

ADAPT ACD status report

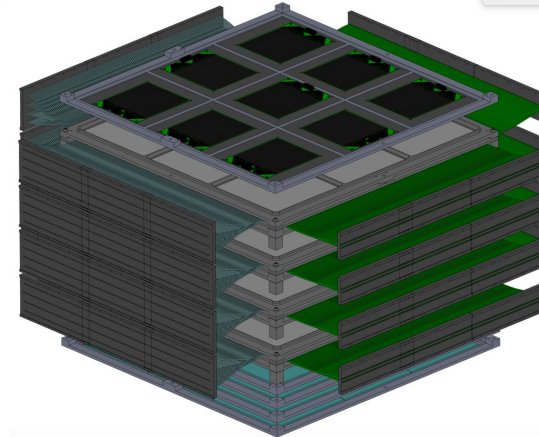
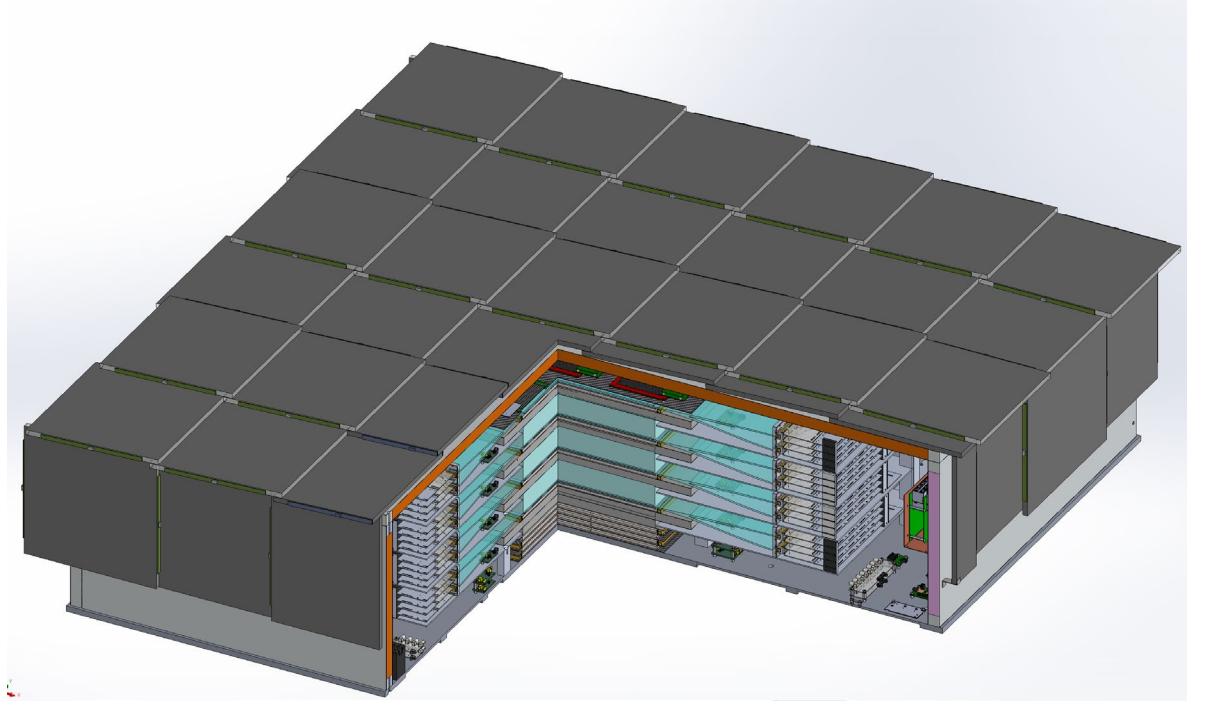
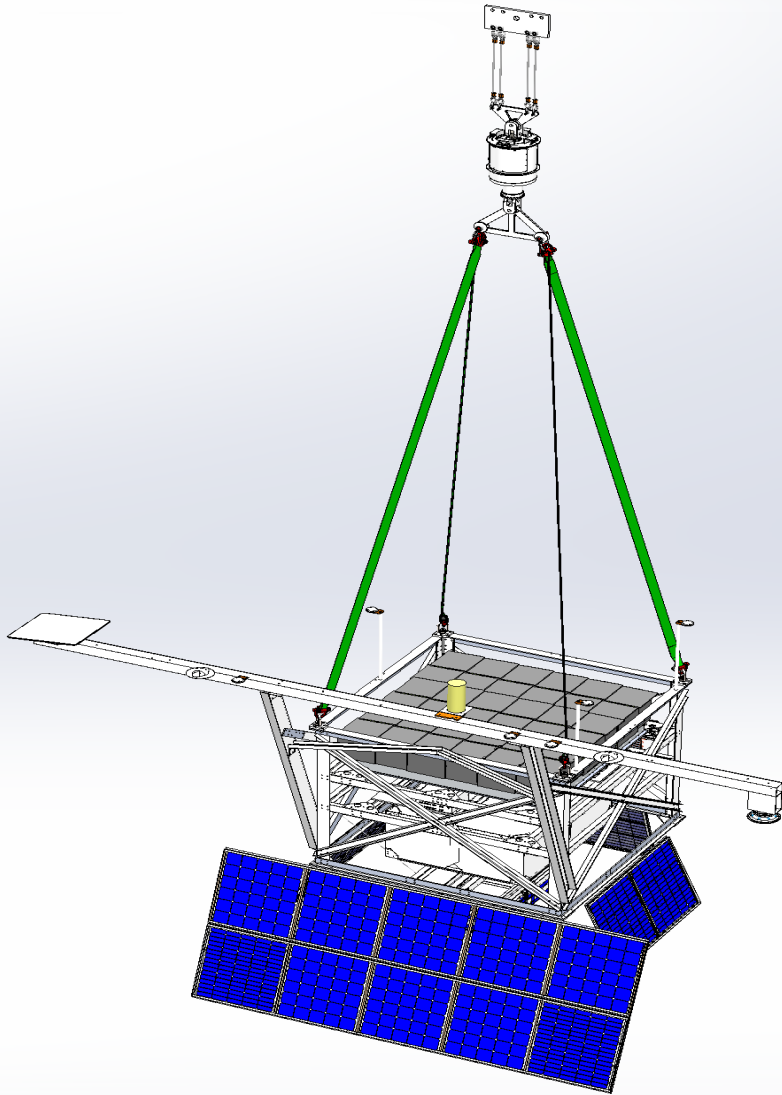
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INFN Bari

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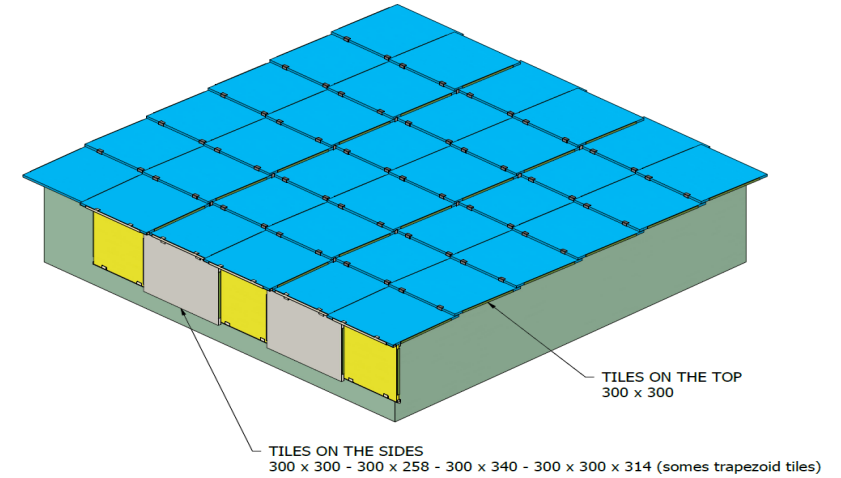
Nov 5, 2025

ADAPT instrument

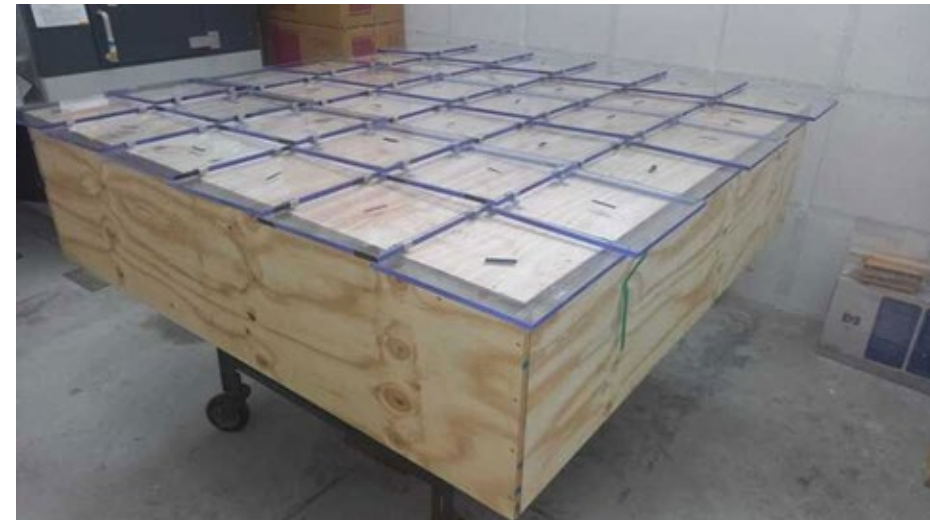


ADAPT-ACD layout /1

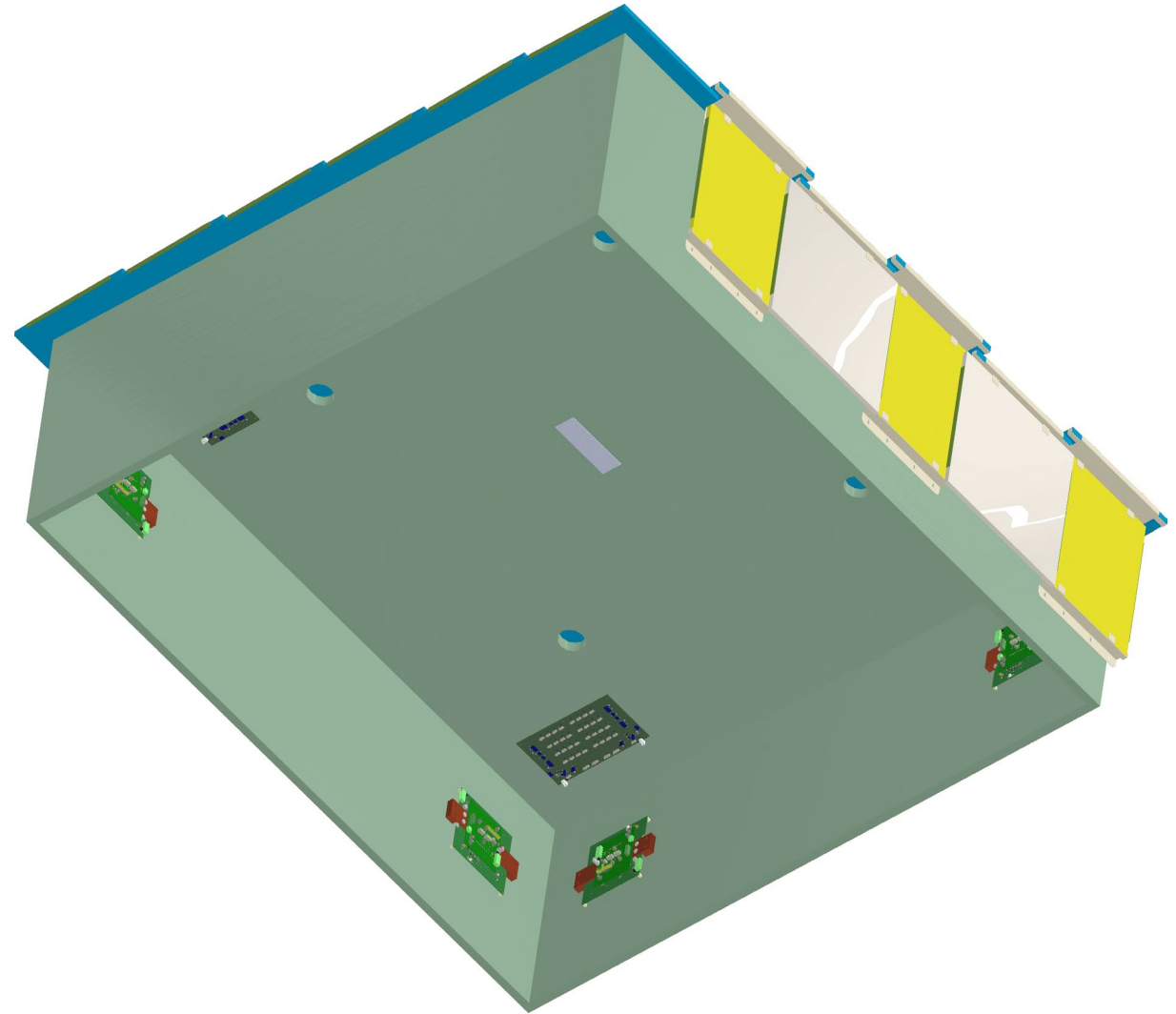
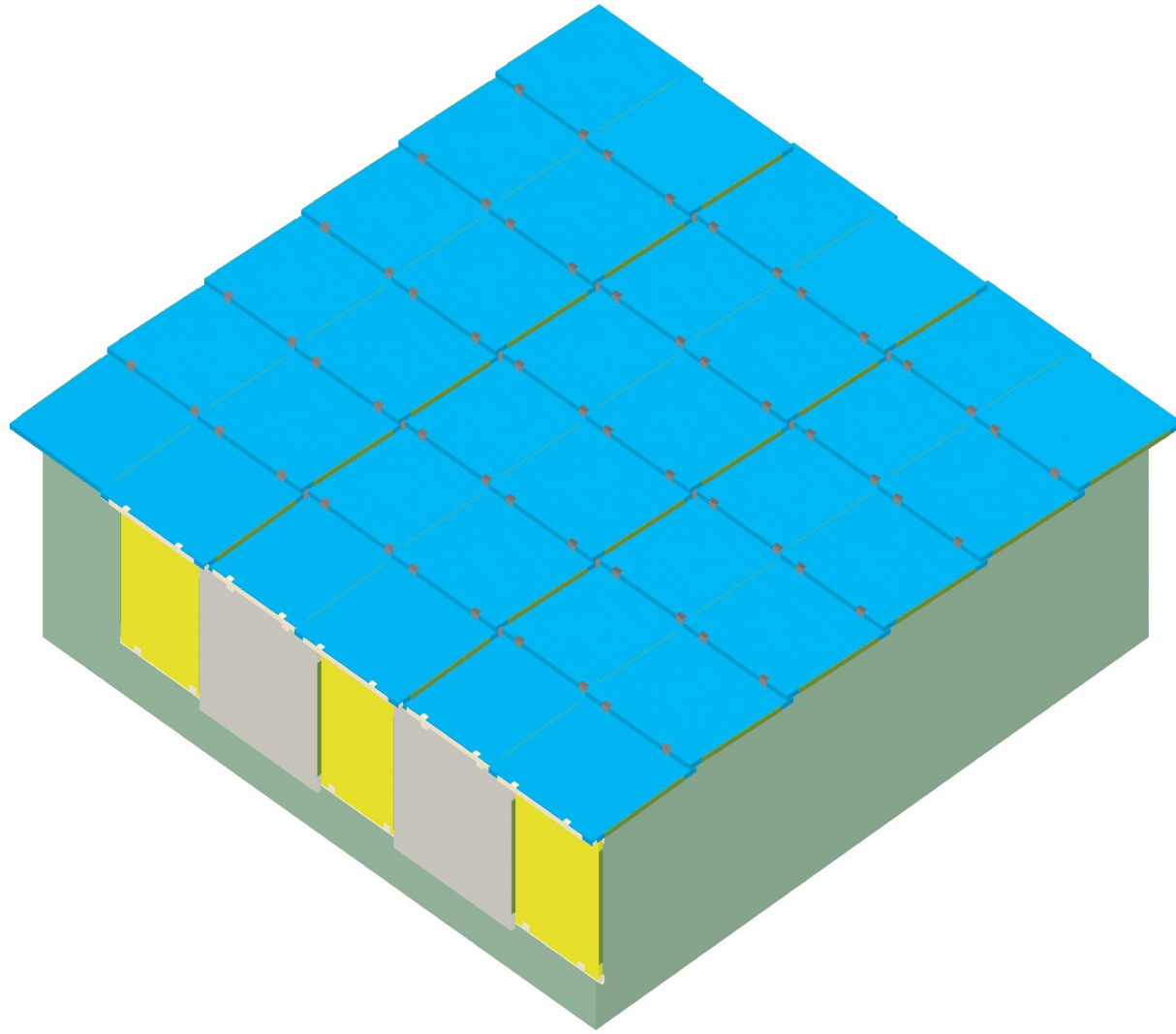
- ACD design proposal: tile option à la Fermi
 - Single tile cross sections of 30 cm × 30 cm
 - 2 cm overlap in both directions
 - Top face with 6 x 6 tiles
 - Slightly tilted in one direction to accommodate the overlap and to have an overall flat layout
 - Even and odd rows are staggered in height
 - Side faces with 1 x 6 tiles
 - 60 EJ-200 plastic scintillator tiles 1 cm thick
- Read-outboard with beta-chipASIC developed by ICCUB for the HERD PSD
 - Each tile will be readout by different SiPMs in order to increase the light detection efficiency and the dynamic range for nuclei identification



Mockup@INFN Bari

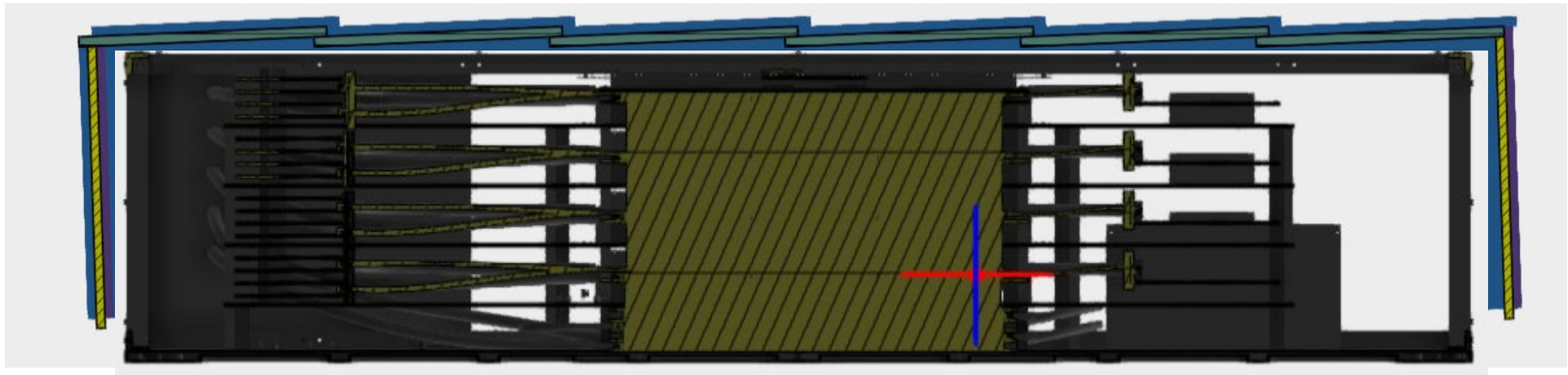


ADAPT-ACD layout /2



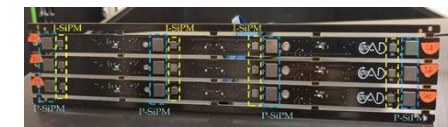
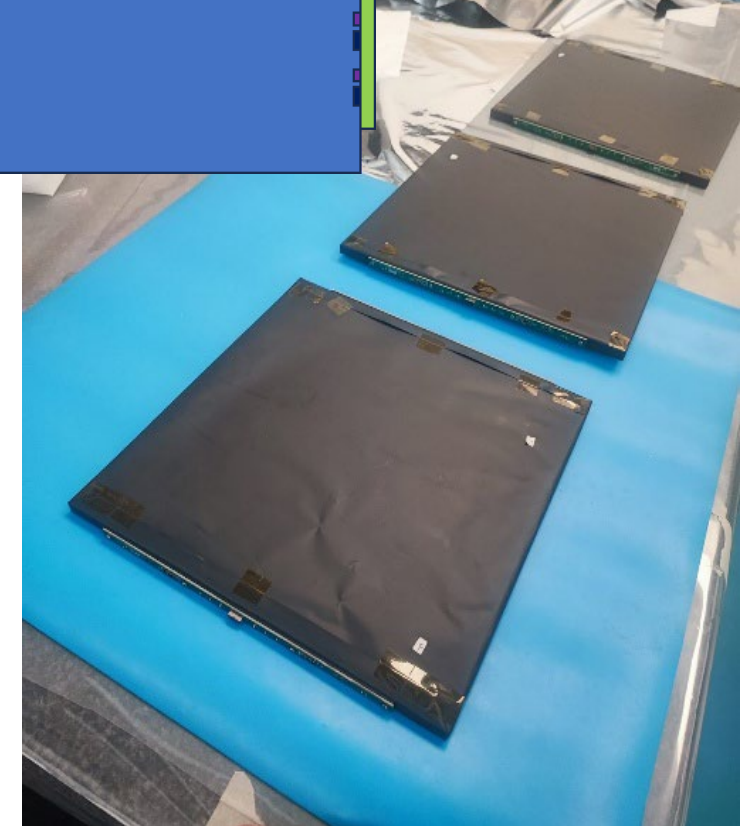
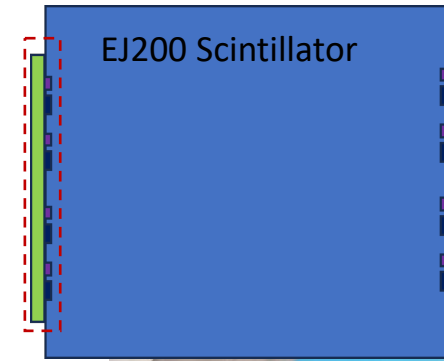
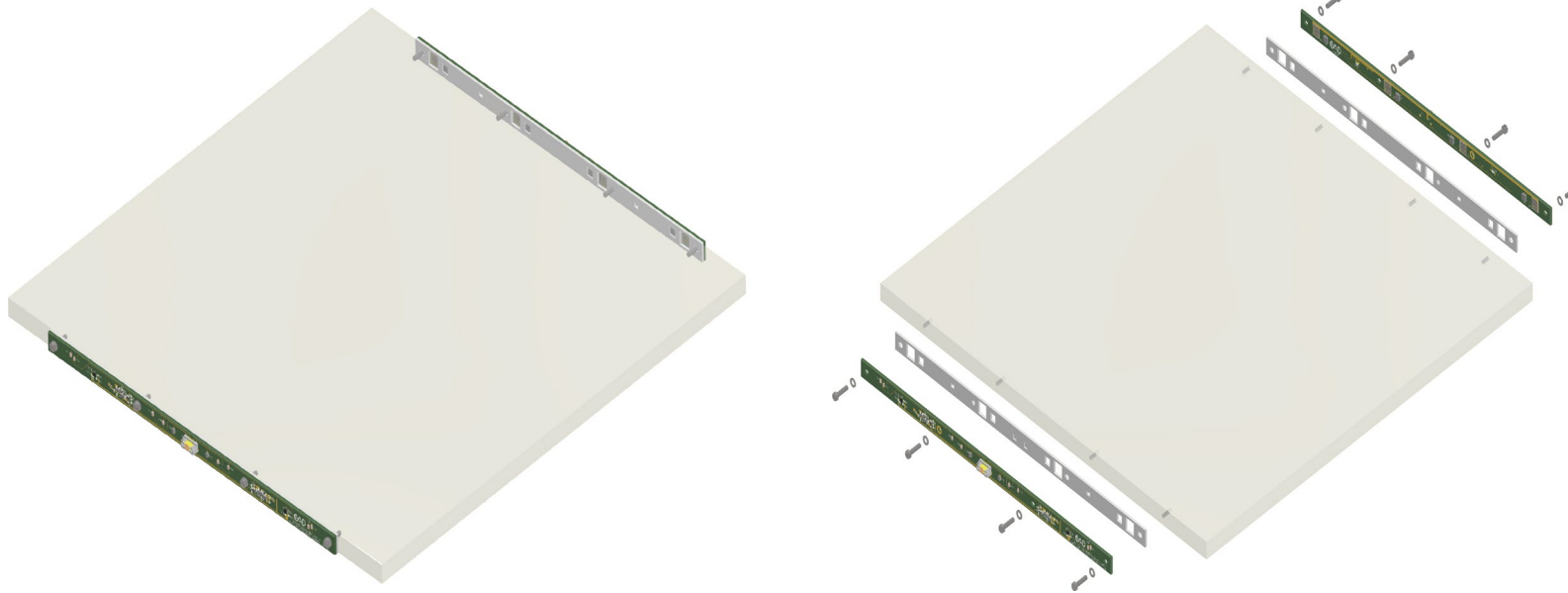
Credits Maurizio Mongelli

ADAPT-ACD layout /3

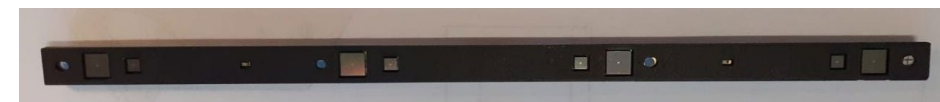
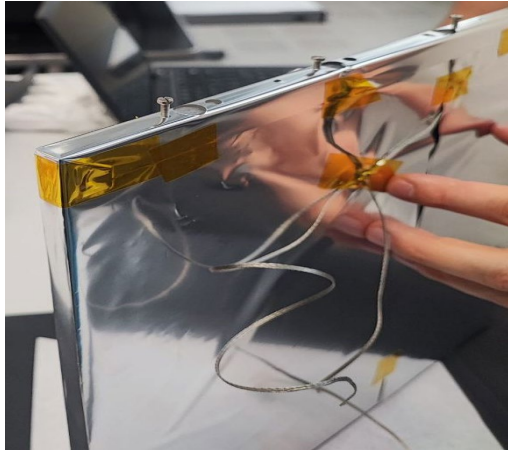
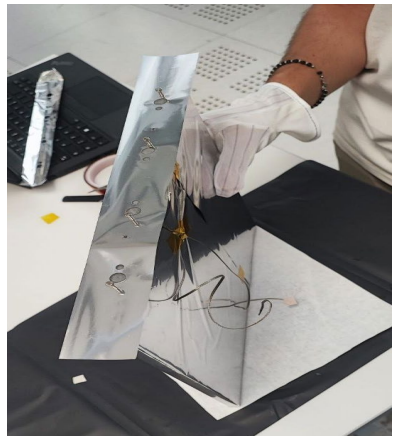
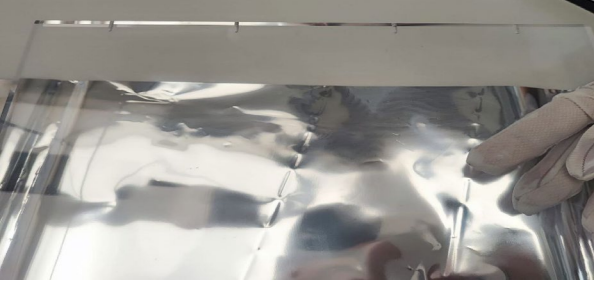


Tile layout

- Two edge SiMP carrier board per tile
- Each edge SiPM carrier board:
 - 4 proton SiPM 6x6 50um cell pitch (proton VETO, light Z nuclei)
 - 4 ion SiPM 3x3 40 um (50um) cell pitch (high Z nuclei identification)
- Each Tile:
 - 16 output channels to concentrator boards
- Wrapping: Al foil (15um) + 2-3 Tedlar black foils (50um thick)

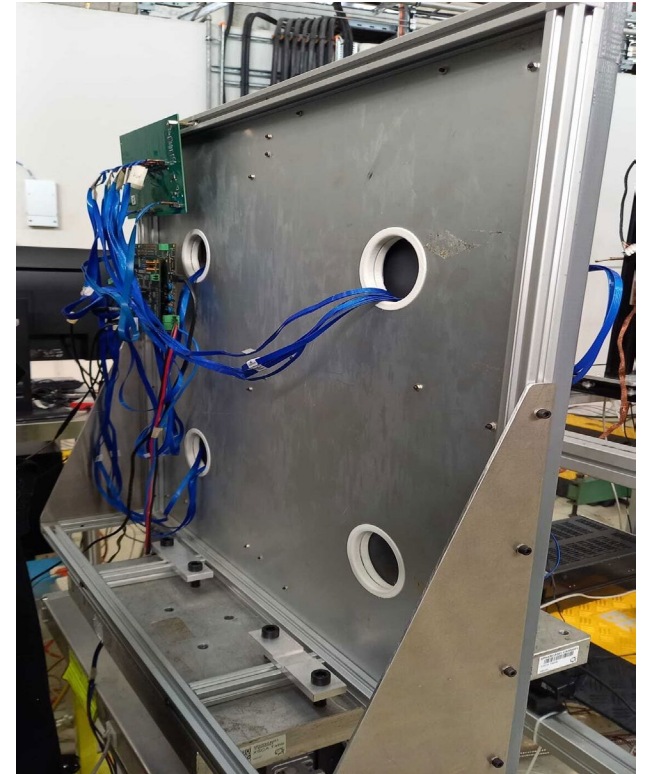
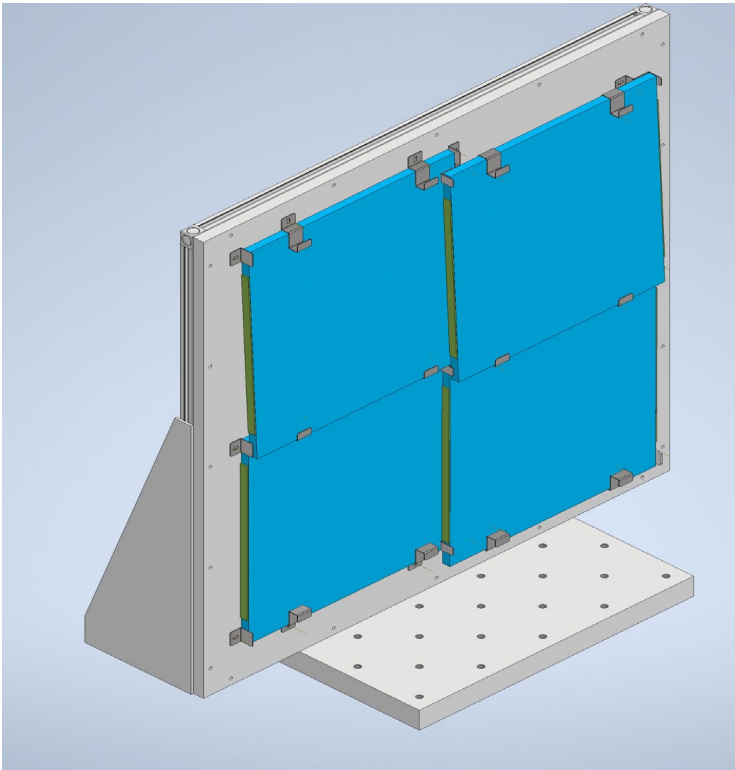


Tile wrapping



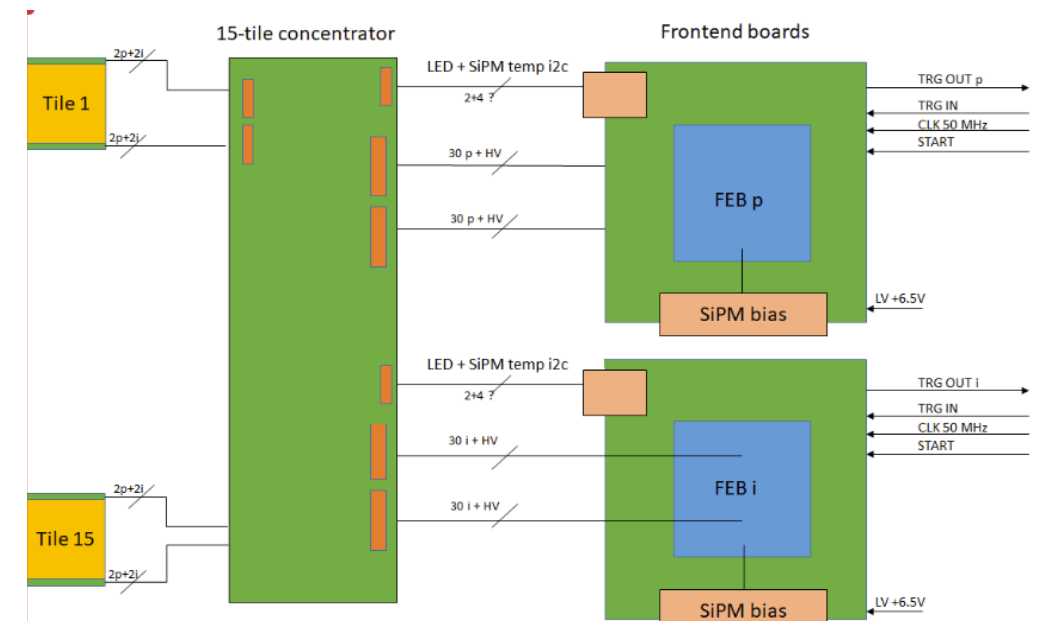
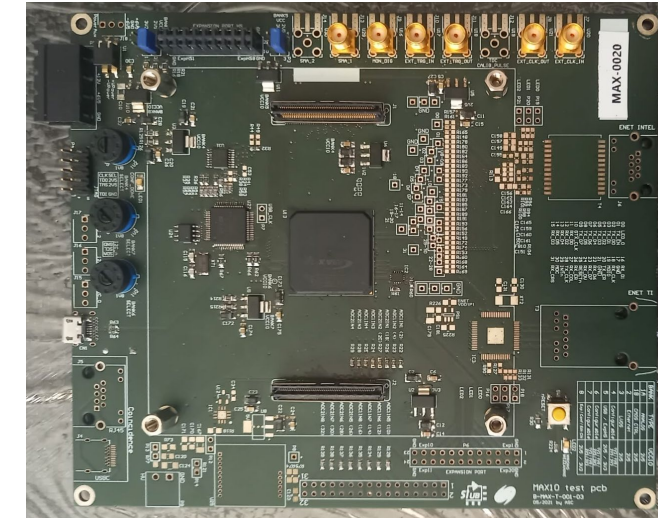
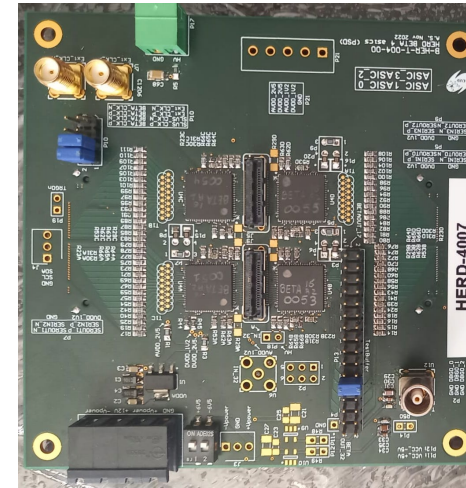
4-tiles prototype

- We assembled a prototype made with 4 tiles for CERN beam test (July, Sept)
 - The 4-tile layout overlapped as in the final ACD design
 - ACD-ADAPT concentrator
 - ICCUB Read-out boards very close to the final one
 - Preliminary test in July



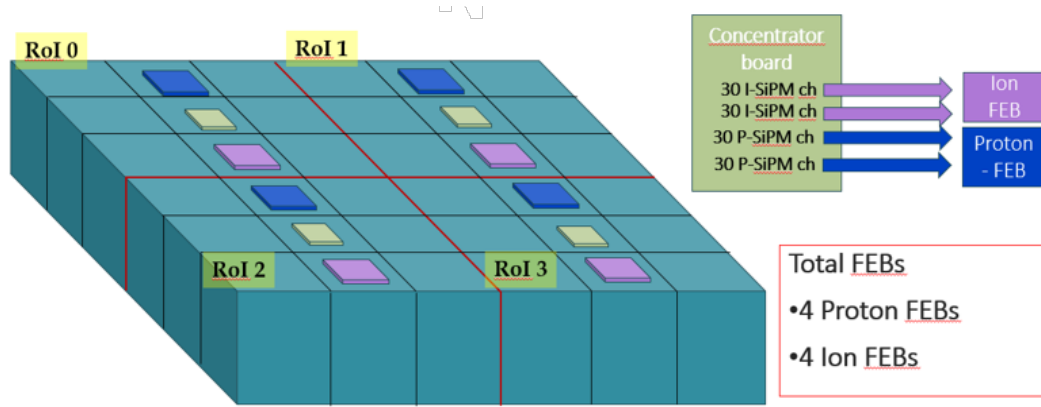
Current β -chip mezzanine and FPGA board (front-end board, FEB)

- Four 16-channels ASICs
- Single channel threshold for fast trigger output
 - Only HG path
- Min/Max peaking time: 0.5-1.5 μ s
- I/O:
 - Two LSHM-120 40 pins SiPM input connectors
 - TRIG IN 3.3V logic
 - TRIG OUT 3.3V logic
 - Current USB, ethernet? SPI? TBD
- Power (typical) about 5 Watt
 - +6.5 Volt (<700 mA)
 - -6.5 Volt (<100 mA) (we can skip ...)
- Current max read-out rate 8 kHz (there is room to improve)
- VETO/heavy ions trigger out:
 - Two trigger out signals could be needed to reject protons and to keep heavy ions



ACD layout and readout

- The ACD read-out is based on four region-of-interest (RoI) consisting on 15 tiles
 - 3x3 top tiles + 2x3 lateral tiles
- The signal of each RoI are routed to a "concentrator board" then to a Front-End Board (FEB) with 4 BETA 16-channel ASICs each



RoI - Concentrator readout layout

- OR every 2 proton ch (or 2:1) performed at concentrator level

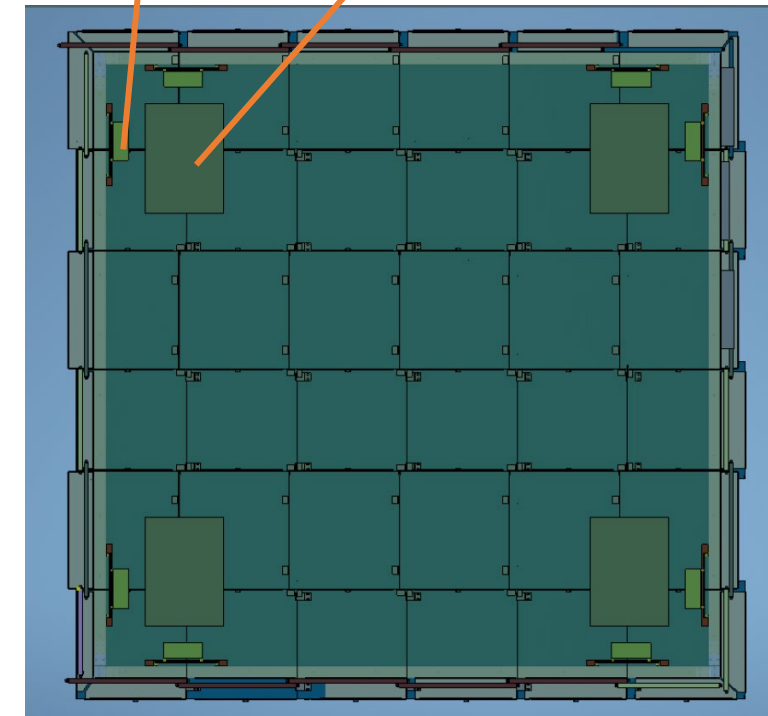
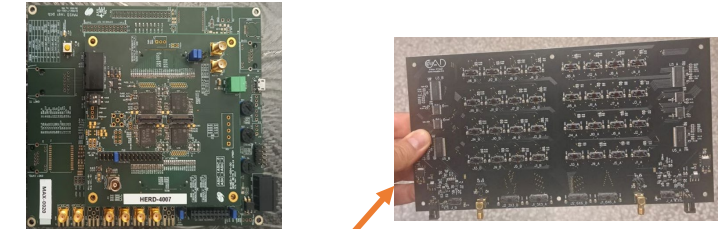
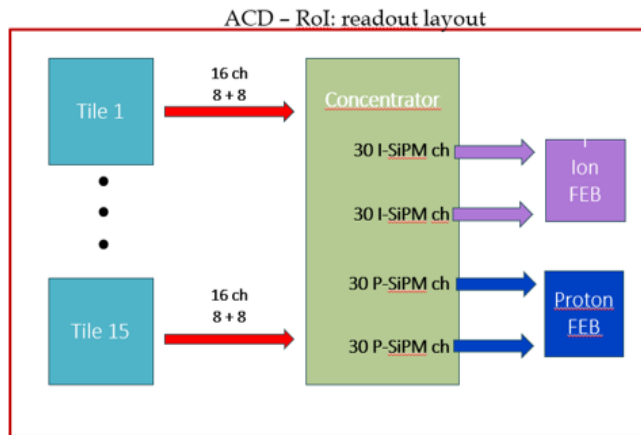
4 proton ch per tile

- OR every 2 ion ch (or 2:1) performed at concentrator level

4 ion ch per tile

Each concentrator max 16 tiles:

- 64 ion ch (60 + 4 spares) → 1 Ion FEB equipped with 4 BETA16r3 asics
- 64 proton ch (60 + 4 spares) → 1 Proton FEB equipped with 4 BETA16r3 asics



Inside view, from bottom

Mechanical support assembly sequence

- A support mechanical structure (support shell) is needed to assembly the tiles
 - Baseline: aluminum honeycomb core with aluminum sheet
 - Option: aluminum, Momex or similar honeycomb core, with fiber carbon sheet
 - Thermal blanket?
- The order is in the INFN pipeline
 - 1-2 months to review the CAD design and static analysis
 - Clearance check (be ready)
 - 2-3 months for procurement and production

Fermi ACD image



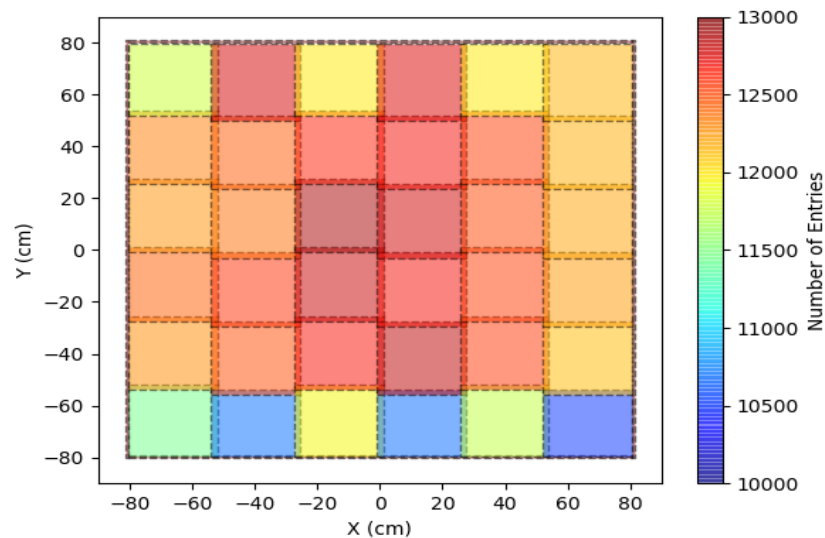
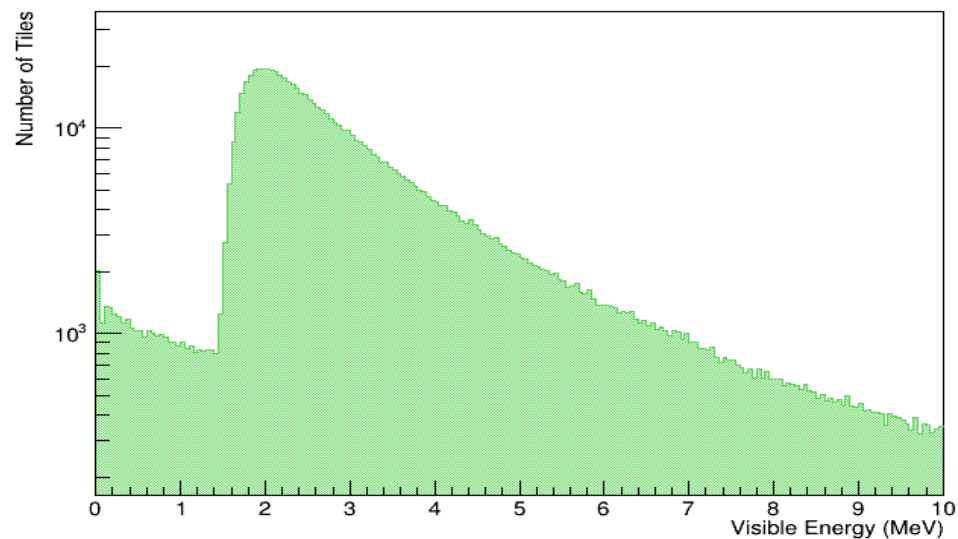
<https://fermi.gsfc.nasa.gov/acd/images/index.html>

Timeline, procurement

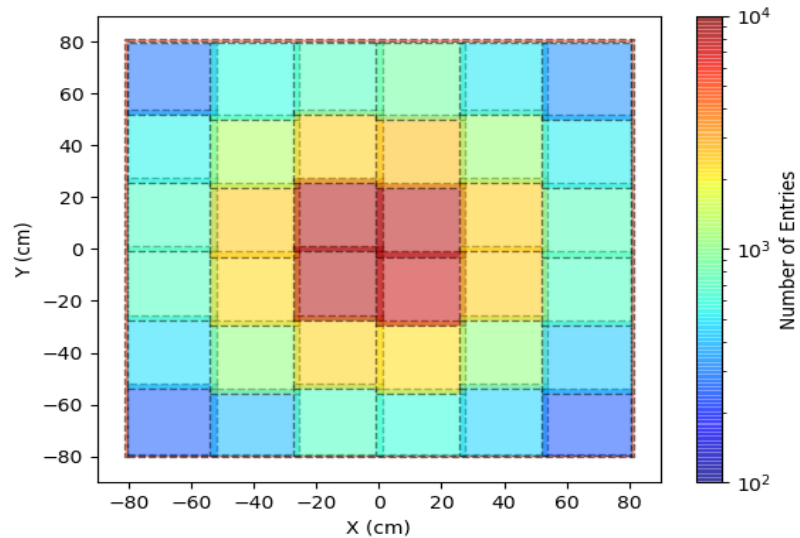
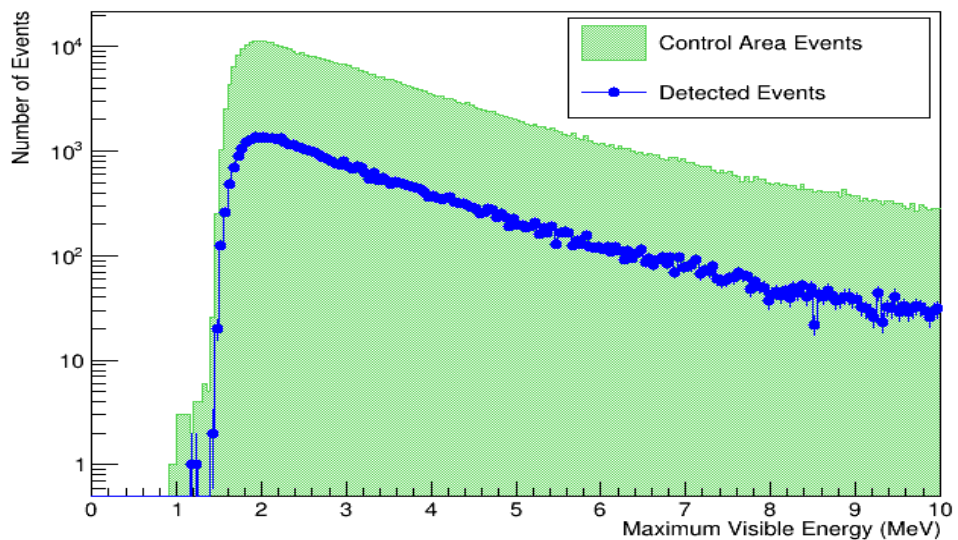
ADAPT ACD timeline																
		Done														
		On going														
		To be done														
	2024					2025					2026					
Item	M 1-2	M 3-4	M 5-6	M 7-8	M 9-10	M 11-12	M 1-2	M 3-4	M 5-6	M 7-8	M 9-10	M 11-12	M 1-2	M 3-4	M 5-6	M 7-8
Conceptual design layout																
Tile prototype assembly and test																
Flight tile procurement																
Flight SiPM procurement																
Flight FEBs procurement																
Flight cable procurement																
SiPM edge carrier design optimization																
SiPM edge carrier assembly and test																
Concentrator board design optimization																
Concentrator board assembly and test																
Flight tile assembly and test																
Shell support design																
Shell box fabrication																
Delivery																

- Secured cables:
 - From tiles to concentrator: HLCD-10-40.00-TD-TH-2-T and HLCD-10-40.00-BL-TH-4-T (1 m long)
 - From concentrators to beta board: HLCD-20-20.00-TD-TH-2-T (0.5 m long)
- Missing cables:
 - USB connection
 - From beta-board to trigger-board
 - Power connection
 - Copper thermal strip
- Missing items
 - Event synchronization

FLUKA simulation results with 3 GeV proton (MIP)

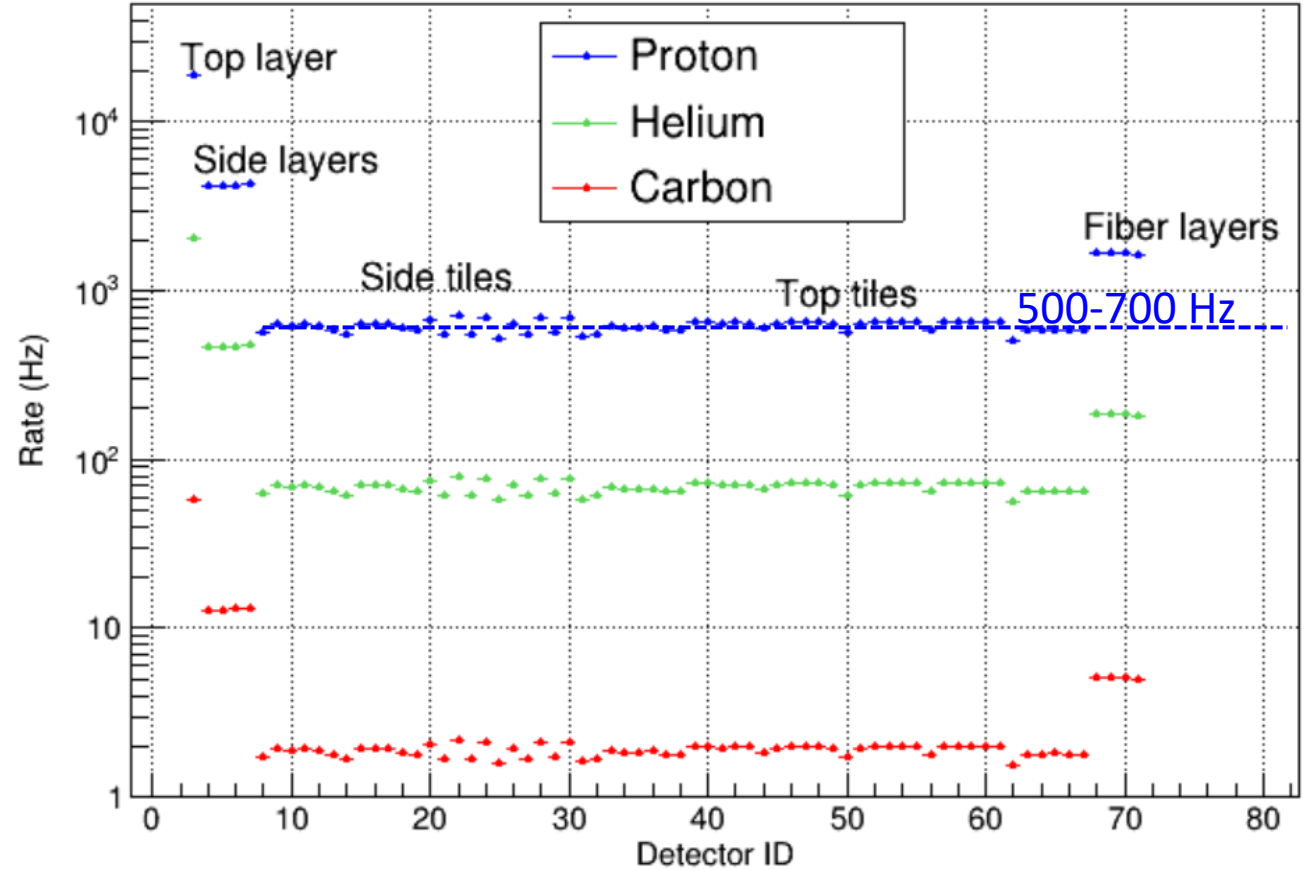
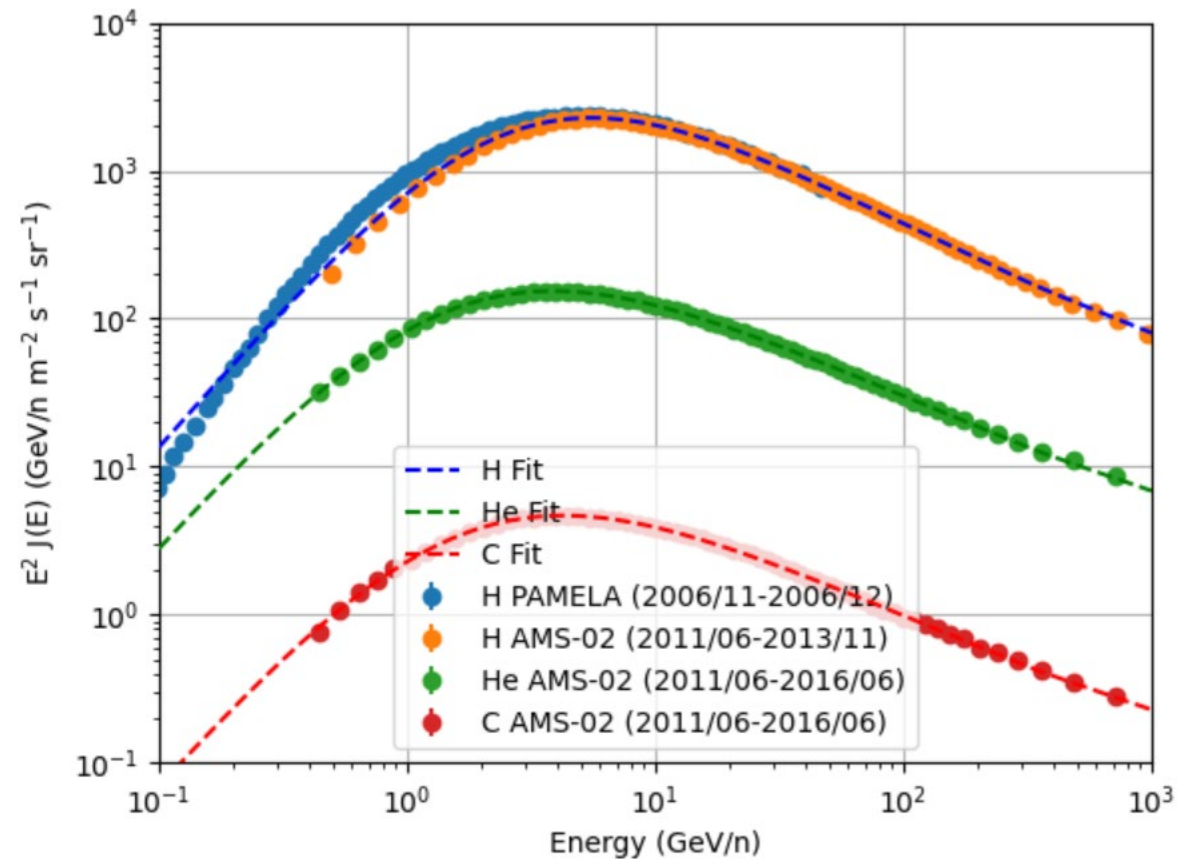


Control Area Events



Detected Events

Expected trigger rate (null energy threshold)



BACKUP