

INSTITUTE FOR
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PHYSICS



UNIVERSITY OF THE WITWATERSRAND



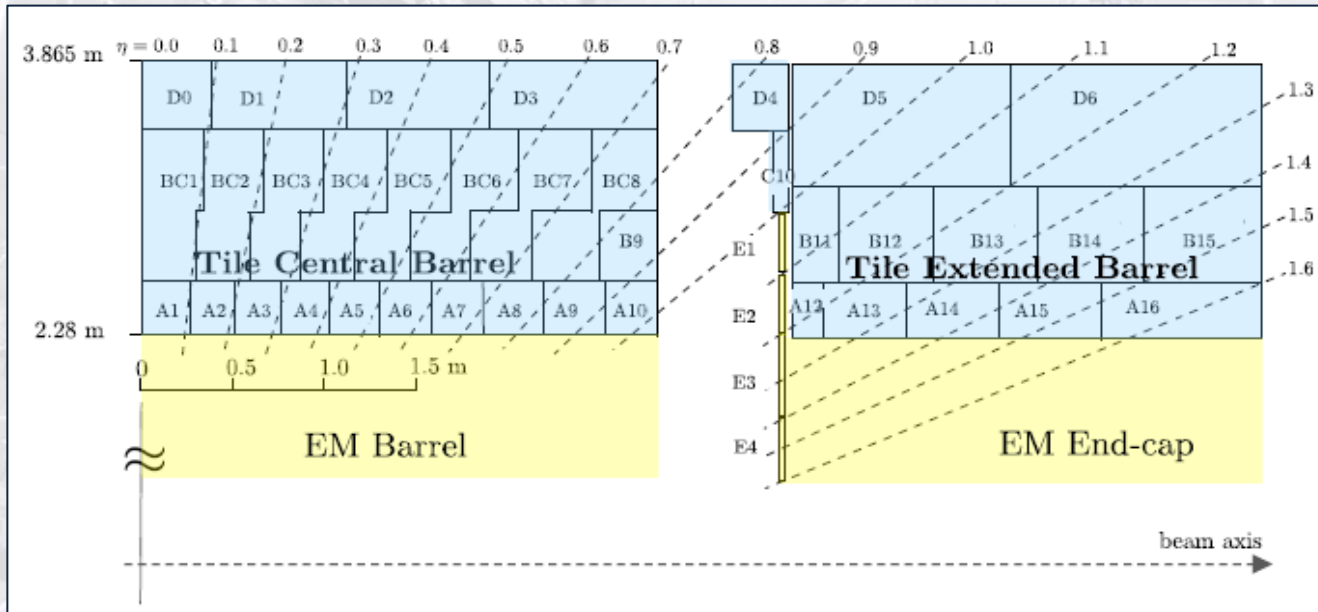
University of Venda

Assembly, quality checks and installation of the scintillator detector modules for phase I upgrade of the Tile Calorimeter of the ATLAS experiment

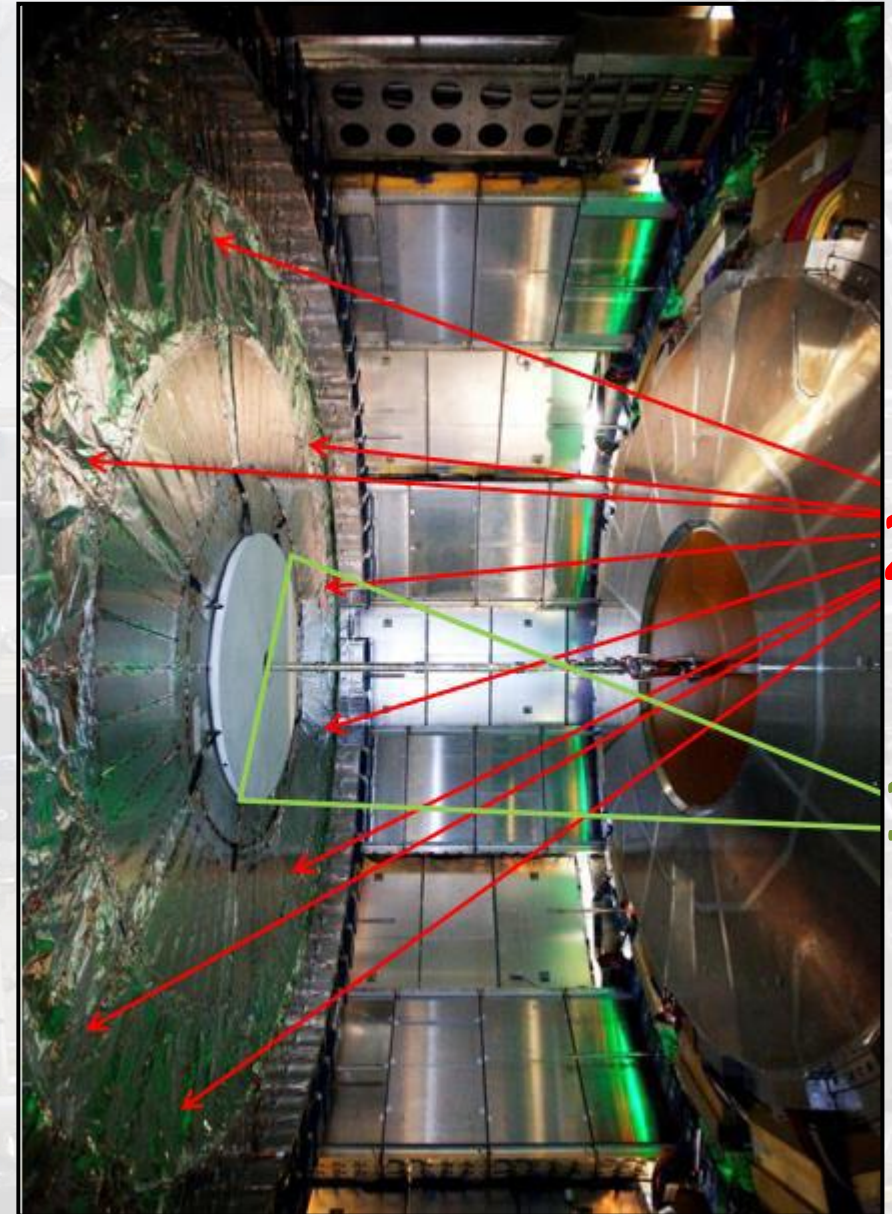
HEPP WORKSHOP 29-31 January 2020
University of Venda

Gaogalalwe Mokgatitswane

Crack and MBTS counters



- Occur in the gap region between the central and extended TileCal barrels
- During run 2, these counters were severely degraded by radiation and had to be replaced. (they are designed to be easily replaceable)
- Radiation hard plastic scintillators are ideal for high radiation environment
- WITS University was previously involved in the radiation qualification and selection of the scintillator material to be used in the counter production.

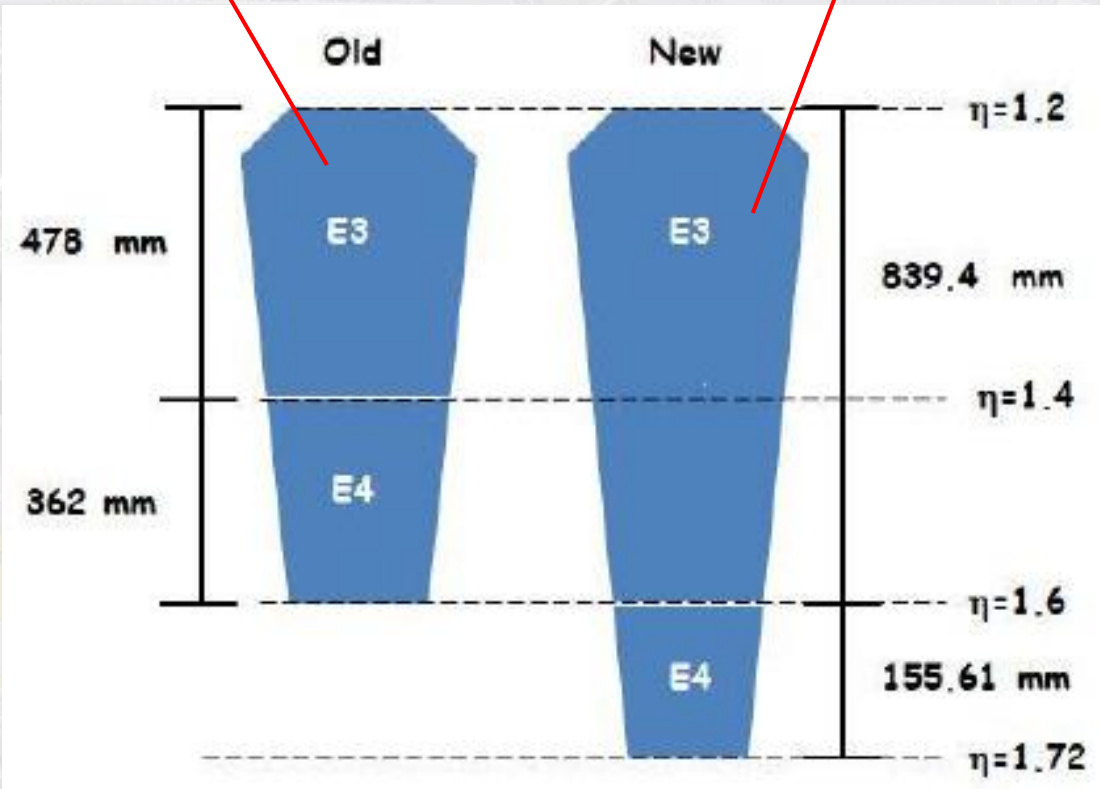


1: MBTS scintillators
2: Crack scintillators

Counters geometry optimization

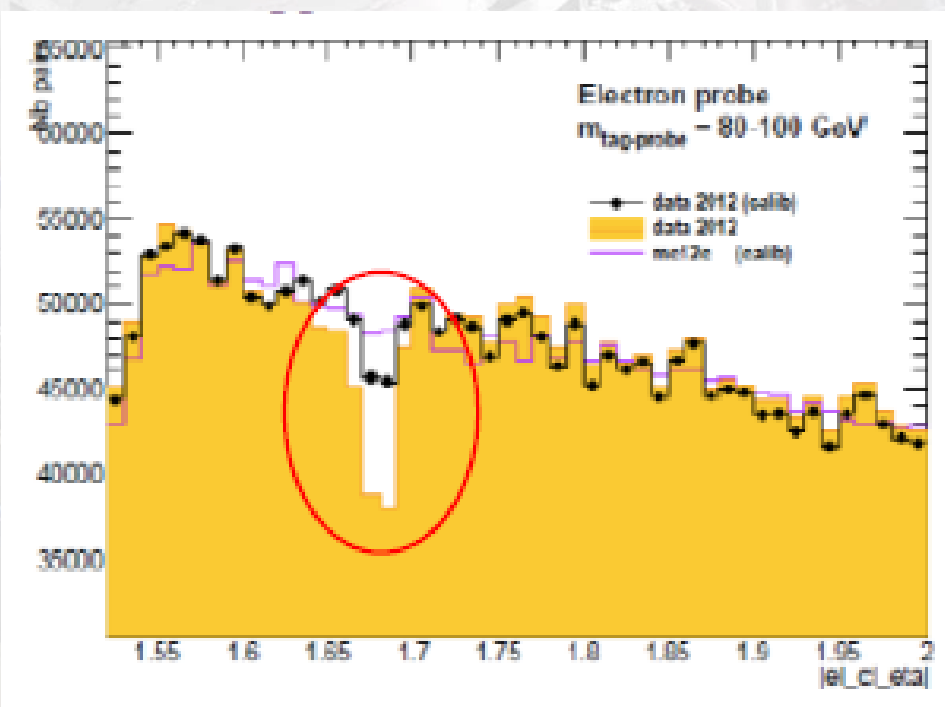
PVT scintillator
(EJ-200)

high-performance PVT scintillator
(EJ-208)



Details:

<https://indaico.cern.ch/getFile.py/access?contribId=6&sessionId=0&resId=0&materialId=slides&confId=295935>

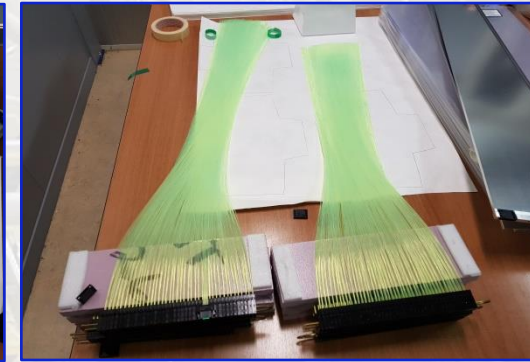
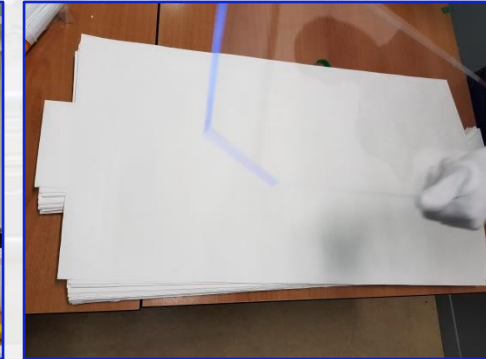
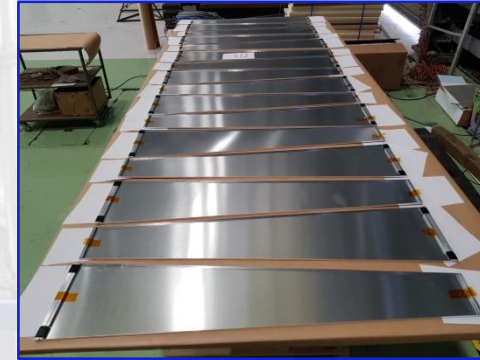


- The geometry of new counters extended up to 1.72 in pseudorapidity
- In the past there was a low electron reconstruction efficiency in the electromagnetic region ($1.6 < \eta < 1.72$) -

Assembly of E3E4 counters

Procedure

- ✓ Prepare aluminum cans (gluing).
- ✓ Tyvek paper for tile wrapping.
- ✓ Place the fibers carefully along each tile and wrap with tyvek.
- ✓ Encapsulate wrapped tiles in Al cans.
- ✓ Seal the counter – plastic (black) and Al tape.
- ✓ Check the quality with the Sr90 scan.



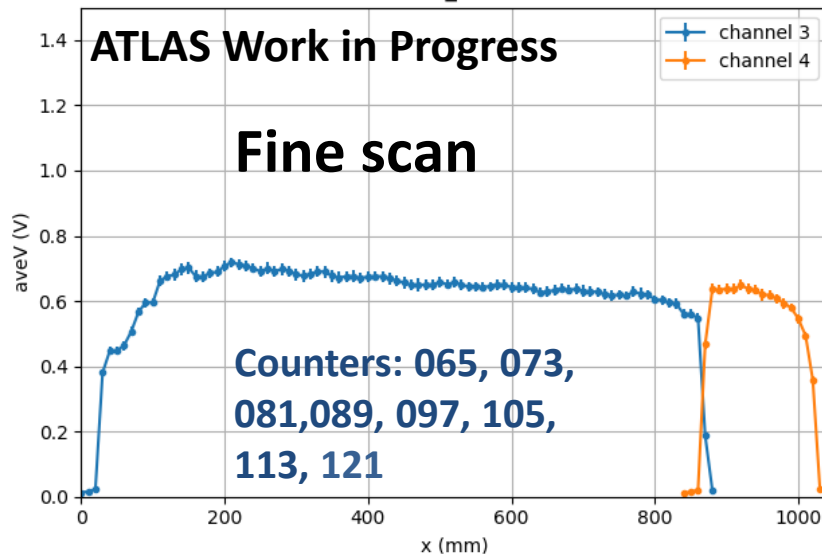
➤ 128 counters were assembled for the EBA and EBAC.

Sr90 scans

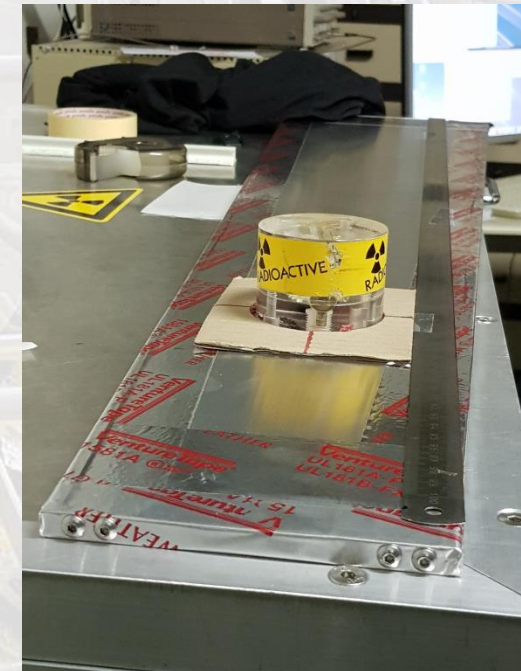
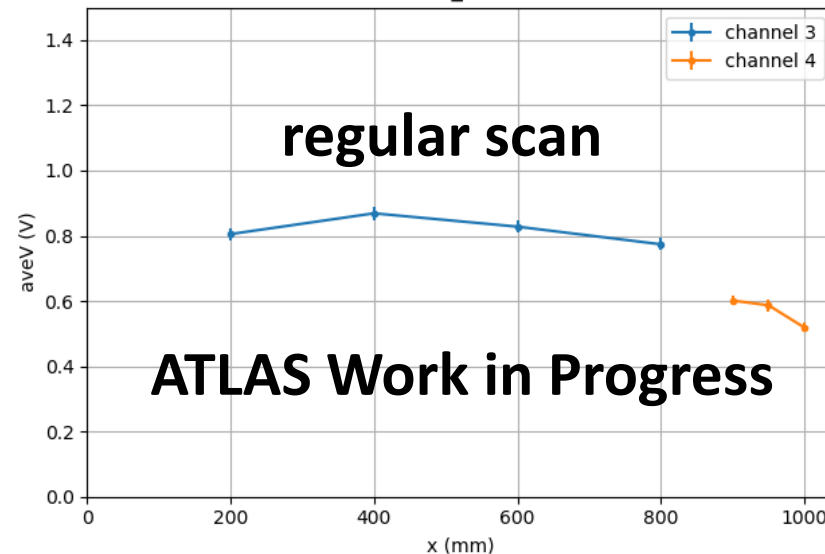
- PMT inside the light tight scan box
- High voltage source for the PMT and a digital multimeter for readout
- Counter is connected to the PMT with a clear optical fiber cable.
- Sr90- beta source (25MBq)
- Fine scans (steps of 10 mm) and regular scans (200, 400, 600, 800 & 900, 950, 1000mm) were conducted.
- One fine scan after every 7 regular scans
- All EBA and EBC counters were certified



EBA00_065-v1

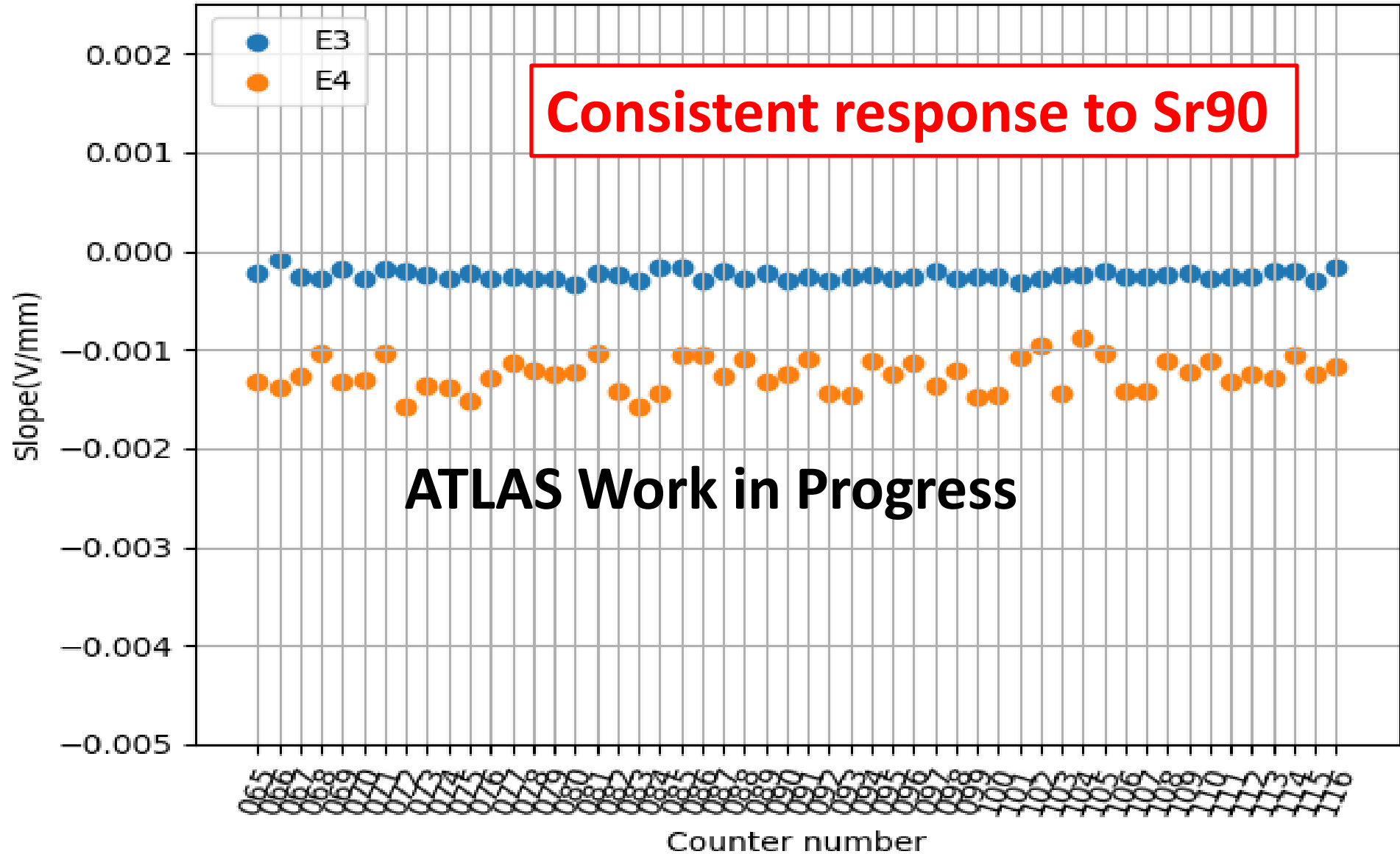


EBA00_066-v1

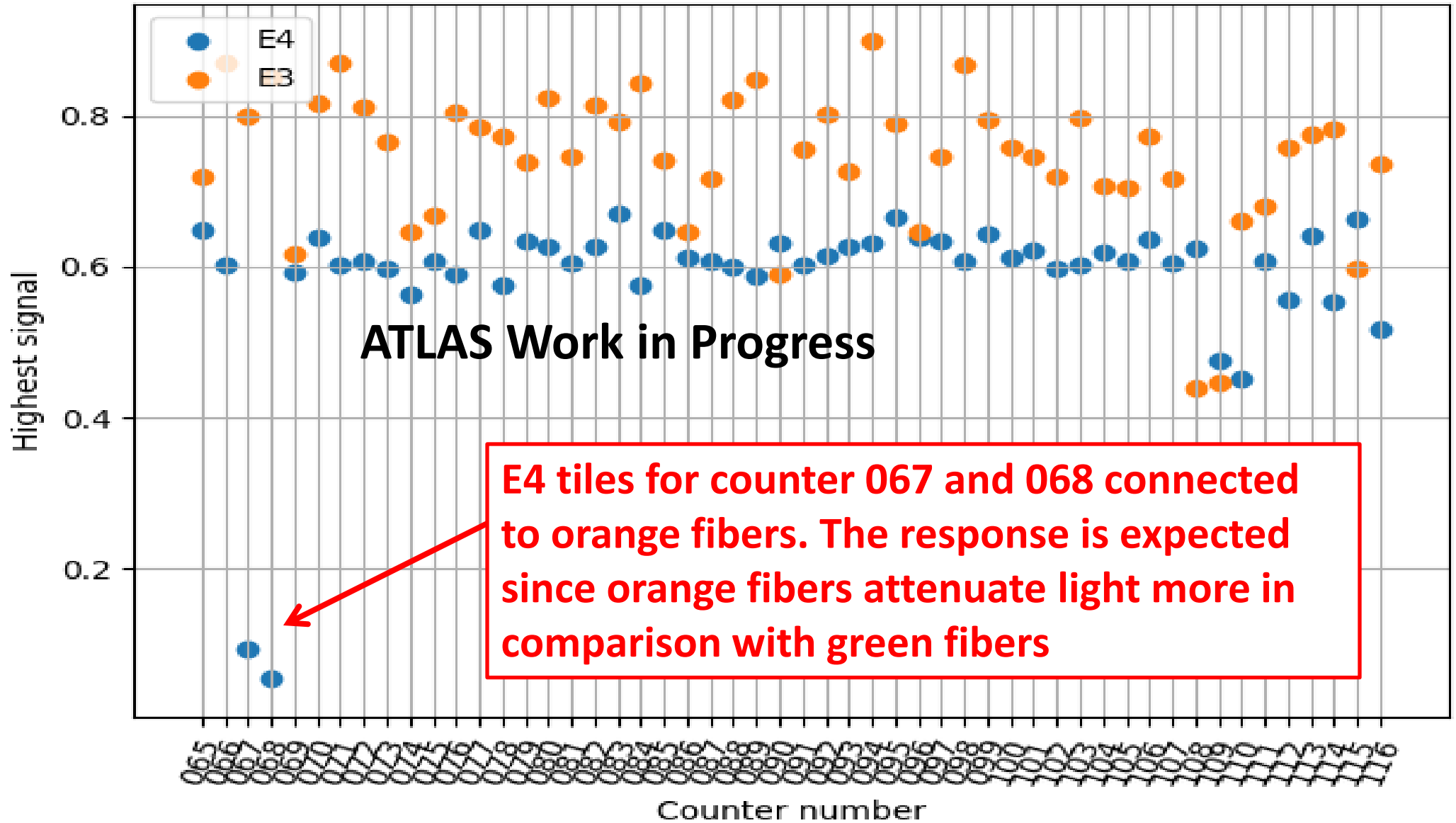


➤ Signal output after subtracting pedestal

Summary of the slopes for each counter



Highest voltage for each counter



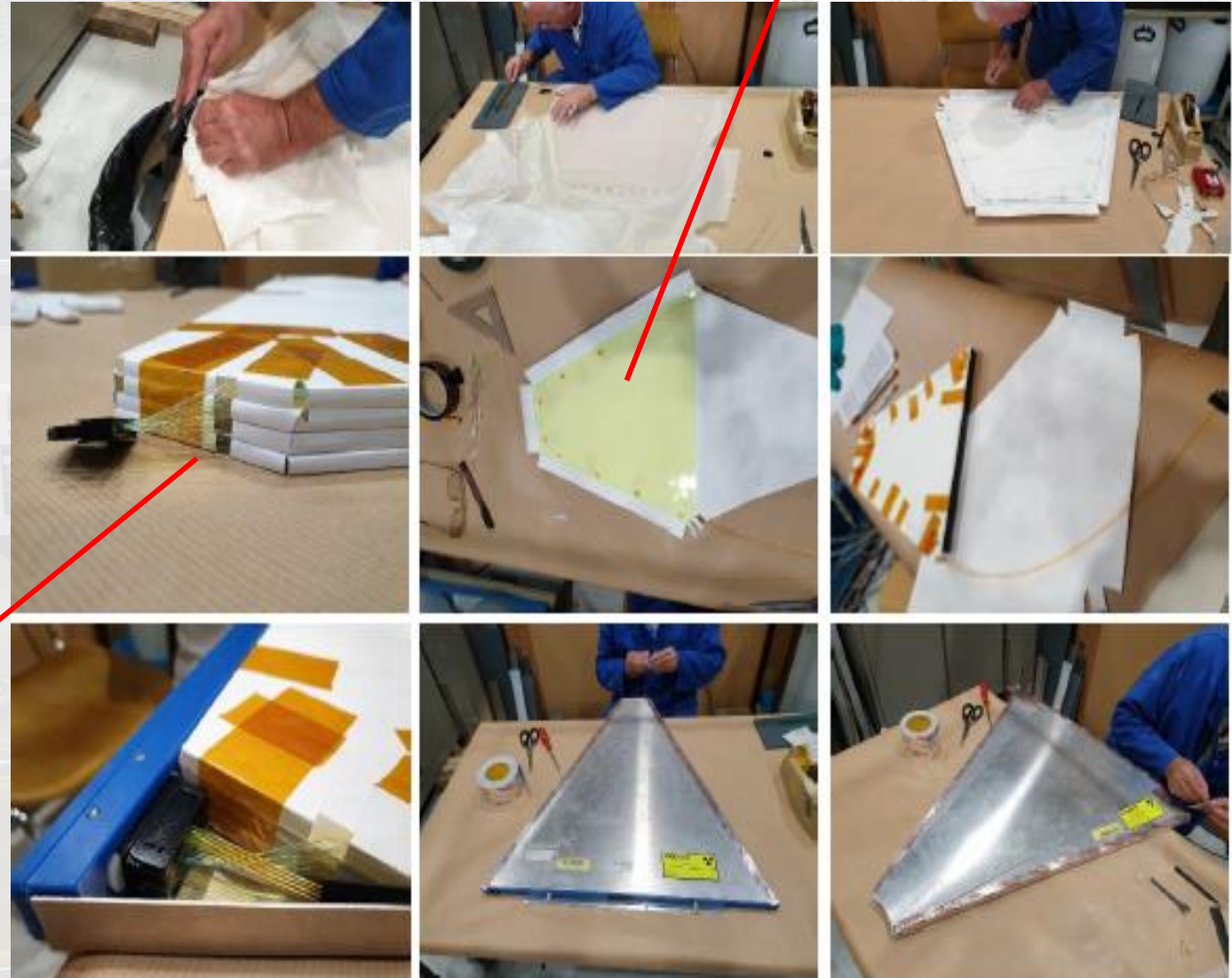
- The overall response of counters to Sr90 is consistent

MBTS refurbishment

Green scintillator (inner counter)
from IHEP Protvino + Orange fibers

Procedure:

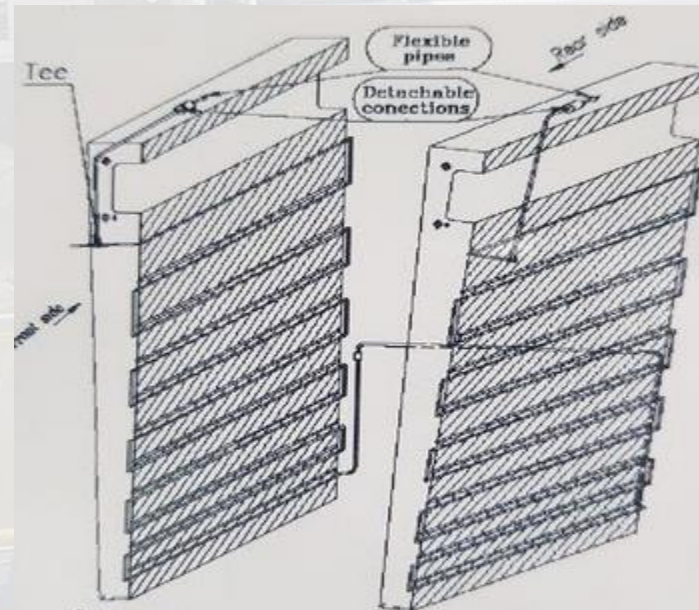
- Open the can, remove old scintillator and fibers, clean
- Prepare the scintillators and Tyvek wrapping
- Put the fibers and wrap the plates in Tyvek one by one
- Put the wrapped plates in the can
- Seal the counter
- Total of 16 counters produced and tested with Cs137



PS scintillators (outer counter)
and new green fibers

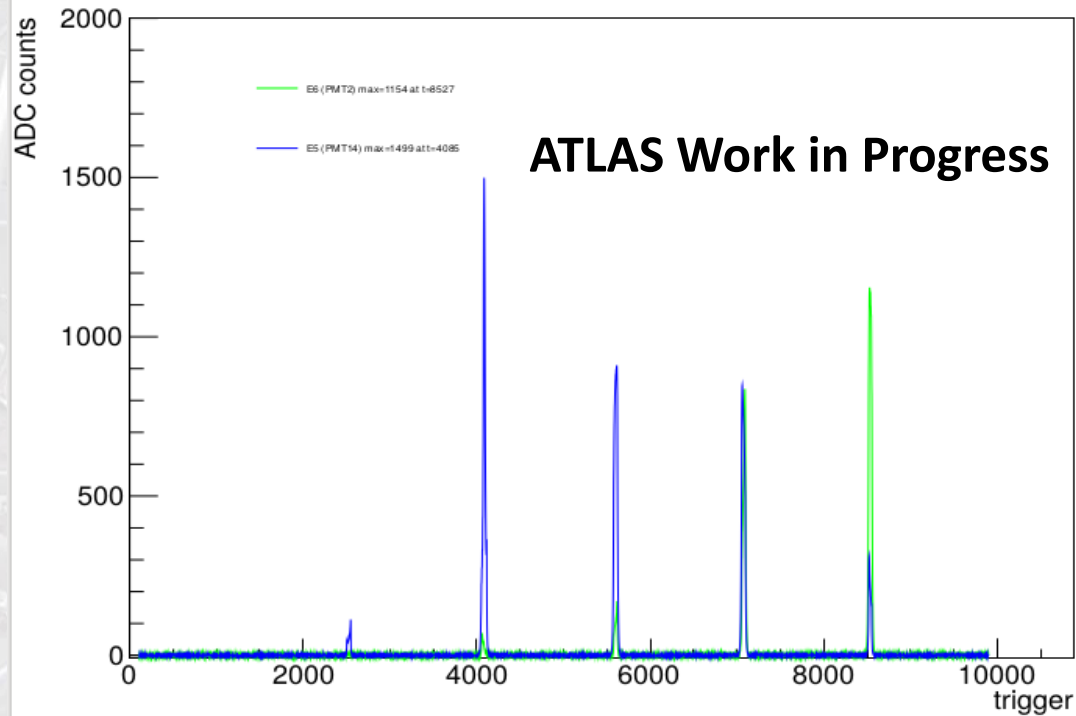
Cs137 scans : MBTS

- Each counter was tested with Cs137 system
- Counter is attached to the edge of the EB module, where the tubes are going out of the calorimeter module.
- The maximum amplitude with pedestal subtracted is used a metric.
- All EBA and EBC counters (16) were certified

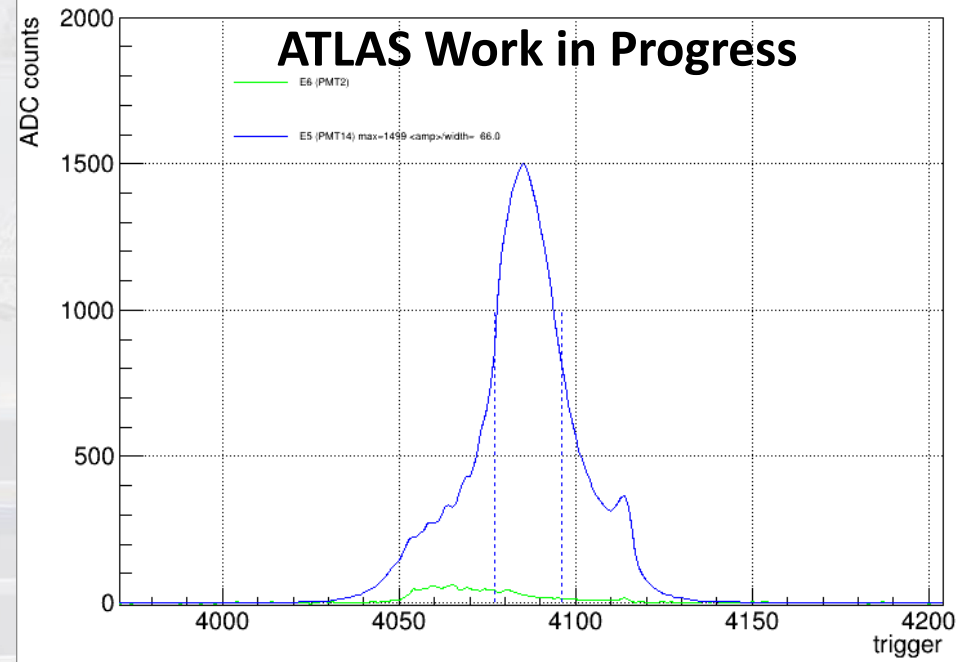


Barrel module tube layout (inside view)

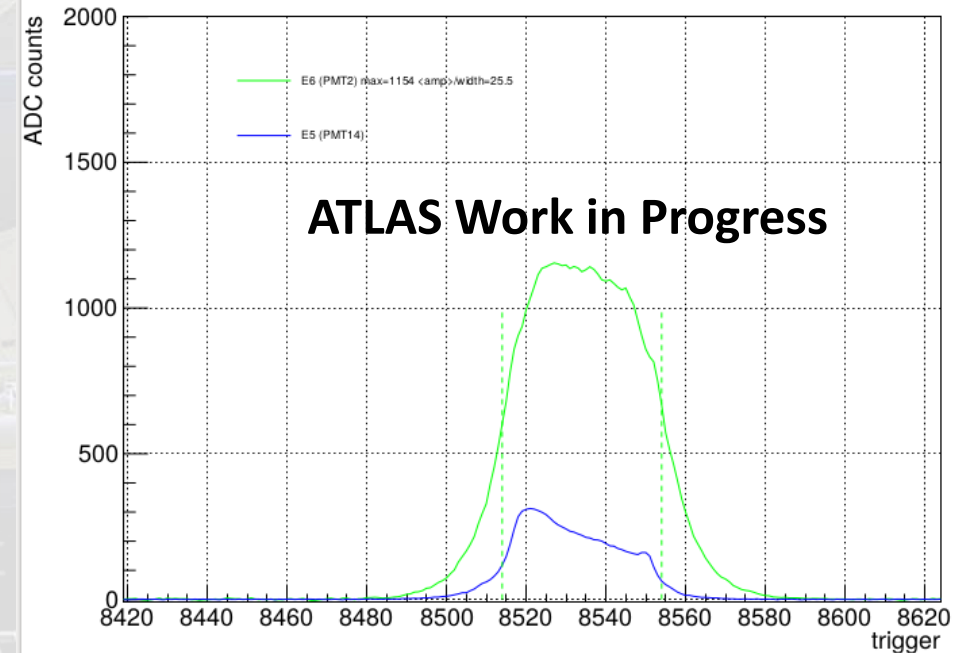
MBTS # Cs scan



MBTS # Cs scan T5



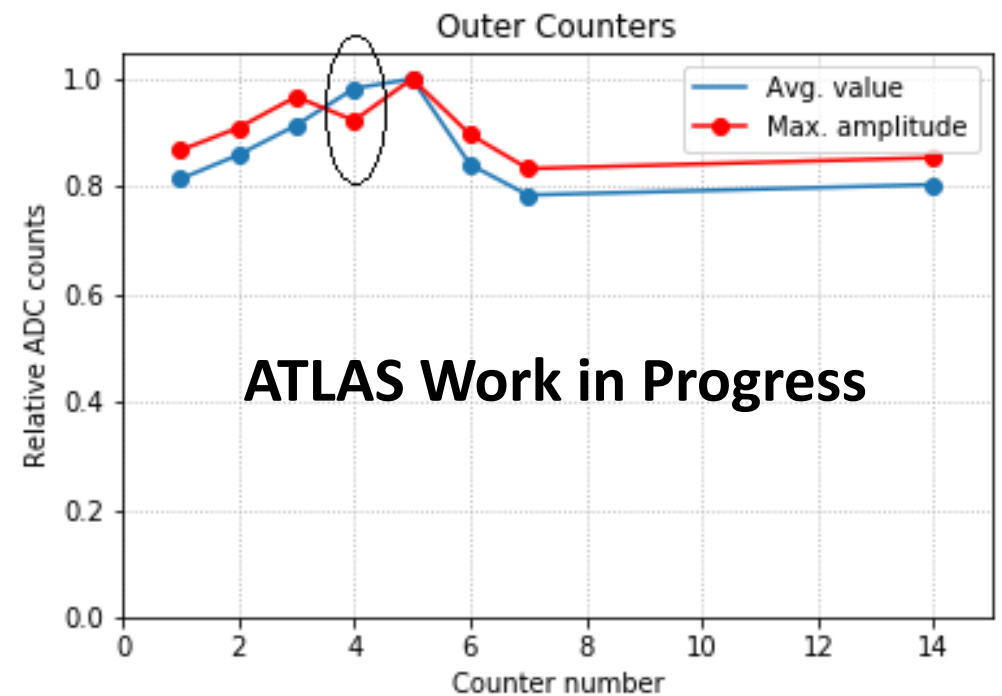
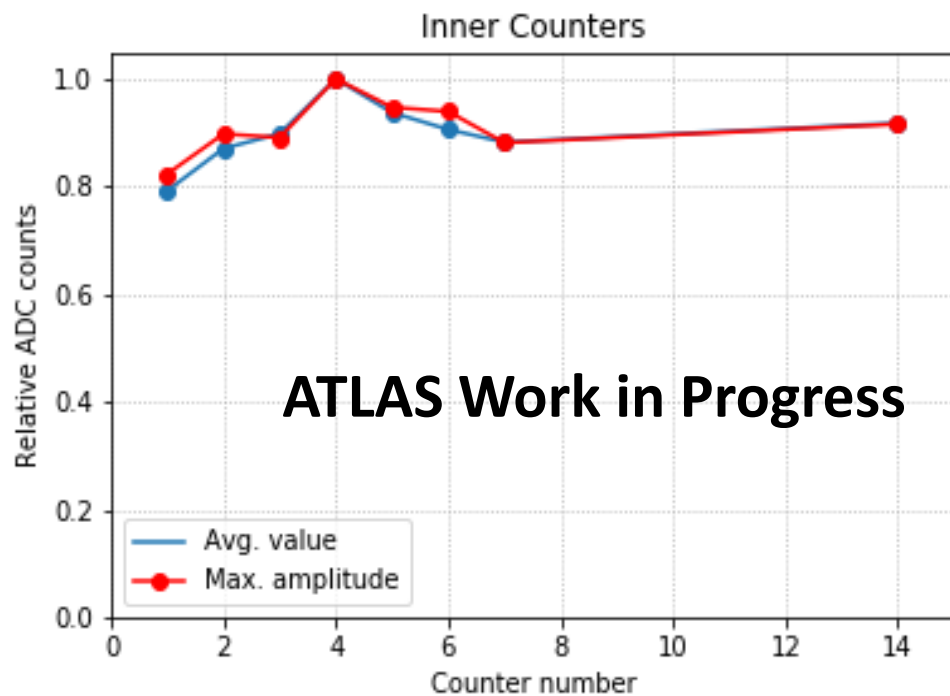
MBTS # Cs scan T2



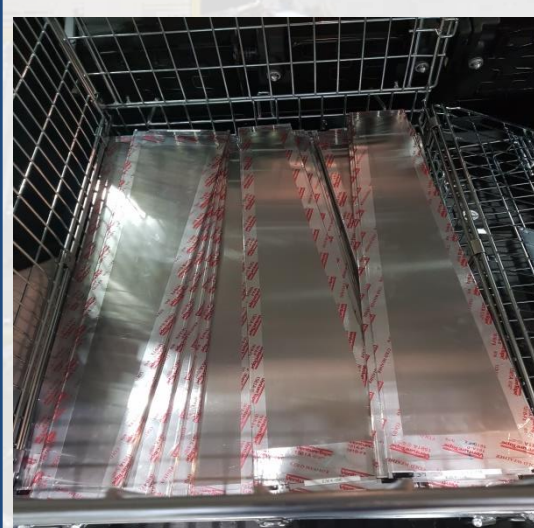
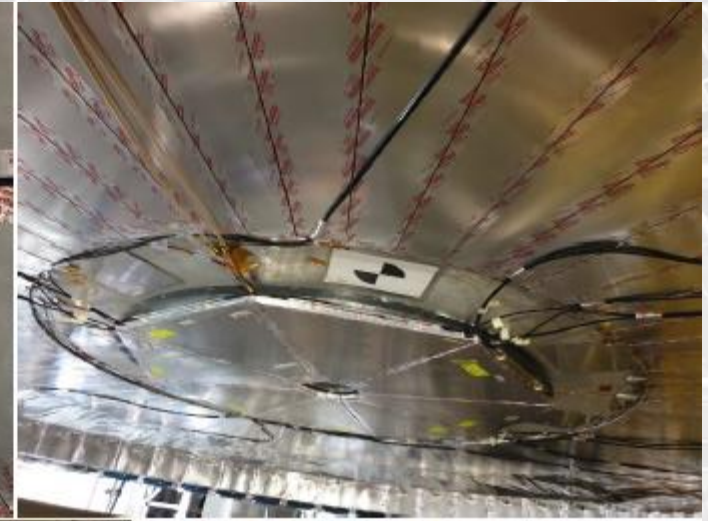
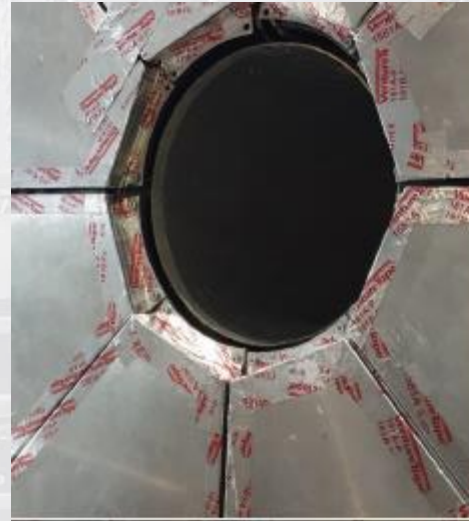
MBTS #	C PHI	Cs run	Inner	Outer
14	0	11316	1057	1387
04	1	11320	1154	1499
06	2	11322	1084	1457
05	3	11326	1093	1625
01	4	11328	0950	1409
07	6*	11330	1017	1354
02	5	11332	1036	1477
03	7*	11334	1028	1571

* Phi positions had to be swapped

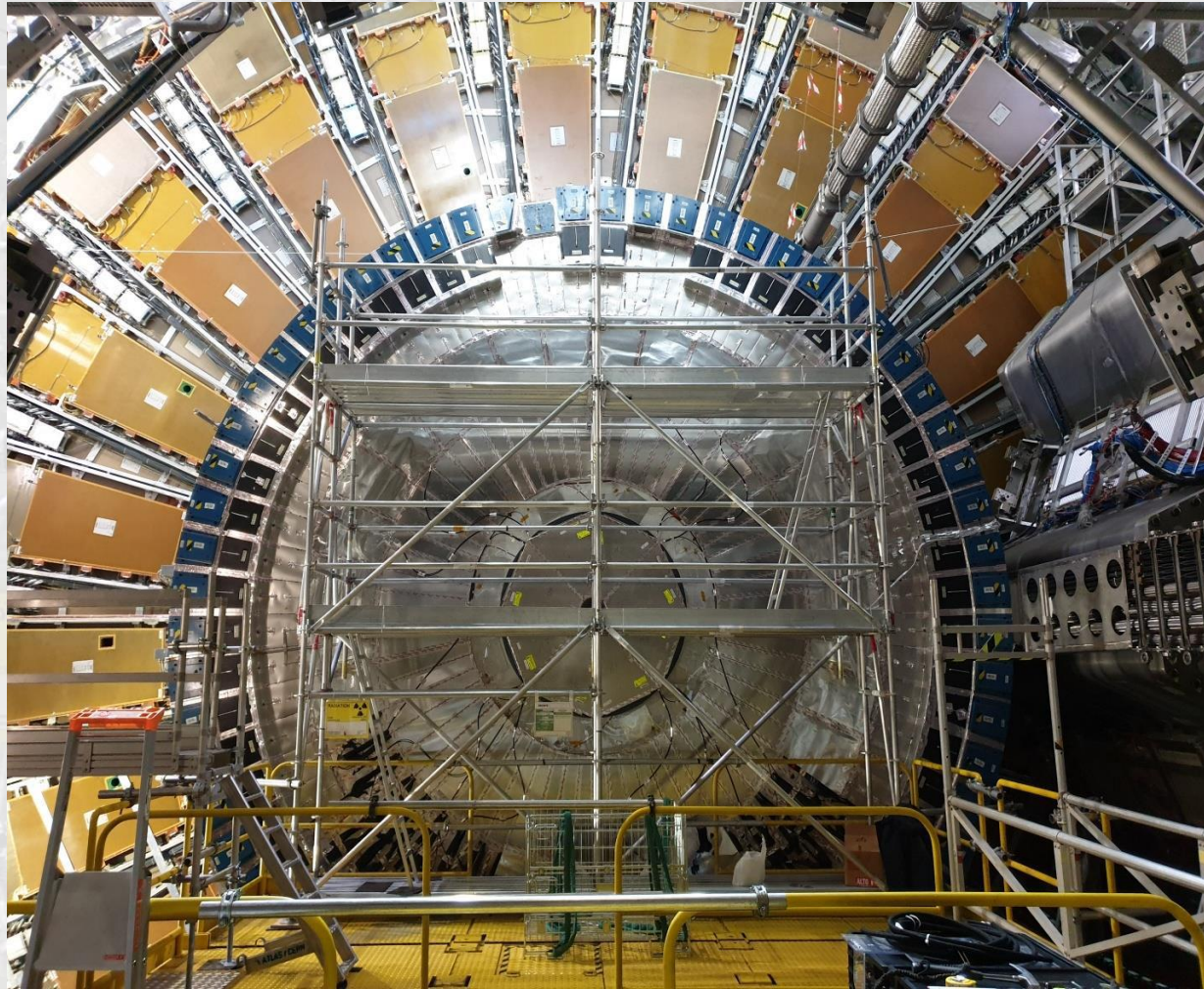
ADC ratio plots for inner and outer counters



Installation of counters on the ATLAS detector



Conclusion



Phase I upgrade completed with a strong contribution from South Africa

- During Run 2 (2015-2018), Crack and MBTS scintillators were severely degraded by radiation and had to be replaced.
- Crack and MBTS counters were assembled, qualified and characterized using radioactive sources (Sr90 and Cs137)
- All counters certified and installed on ATLAS.