A PMT “sans Cherenkov”

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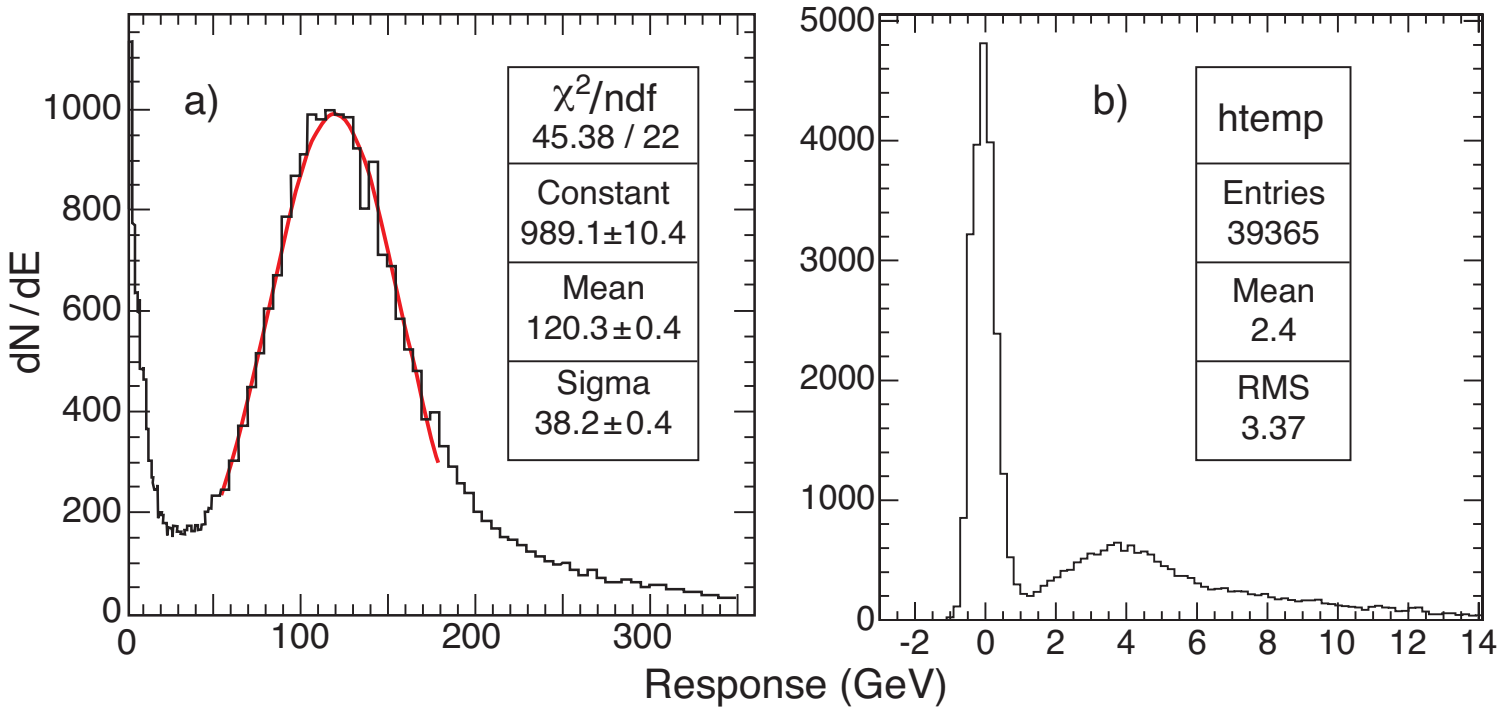
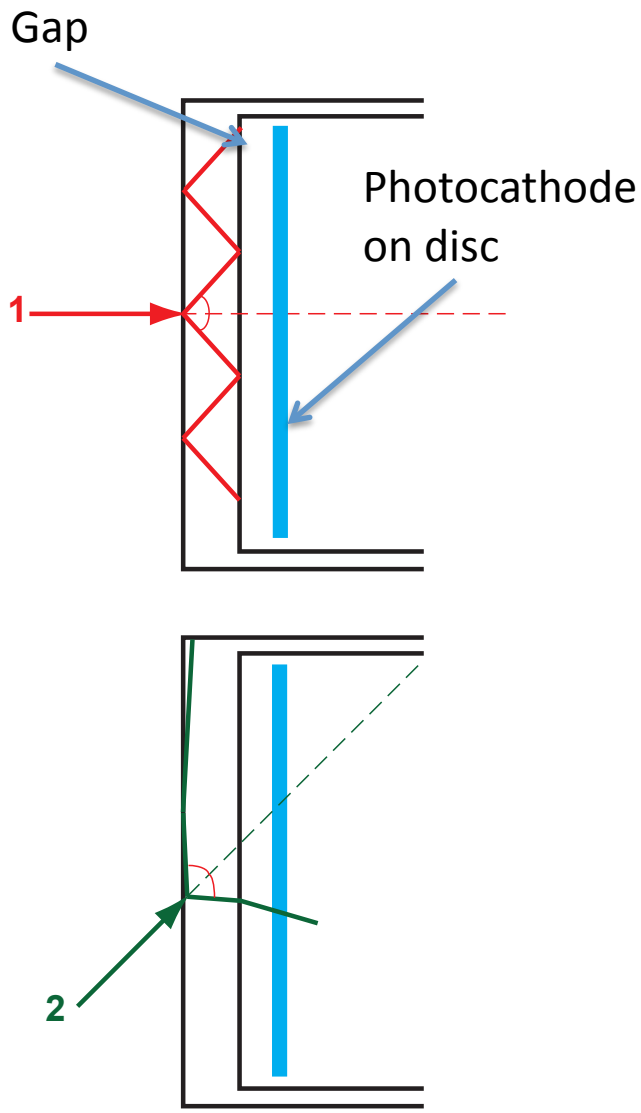
Problem ?



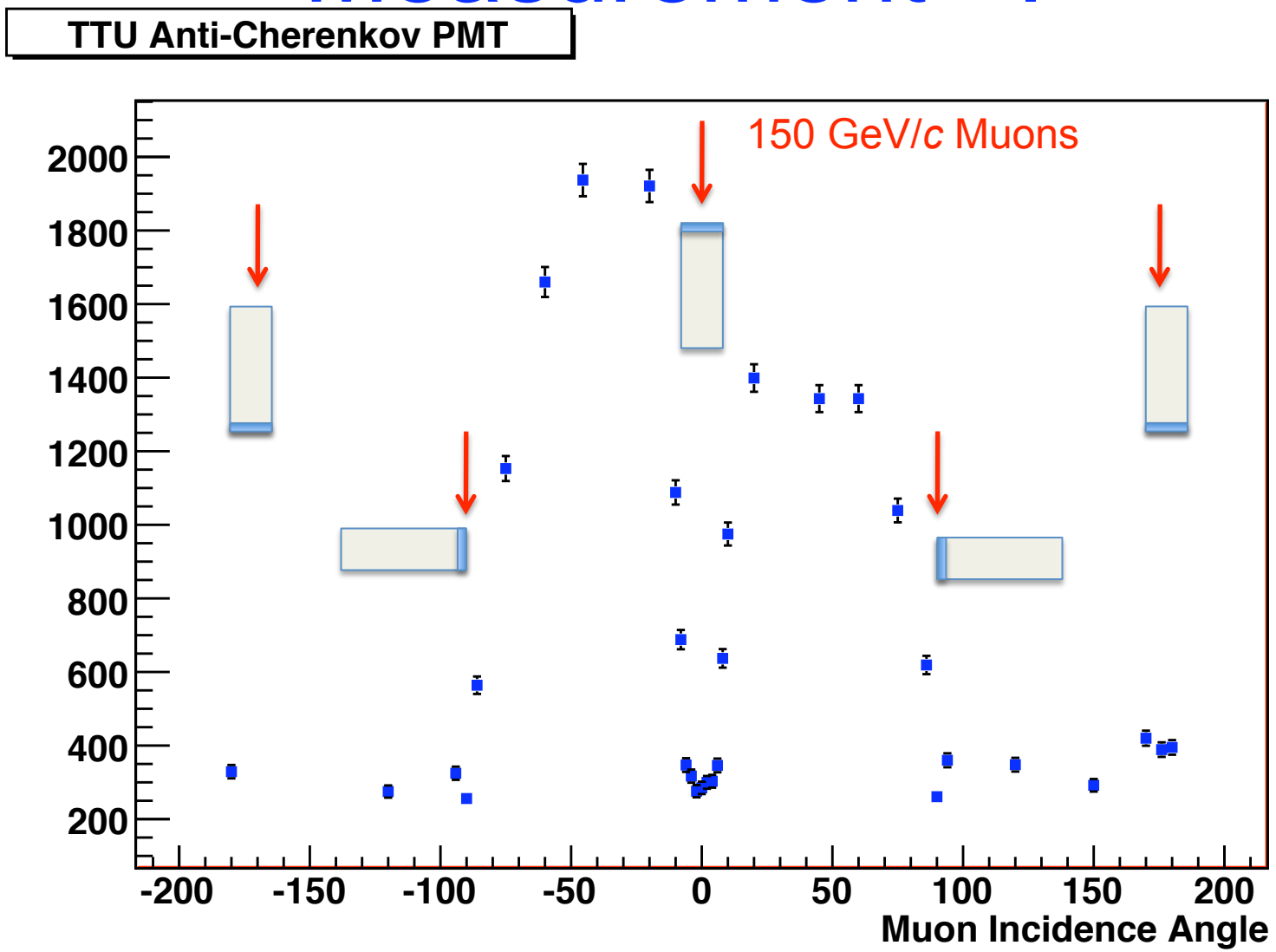
- TB04 data showed that a through-going muon generates ~30 pe in the HF PMT window, equivalent to ~120 GeV signal, due to the Cherenkov light produced in the window.
- It is yet to be conclusively demonstrated that this problem limits any physics reach.

Idea

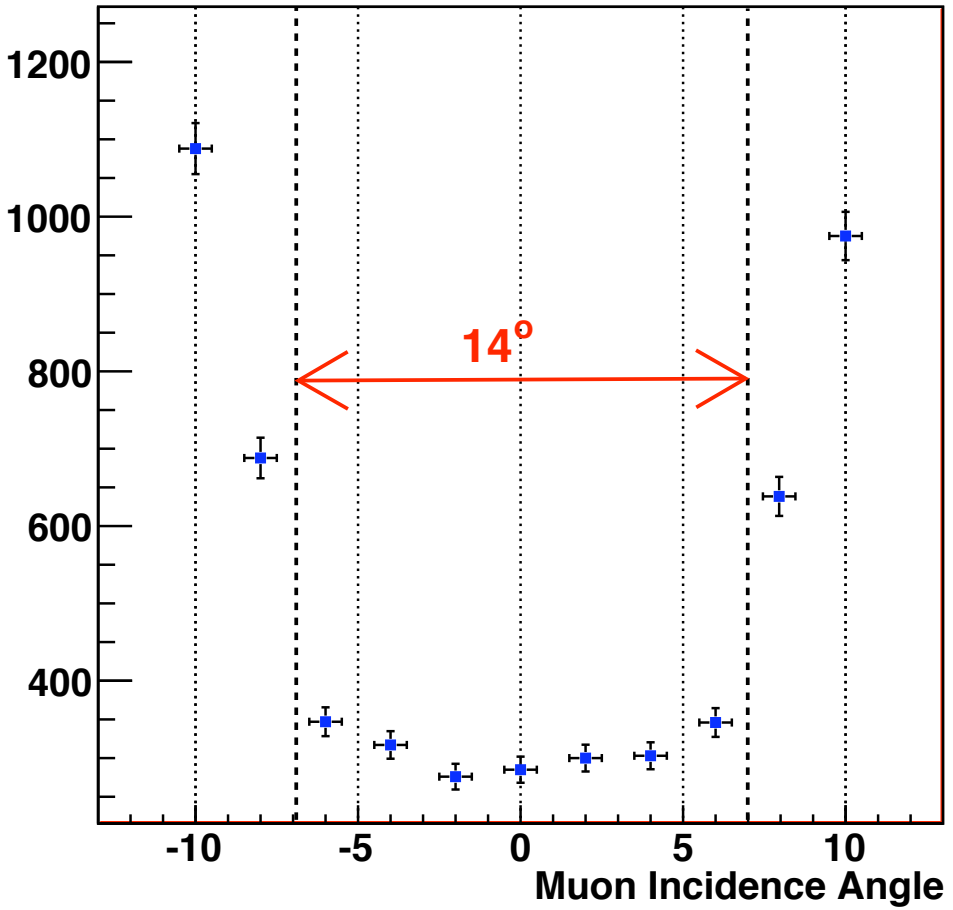


1. Remove the photocathode from the window by ~1 mm and place it on a thin ~40 micron disk.
2. Trap Cherenkov light in the PMT window for all angles where the Cherenkov cone is larger than the critical angle.
3. Cherenkov angle is 48 degrees (n=1.517 for borosilicate) and the critical angle is 41 degrees.
4. Thus, for 7 degrees of angle of incidence (14 degrees), there should be no Cherenkov signal from the PMT.
5. Larger the n, larger the angular range. (CMS-IN 2009/028).

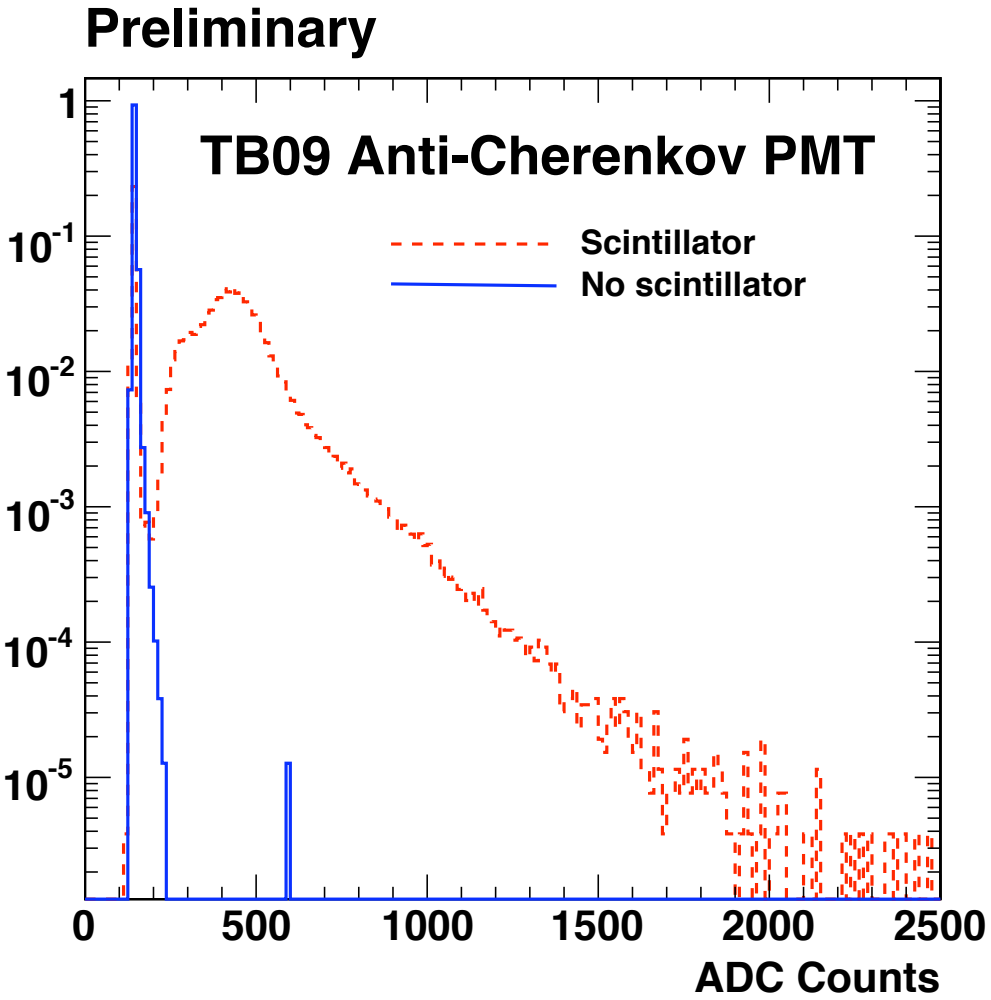
Measurement - I



Measurement - II

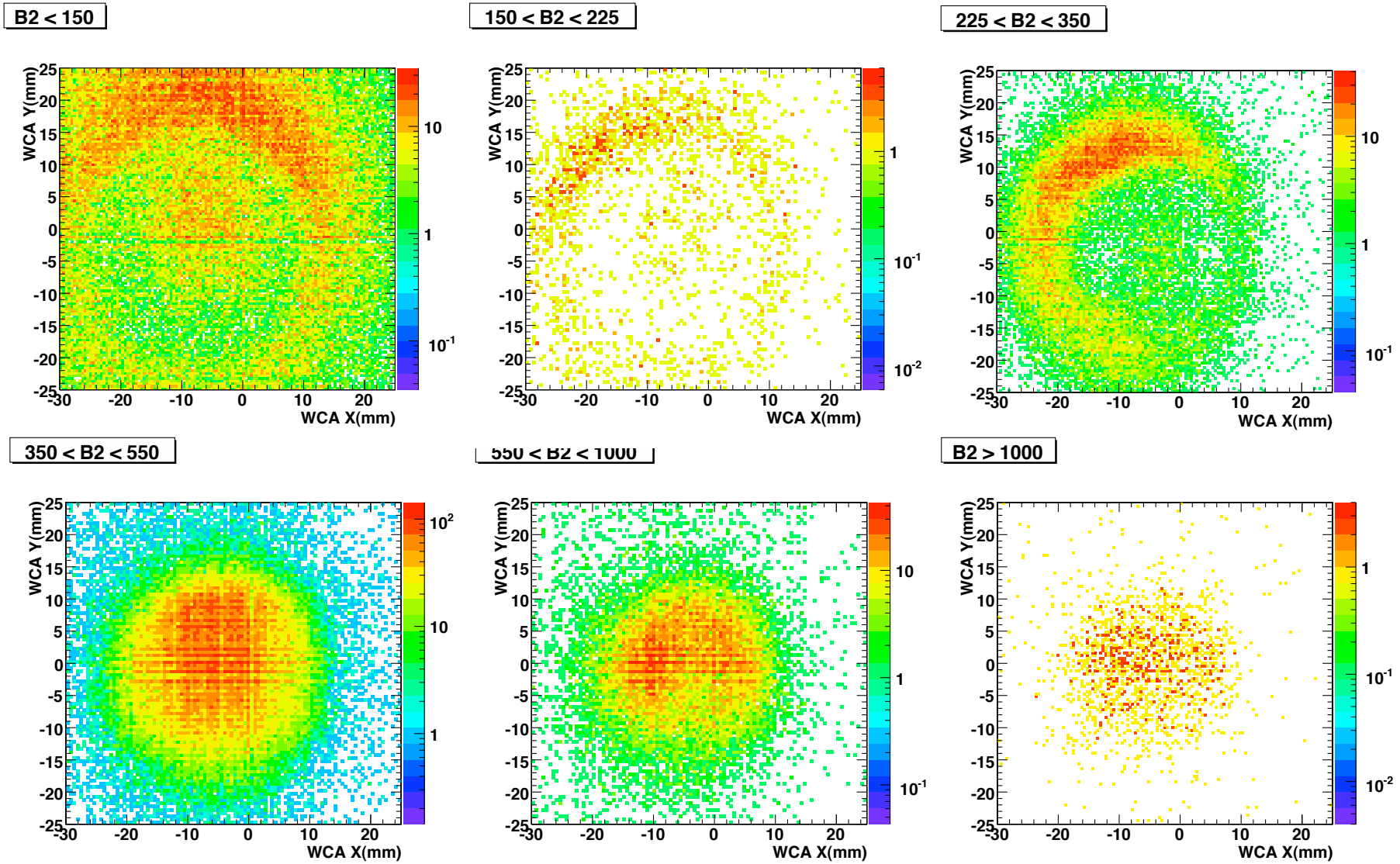


Measurement - III



- We measured the PMT signal distribution with and without a thin scintillator disk in front of the PMT for comparison using head-on muons.
- There is no measurable Cherenkov signal as expected for O(10^5) head-on 150 GeV muons.
- Measurements with scintillator gave us preliminary information about the photocathode uniformity.

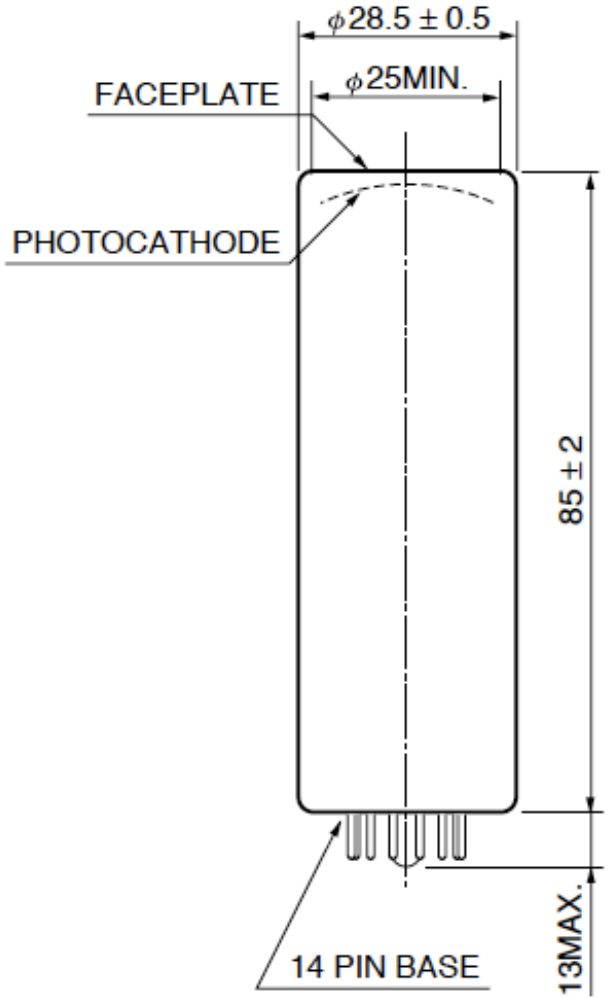
Measurement - IV

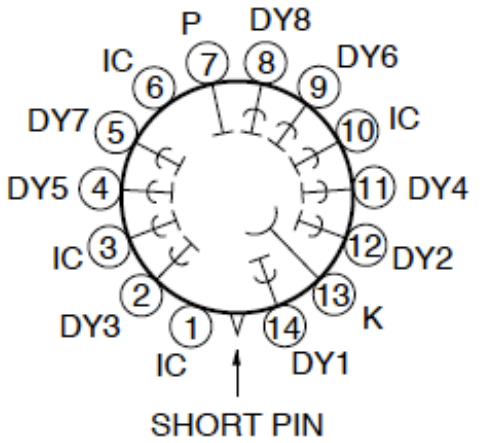


Practical Issues - I

Practical Issues - II

- R7525





IC: Internal Connection (Do not use)

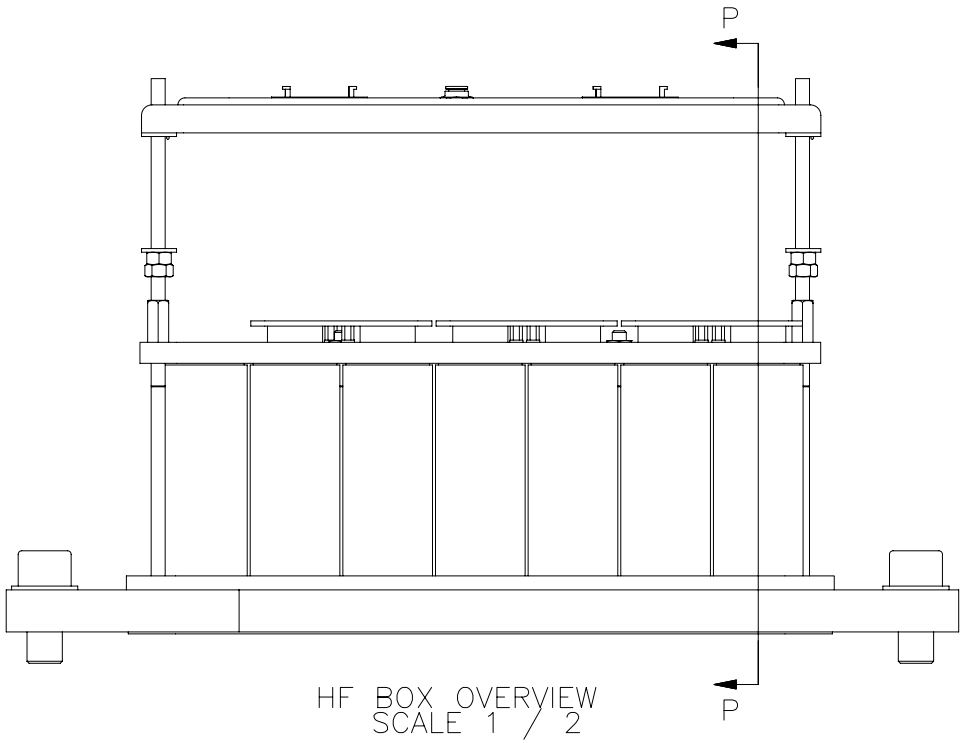
BOTTOM VIEW
(BASING DIAGRAM)

TPMHA0450EA

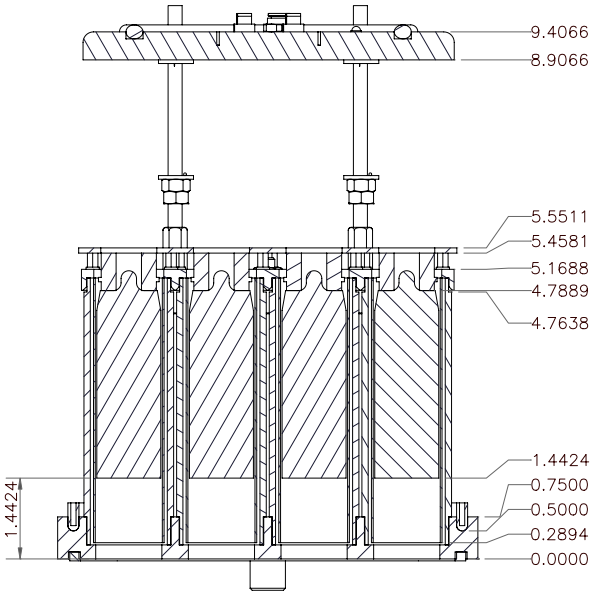
What's Next?

- The data support that the Cherenkov signal can be completely suppressed by this technique. The proof-of-principle is established.
- Electron Tubes is prepared to produce 30 PMTs with the same dimensions and pin-outs as R7525. The cost is $960 each. Delivery by February 2010. Higher *n* window can be the next iteration.
- Neither the HF readout-boxes nor the high-voltage cards need to change.
- One readout-box with anti-cherenkov PMTs can be mounted on the HF early next year.
- If needed, 2000 PMTs can be procured at $390 each and delivered over 6 months (~80/month).

Practical Issues - III



HF BOX OVERVIEW
SCALE 1 / 2



SECTION P–P
SCALE 1 / 2

TEXAS TECH UNIVERSITY HF READOUT BOX			
Readout Assembly			
DRAWN Ray Thomas	TOL./UNITS 0.005 in.	SHEET NO. 1 OF 14	REV. M