TIMING IN A FLASH

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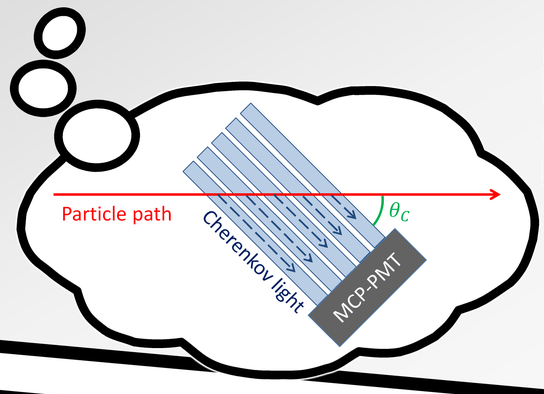
WHAT IS A FLASH?

The **F**ast **L**ight **A**cquiring **S**tart **H**o-doscope is a demonstrator for a segmented start counter.

It delivers **precise event timing** and coarse position information by taking advantage of the **Cherenkov** effect.

Its design is based on the principles of **QUARTIC**.



Only **Time-over-Threshold** (ToT) is measured.
NINO-based electronics read out by **TRB3** FPGA-TDCs.

Fused Silica Radiator Bars (5×5.5×140 mm³) coupled to PLANACON **MCP-PMT**

Basic System Resolution

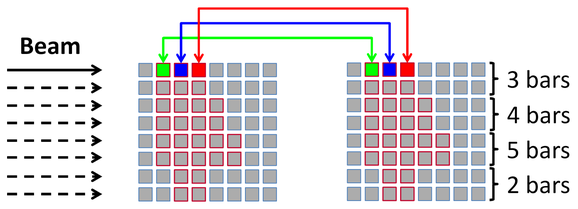
$$\sigma \approx \sqrt{\sigma_{opt}^2 + \sigma_{el}^2 + \sigma_{beam}^2}$$

TESTING FLASH...

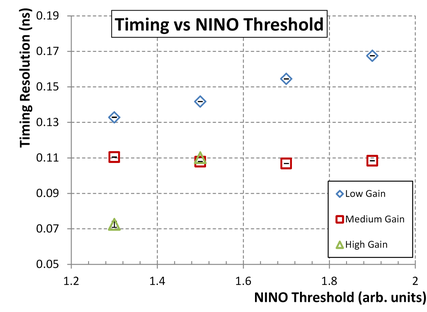
Using the **855 MeV electron beam** of the Mainz Microtron (MAMI).

25-30 detected photons per bar expected (SLITRANI simulation).

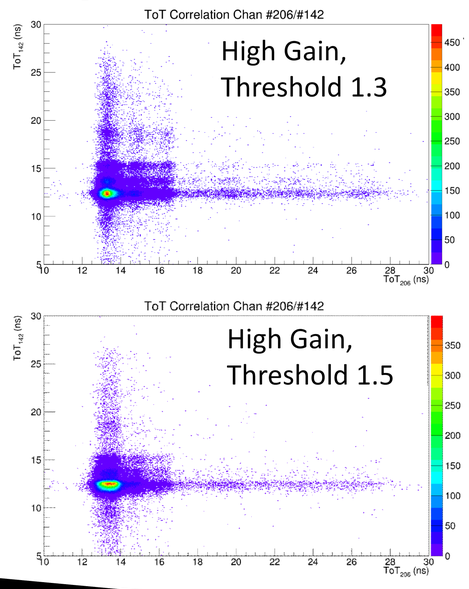
Placing two FLASH units ~0.5 m apart and scan the beam across rows with different number of radiator bars.



Form **pairs of pixels** from different FLASH units in each row and extract **ToT** correlations and **ΔT**



High MCP-PMT **gain** and **low** NINO **threshold** favoured for timing!

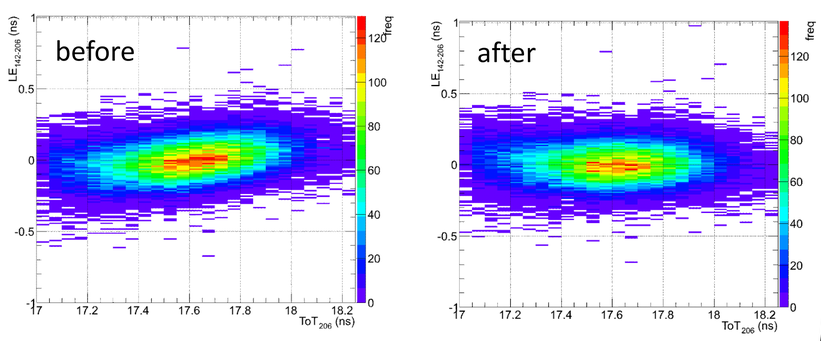


WALK CORRECTIONS

Extracting time-walk spectra by selecting a reference pixel.

Assuming a **single slope** model, parameters are chosen to **minimise RMS**.

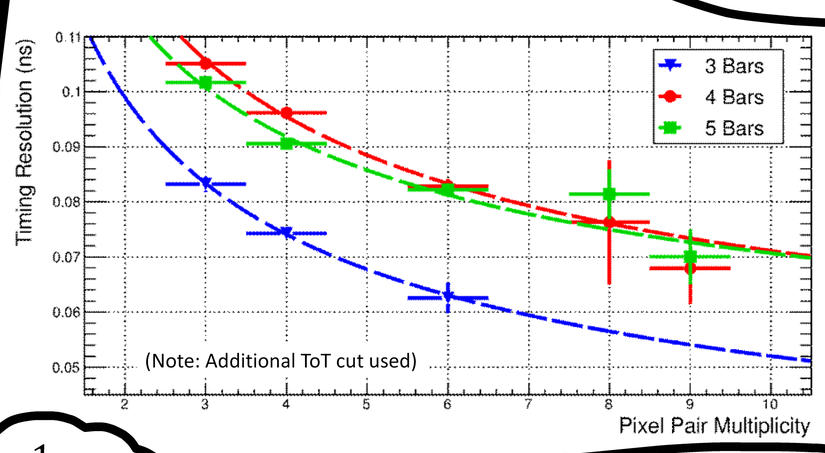
Extracted walk parameters are universal for different reference pixels.



RMS improves by up to 15% (122 ps to 115.6 ps or 5% in above case).

OPTIMISING FLASH

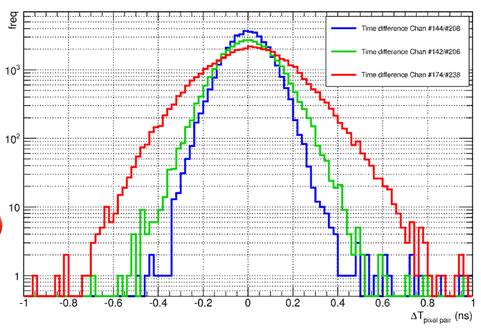
Three bars is best!
Resolution **improves** with number of pairs!



$\sim \frac{1}{\sqrt{N}}$

Multiple scattering limits **timing resolution**!

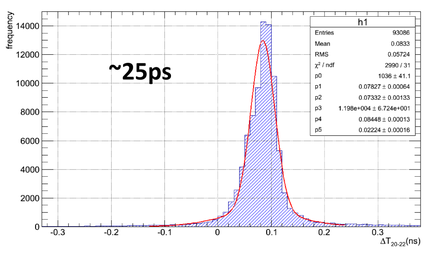
Individual pixel-pair timing resolution for three bars.



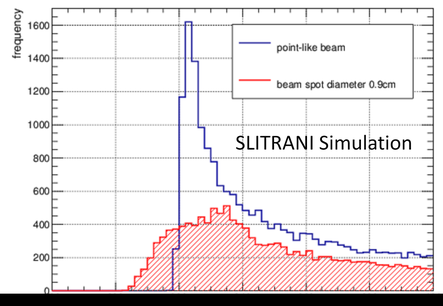
(ranges from ~88 ps to ~179 ps)

TIMING CONTRIBUTIONS

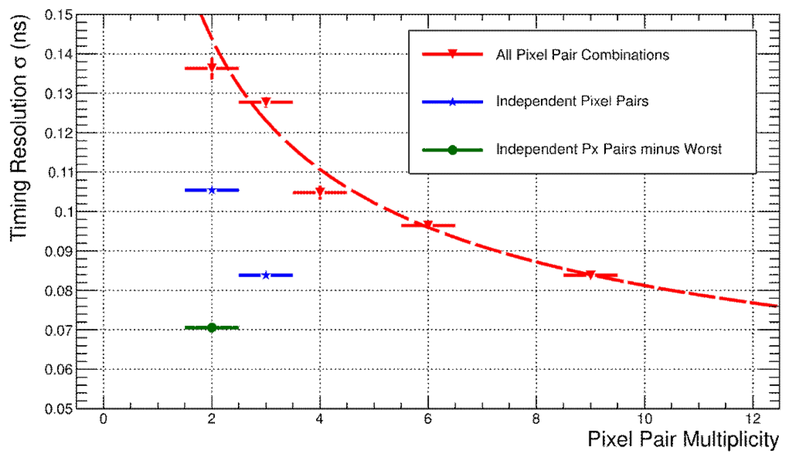
Estimate contributions from **Frontend Electronics** (by using crosstalk)



and **beam spot size** on timing resolution.



TIMING RESOLUTION



	Resolution σ
FLASH	(70.6±0.3) ps
Included contributions	
TRB synchronisation	~15 ps
Frontend Electronics	~25 ps
[illegible]	[illegible]

CONCLUSIONS

Two FLASH detector units tested with **855 MeV electron beam**.

$\sqrt{N}^{-1}$ behaviour of timing resolution observed as expected.

Time-over-Threshold is used **successfully** to **correct** for **walk effects**.

Best observed timing resolution is **~(70.6±0.3) ps** for **ΔT**, i.e. **~50 ps** per FLASH unit.

The authors would like to thank the **TRB3 collaboration** for their outstanding support.

Furthermore, thanks to