

Presentation on

Exp. 249 -

"OTR based beam diagnostics
in high energy beamlines."

Rupeshkumar Ghagi

■ Particle Counting Experiments

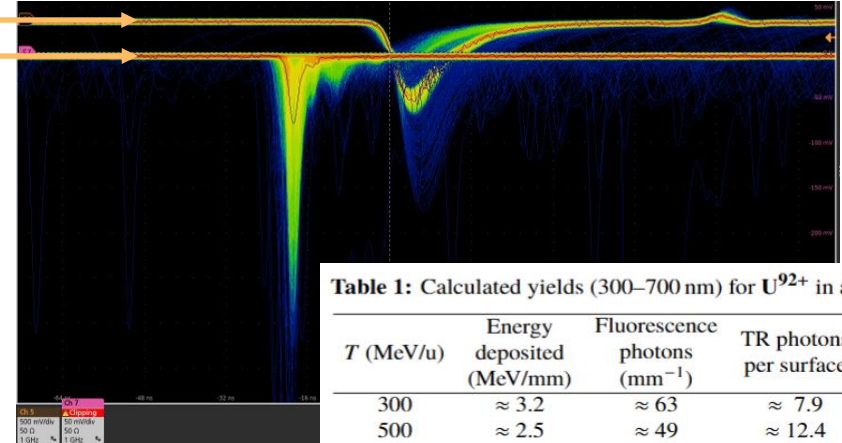
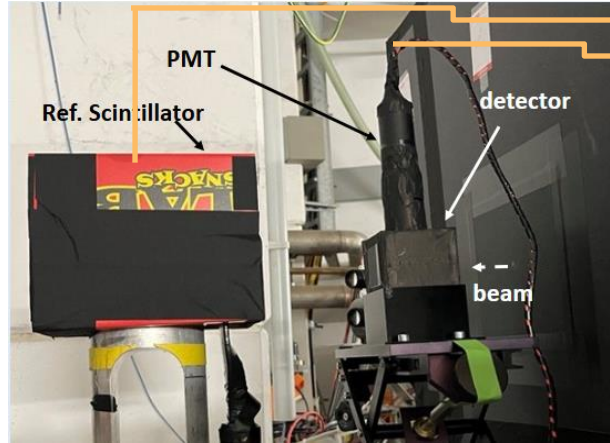
- Proof-of-Concept Prototype in Air with U^{73+} : June 2024
(Findings presented @IBIC2025)
- Prototype Geometry Studies in Air with Ag^{45+} : Feb 2025 – 1 Shift
- Air vs Vacuum Studies with Bi^{68+} / U^{73+} : May/June 2025 – 1 Shift

■ Beam Profile Experiments

- Beam Imaging and Angular Distribution/Polarization studies in Vacuum with U^{73+} : June/July 2025 – 1 Shift

Proof-of-Concept Experiment (2024)

...to Oscilloscope

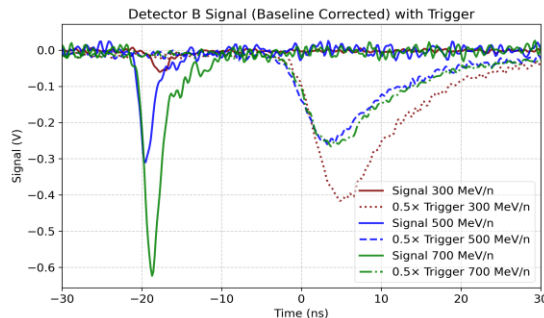
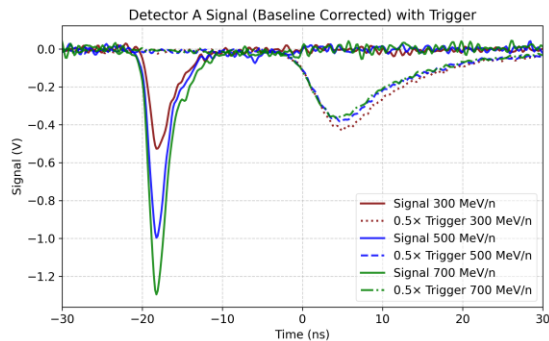
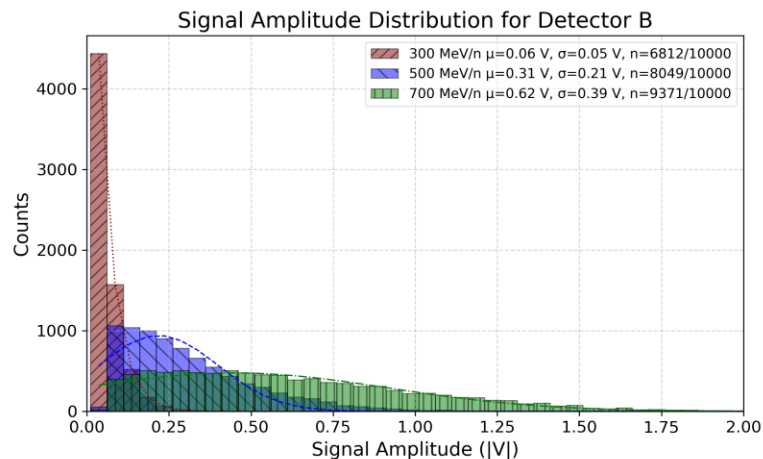
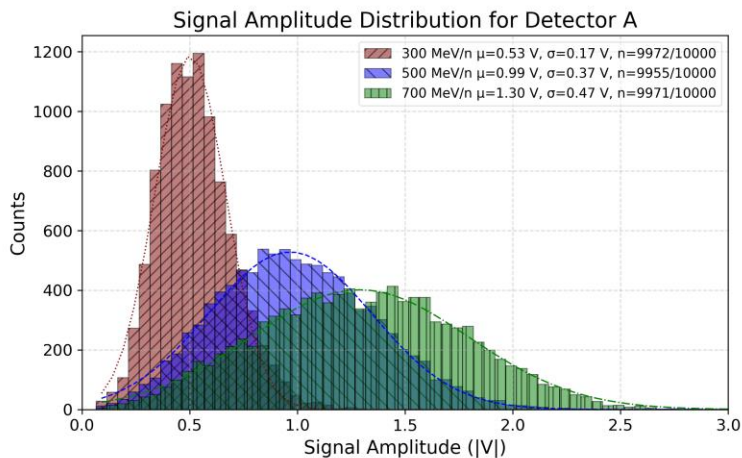


Detector A consisted of a $5 \times 5 \times 5$ cm empty paper box with a 1×3 cm window through which the PMT observed the signal perpendicular to the beam path.

Detector B consisted of a stack of 100 aluminum foils, each $18 \mu m$ thick, separated by 0.1 mm gaps; the spacing was chosen to ensure that the OTR yield exceeded that from air fluorescence as evident later in the text.

The detectors were coupled to a Hamamatsu R6427 PMT and operated in coincidence with a standard BC400 scintillator providing the trigger signal.

Proof-of-Concept Experiment (2024)



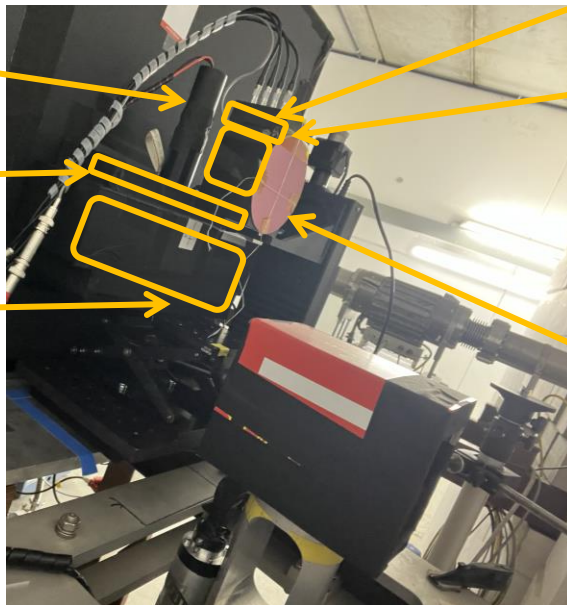
R. Ghagi et. al.,
IBIC 2025

Study of Detector Geometry

PMT Assembly (H7415)
(Contains PMT R6427)

4-Position Filter Slider
(Empty, 400, 500, 600 nm) Cut-
ON

Detectors with different Target
Materials, Mounted on Horizontal
Translation stage



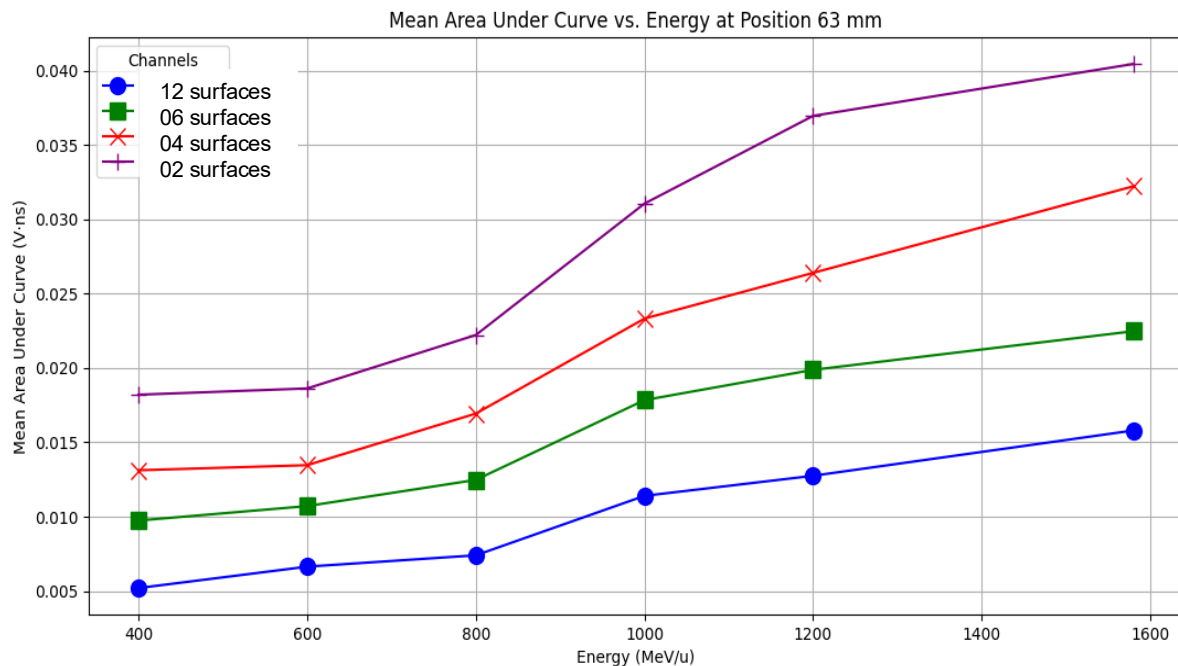
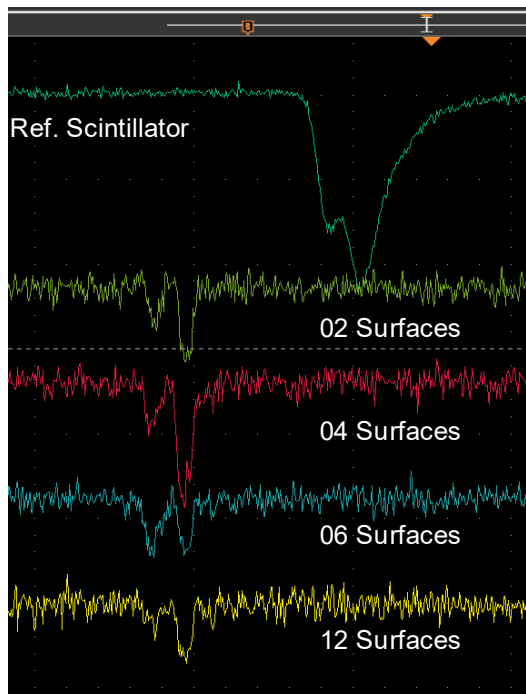
MA PMT Assembly H14220

Detectors with different gap between
foils,
Mounted on Vericle Translation stage

Cromox Screen to
Observe Beam



Study of Detector Geometry



Better Resolved Peaks

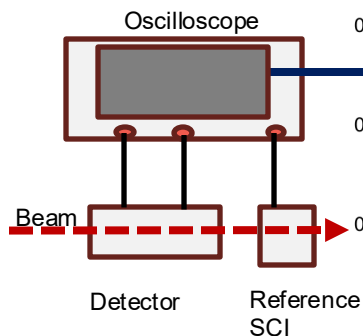
Detector Signal Trend with Beam Energy

OTR based Particle Counting

- Single ion counting with OTR from Al+PMT Detector at 5×10^{-3} mbar vacuum
- Triggered on 10000 SCI pulses and plotted the area distribution ~98% efficiency
- Between 12-50 photons produced per ion

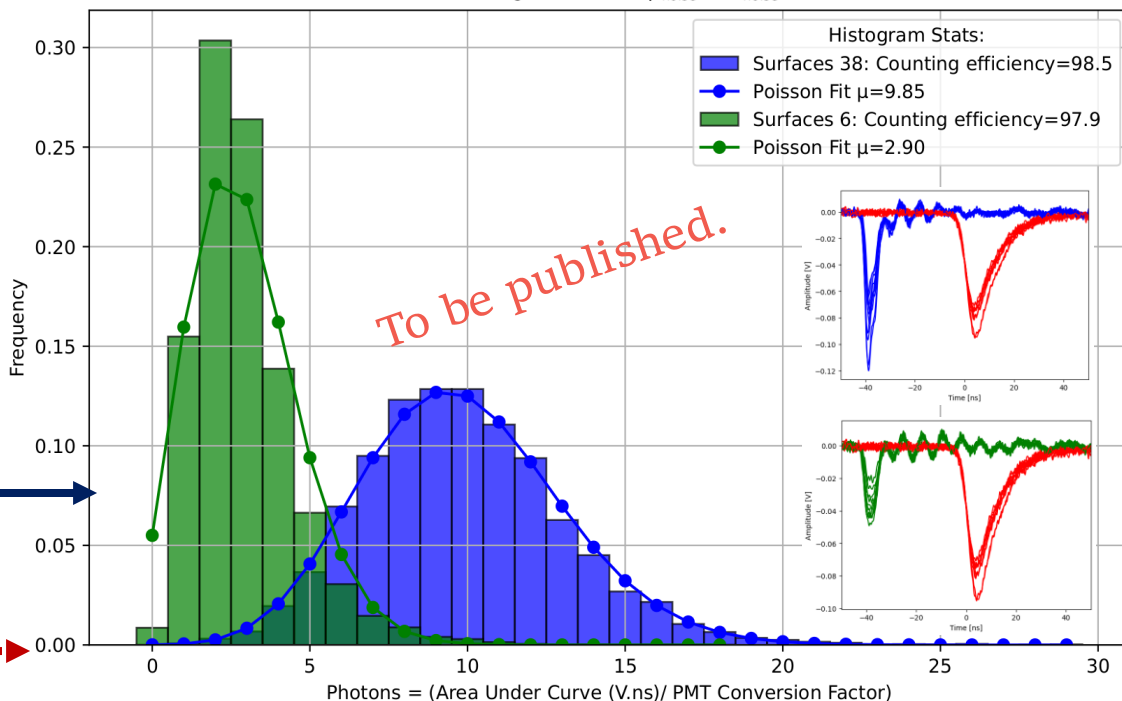


Two OTR Detectors



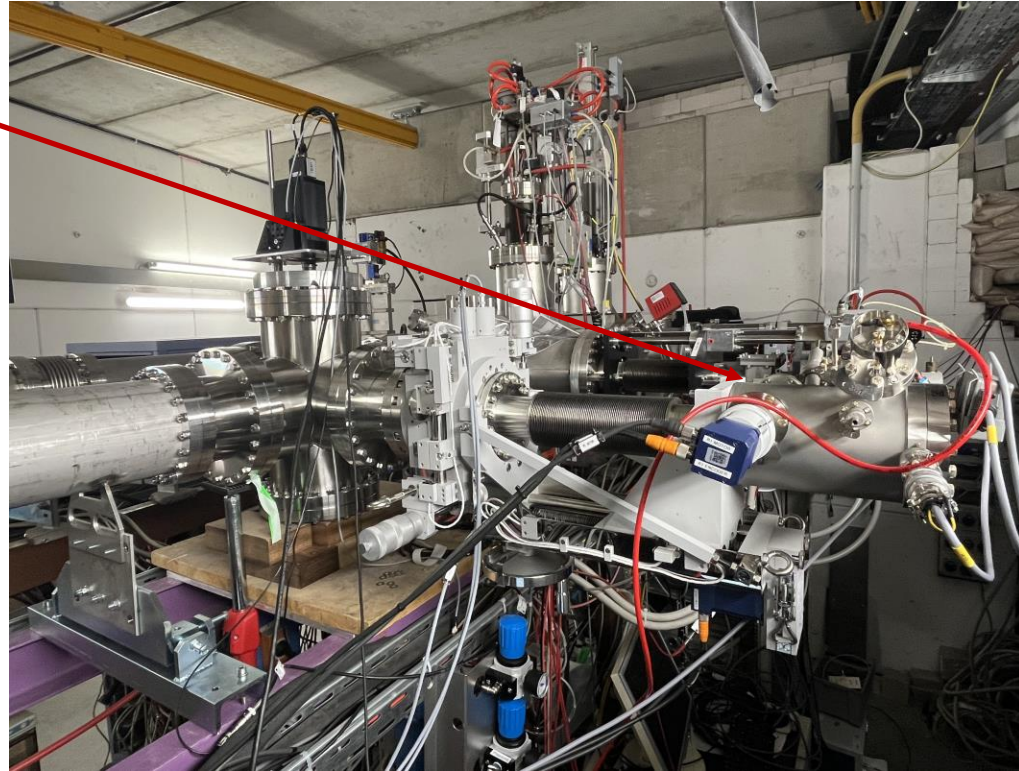
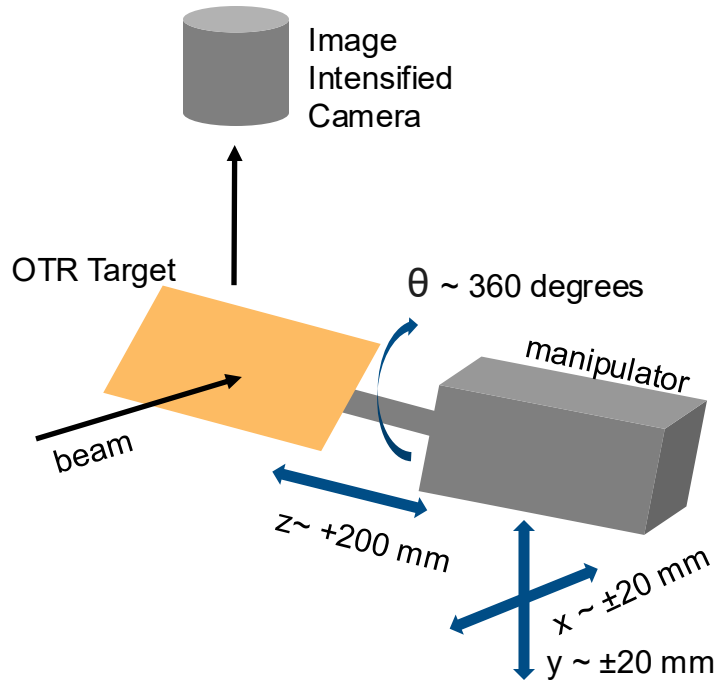
Histogram of Area Under Curves for Medium: vacuum, Energy: 600 MeV/u

Counting Threshold = $\mu_{\text{noise}} + 3\sigma_{\text{noise}}$



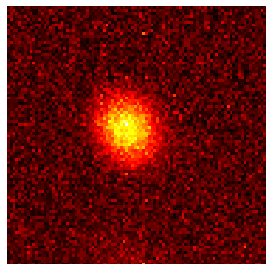
Beam Profile Measurement and OTR Characteristics

- 4D manipulator (PREVAC)



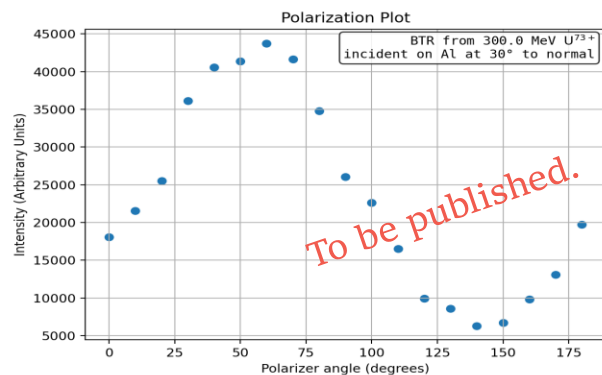
Beam Profile Measurement and OTR Characteristics

- Beam Profile Measurement performed with U^{73+} ions from 300 MeV/u to 700 MeV/u

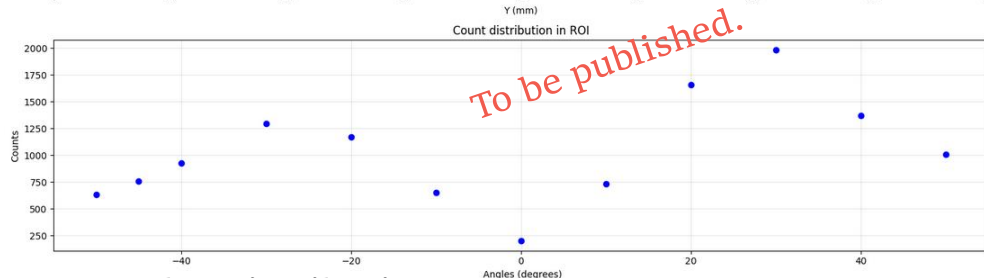
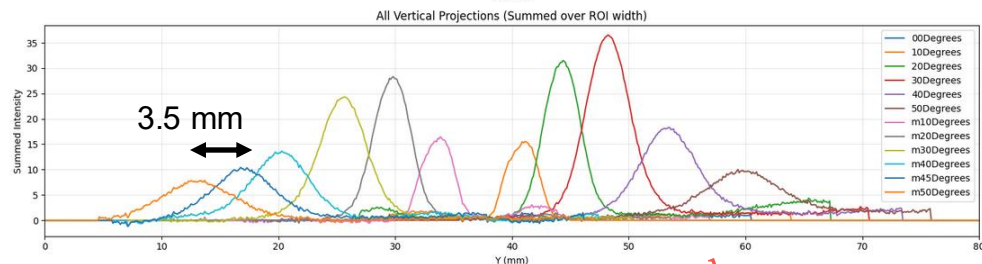
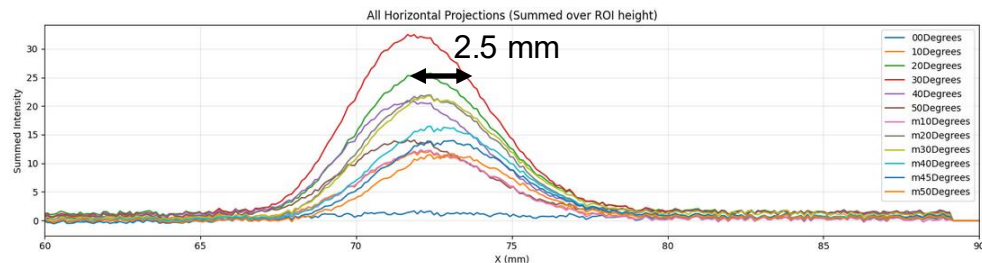


Beam Image

- The OTR characteristics
 - Angular Distribution
 - Polarisation



Polarisation Characteristics



Angular Distribution

Thanks!

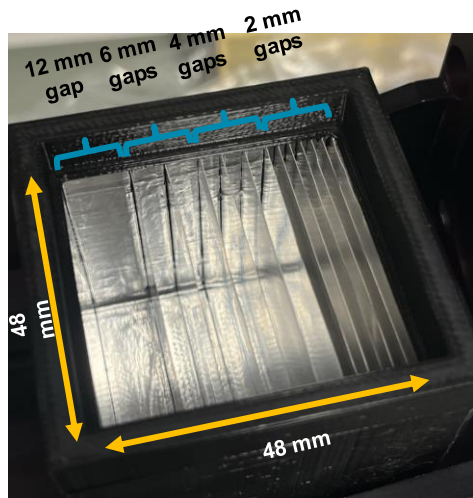
Acknowledgements

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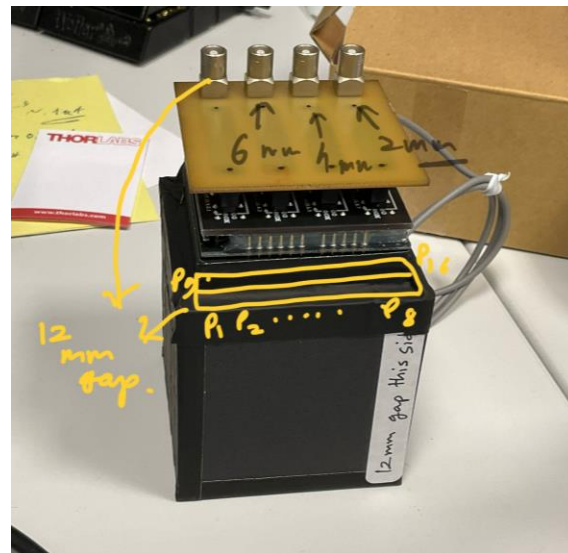
And

Beam Operations Team

Study of Detector Geometry



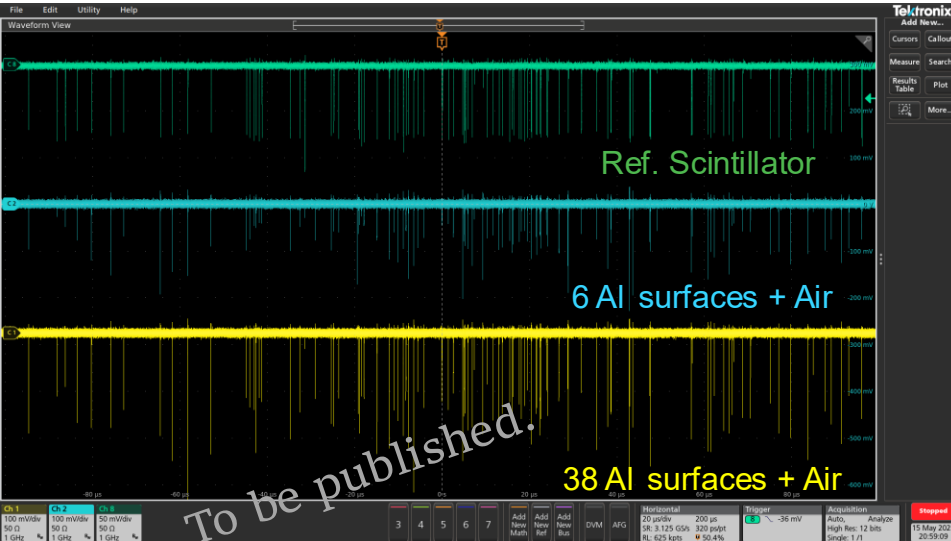
8 x 8 array of 6 mm x 6mm PMTs



Particle Counting and Beam Profile in Air

- Single ion counting with same setup as shown on slide 1, at 1 atm.
- Prompt Signal (as compared to scintillator)
- Fast, Radiation hard particle counter performs well in air and in vacuum

- Imaging on Paper in Air with Carbon beam
- Paper at 45 degree wrt beam
- 200 ms KO extraction with precise set intensity
- Photons from air until beam hits the paper



1e9 particles

Beam direction

5e8 particles

500 MeV/u

700 MeV/u

