Facing the Hydra: commisioning of a small PET setup for testing perovskite crystals

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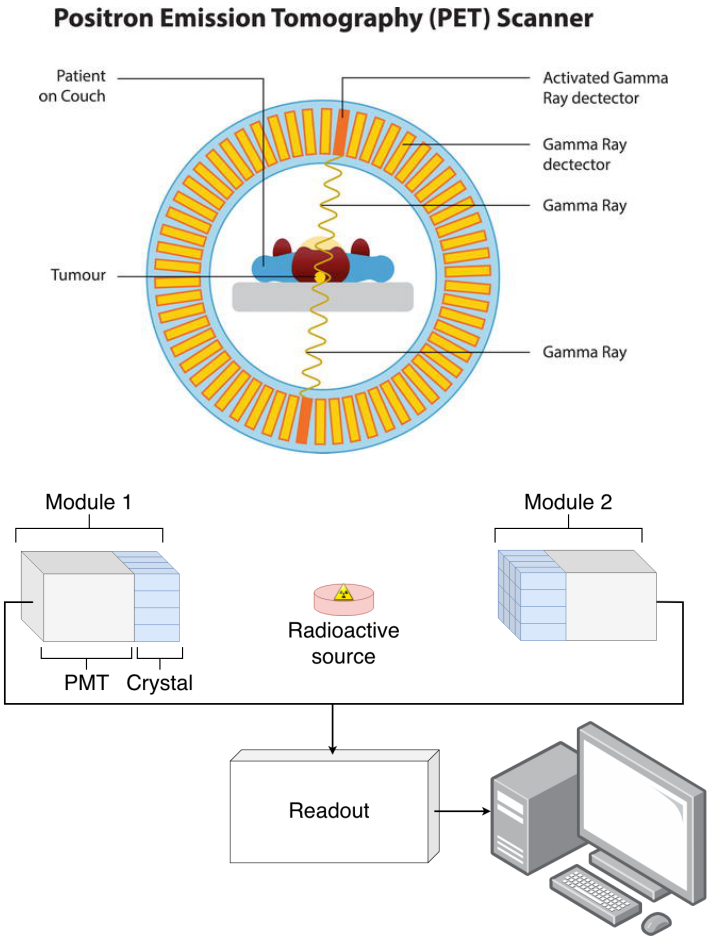
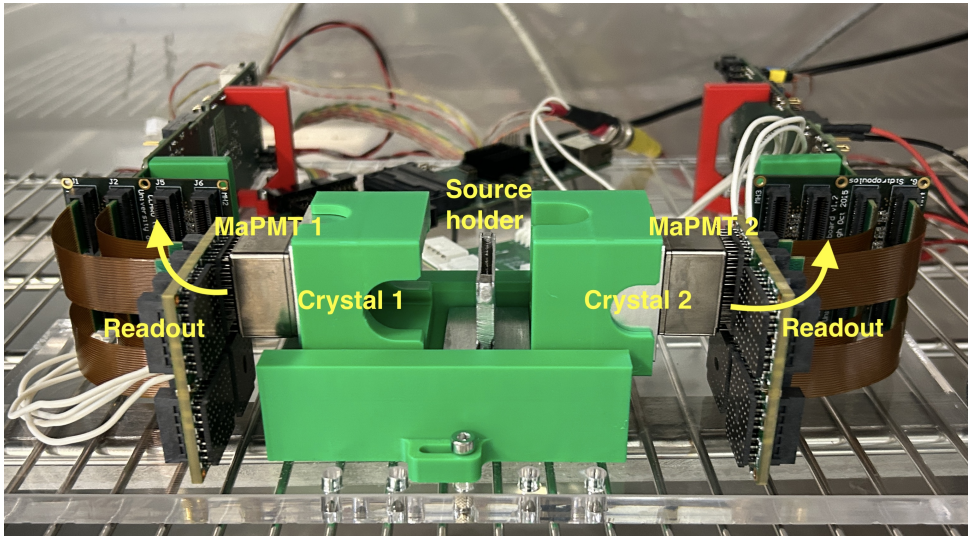
Where are we and what we do?

- Our setup is located in the corner of room 5203b on the right side from the fume hood
- We make use of 2 desks, climate chamber, safe and a number of equipment discussed in the following slides
- The setup is built in a way that it mimics the idea of Positron Emission Therapy scanner, i.e. we have two scintillators (LSO, NaI, perovskites) placed opposite each other with a positron source in between



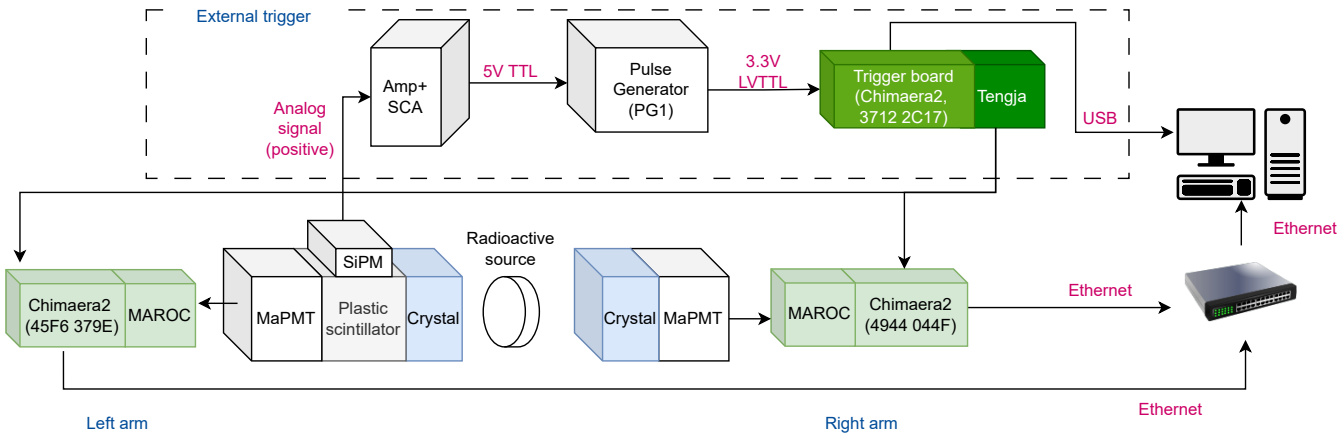
The setup in real life (initially)

- Due to financial constraints we could not purchase SiPM arrays that are normally used in PET scanners these days
- Instead, we borrowed MaPMTs and the whole readout from the LHCb PDQA setup
- This solved the financial issues and provided us with the whole DAQ infrastructure (readout boards, signal digitisation, GUIs to operate the run, means to save data into an easy to analyse format)



Trigger

- The number of advantages of using MaPMTs and LHCb readout came at a price – LHCb detectors need a trigger, but PET scanners do not (at least not in the same sense)
- Needed to introduce a trigger in a form of a plastic scintillator placed between the crystal and MaPMT
- Plastic scintillator does not detect gamma rays; it is used only to transfer the optical photons from the crystal that will be read out not only by the MaPMT but also a SiPM attached to it, and which output will be triggering the LHCb readout

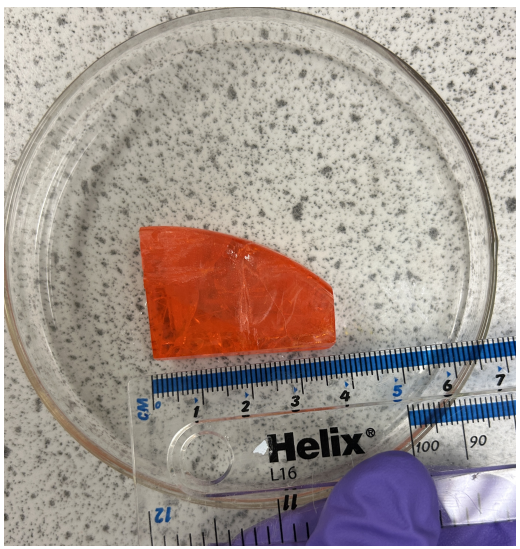


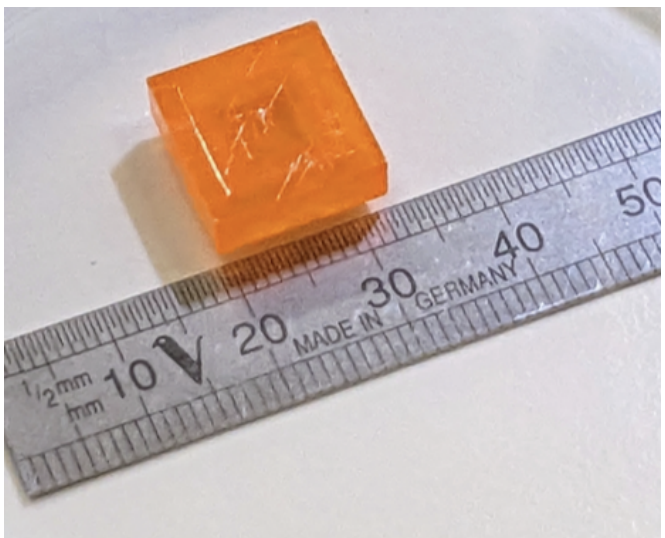
Equipment, equipment, equipment...

- As our setup grew significantly wrt the initial idea we are using a bit more equipment
  - 3 LV power supplies (for powering readout boards, SiPM and Slow Control)
  - 1 (quite old) Scope
  - NIM crate with Amp+SCA module
  - 1 Pulse generator
  - 1 Slow Control module (biasing MaPMTs)
  - For timing scans: LED driver, 1 LV power supply, 1 pulse generator
  - 1 PC, 1 laptop (private), 1 switch (private)
- Already run a timing scan, however, it has to be repeated as the results do not change while varying the timing parameters (current mystery to solve)

What about the perovskites?

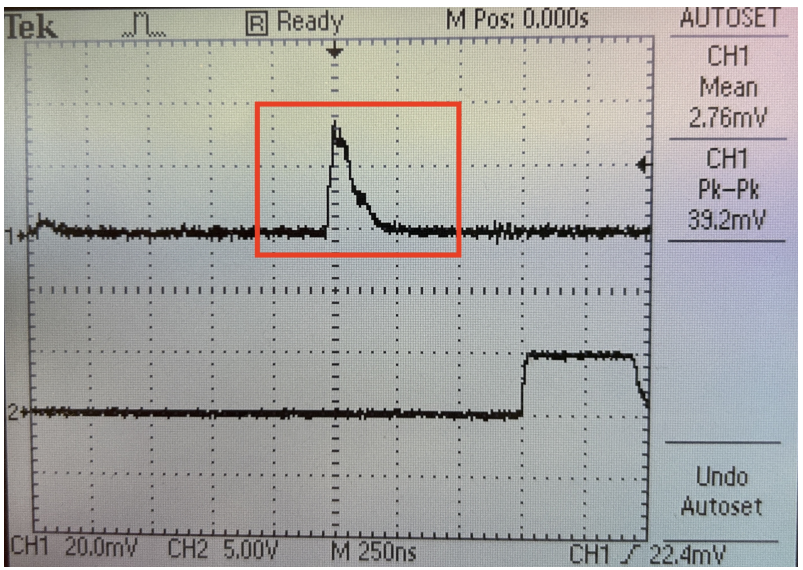
- We are currently growing perovskites on our own in Chris Stock's lab on the second floor
- Perovskites are grown using a solution method (perovskites precursors are dissolved in a mixture of DMF and DMSO, stirred for 24h and then placed in the oven at around 82 degC for at least 9 days; the process is repeated a few times to get a crystal of suitable size)

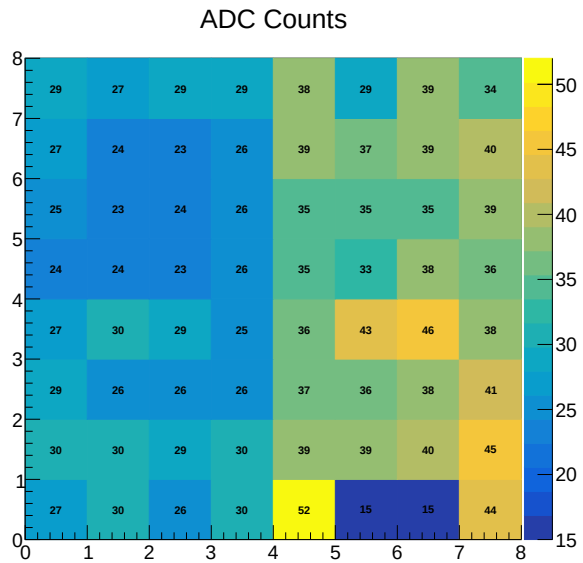




First results with perovskites

- As the timing for the main setup is not yet fixed I run first test with a MAPbBr3 crystal attached to a SiPM (to see the analog signal) and then tried it in the full setup when attached to MaPMT
- The output is not corrected for the pedestal so the right side appears to show more light which is not exactly the case





Soon to take over

- As my contract is ending soon, **Ben Wynne** and **Finn Onori** are taking over from me
- Currently, they are getting familiar with the setup so you can now see them in 5203b a bit more often


Thank you

A big **thank you** to **Bojan, Dan, Deb, Hubert, Rob and Stephan**, who helped me with the setup in 2025 when I was rushing with my grant report.

I would like to especially thank **Jon**, who spent a lot of time helping me and listening to me complaining about yet another thing not working as expected

Summary

- The setup is unfortunately not yet fully operational and the main issue to solve now is the timing adjustment
- Currently, the focus is on training Ben and Finn so they can operate the setup
- The climate chamber is occupied by the setup continuously; If anyone needs access to it please let us know in advance
- In the coming weeks we will need to borrow again the LED driver to repeat the timing scan (already in contact with Jon and Deb regarding that)