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

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Int. Workshop on Aging Phenomena in Gaseous Detectors 10/4/2001
Outline of Talk

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Collaboration & Publications

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
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