

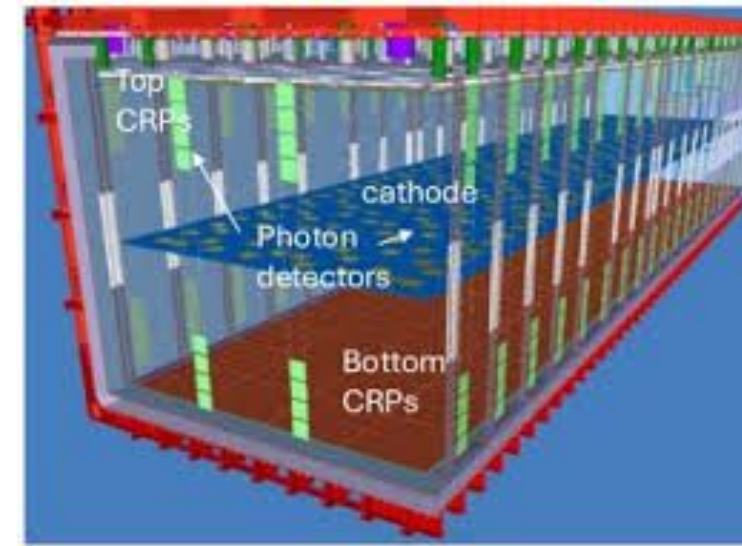
Measuring Photon Detection Efficiency for mini-ARAPUCA

Xabier Arrue, Anselmo Cervera

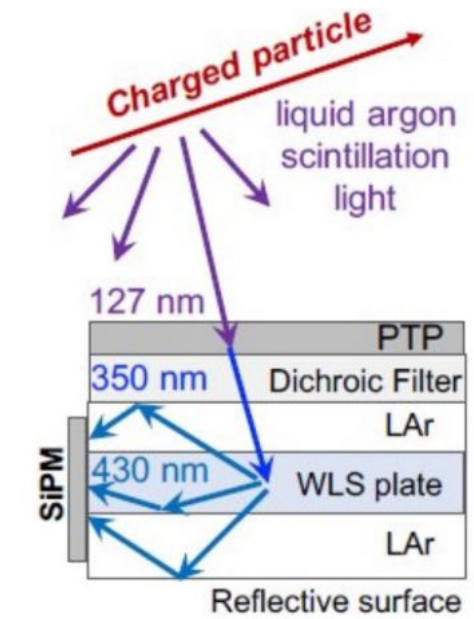
Group Meeting 26 May 2026

Photon Detection System: X-ARAPUCA

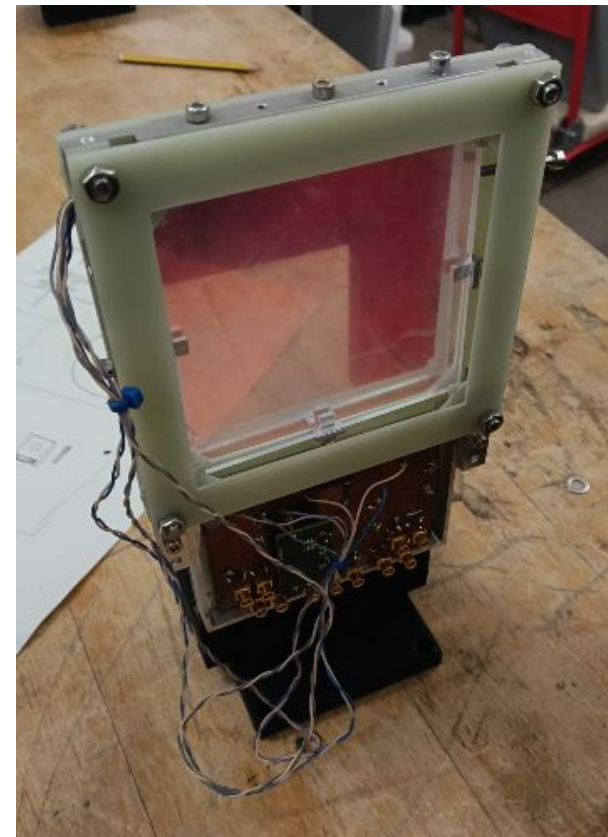
- **X-ARAPUCA** is a light trapping device developed for the Photon Detection (PD) system of the DUNE Far Detector (FD)
- **In our lab**, mini-XARAPUCA is a simplified version with a WLS bar coupled to 4 SiPM.



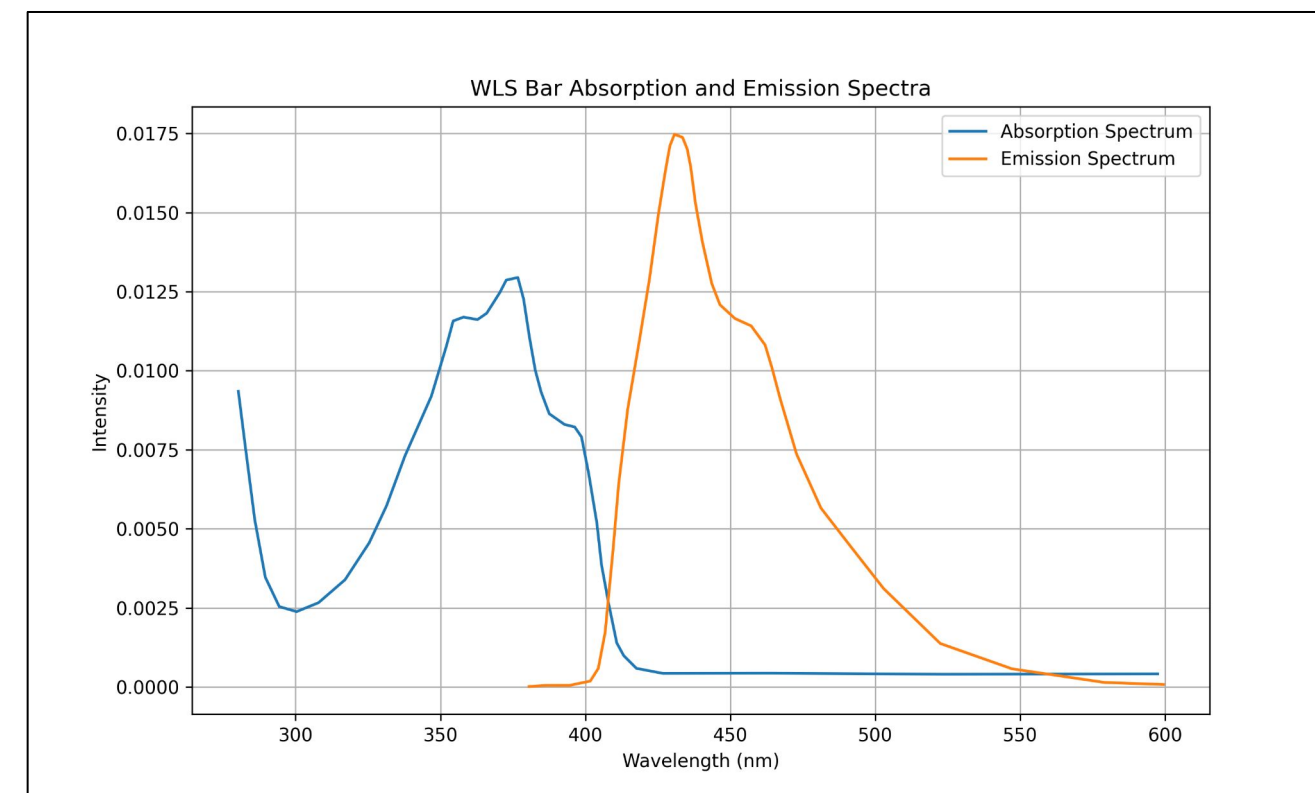
Far Detector module



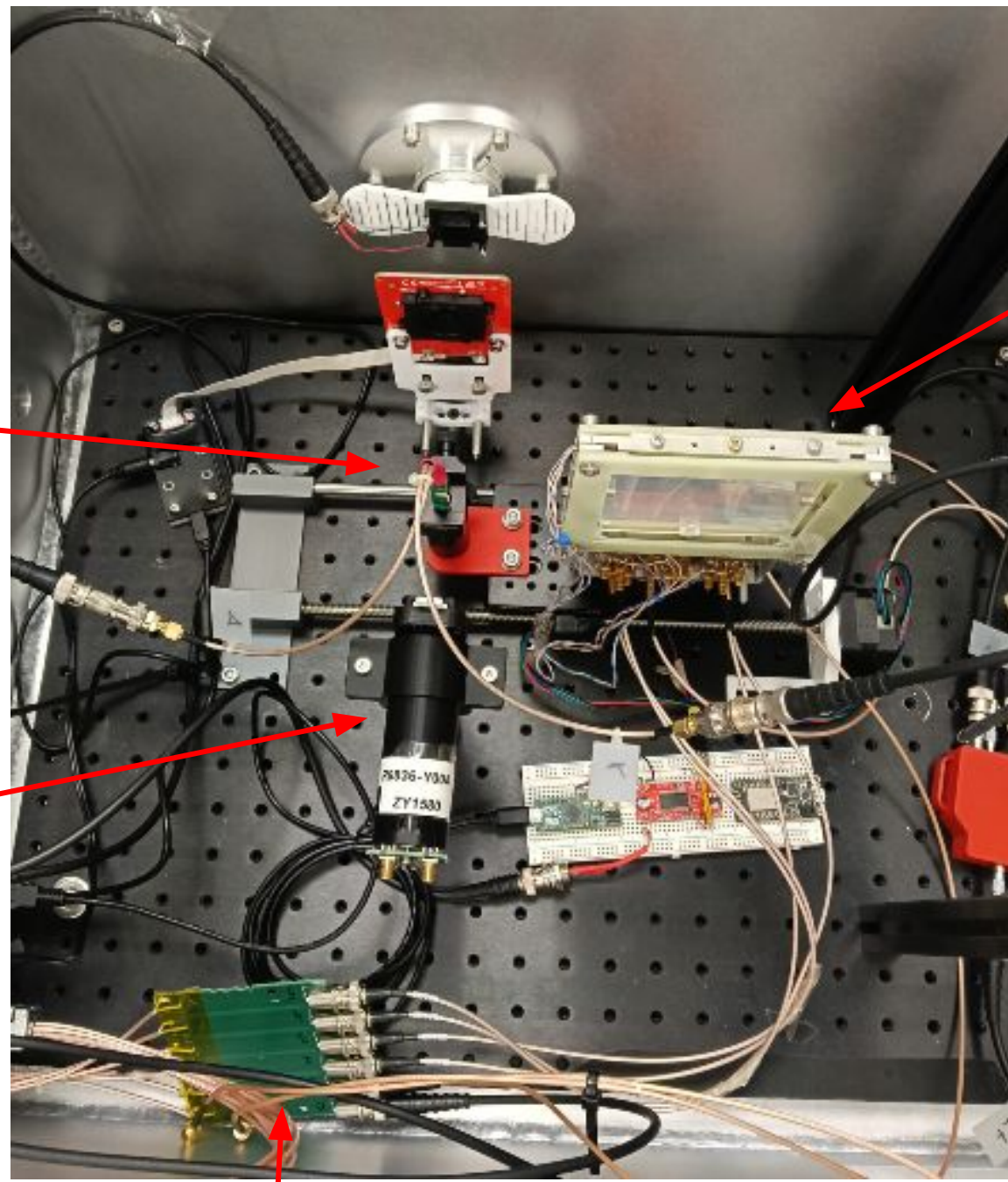
X-ARAPUCA diagram



mini-XARAPUCA

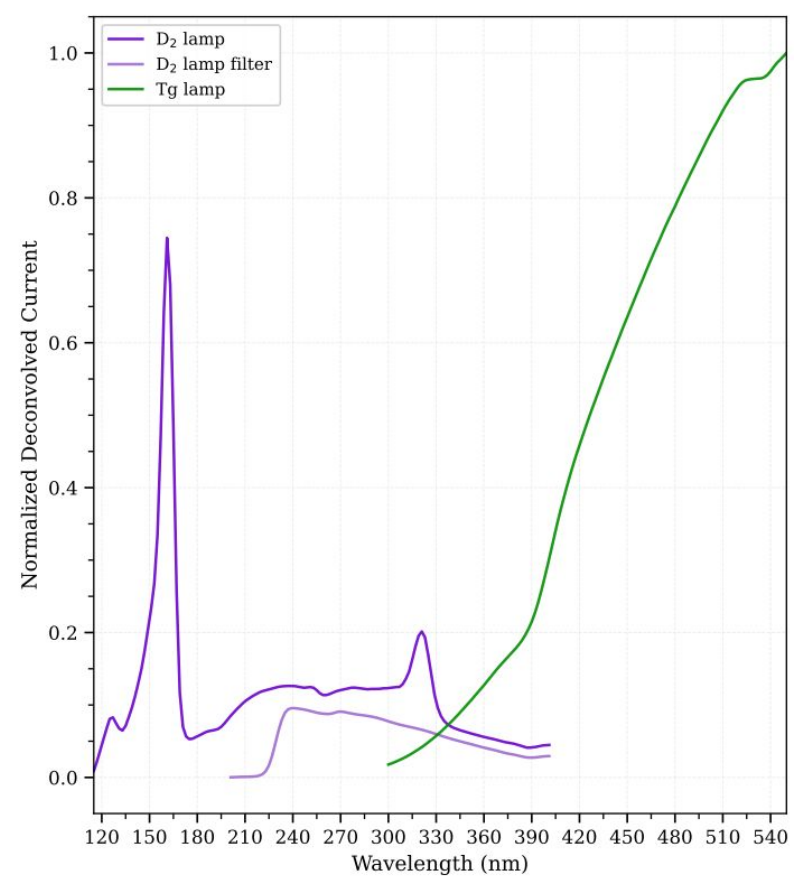


Efficiency measurement setup

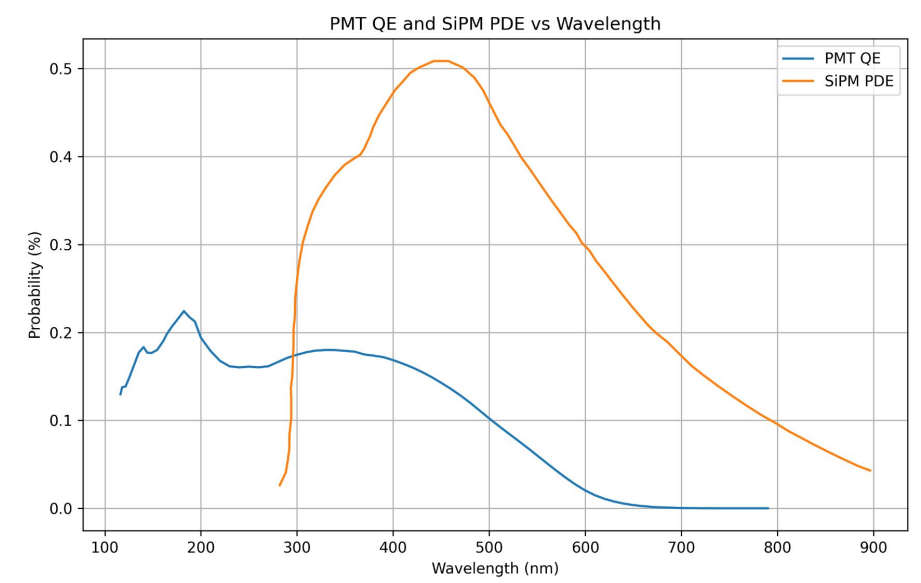


mini-XARAPUCA

Lamp spectrum



Reference sensors

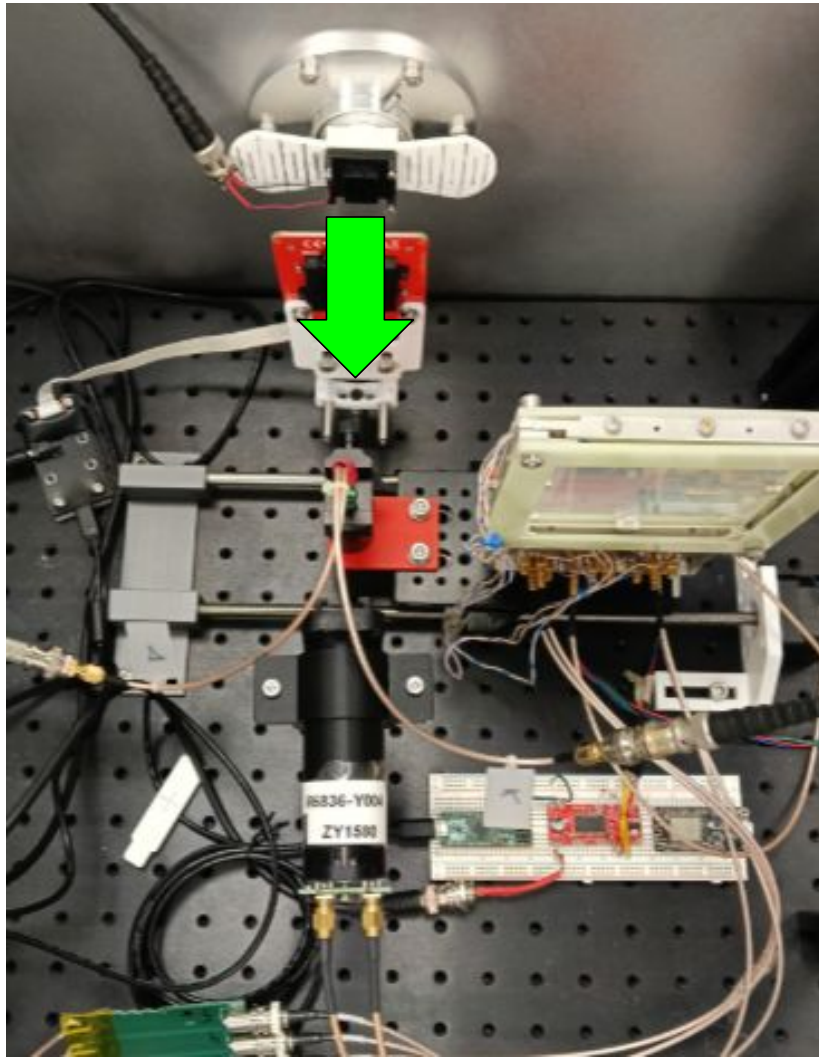


Reference SiPM

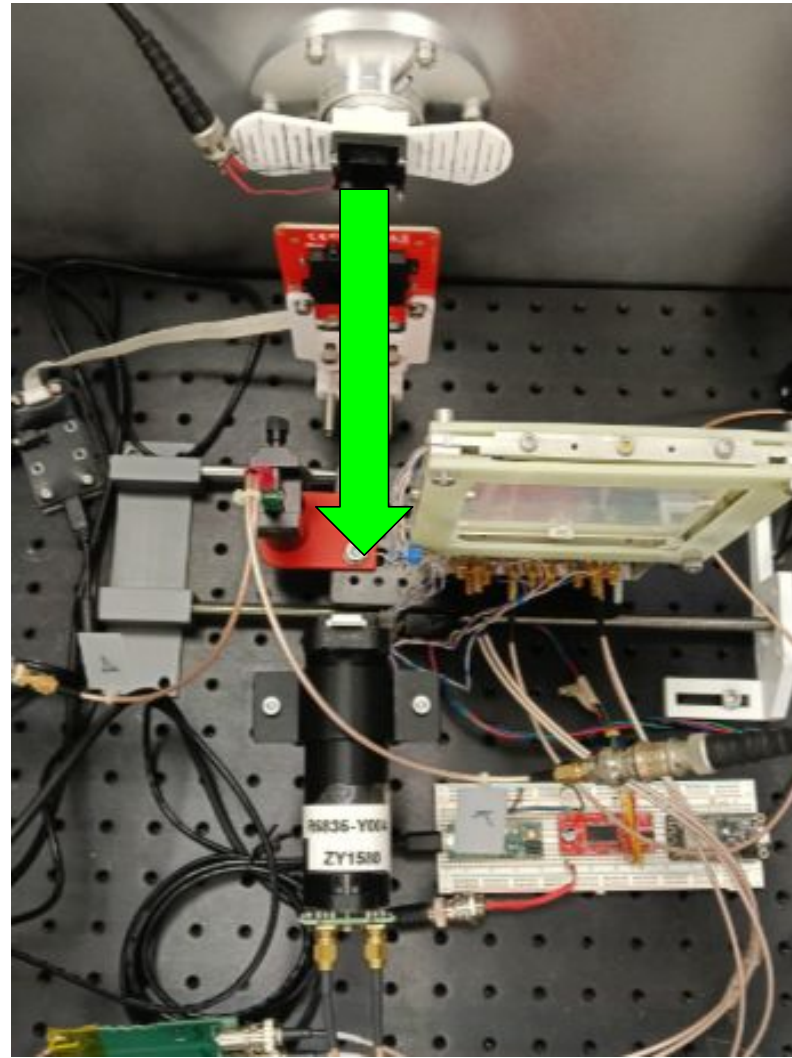
PMT

MUX

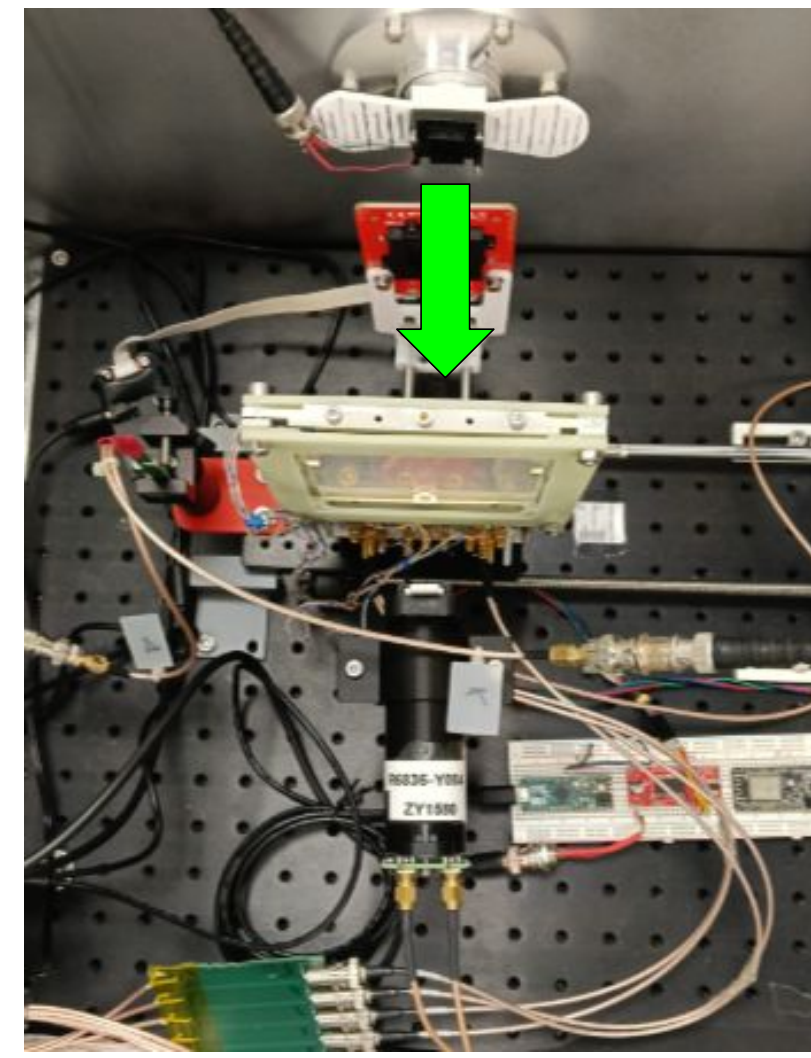
Efficiency measurement setup: Photocurrent method



Reference SiPM



Reference PMT

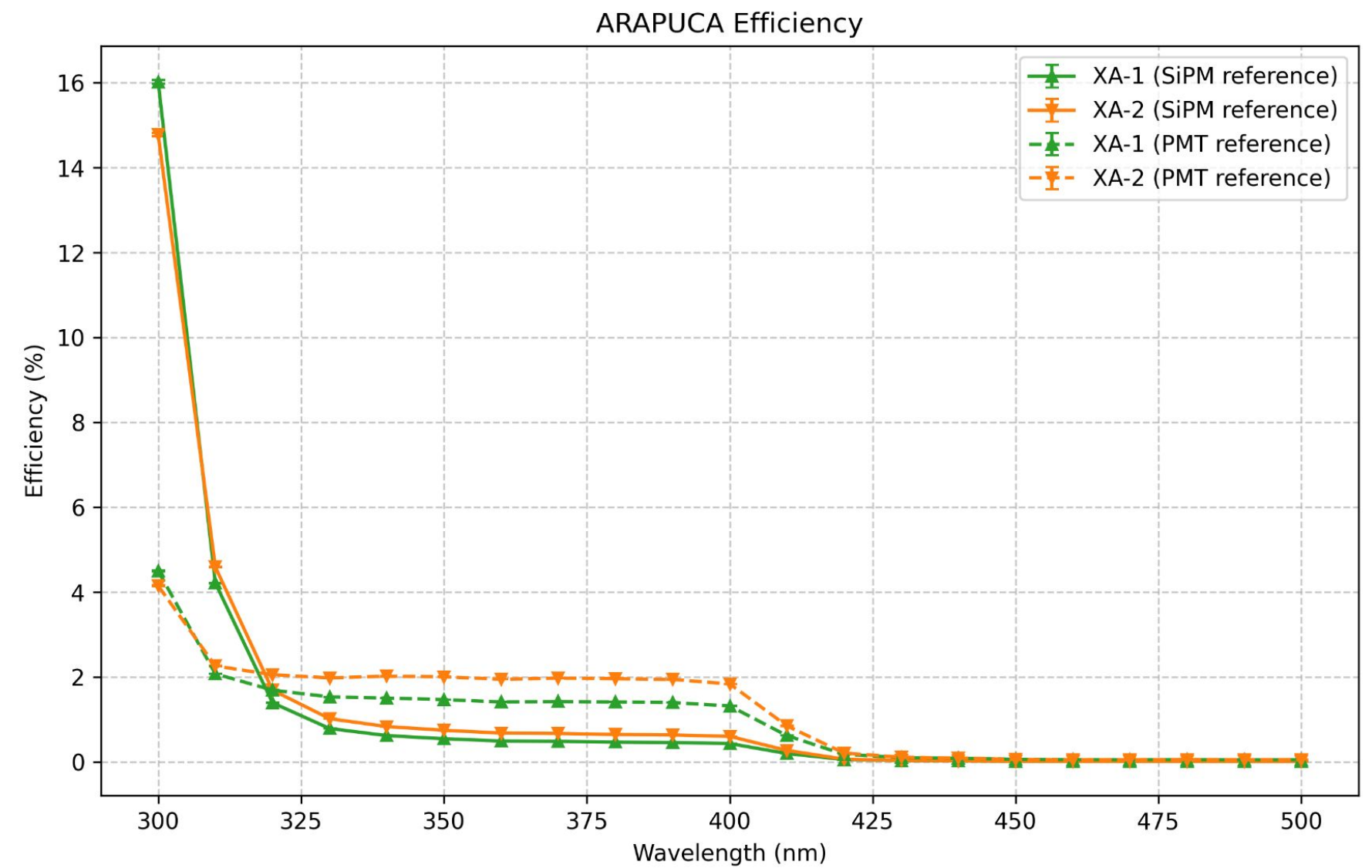
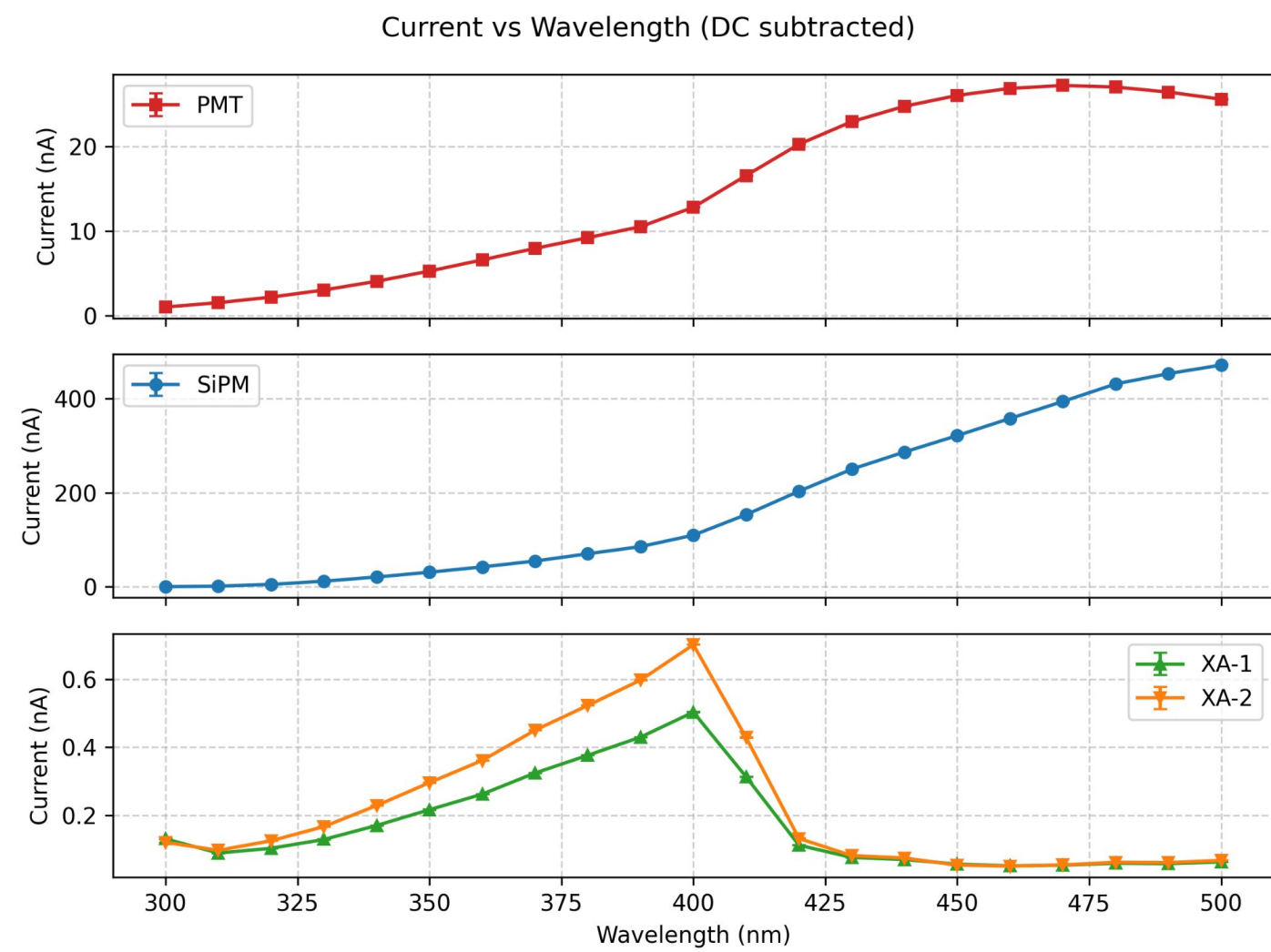


mini-XARAPUCA

$$eff = \frac{I_{SiPM}}{I_{ARA}} \frac{PDE_{SiPM}}{PDE_{ARA}} = \frac{I_{PMT}}{I_{ARA}} \frac{QE_{PMT}}{PDE_{ARA}}$$

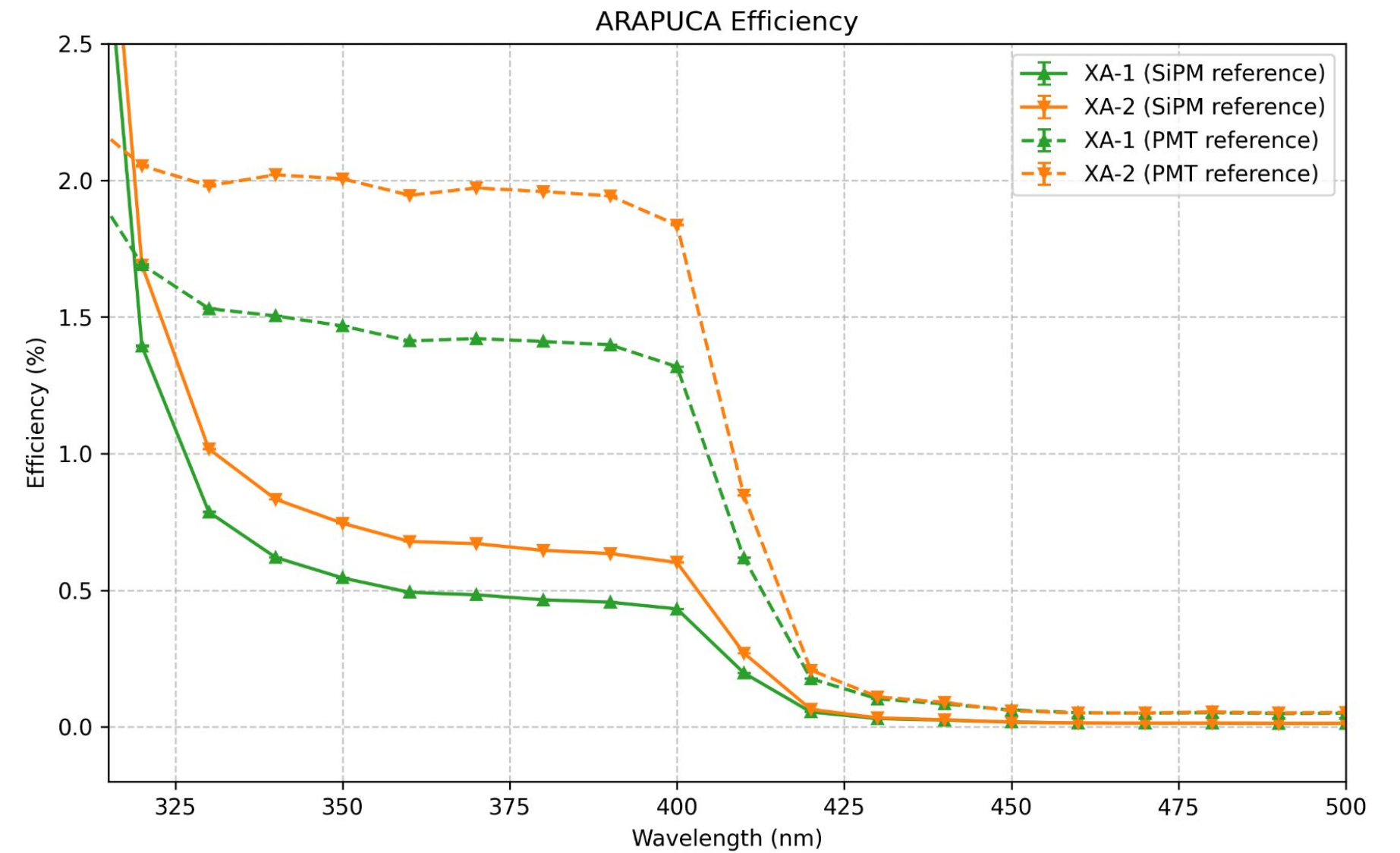
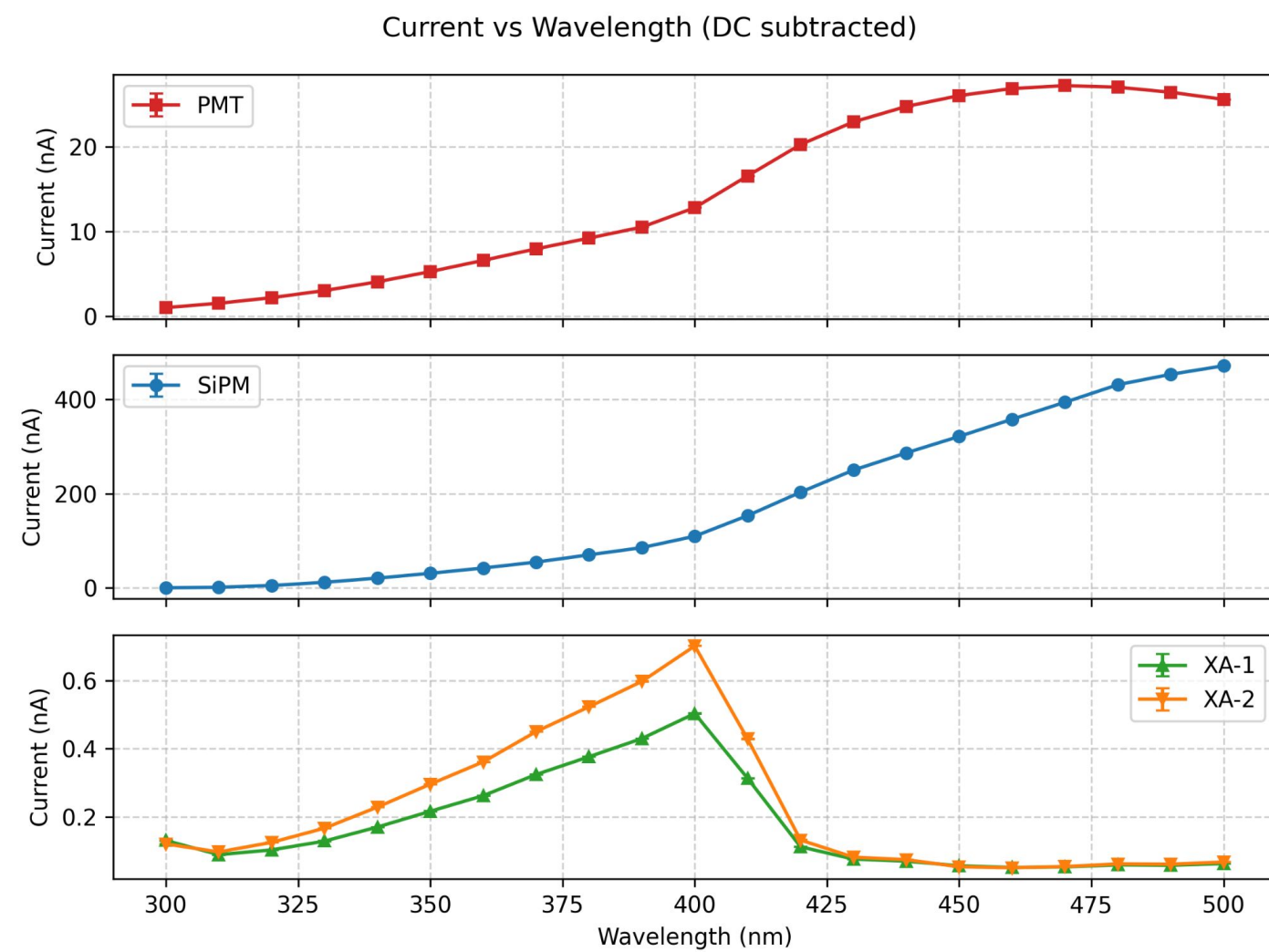
→ $PDE_{ARA} = 50.18\%$, for the averaged WLS emission, weighted by the SiPM PDE

Efficiency results: Tg lamp

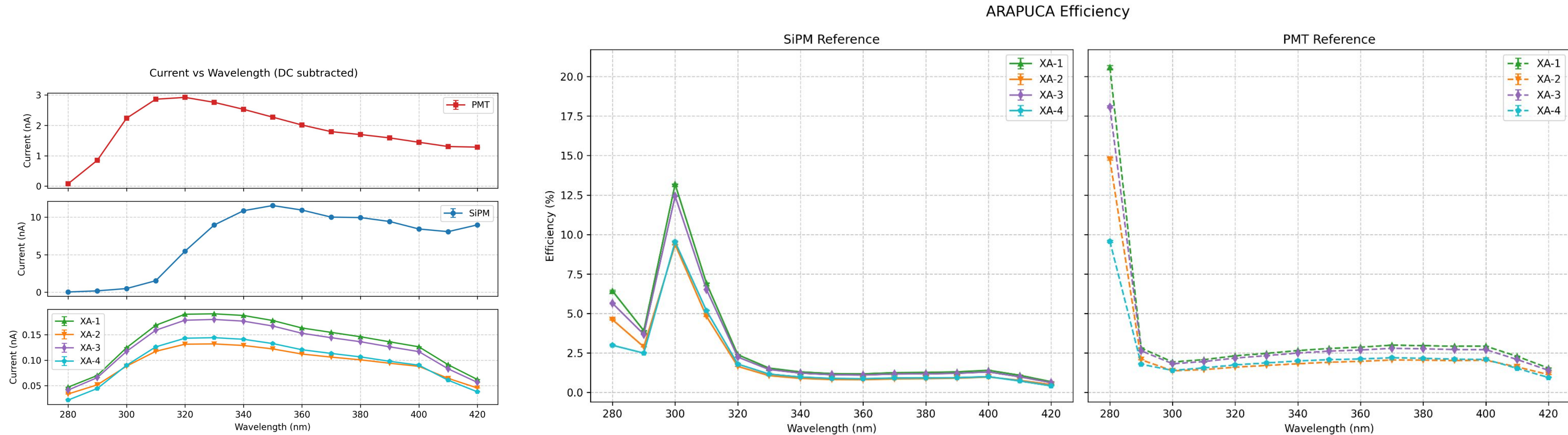


Efficiency results: Tg lamp

- Total efficiency of 2% for SiPM reference
- Around 300 nm, los light makes efficiency overestimated

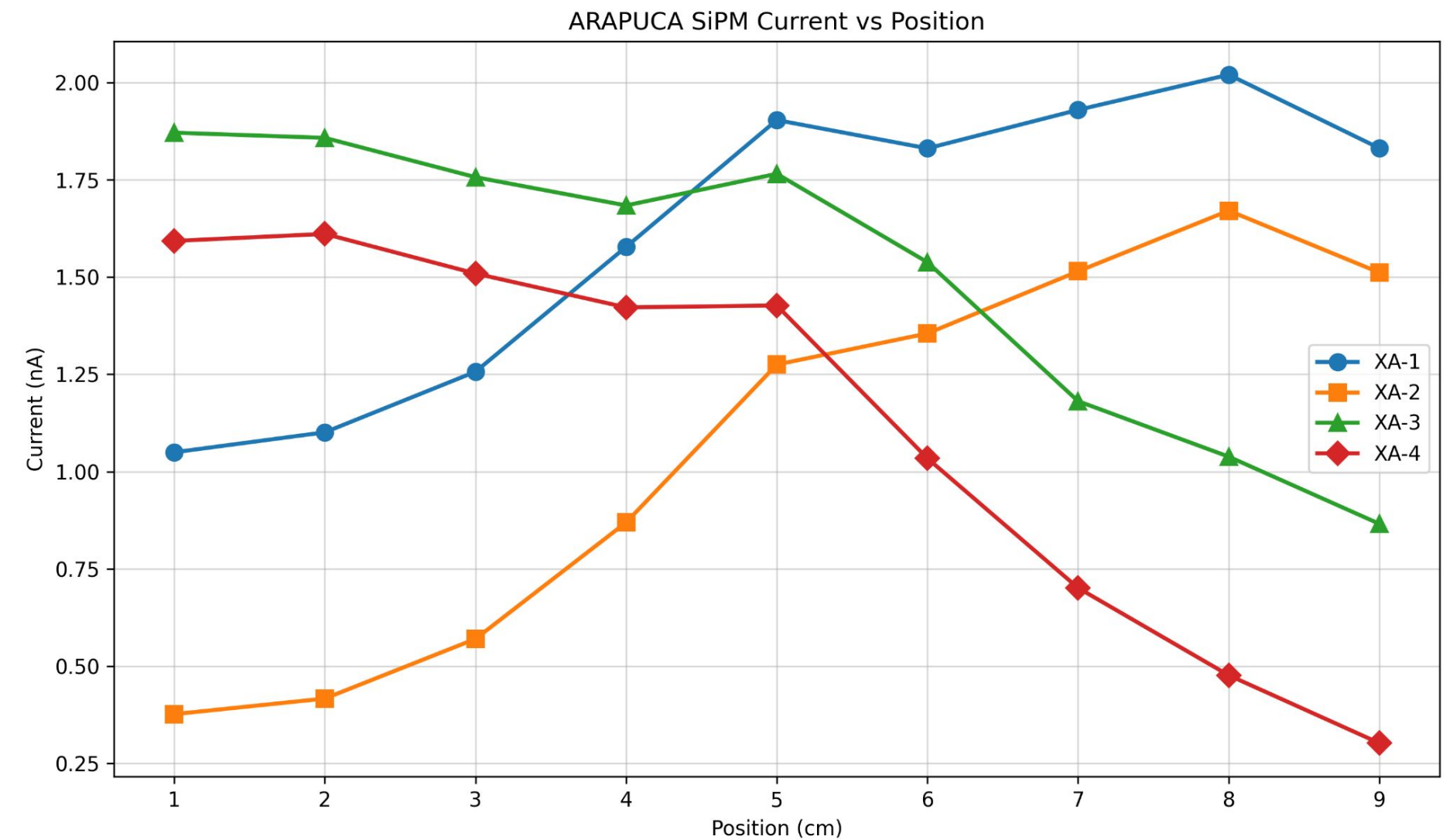
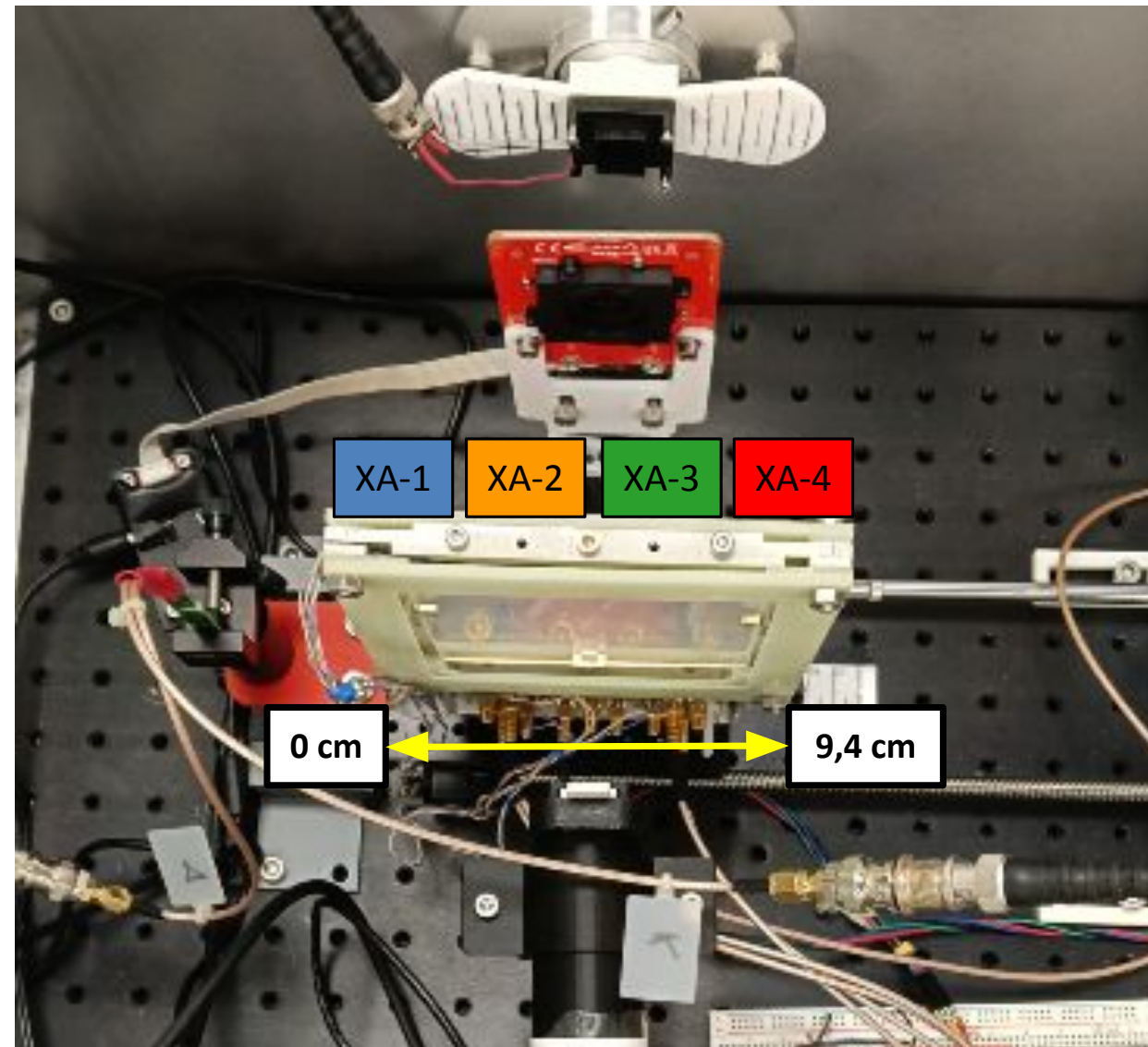


Efficiency results: D2 lamp



- Total efficiency of 8% for SiPM reference in 320-420 nm range
- Ar 300 nm, total efficiency of 43 %

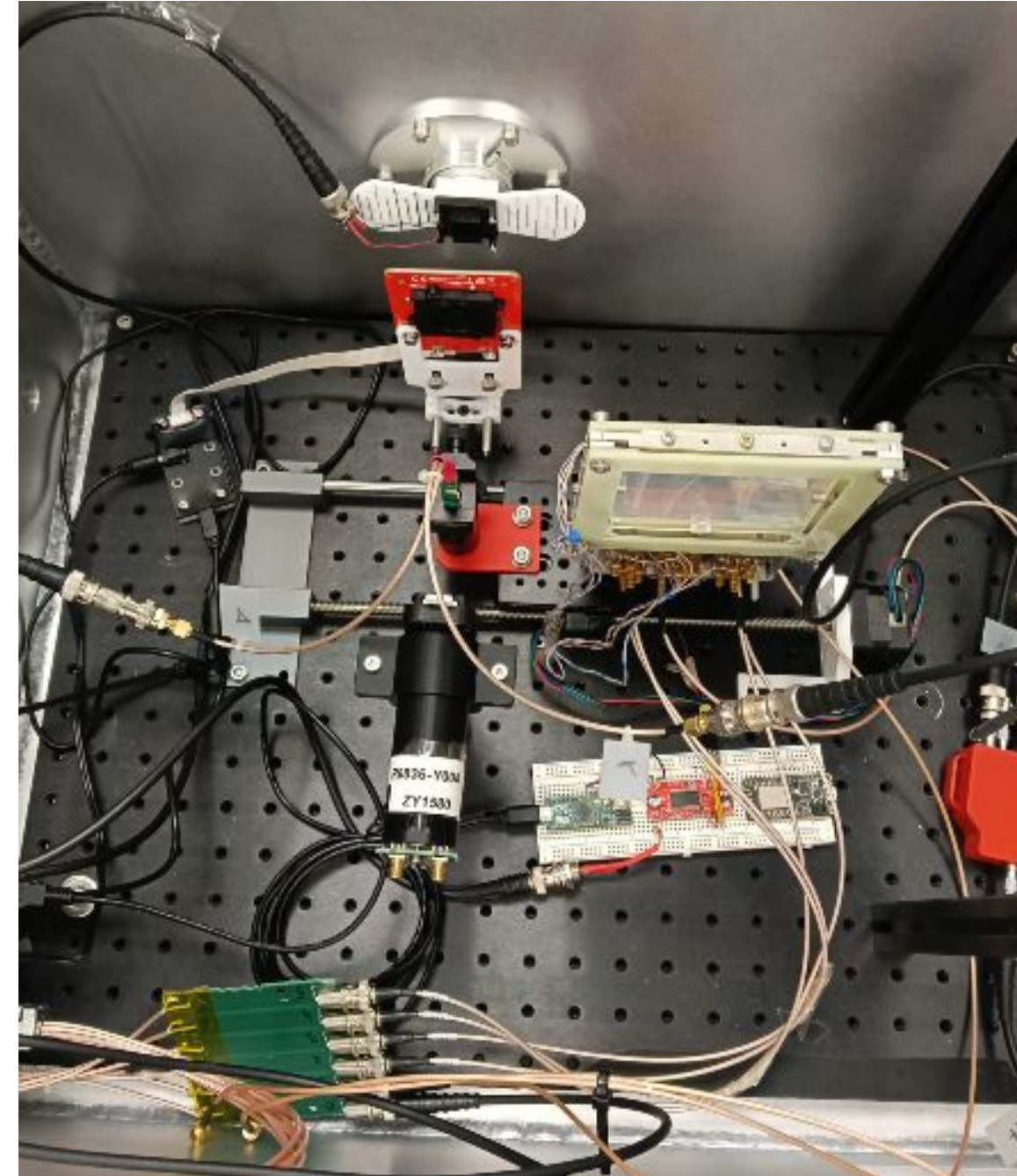
Horizontal scan on ARAPUCA



- Check connections?
- Check coupling between WLS bar and SiPM?

Next steps

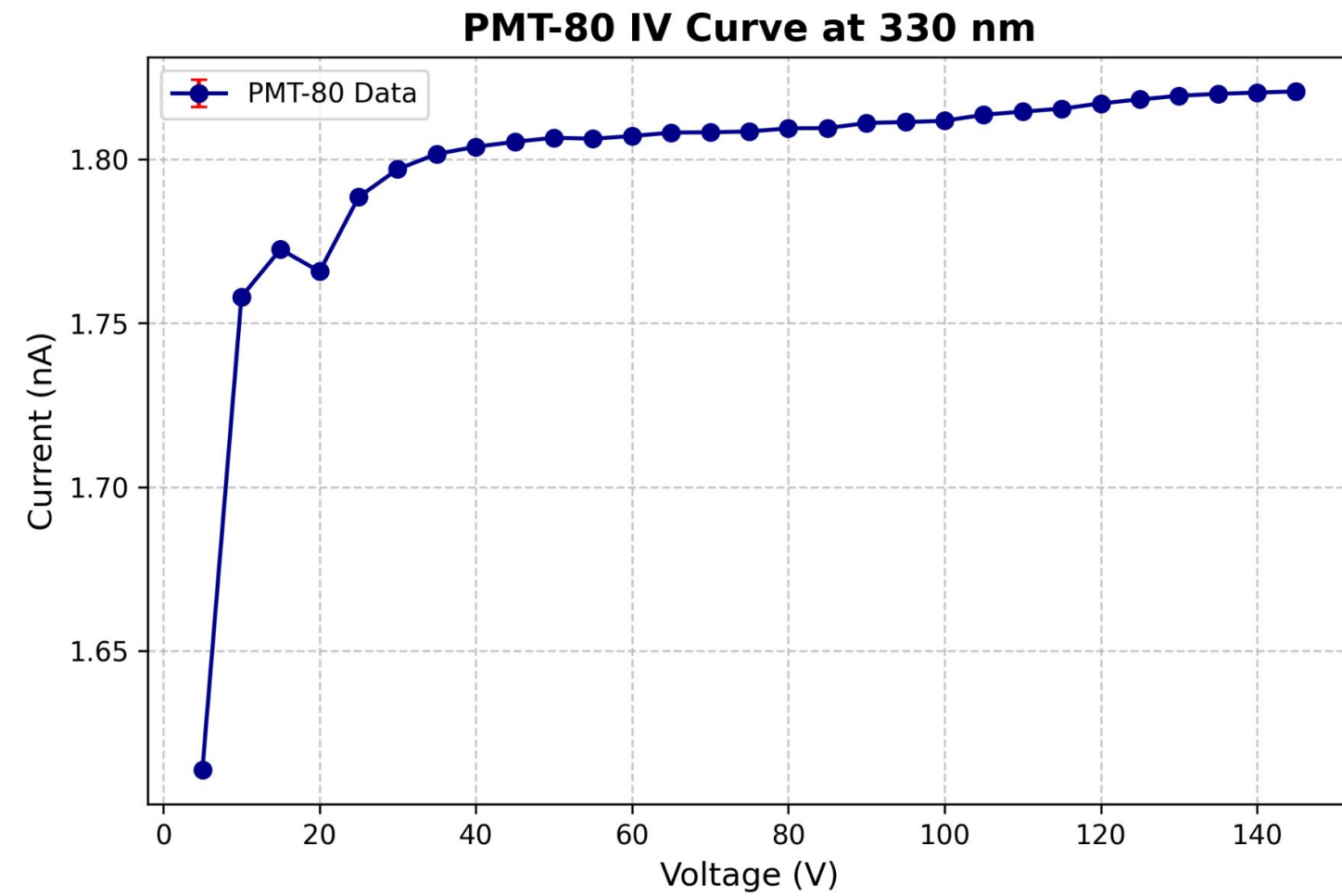
- Reference SiPM alignment improvement with target
- Improve WLS bar coupling in mini-XARAPUCA
- Deposit PTP into bar and measure in VUV light with GAr atmosphere



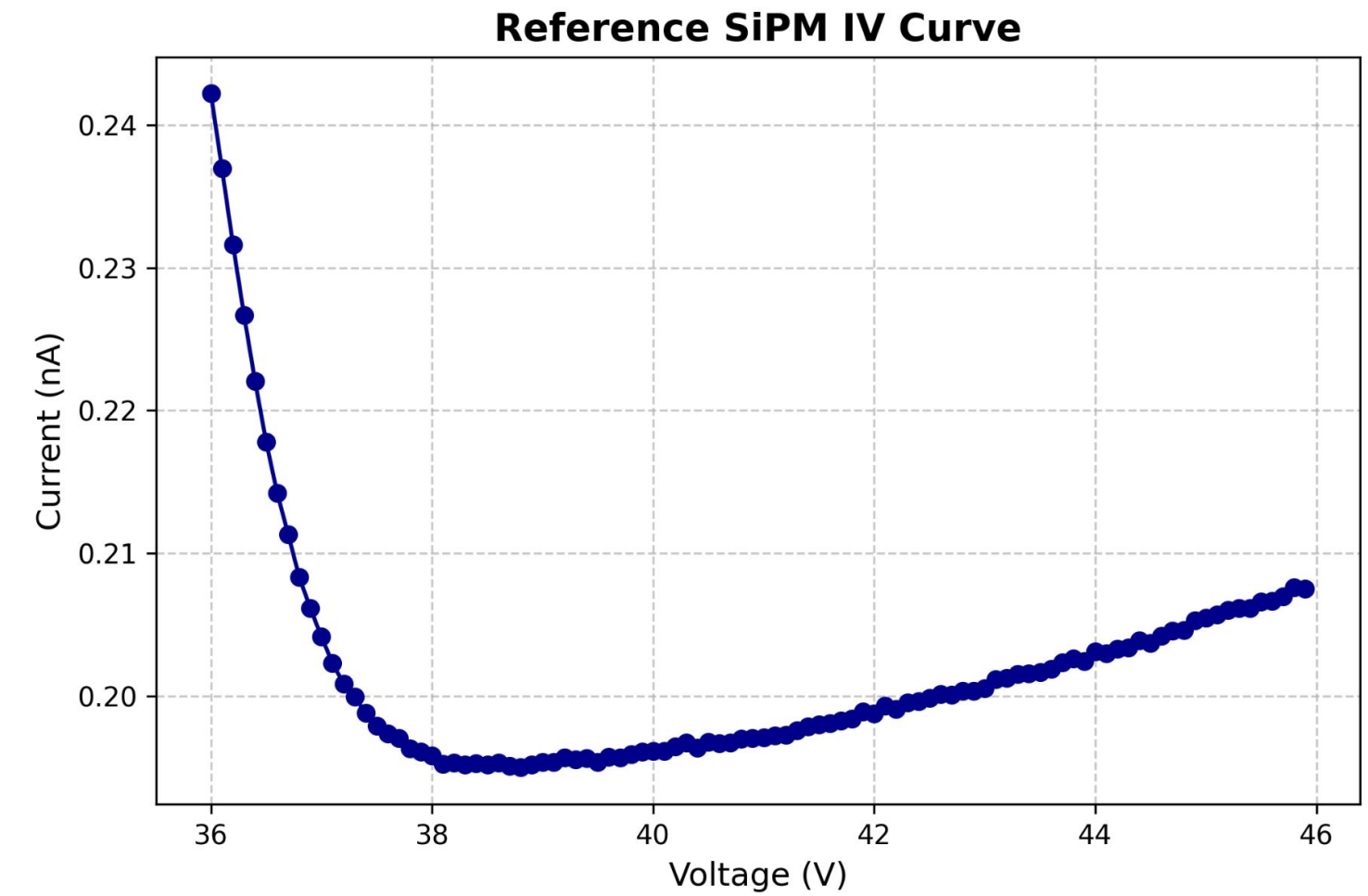
THANK YOU FOR LISTENING!

BACK UP

SiPM gain: I-V curve



- Reference PMT I-V curve for 330 nm light



- Reference SiPM I-V curve with no incident light