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A Fast Timing System for EIC Far Forward Detectors

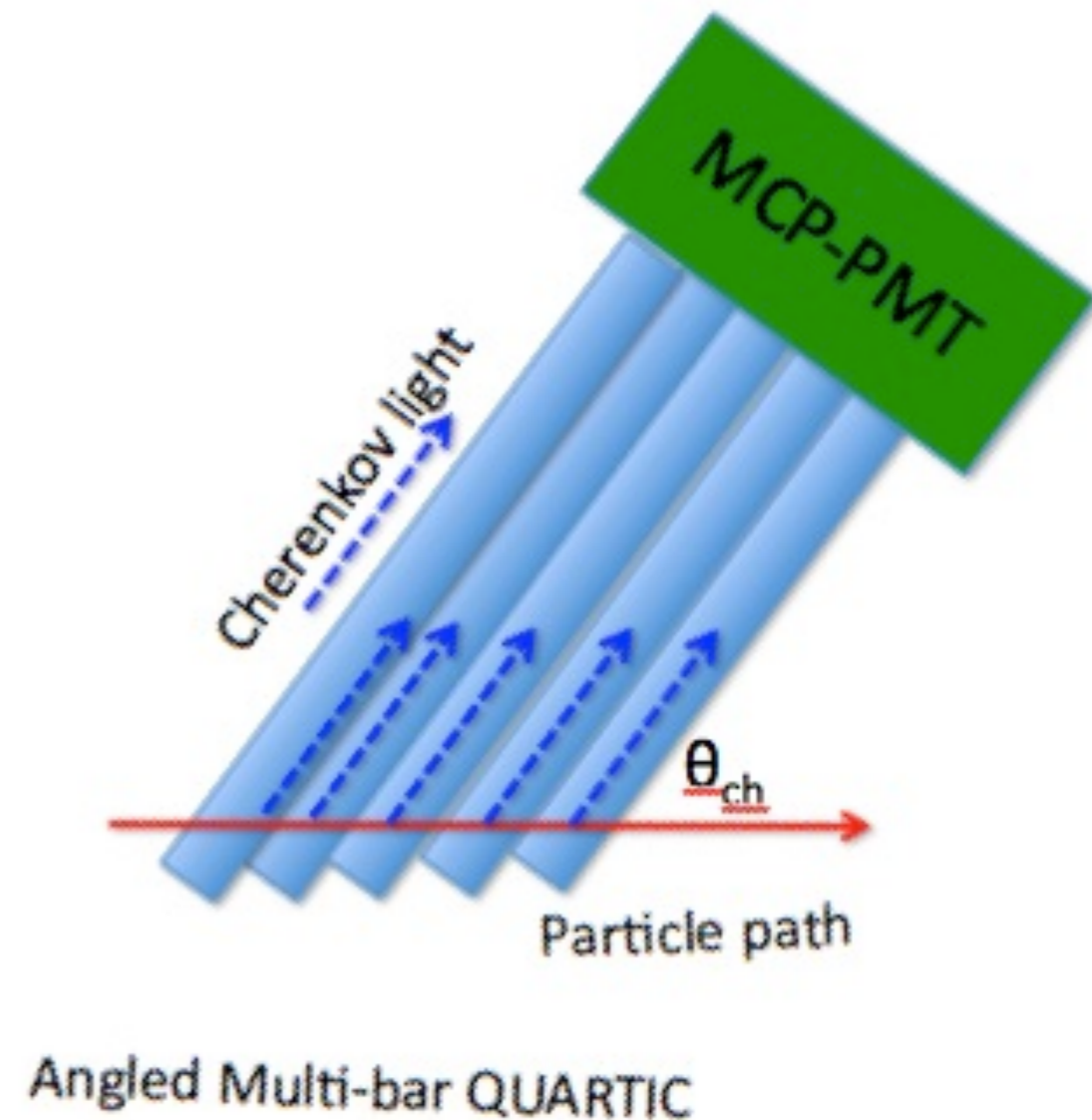
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**WORLD
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THE SUNDAY TIMES
GOOD
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2018
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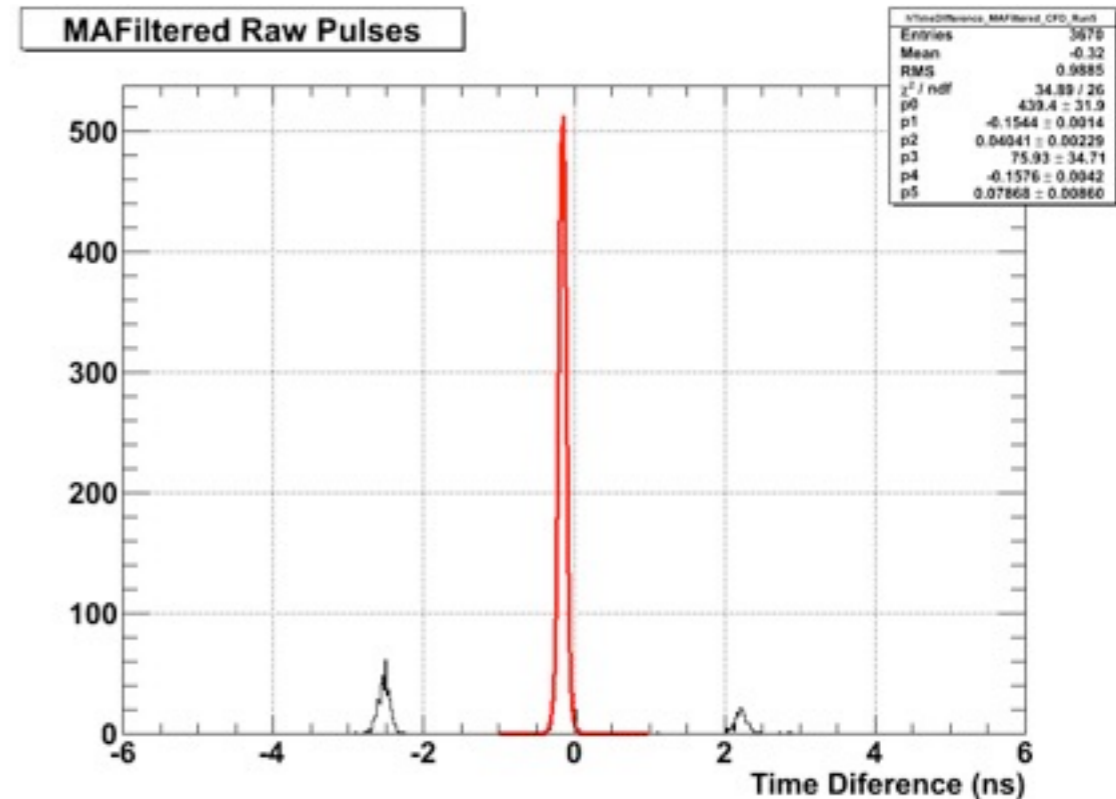
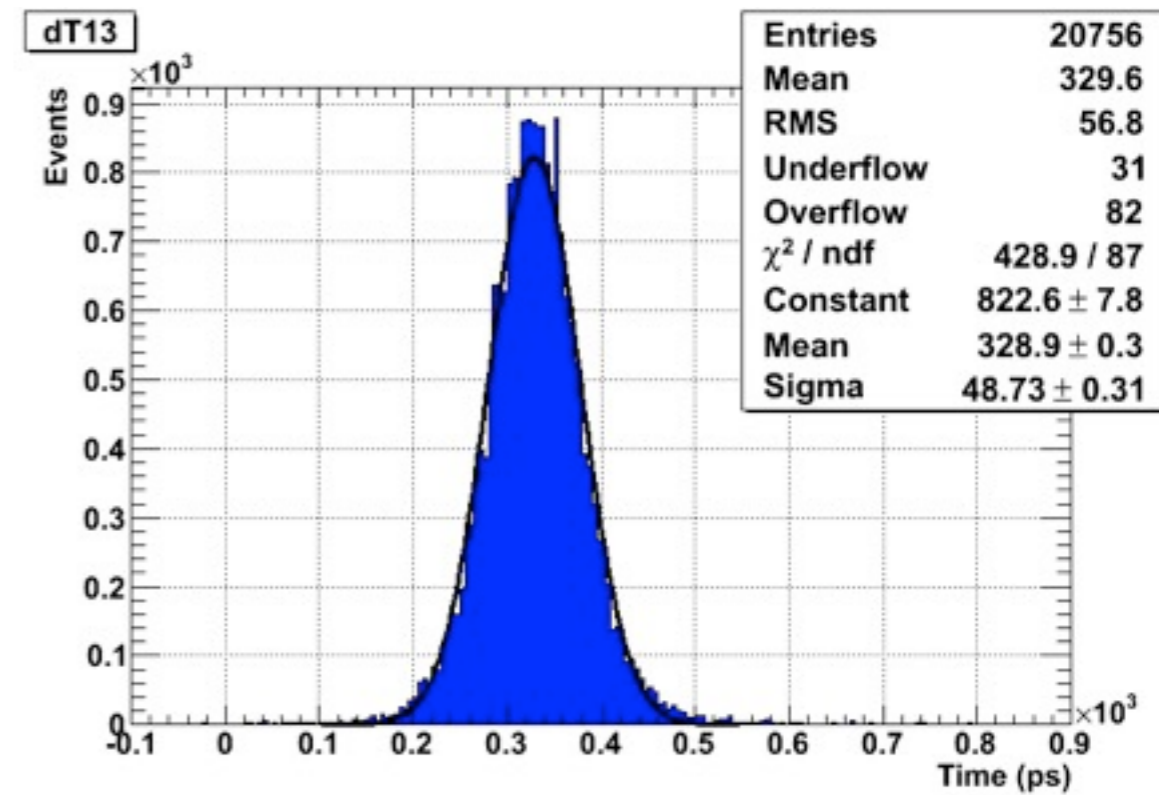
Why Cherenkov counters for timing?

- Light generation instantaneous
- Only sensitive to charged particles
- Light yield is low (~50 p.e.)
- Light is emitted in broad-band spectrum (dispersion)
- Fused silica ($n=1.47$) shown to be radiation hard
- Proton threshold ~400 MeV/c
- MCP-PMT fast and insensitive to magnetic fields
- Compact configuration

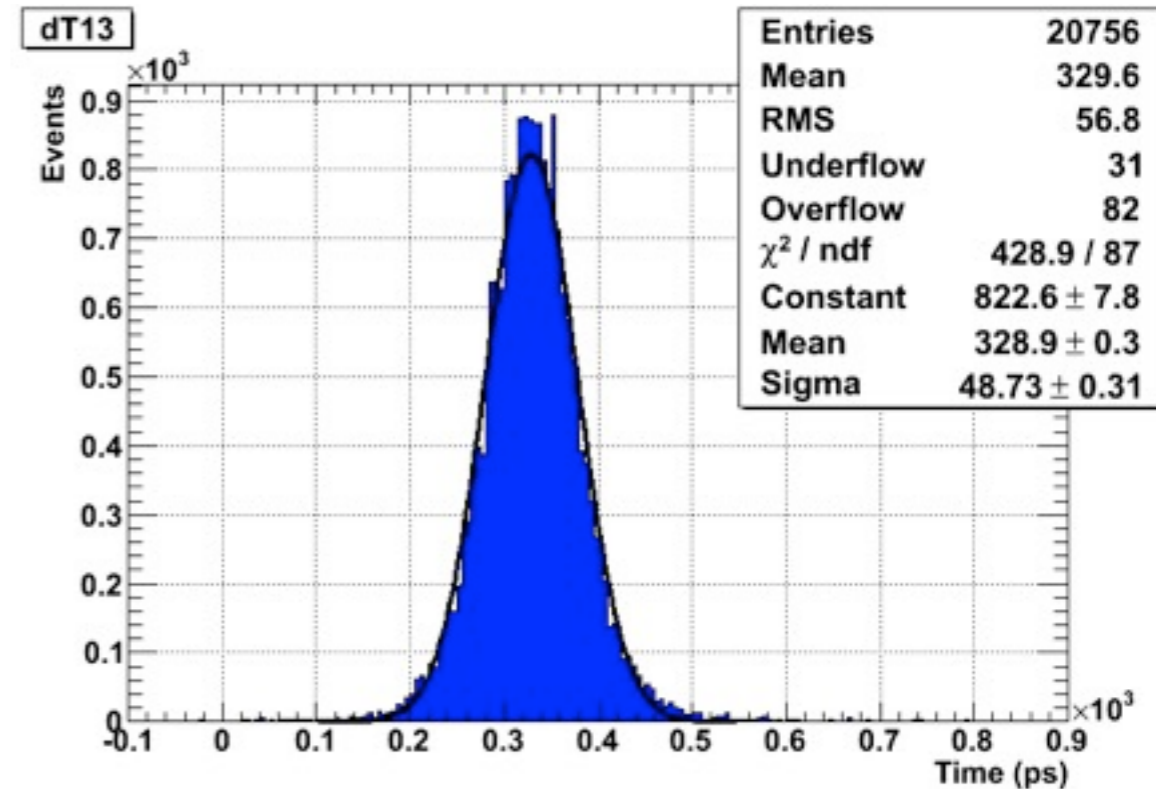
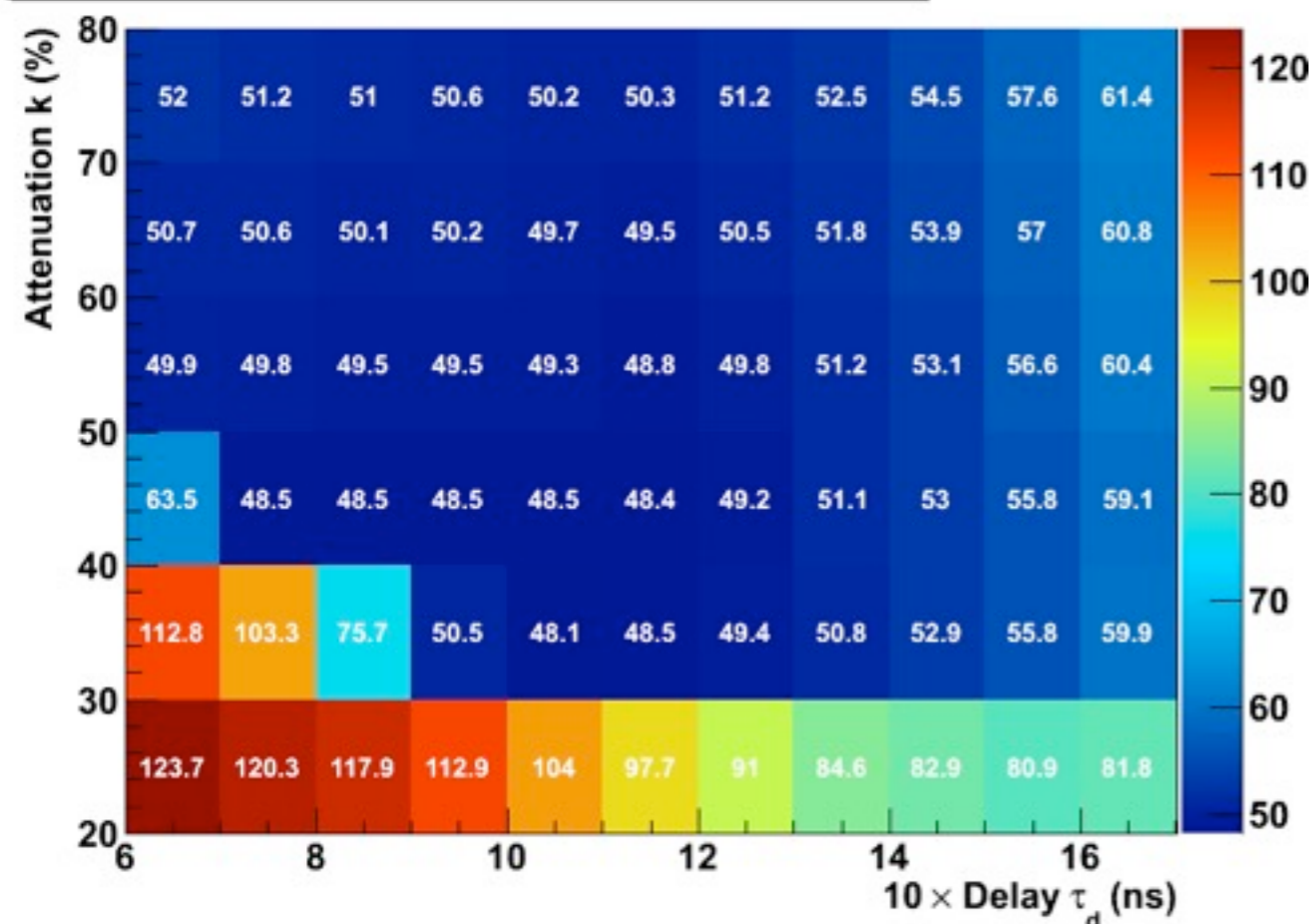


$$\cos \theta_{\text{ch}} = \frac{1}{n\beta}$$

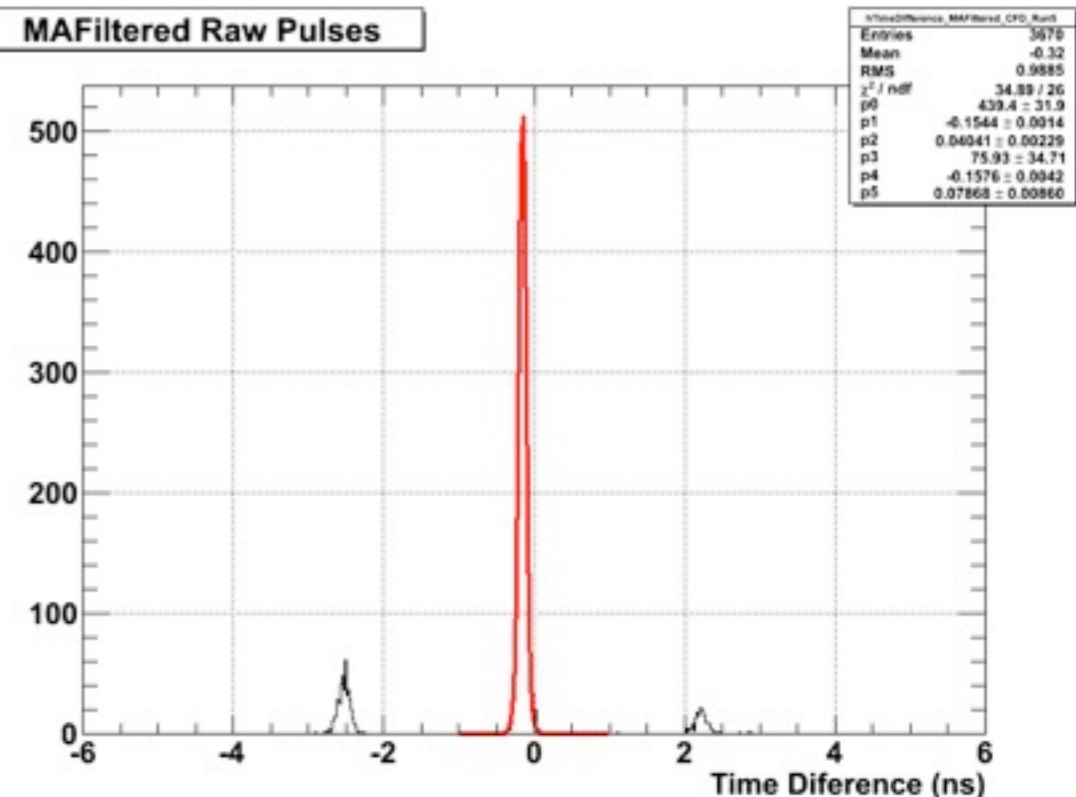
with ATLAS Forward Physics Project (Quartic test beam @CERN SPS)



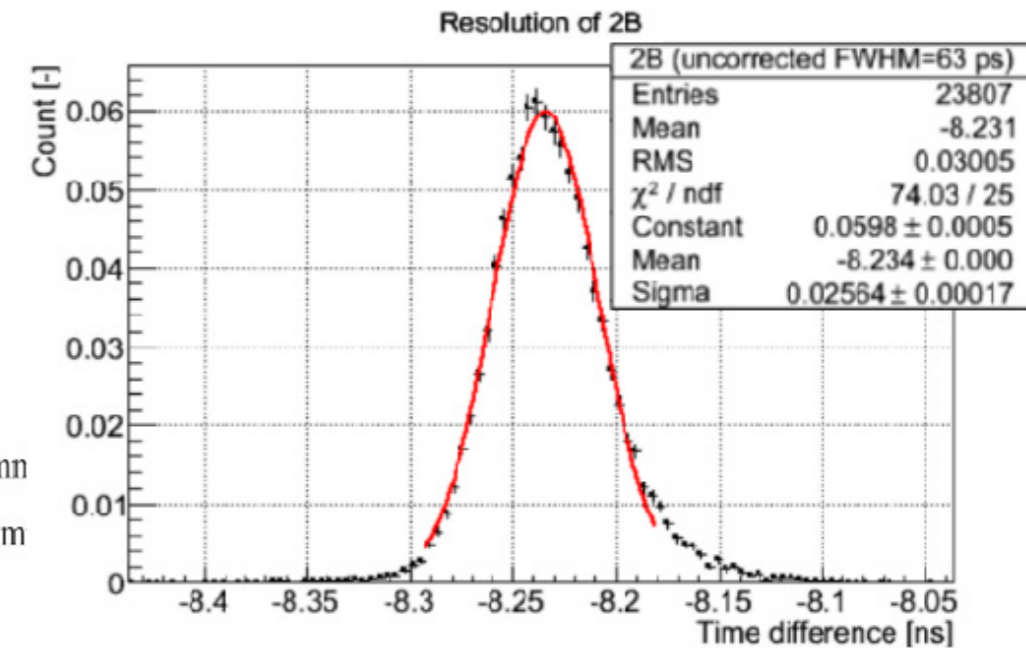
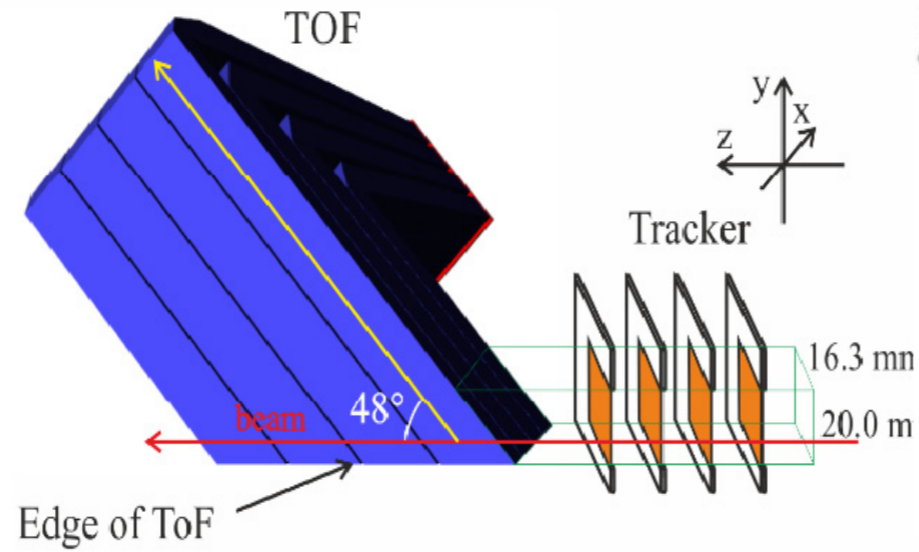
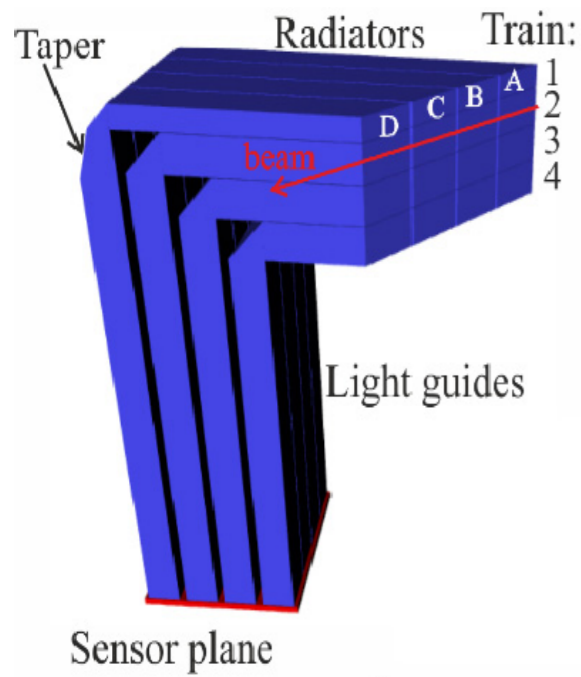
Software CFD Time Resolution Dependency Upon τ_d and k



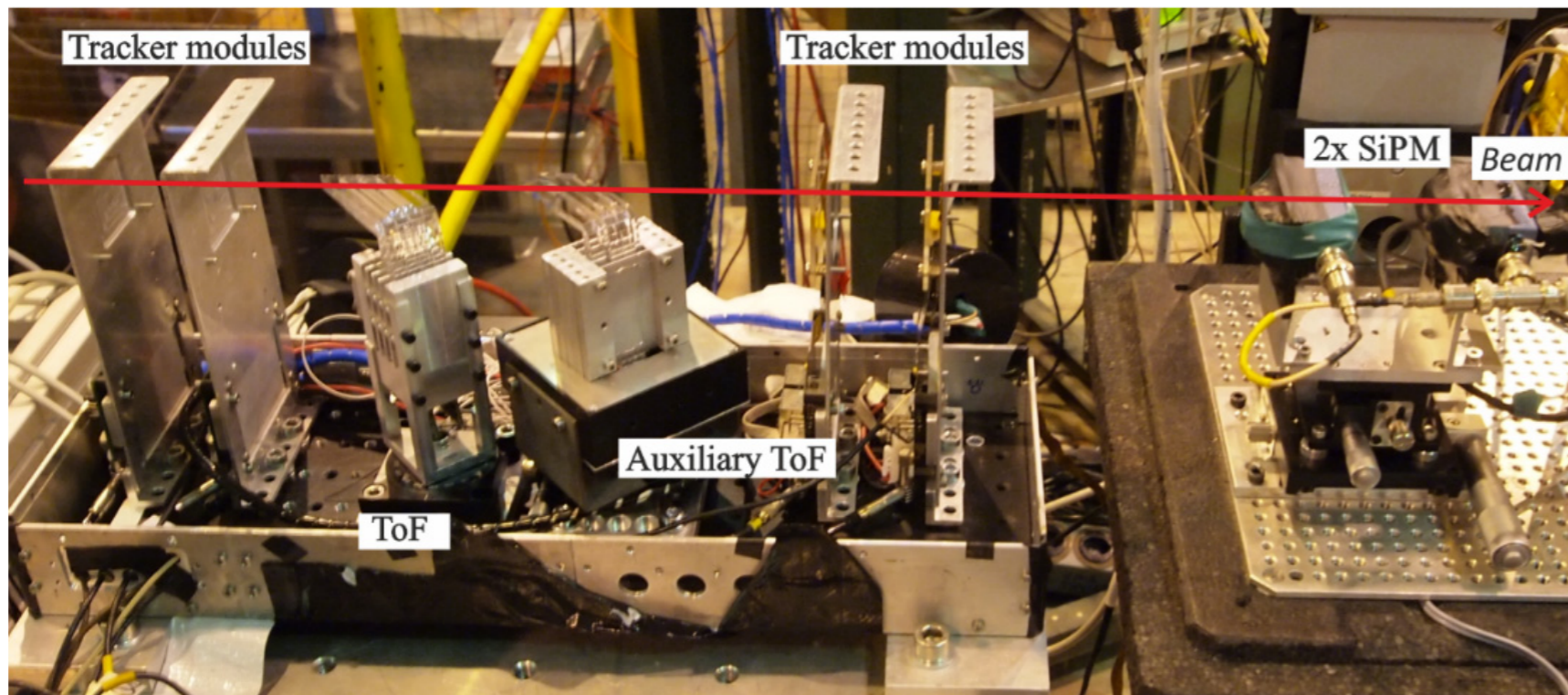
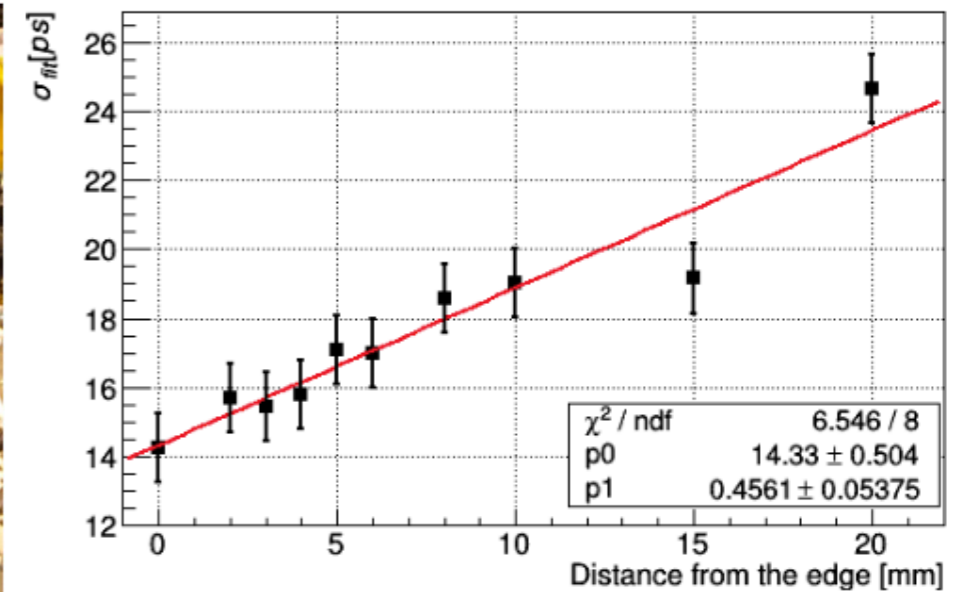
MAFiltered Raw Pulses



How it turned out (ATLAS Forward)



Timing resolution of the Train 2



$$\frac{N_{pe}}{L} = 90 \frac{1}{\text{cm}} \langle \sin \theta_c \rangle \qquad \cos \theta_c = \frac{1}{n\beta}$$

$$\Rightarrow \frac{N_{pe}}{L} \approx 90 \frac{1}{\text{cm}} \left(1 - \frac{1}{n^2} \right) \approx 50 \frac{1}{\text{cm}}$$

- MCP-PMT (eg. TORCH model) have about 40 ps single photon timing resolution
 - < 10ps per module possible
- additional modules give \sqrt{N}
 - < 5 ps for system of N=4?



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Thank you very much for your attention

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