

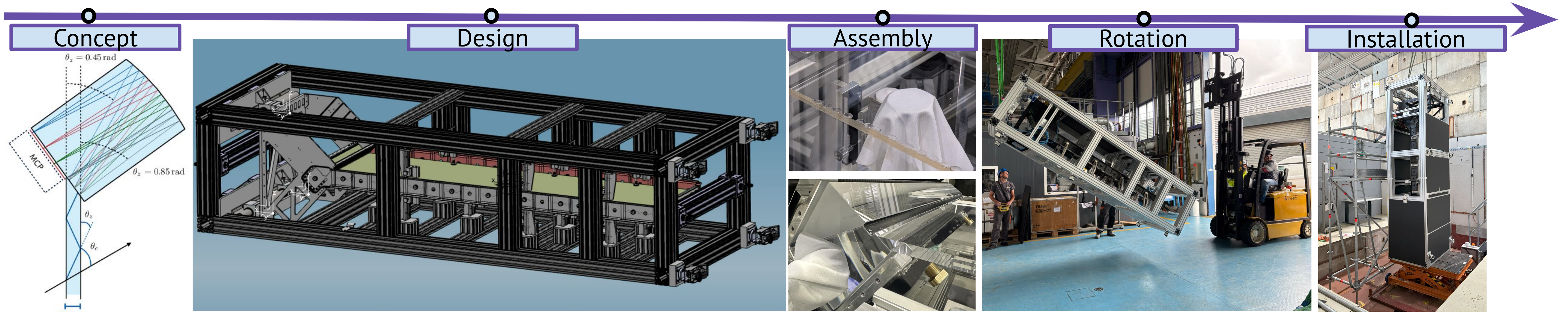
First results from a full-scale TORCH prototype

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Motivations

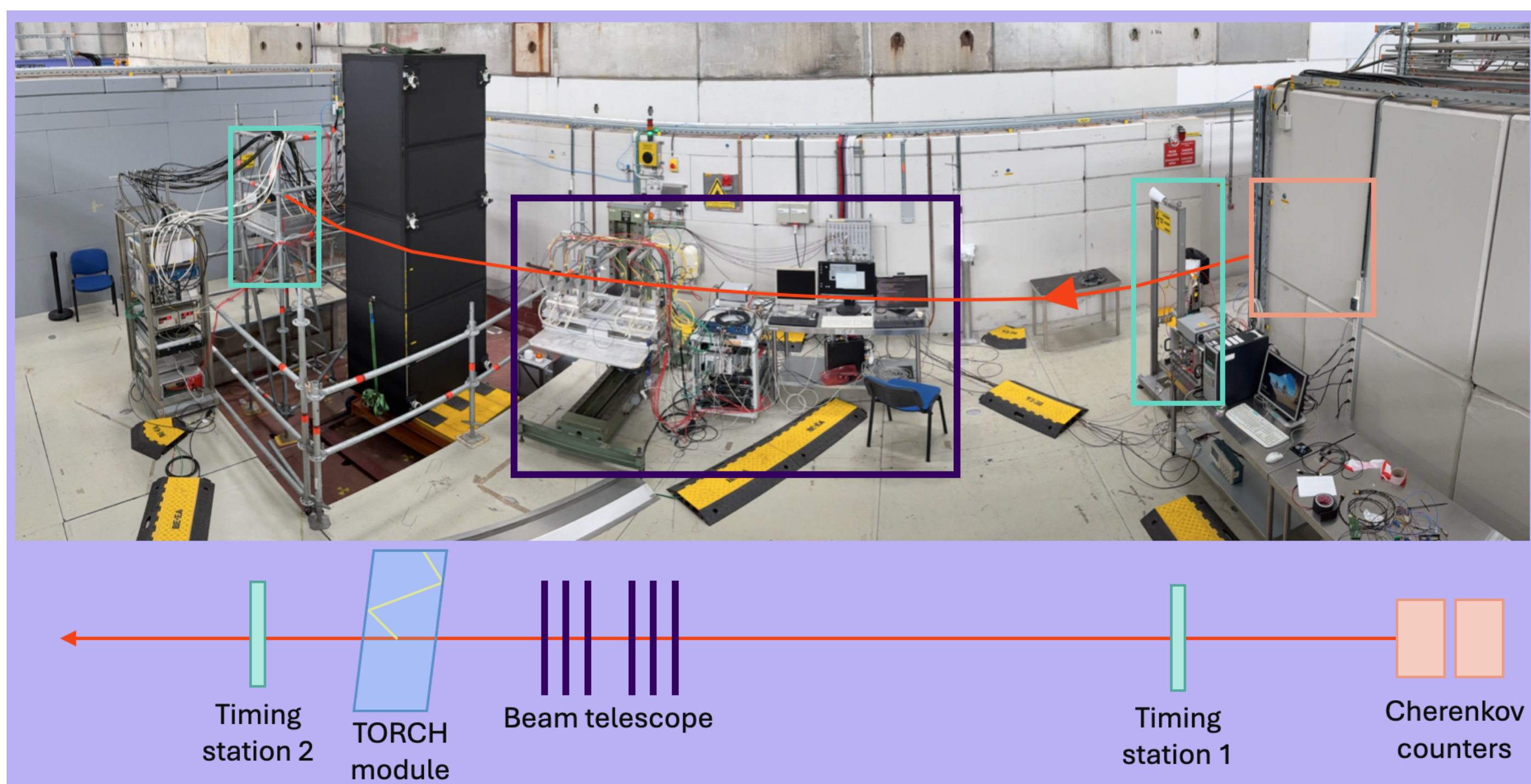
The time of internally reflected Cherenkov light (TORCH) detector [1] is a large area time of flight detector to operate in the high luminosity LHC as part of the LHCb Upgrade II. It is designed to provide complementary particle identification coverage to the RICH2 detector [2], extending to the low momentum (2-10 GeV/c) range. A full scale prototype of one TORCH detector module was assembled and tested at the CERN PS beamline in July 2025. This allowed extensive testing for mechanics assembly, transport, electronics and data acquisition in preparation for the Technical Design Report expected next year.

From Concept To Prototype

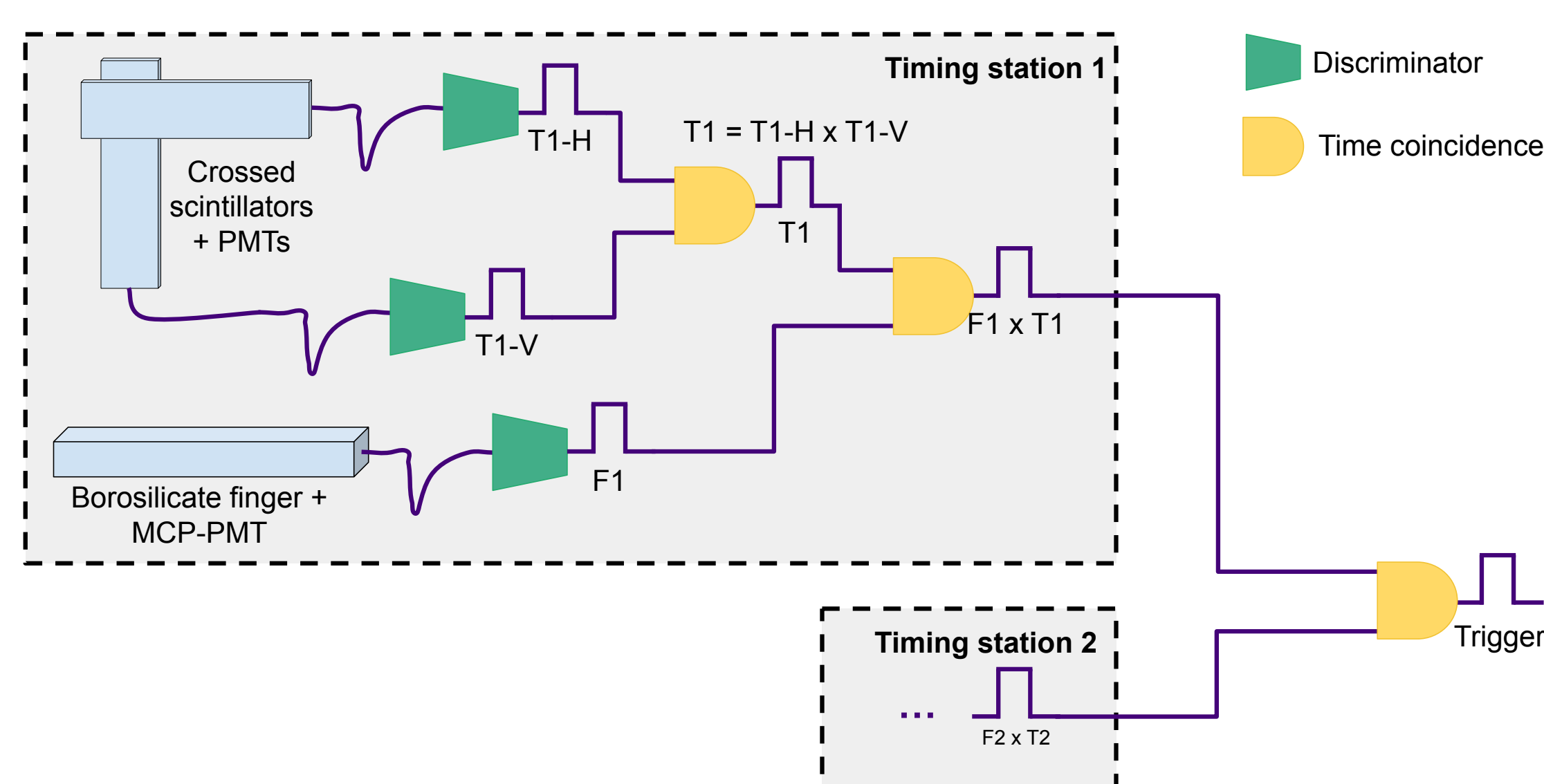


- Exploits prompt production of Cherenkov light in an array of fused-silica bars to provide timing
- Radiator plate made out of three pieces bonded together using structural adhesive for final dimensions of 66 cm × 250 cm × 1 cm
- Aluminum frame used as bonding-jig and exo-skeleton to support the module on a curtain rail support and protected by light-tight paneling
- Prototype bonded and assembled at LHC Point 8 before being transported over 8 km and rotated vertically for testing in the CERN PS beamline

Test Beam Setup

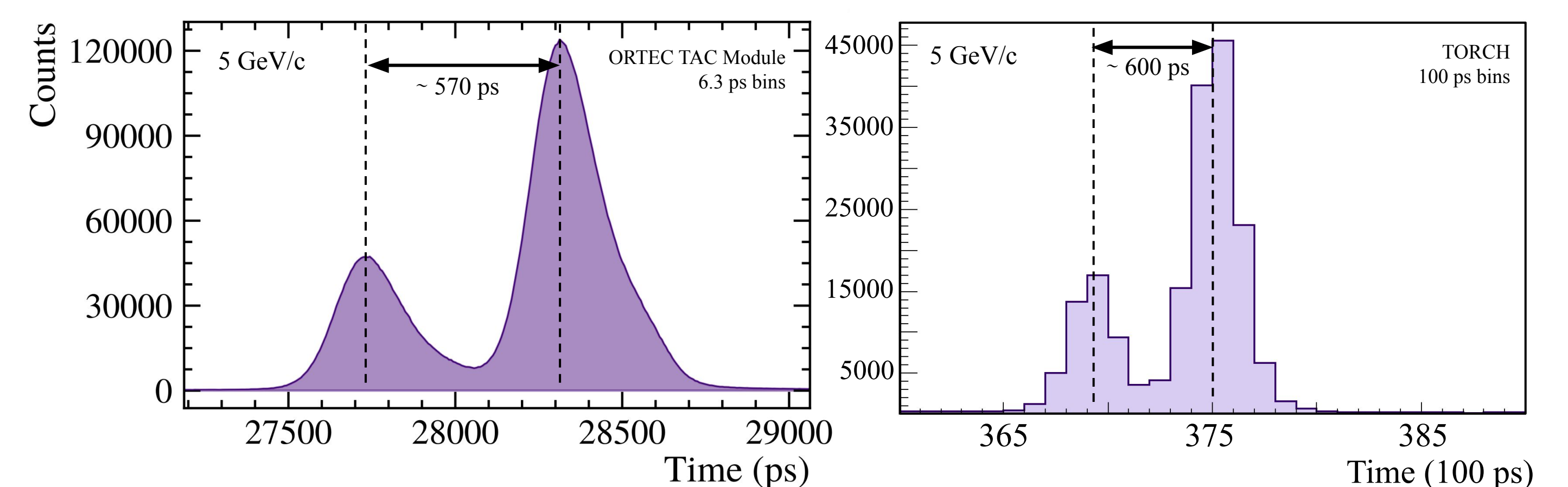


- Beam test conducted at CERN in the PS East area zone T9 from July 9th to August 5th 2025
- Beam: π^+ and p at 5, 8 and 10 GeV/c
- Module instrumented with 6 Photek MCP-PMTs
- Measurements made at four positions vertically along module.
- External PID information provided by two Cherenkov counters
- Tracking information provided by AZALEA beam telescope
- Two timing stations are used to provide a reference time for each event as well as trigger purposes

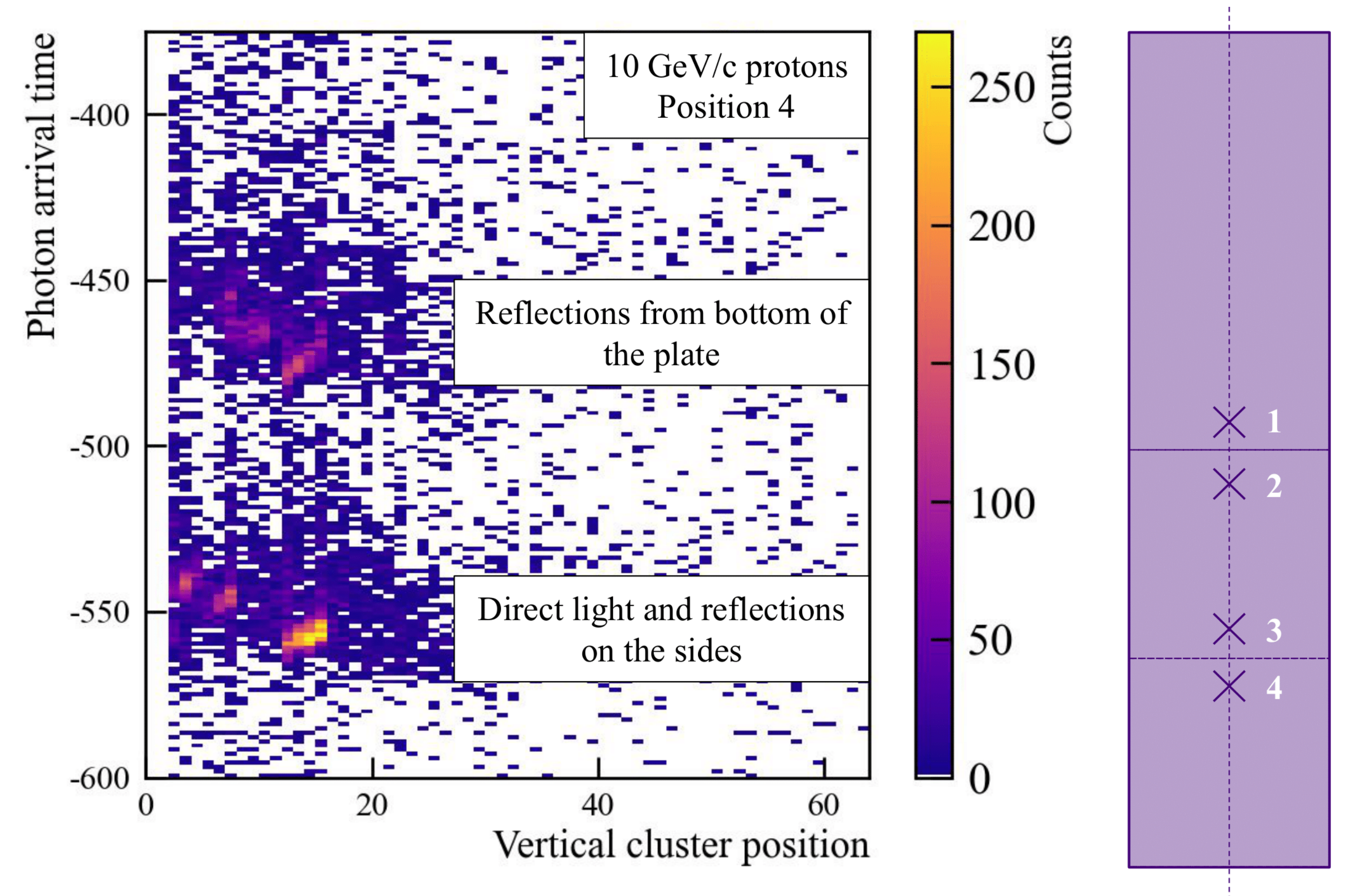


Preliminary Results


- Obtained expected time of flight difference between p and π over 10 m distance at 5 GeV/c from external timing system and TORCH data




- Can clearly see light for all tested beam entry positions
- Time projection matches what is expected from simulation
- No significant photon loss observed over bond joints.



References

[1]  TORCH: Time of Flight Identification with Cherenkov Radiation
M. J. Charles and R. Forty
Nucl. Instrum. Meth. A, 2011, **639**, 173-176

[2]  Performance of the LHCb RICH detector at the LHC
M. Adinolfi et al.
Eur. Phys. J. C, 2013, **73**, 2431.

