

IMPERIAL



# Time-of-Flight Detector in the T2K ND280: From Commissioning to First Physics Insights

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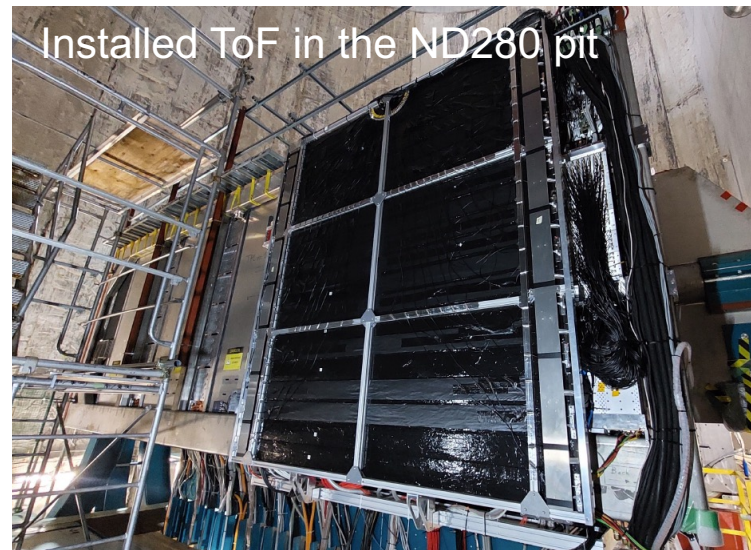
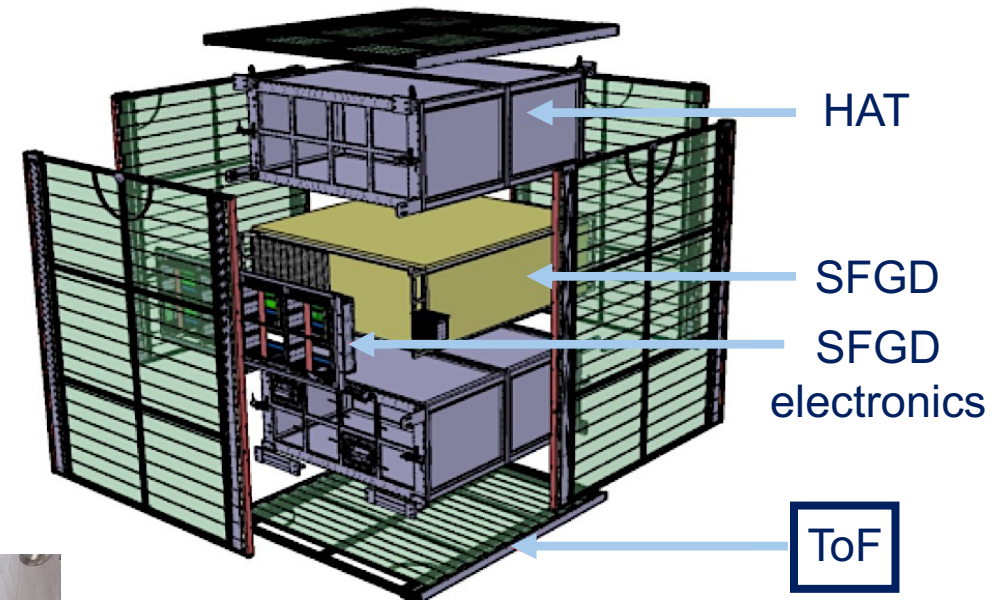


September 3<sup>rd</sup>, 2025  
Liverpool

# Time-of-Flight detector

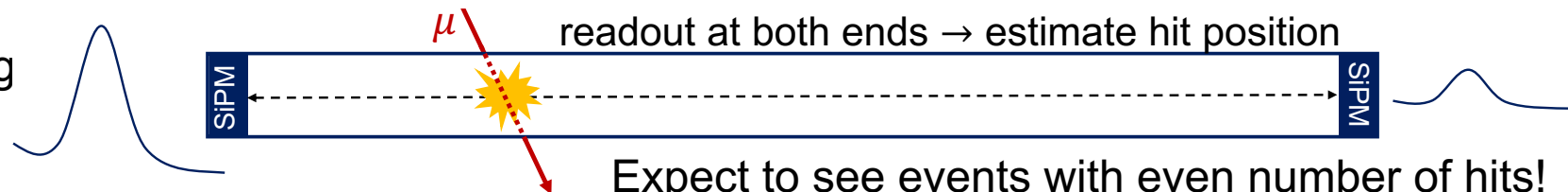
One of the upgraded ND280 subdetectors providing:

- 🕒 ~175 ps timing per track
- ❌ out-of-fiducial rejection
- 🔔 cosmic trigger for SFGD & HAT

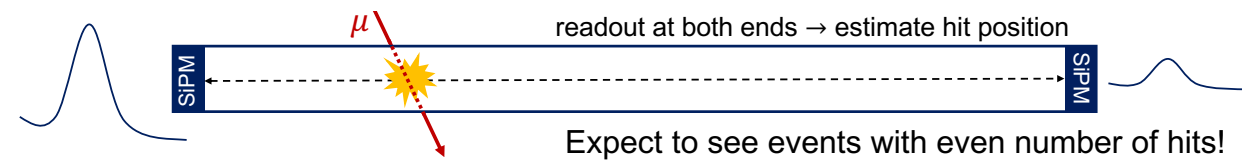


Each plane made of 20 plastic scintillator bars ( $220 \times 12 \times 1 \text{ cm}^3$ ), read out by 8-SiPM arrays at both ends

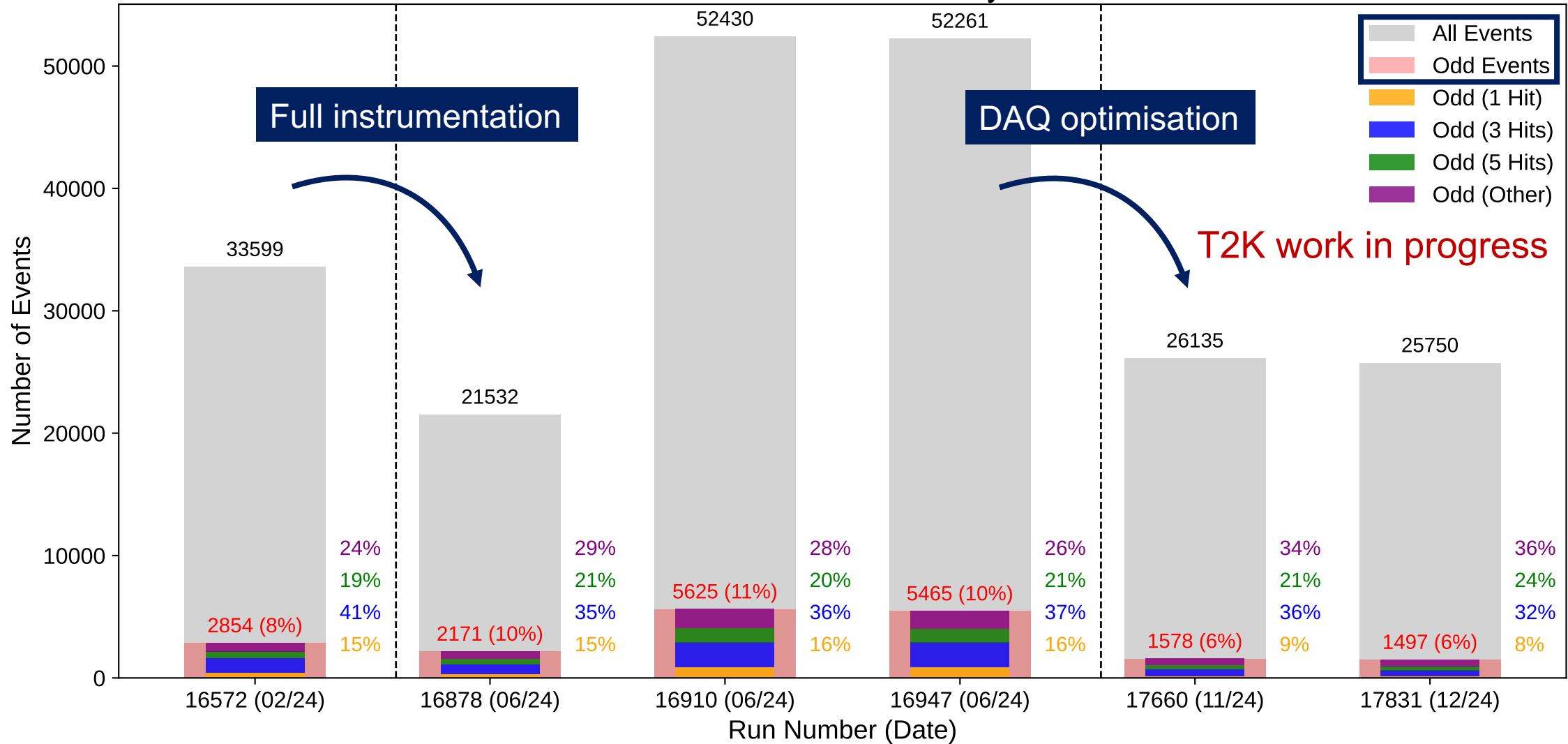
Signal digitised by SAMPIC, enabling fast waveform sampling (3.2 GHz)



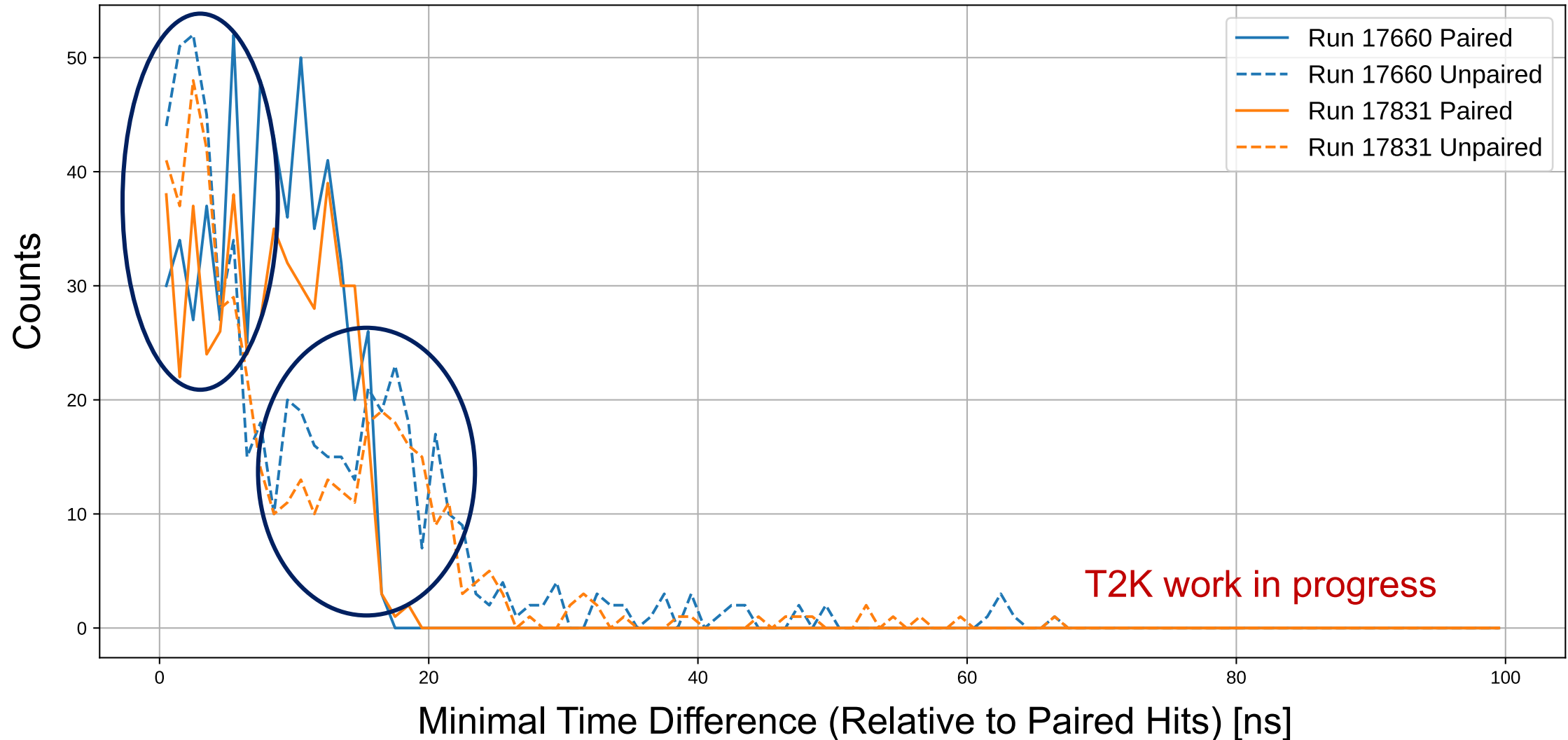
# Understanding our hits



## Beam Events Recorded by ToF

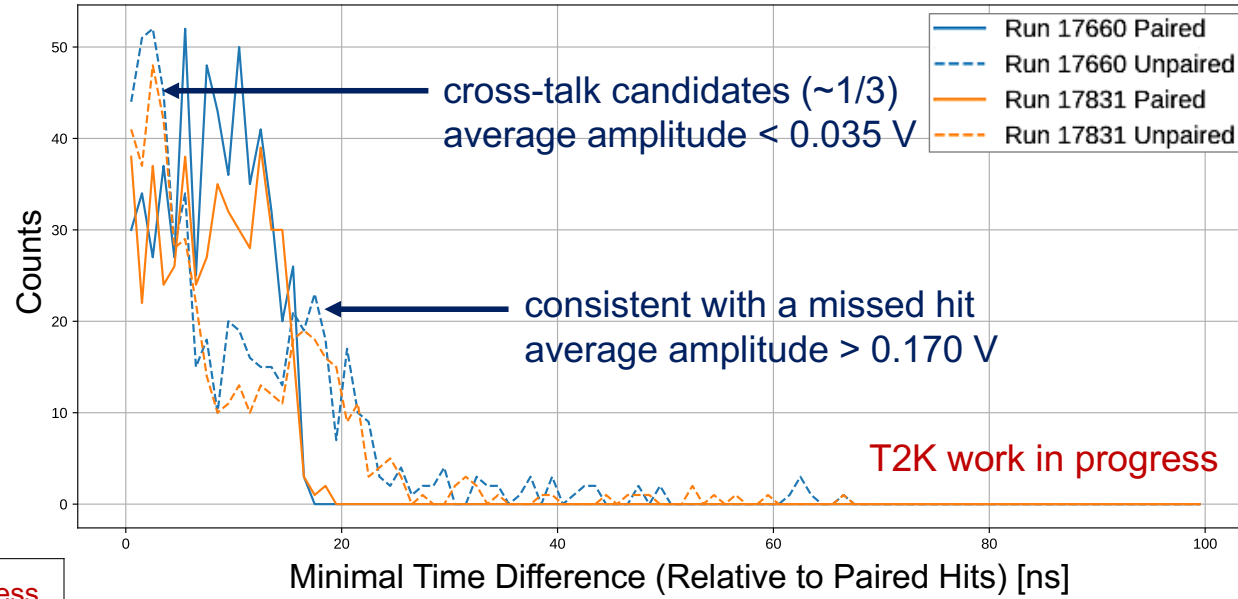


# Understanding our hits: events with 3 hits



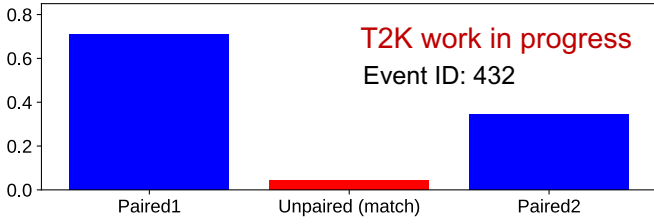
# Understanding our hits: events with 3 hits

cross-talk

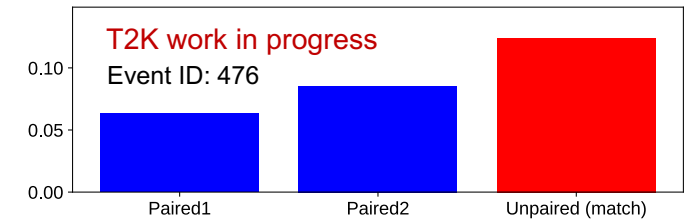


missed hit

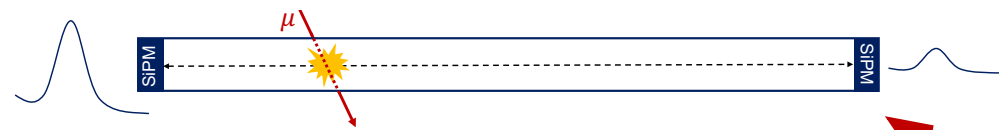
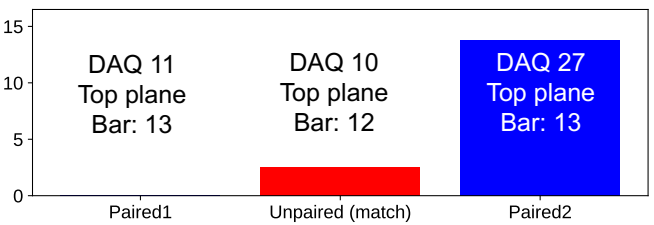
Peak Amplitude [V]



Peak Amplitude [V]

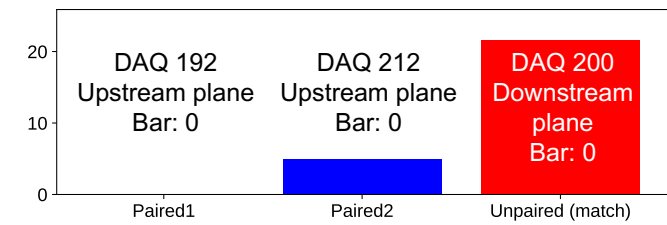


Time Difference (Relative to First Hit) [ns] and Geometry Info

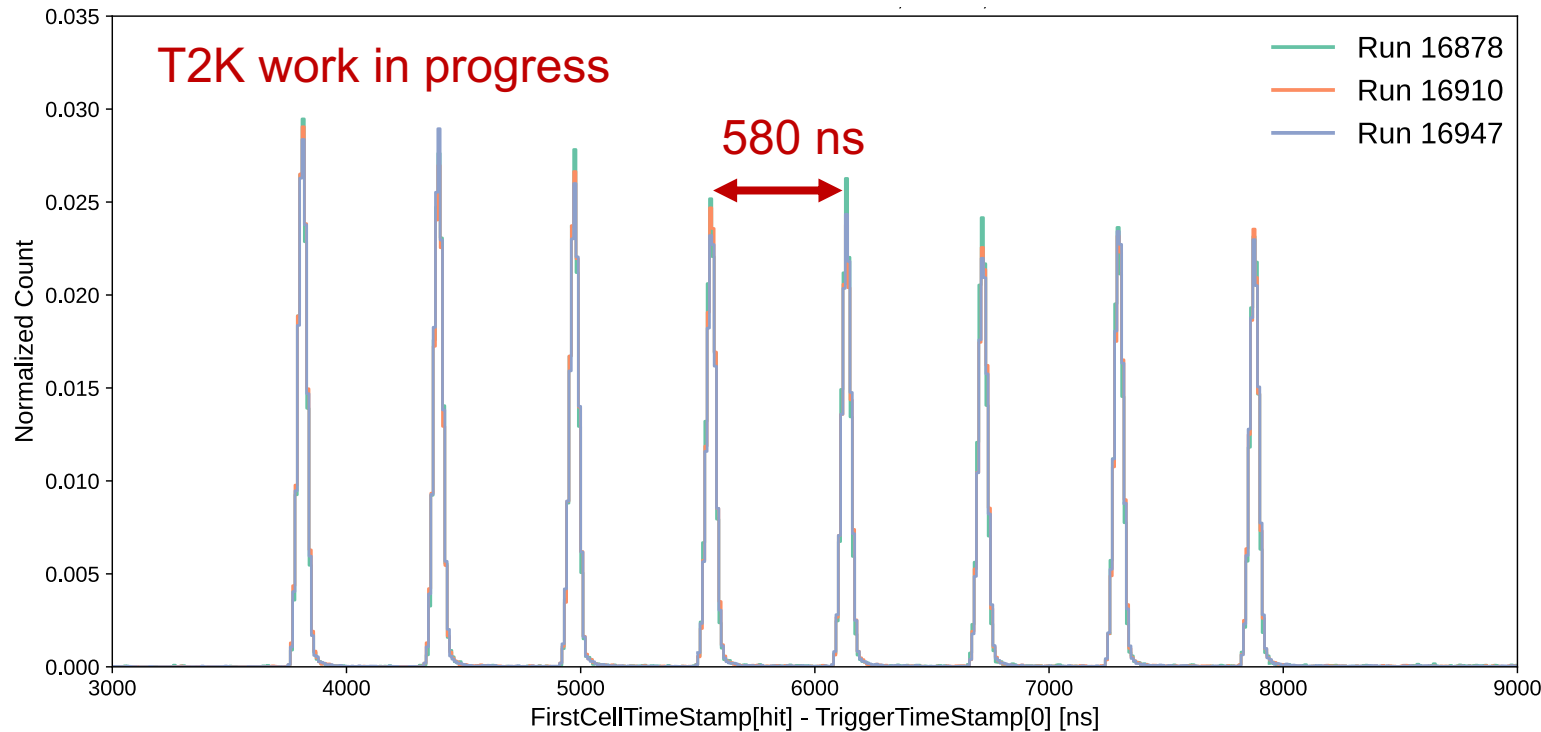


Can be missed if  $<$  threshold

Time Difference (Relative to First Hit) [ns] and Geometry Info



# Beam structure and out-of-fiducial rejection



**Clearly resolves bunch structure of the T2K beam spill**  
Excellent agreement across beam runs

For more info, see [my poster](#) or [S. Samani's talk tomorrow!](#)

CC inclusive **out-of-fiducial HAT muons can be rejected by ToF-SFGD time difference**

