Fluorescence Camera

June 2025 Update

Take Home Message

- Currently waiting on production of ECs, outside of our control
- Lots of work going on in parallel
- Still work that needs to be done
- A 2027 launch is still feasible, but **very** little margin!

EC-Procurement status

- 160 MAPMTs delivered and characterized
- 45 HVPS generators delivered and tested
- 100 ASICs packaged and tested
- 50 EC-ASIC boards produced (30 delivered, 20 in transit)
- 50 EC-ASIC boards remain to be produced
- **44 ECs to be produced and delivered**

EC Production Schedule Received From Matra

- First ECs expected in May
  - None yet produced
- First “PDM” expected in July 2025
- Last “PDM” **April 2026**
- “Spares” available after

Art	Desc	Qte	Mois
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/05
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/06
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/06
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/06
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/07
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/08
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/09
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/09
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/10
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/11
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2025/12
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2026/01
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2026/01
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2026/02
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2026/02
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2026/03
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2026/03
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2026/04
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2026/04
Y020963R03	EC-UNIT V3 EUSOBALLON	2	2026/05
Y020963R03	EC-UNIT V3 EUSOBALLON	1	2026/05
Y020963R03	EC-UNIT V3 EUSOBALLON	1	2026/06

ZYNQ & CROSS BOARDS – DESIGN REVIEW AND UPDATES

Zynq and Cross board projects build upon the design originally developed by the Russian team for SPB2.

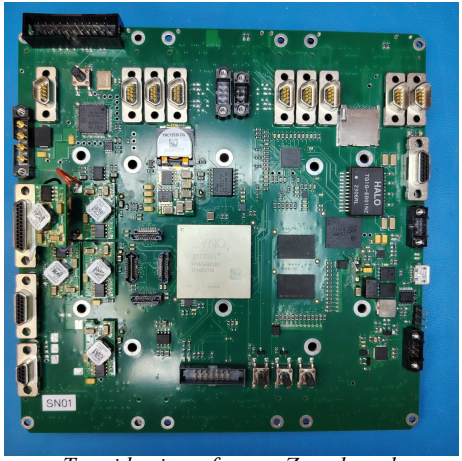
The following activities have been completed:

- Reviewed the electronic design of the Zynq and Cross boards.
- Replaced 20+ obsolete or unavailable components with functionally equivalent alternatives.
- Optimized the PCB stack-up using available materials, with particular attention to controlled-impedance nets.
- Reviewed the manufacturing and assembly process, focusing on PCB finishing (HASL Sn/Pb) and BGA component re-balling.
- Procured long lead-time items, especially the Xilinx Zynq XC7Z035-2FFG676I FPGA.
- Conducted an initial review and synthesis of the Zynq firmware developed for SPB2.
- Defined the bring-up procedure for testing the Zynq and Cross boards.

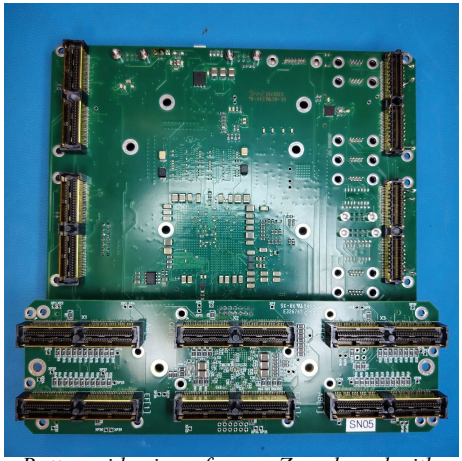
ZYNQ & CROSS BOARDS – MANUFACTURING, ASSEMBLY & TESTING

The following activities have been completed:

- Manufactured, assembled, and brought up 2 new Zynq boards.
  - Bring-up required removal of specific amplifiers and resistors to enable proper initialization.
- Manufactured, assembled, and brought up 2 new Cross boards.
  - Attempted verification with PDMs in April 2025; failed due to incorrect FPGA mounted.
  - Identified issue: Xilinx Artix XC7A**15**T-L1CSG to be replaced with XC7A**35**T-L1CSG324I.
- Tests conducted in Paris using the new Zynq board in combination with SPB2 spare Cross boards and the PMD demonstrated that:
  - the board operates correctly at a GTU of 2.5 µs.
  - However, the system fails to function properly at GTU < 2.5 µs. Further investigations are currently underway.
- Assembled and brought up 3 new Cross boards using the correct Xilinx Artix FPGA.



Top side view of a new Zynq board



Bottom side view of a new Zynq board with one new Cross board connected

ZYNQ & CROSS BOARDS – PLANNED NEXT STEPS

- System Testing:
  - Integration and verification of the new Zynq and Cross boards with PDMs (Paris, June 2025 – To Be Confirmed)
  - Address GTU limitation: aim to achieve stable operation at 1 µs GTU.
  - If 1 µs GTU cannot be attained with the current Zynq board batch, evaluate the feasibility of implementing an external trigger mechanism.
- Board Assembly:
  - Assemble 6 additional Zynq boards (4 Flight Models, 2 spares) contingent on successful board validation.
  - Assemble 15 additional Cross boards (12 Flight Models, 3 spares) contingent on successful board validation.
- Firmware Development:
  - Development and testing of an upgraded firmware version aimed at minimizing acquisition dead time.

ZB Summary

- Very productive week of integration at Tor Vergata in April
- Newly produced ZB work very well at 2.5 microsecond GTU
- Major Issues Identified with newly produced ZB at 1 microsecond (unuseable)
- Waiting for this to be understood before producing flight models
- Once produced, the plan is to have multiple flight spares so that development can happen in parallel

Is a 1 microsecond GTU the right choice?

Using SPACIROC with a (80Mhz; GTU=1μs) is not recommended

I don't understand why it doesn't work with the same routing and same firmware.

Best regards,
Sylvie

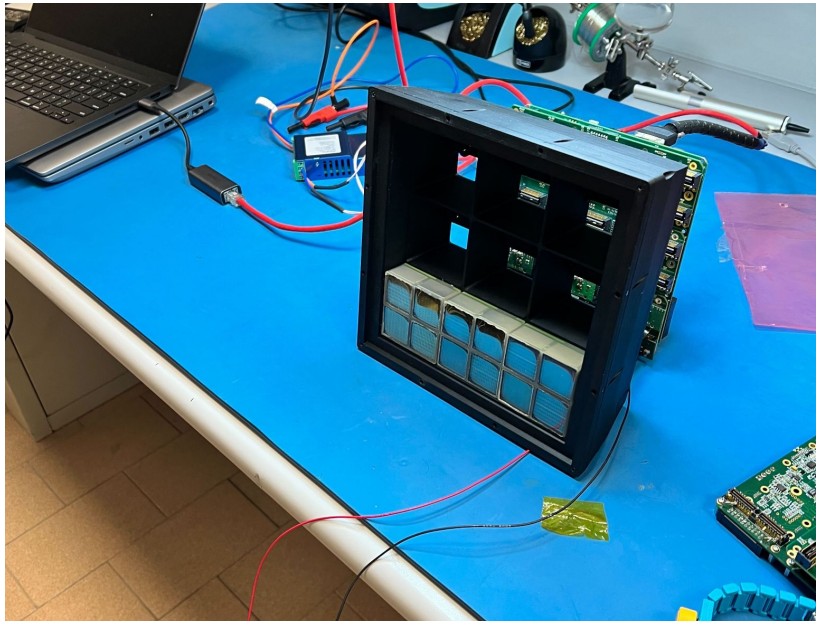
Synchronization of PDMs

- Current:
  - One pulse per second received over the LVDS that connects PDMs to CLKB
- Desired:
  - “GTU” signal to be carried over LVDS, so that all GTUs are aligned
  - Very minor (ocasional) drift visible in SPB2 HLED data
- Possible (?):
  - 40 MHz clock delivered via LVDS from CLKB

It is difficult to develop the FW for this without access to a version of the CLKB

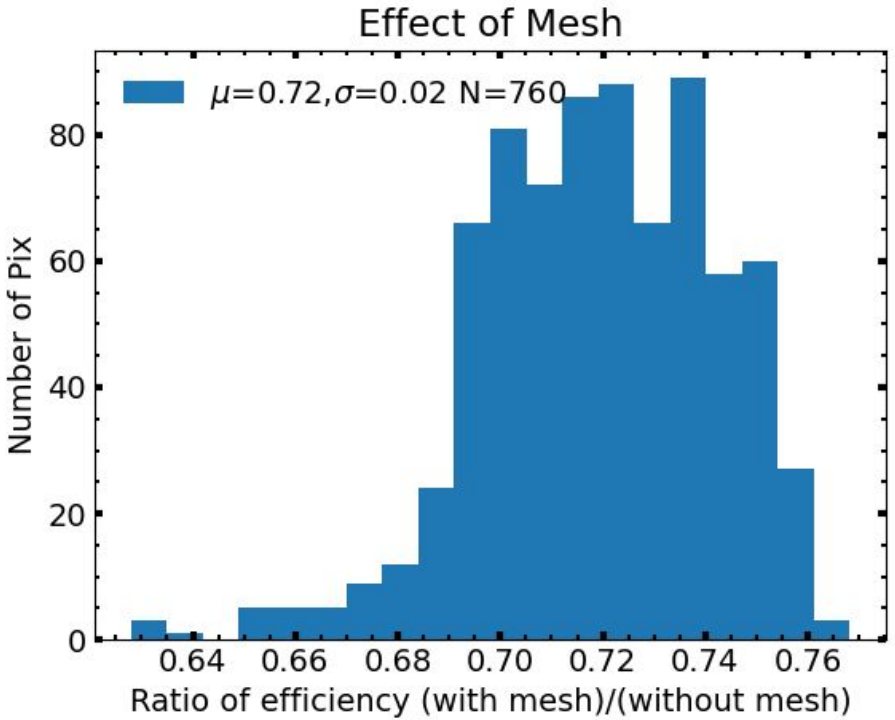
Important for scaling! I.e. SPB2 setup worked with 3 PDMs, but would it work for 49 on M-EUSO?

Mechanical frame prototype produced

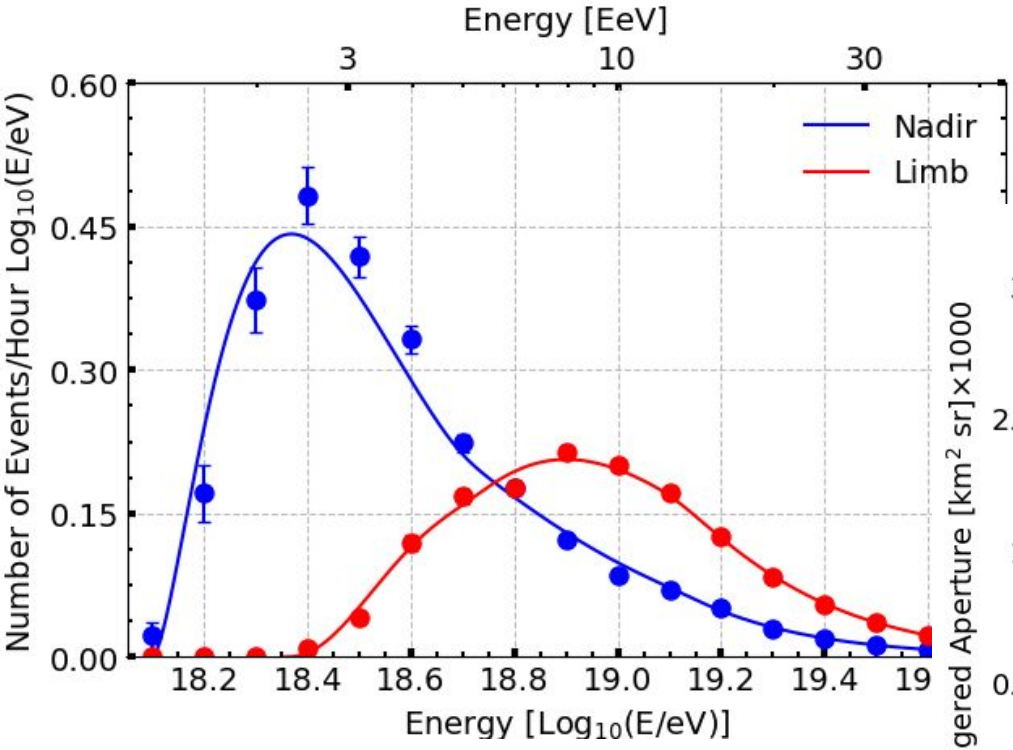


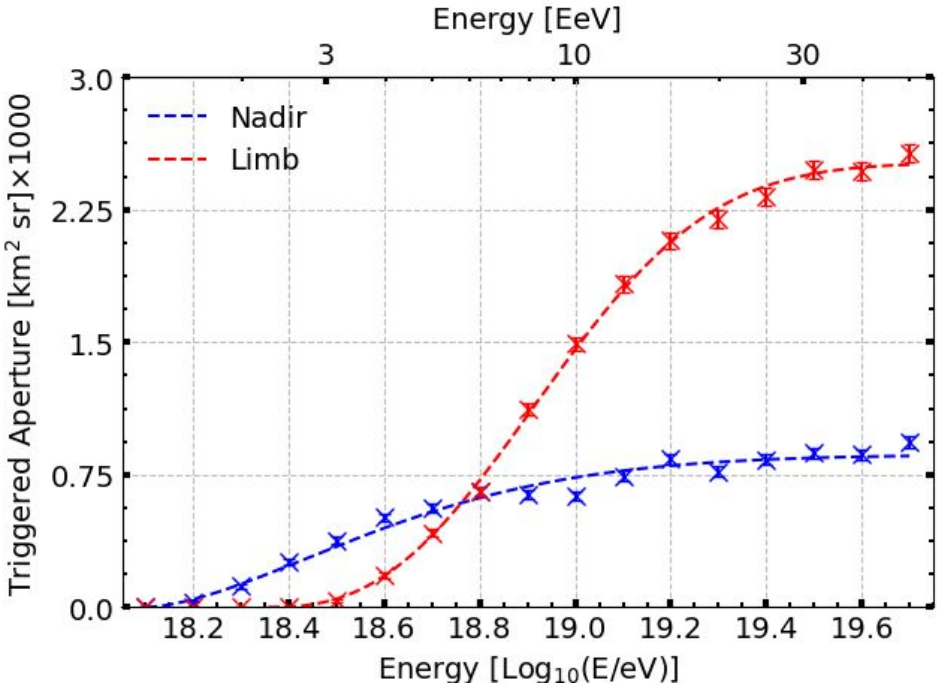
EMI Measurements

- PDM electronics by themselves are very noisy
- Only “workable” solution from the perspective of the RI is a fully enclosed faraday cage
- Unacceptable from PoV of the FC
- Unclear if a truly viable option for long-term radio quiet
    - Setup achieved in testing was **very unstable**
- Will the PDMs really be the noisiest thing on the payload?



Updated simulations





Updated Schedule (assuming EC production from slide 4)

- First “PDM” ready for integration with CLKB/DP in Fall of 2025
  - Could be done with ~6 ECs and two ZBs
  - Would be best with 36 ECs and 4 ZBs, but we do not need to wait for this
- All four PDMs can be in the US by May 2026 for field testing
  - In principle 1 or more could be sent earlier, if there is motivation for this
- Thermal vacuum testing remains an open question
  - With 4 ZBs this could be done prior to completed EC production, with realistic results
  - Would need ~12 ECs for 4 ZBs to work in L1 data-taking mode, necessary for realistic thermal output
  - Could be done in **2025**

Plan moving forward

- Continue with “rolling” calibration of ECs as they are produced (Jun 25-Jun 26)
- Verify new production of Cross Boards (Jun 25)
- Identify issue new ZB at 1 mus, or test new ZB at 1.5 mus (Jun 25)
- Test FW with external GTU signal (Jun 25)
  - With help of Alexander Belov via remote connection to APC
- Test different copper meshes in hope of finding one that meets EMI requirements and allows an acceptable amount of light through
  - Difficult to test the EMI effect outside of Penn State