Test-beam Aging Studies of a TMAE Prototype for the HERA-B RICH

Kwong Lau

University of Houston

Outline of Talk

- Collaboration & Publications
- Why TMAE?
- Previous TMAE Aging Experiences
- Beam-Test Strategy
- Chamber Design
- Schematic of Test Set-up
- Results
- Preventive (Heating) Strategy
- Conclusions

Collaboration & Publications

- Collaboration: M. Atiya, D. Broemmelsiek, Th. Hamacher, M. Ispiryan, S. Korpar, P. Krizan, K. Lau, P. Maas, J. McGill, J. Pyrlik, K. Reeves, P. Rose, J. Rosen, A.S. Schwarz, R. Schwitters, M. Staric
- Institutions: U. of Houston, BNL, Northwestern U., U. of Texas at Austin, DESY, U. of Maribor, J. Stefan Inst., U. of Ljubljana
- Publication: J. Pyrlik et al., Aging measurements of a TMAE based photon detector for the HERA-B RICH, NIMA 414, 170 (1998)

Why TMAE ?

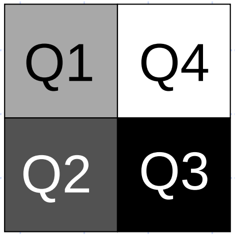
- Granularity for RICH at HERA-B is difficult to realize with single-anode PMTs or other technologies at the time of design
- There exist considerable aging experiences in large experiments (SLD, OMEGA) and bench tests (SLAC/LBL)

Previous TMAE Aging Experiences

- SLD: looks OK if reheat wires
- OMEGA: wash chambers in solvent once a year
- SLAC/LBL Prototypes: Aging seems tolerable with CF4 and thick wires (>45 micron)
- UT/Hamburg 25micron chamber: rapid aging
- UH 45micron chamber: results inconclusive
- Others

Beam Test Strategy

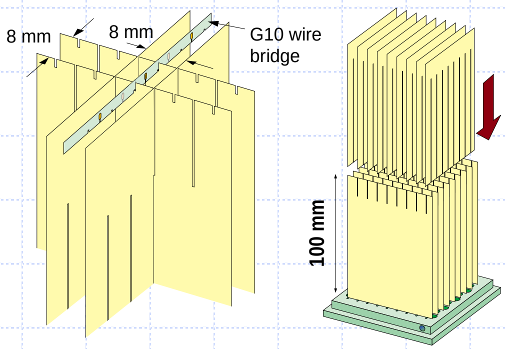
- Incorporate all known experiences in chamber design (gold-plated cathode, G10 surfaces covered by DP 190, stainless steel gas system etc.)
- Redundancy: measure aging in 2 different ways: chamber gain and Cherenkov photon detection efficiency

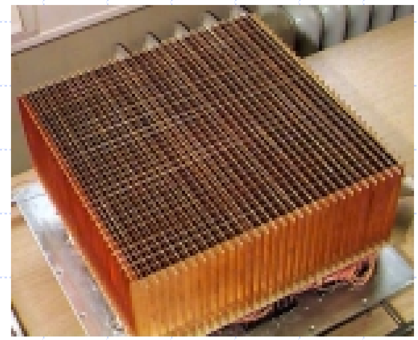


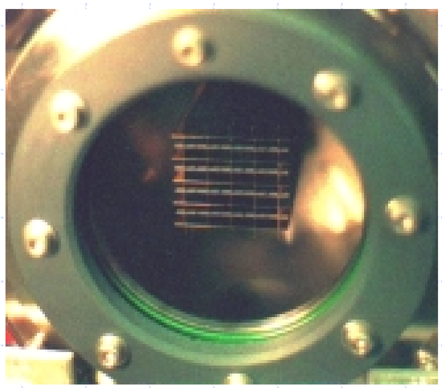
- Aging rate controlled by a UV lamp to expected HERA-B conditions
- Expose chamber to 4 levels of dose simultaneously by using a mask
- Monitor and record all relevant external parameters (pressure and temperature)

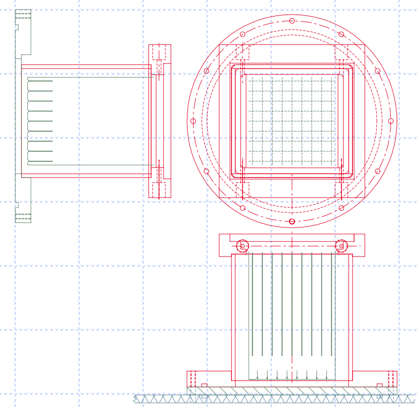
Chamber Design

- Gold-plated cathode with 64 8 mm x 8 mm cells
- 45 micron gold-plated tungsten wires

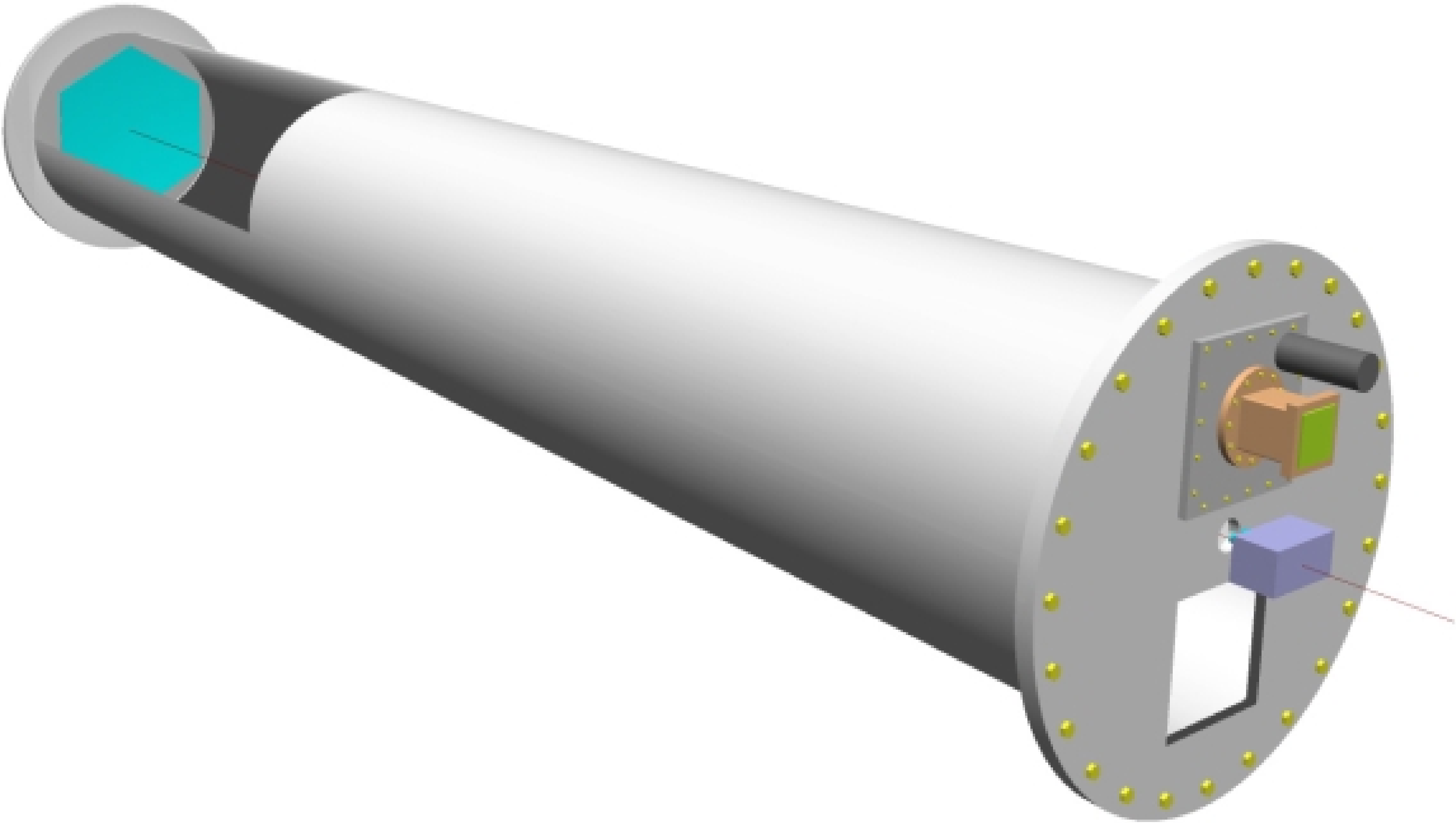








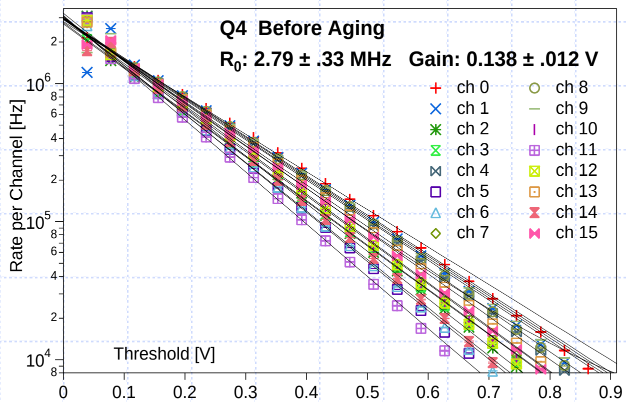
Schematic of Test Set-up

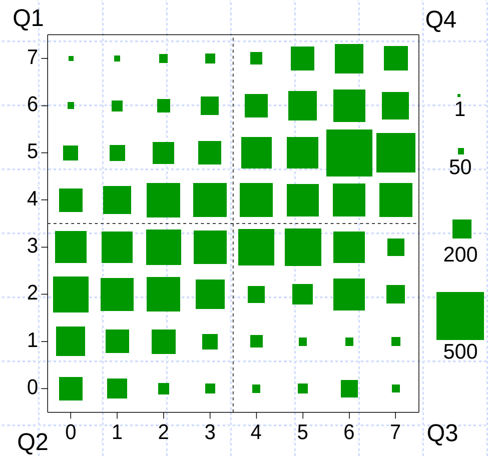


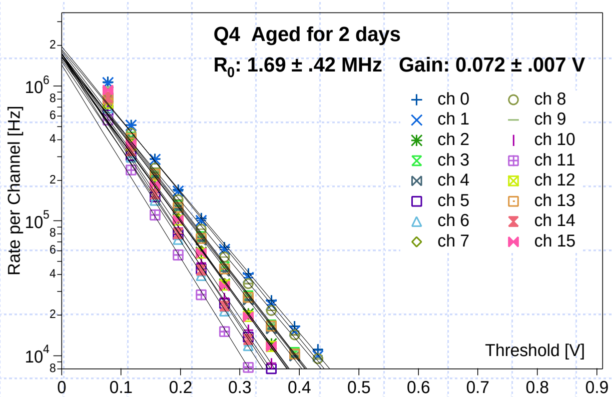
Results

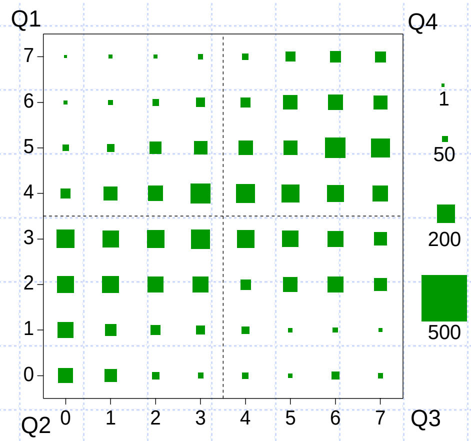
Top plots: Day 0 (Gain: 0.14 V; efficiency: 100%)

Bottom plots: Day 2 (Gain: 0.07 V; efficiency: 60%)



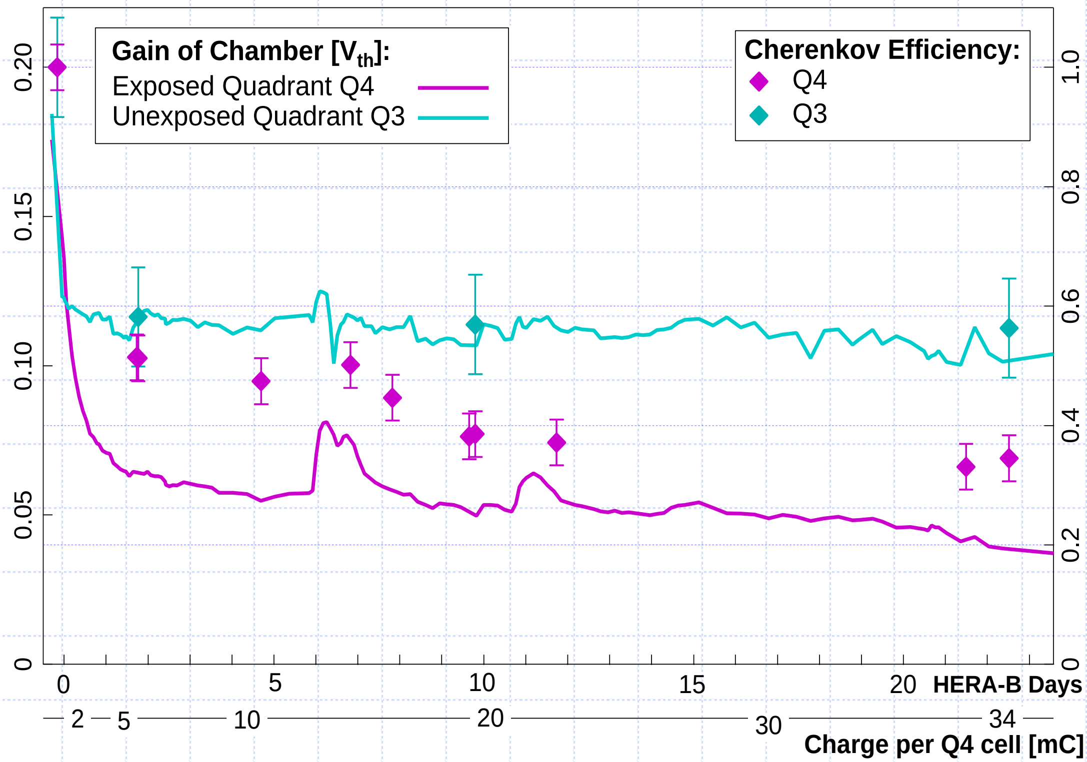






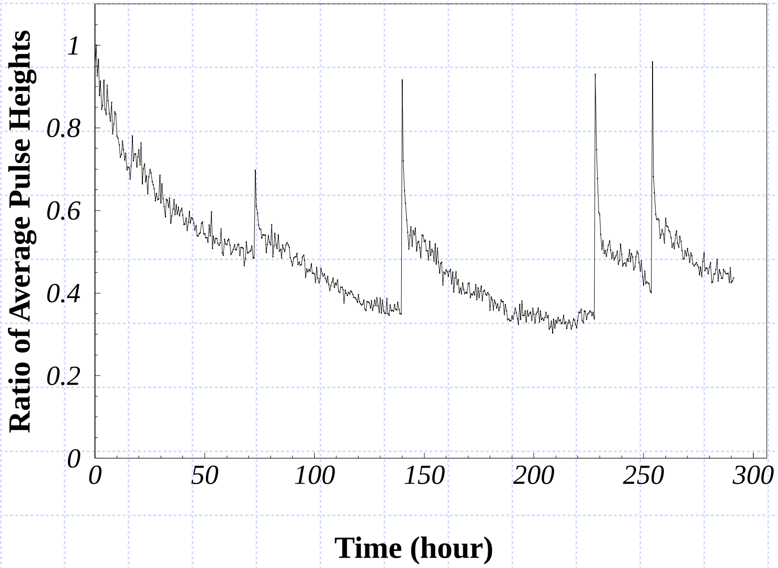
Results: Summary

- After 20 HERA-B days equivalent, gain dropped to 20-50% and efficiency to 30-50%, averaging about 20% per month after initial fast drop of about 50%



Preventive (Heating) Strategy

- Bench Test at Ljubljana: similar chamber design with a mirror to reflect UV light onto the chamber
- Heating recovers chamber gain but gain drops rapidly to what it was before heating
- See IEEE TNS 46, 317-320 (1999) & poster submitted by Skrk et al for details



Conclusions

- Aging is a limiting factor for most wire chamber applications in high-rate environments
- TMAE suffers from additional "chemistry" problems related to the fragile & corrosive photosensitive molecules
- Preventive measure by heating the wire does not work at HERA-B dose