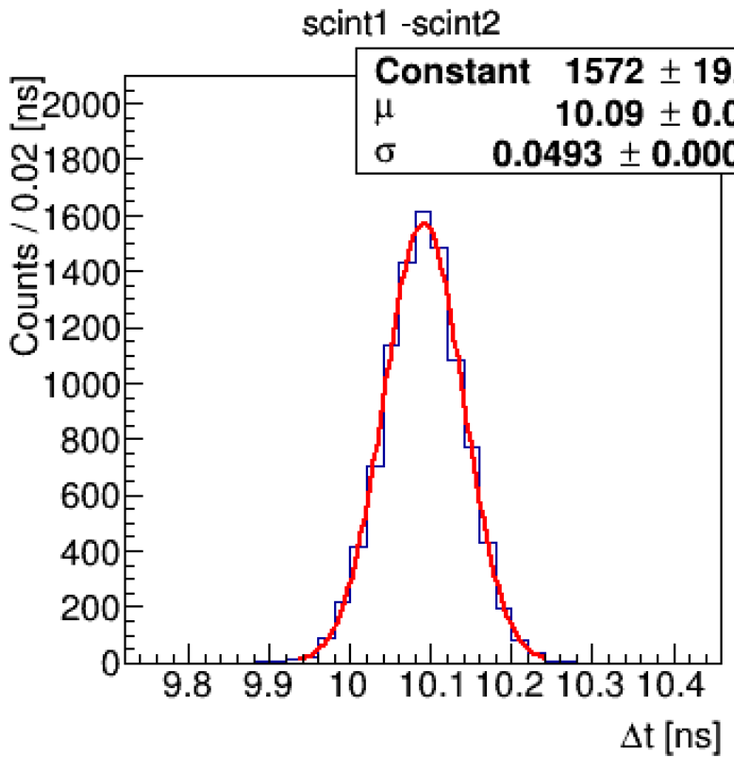
Time resolution

^{12}C (700MeV/u)









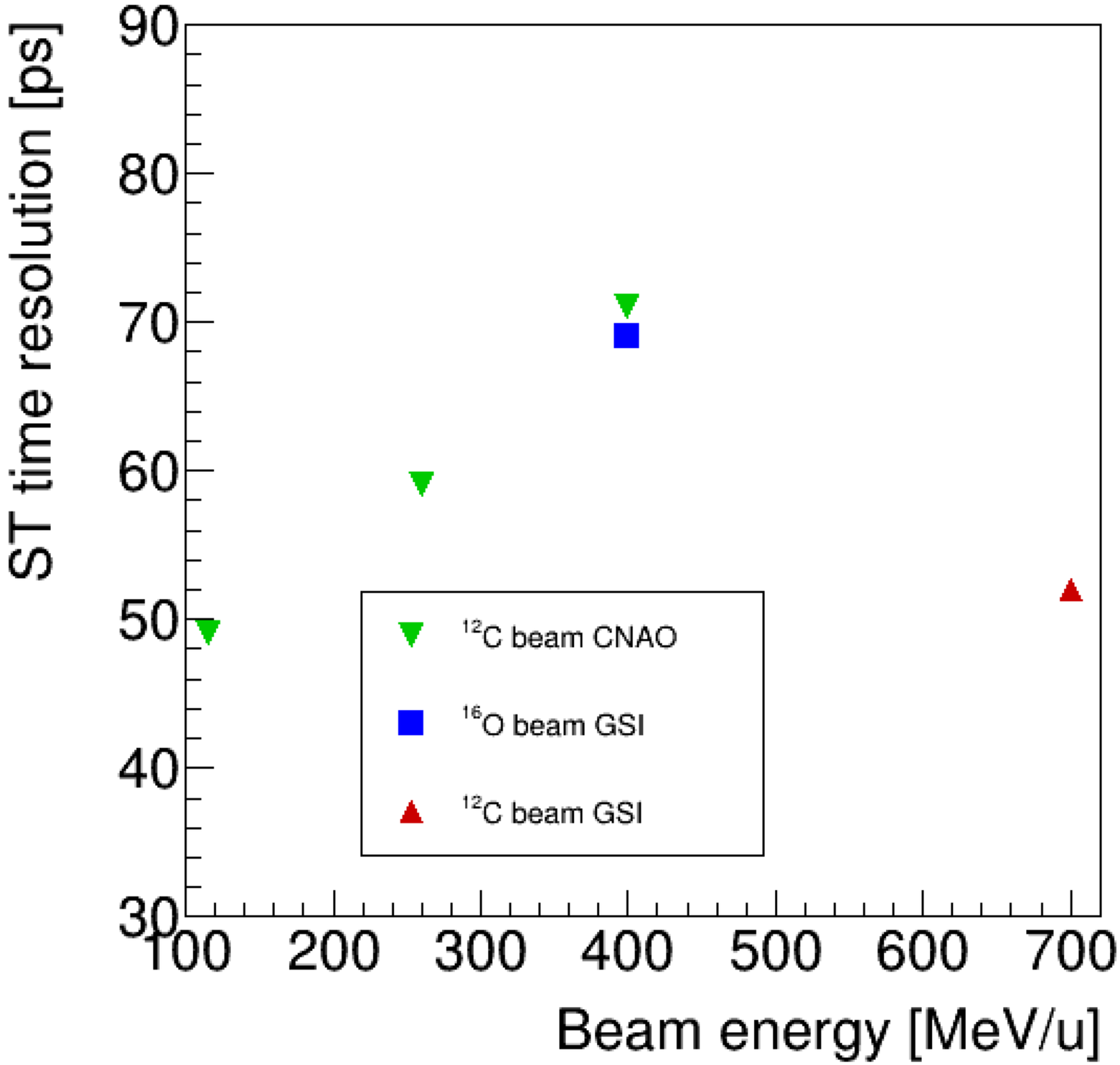
$$\sigma^2_{\mathrm{ST},1} = \sigma^2_{\mathrm{ST}} + \sigma^2_1$$

$$\sigma^2_{\mathrm{ST},2} = \sigma^2_{\mathrm{ST}} + \sigma^2_2$$

$$\sigma^2_{1,2} = \sigma^2_1 + \sigma^2_2$$

$$\sigma_{\mathrm{ST}} = \sqrt{\frac{1}{2}\left(\sigma^2_{\mathrm{ST},1} + \sigma^2_{\mathrm{ST},2} - \sigma^2_{1,2}\right)} \sim 53 \text{ ps}$$

Comparison with the past



Noise study

- The noise is **still observable**. We observed a “low frequency” component that could be observed as a baseline fluctuation, and a “high frequency" component.
- The amount of noise dependent on … whatever! (cable configuration and orientation, positioning in the room). Small setup variations dramatically affect the noise picked up by the system.
- However,acting on the WD internal filters and using **a reasonable threshold (40-50mV), at the operating HV it seems that could be take under control** (~Hz noise rate), keeping an high efficiency on the incoming ion detection.
- The impact on time resolution has to be evaluated, but the obtained results suggest that should be minimum/negligible.

Next steps

- **Analysis**: the time performance on the available data are optimized, even some some further study have to be performed to understand the resolution difference between the GSI runs.

- **HW**: The new detector version have to be characterised with ion beams at different energies in terms of resolution and detection efficiency (for low Z ions as He). We hope to have beam time soon…

  Moreover, the broken SiPM has to be replaced