

SHMS HGC Cerenkov PMT Sanity Checks at UVa

B. Sawatzky ([JLab](#))

D. Day, A. Conover, P. McCormick ([UVa](#))

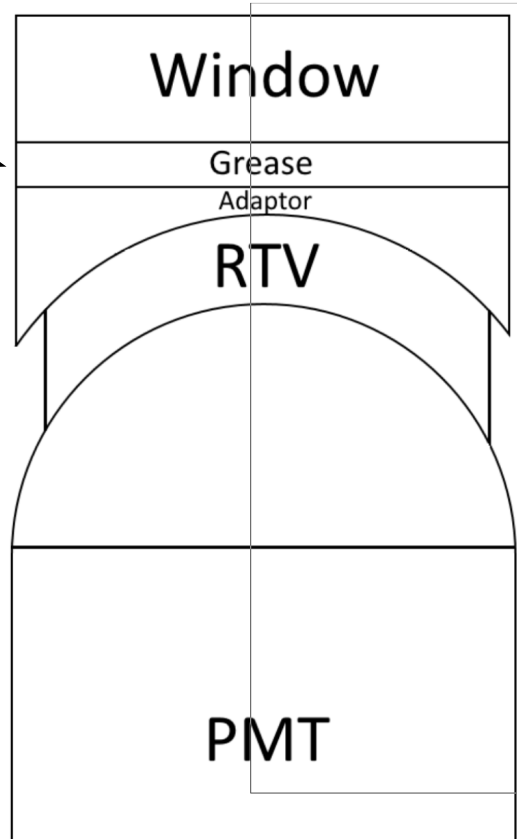
SHMS HGC (Heavy Gas Cerenkov)

- SHMS HGC has lower npe then predicted
 - 13 pe vs >25 pe at 1 atm C₄F₈O
- Low yield theories investigated and eliminated in last year
 - ~~Poor mirror reflectivity~~
 - ~~Poor mirror focus~~
 - PMT optical coupling absorbing UV?
 - » ~~Optical grease between PMT adapter and gas window?~~
 - » ~~RTV joint between PMT and PMT adapter?~~
 - » ~~PMT adapter not quartz?~~
- Last things to check...
 - Directly measure PMT QE in the UV range
 - » Will also measure UV absorption of quartz gas window and quartz PMT adapter while we're at it...

* Ref: [Update on Dec/Jan Running](#)

SHMS HGC PMT Optical Configuration

Removed from PMT1, 2
in Nov 2017

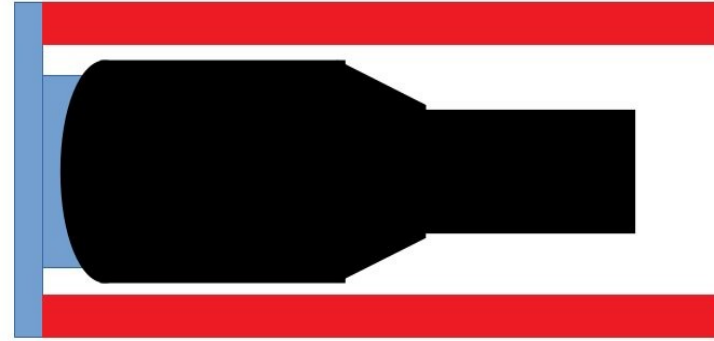


- Replaced with a stand-off ring in PMT1 in Spring
- RTV layer measured
 - ~0.14 mm (PMT1)
 - ~0.06 mm (PMT2)

SHMS HGC PMT1 Optical Configuration

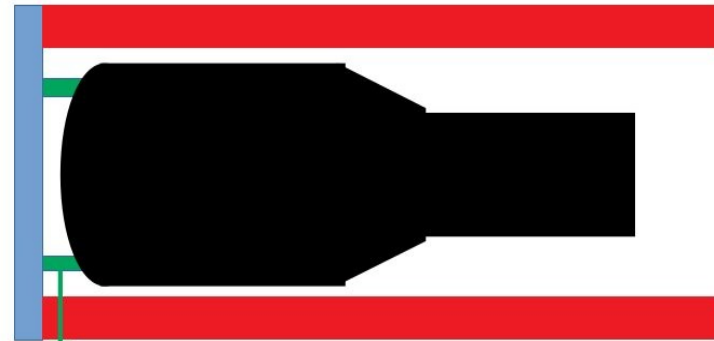
Before:

Quartz Window + Quartz adapter + RTV (130 micron) + PMT UV glass



After:

Quartz Window + Air gap (5 mm) + PMT UV glass



Plastic Ring

Al wall

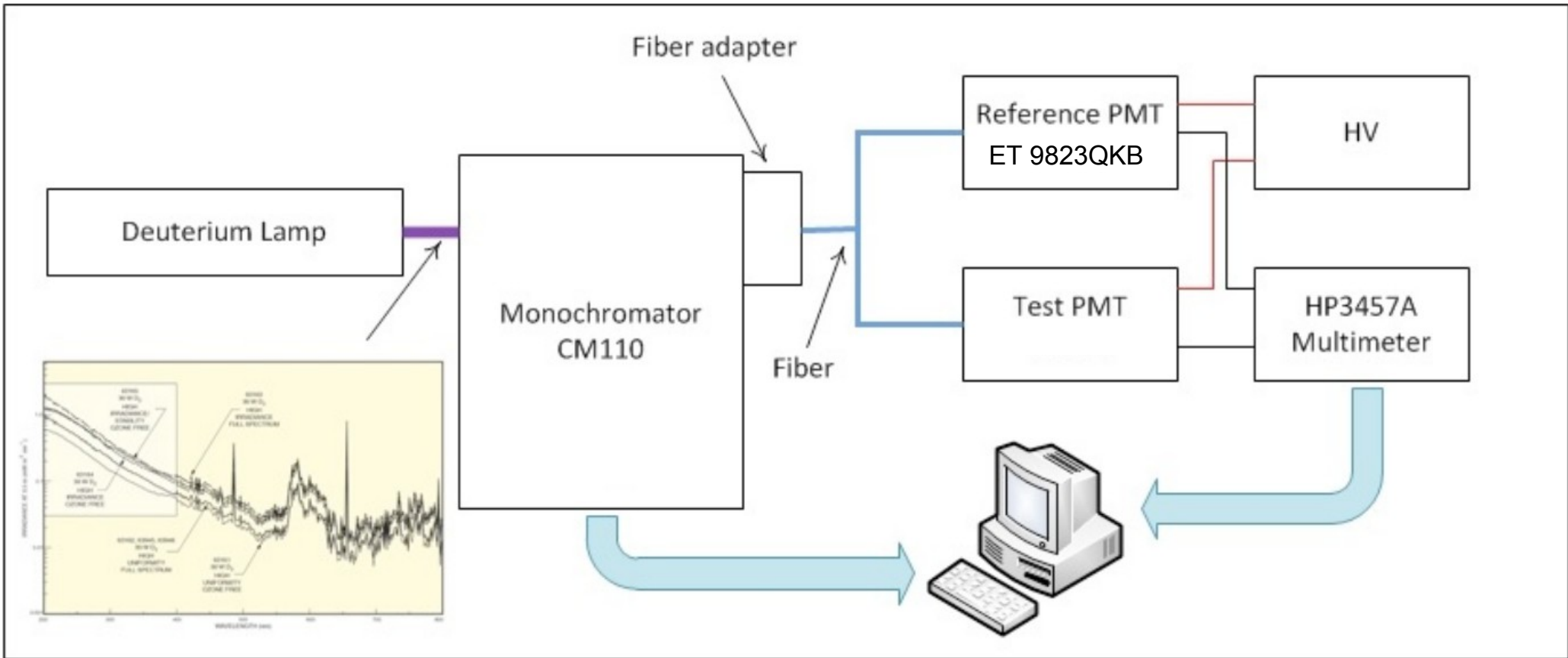


Side view of quartz adapter on PMT 1 (now removed)

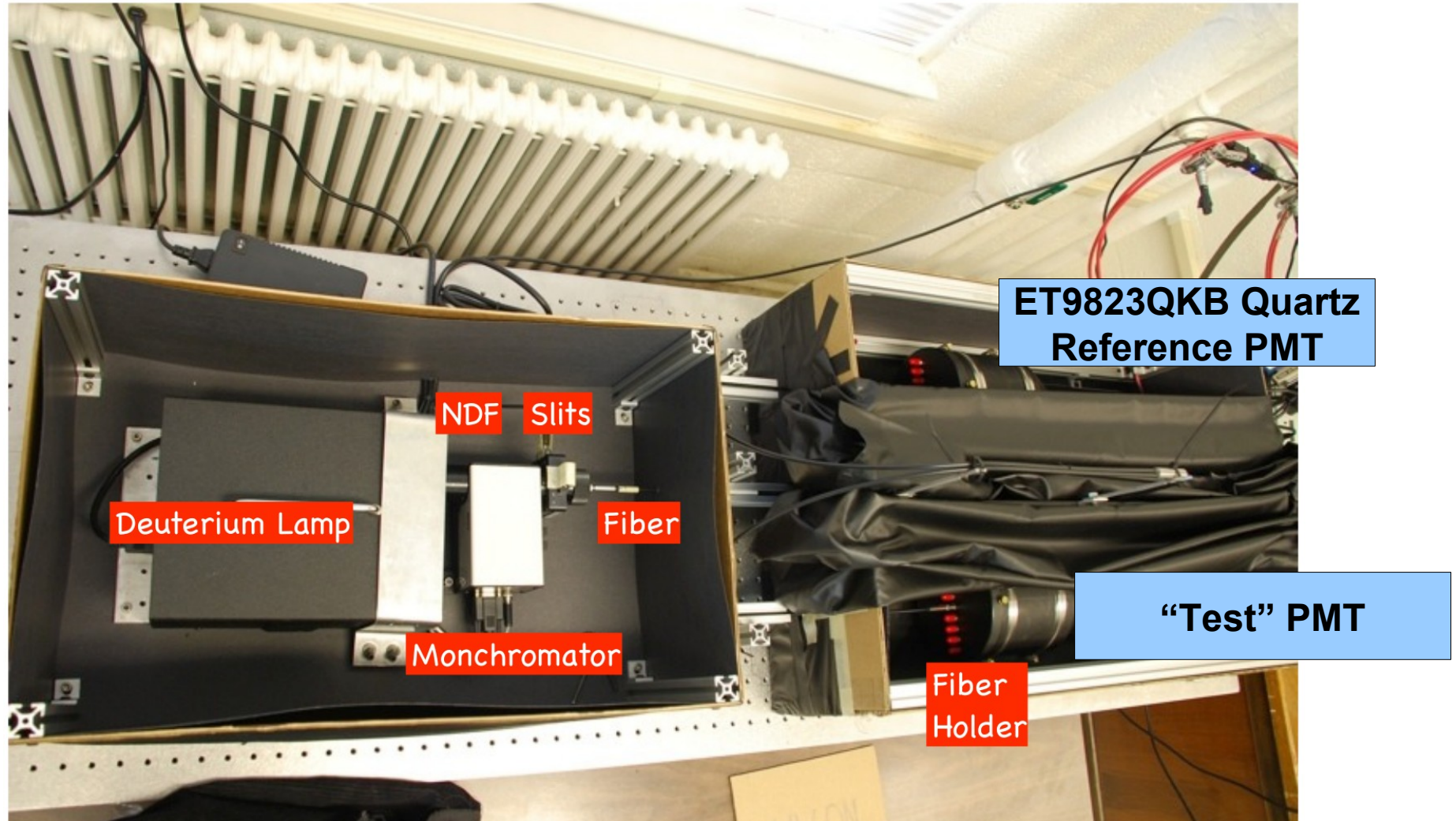
Note: Yellow color is due to kapton tape around perimeter of quartz adapter, NOT radiation damage.

Test PMTs at UVa

UVa PMT Test Stand



UVa PMT Test Stand

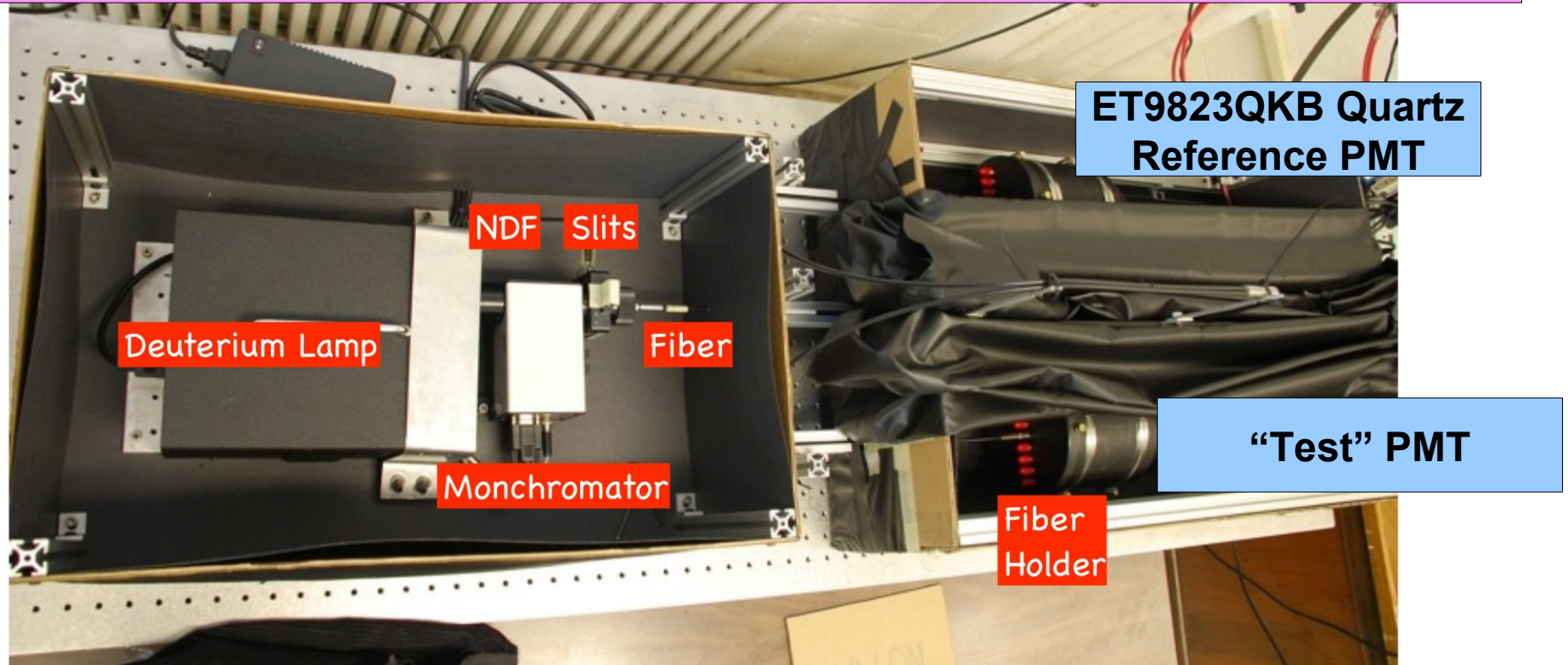


UVa PMT Test Stand

Normalization required for absolute QE measurement

- Difficult, not needed, so we did not do it.

Measurements are relative not absolute



Interpretation Notes

- 'Reference' PMT is ET 9823QKB Quartz-face (dashed curves)

- monitors lamp stability
- reflects spectral response of the system as a whole

Represents "Best Case" PMT response

» Compare PMTs to Ref

- Dash-dotted lines indicate QE curves for (ET) Quartz and Borosilicate PMT

- w/ arb. scaling factor applied!

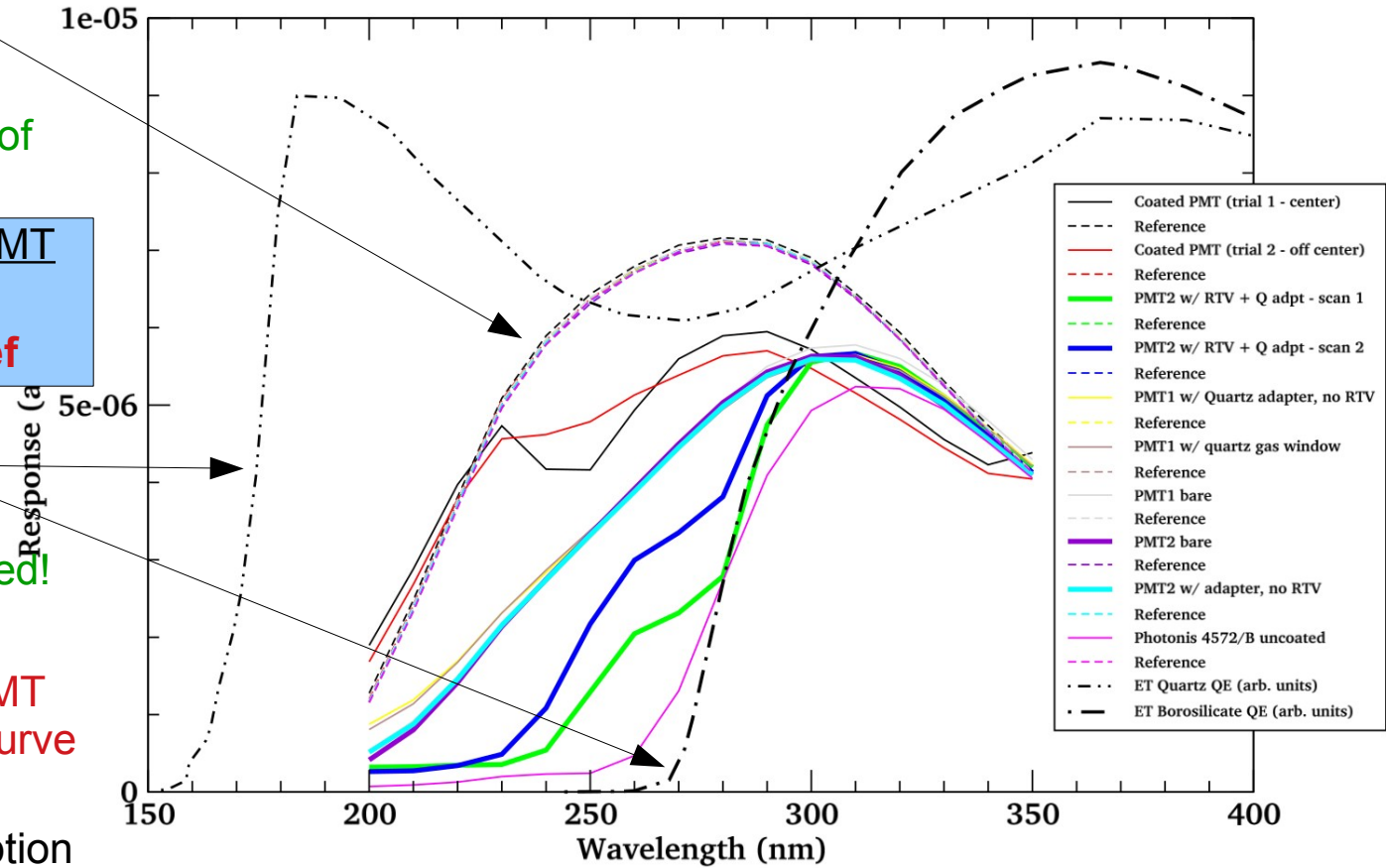
NOTES:

- Difference between Ref PMT response and quartz QE curve reflects system response

» Lamp intensity, absorption in fibers, etc

PMT response vs. wavelength

Note: Ref curves are unmodified; curves for each PMT scaled to match at ~350nm



PMTs Under Test

- Tested 4 'JLab' PMTs

- PMT1, PMT2

- » HGC prod. PMTs
- » Hamamatsu UV glass
- » Different optical elements involved

- 'Coated PMT'

- » Photonis 4572/B from Hall A, Borosilicate PMT w/ p-terp. coating

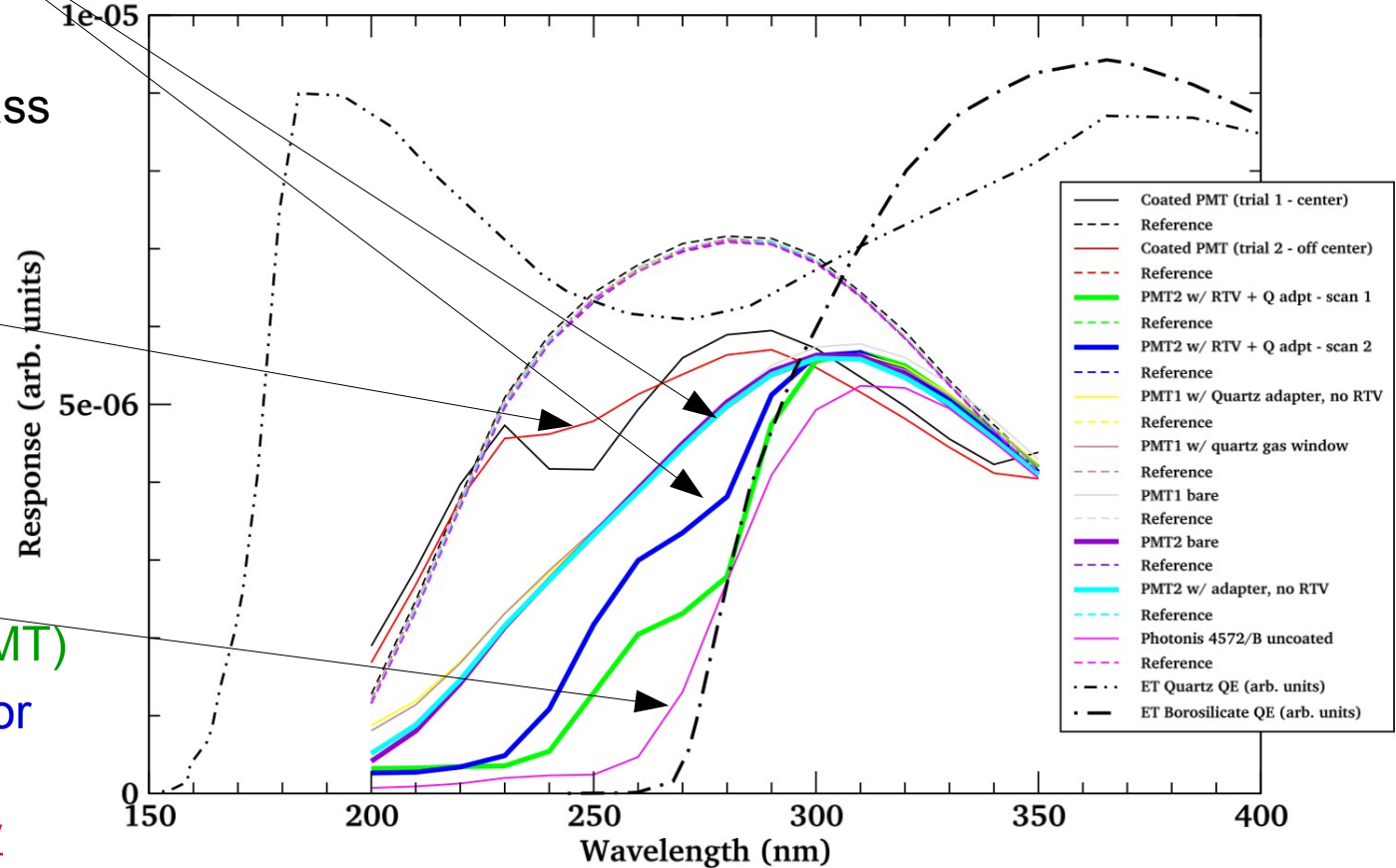
- Photonis 4572/B uncoated (different PMT)

- NOTE: Arbitrary scale factor between each PMT type

- Compare shapes only

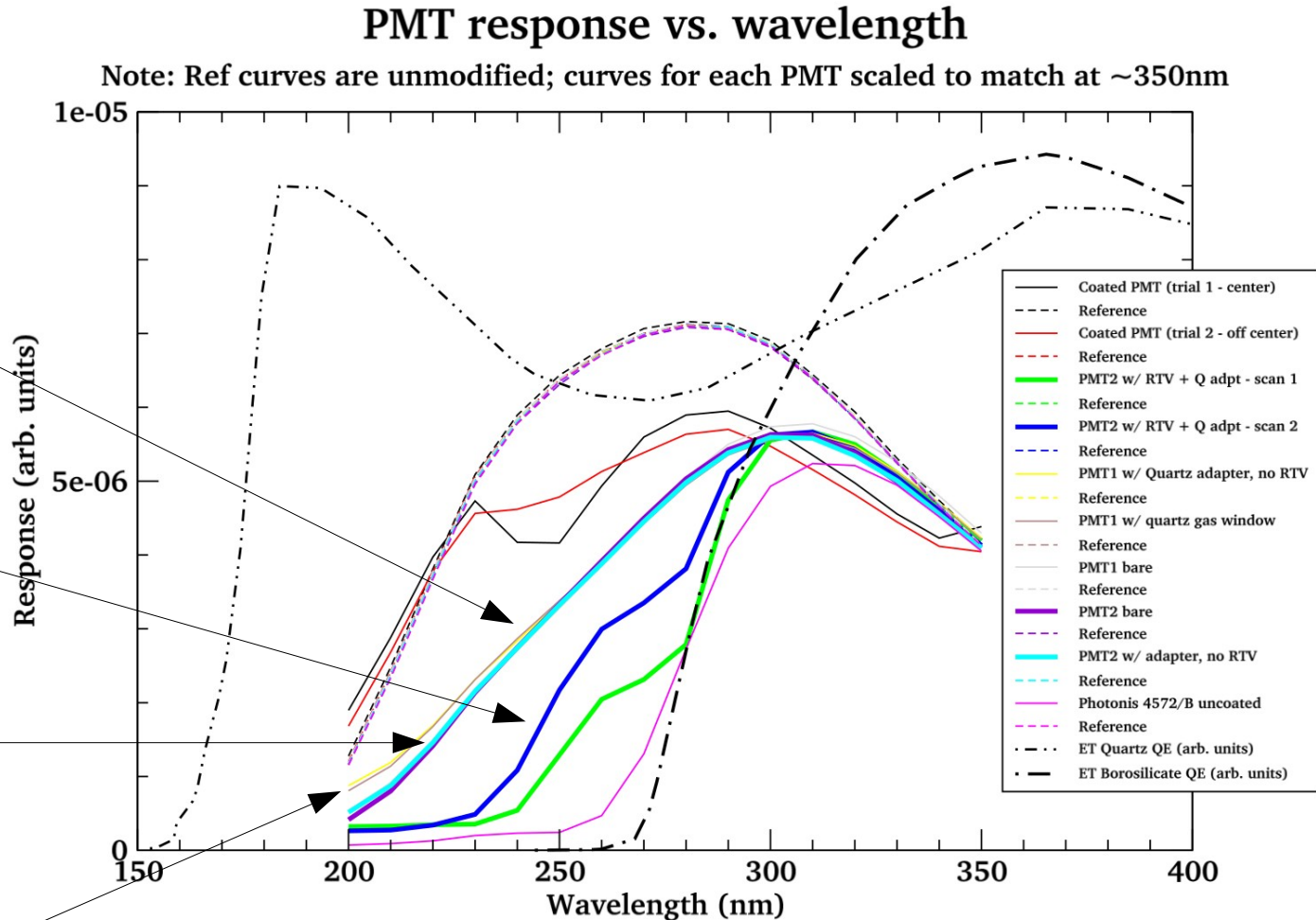
PMT response vs. wavelength

Note: Ref curves are unmodified; curves for each PMT scaled to match at ~350nm



'Production' PMT responses

- **PMT1** (light lines)
 - **Prod. PMT that had all 'interface' parts removed**
 - » no adapter, no RTV, no opt. grease
 - **As expected**
- **PMT2** (heavy lines)
 - **Production PMT**
 - » w/ adapter + RTV
 - **degraded**
 - » adapter + RTV layer (0.06 mm) removed
 - **same response as PMT1**
- **Quartz glass PMT adapter and gas window tested**
 - **transparent (no impact)**

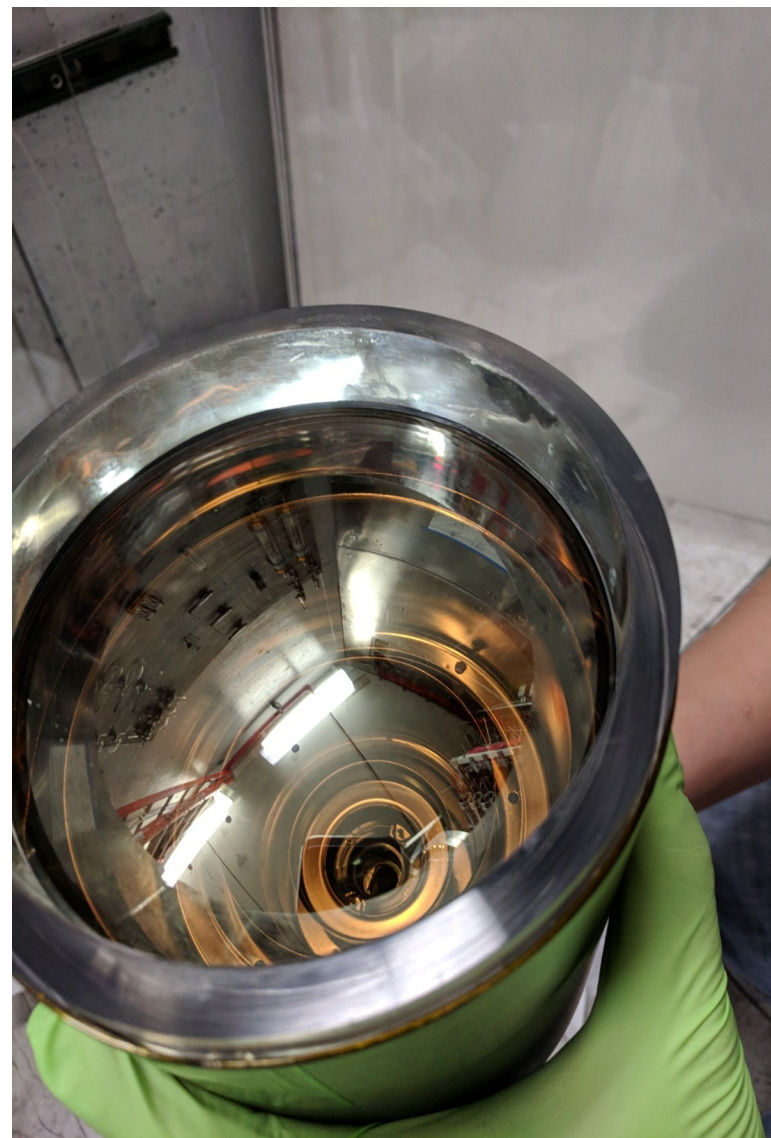


Conclusions

- SHMS HGC PMTs really *are* UV glass
- Quartz gas windows and quartz PMT adapters *are* transparent in UV
- RTV layer cuts enough that we should remove it (PMT adapter goes too)
- Also picked up ET 9823QKB replacement PMT for SHMS NGC from Donal
 - Replace noisy tube
- **Next Steps (ASAP)**
 - Remove RTV, quartz adapter, etc from upper PMTs
 - Re-insert bottom PMTs
 - Reinstall HGC in stack
 - » Gain check with LED
 - Replace noisy *NGC* PMT too
- **Small puzzles / cautions (?)**
 - *Before and After* npe response of PMT1 *in production* showed no/minimal improvement after removing RTV layer...
 - » I would not expect a major boost in photons in the Fall!

SHMS HGC Optical Configuration

SHMS HGC PMT 'Ring'



PMT2 Quartz Adapter Removed

- Quartz adapter on PMT2 removed at UVa
- PMT2 RTV layer thickness
→ 0.06 mm

