Bialkali Transfer Photocathodes for Large Area Psec Photo Detectors (LAPPD)

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LAPPD Collaboration

High Energy Physics Division
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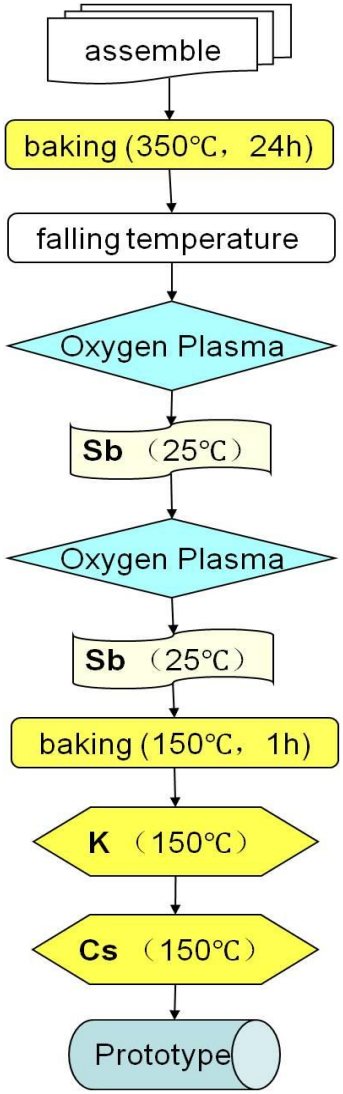
Outline

- Growth of 1’’ PMT Photocathode Growth with Burle Equipment
- Growth of Large Area (7’’) Photocathode with Glass Chalice
- Growth of Photocathode in Single Tile Facility (4’’ & 8’’)
- Future Work

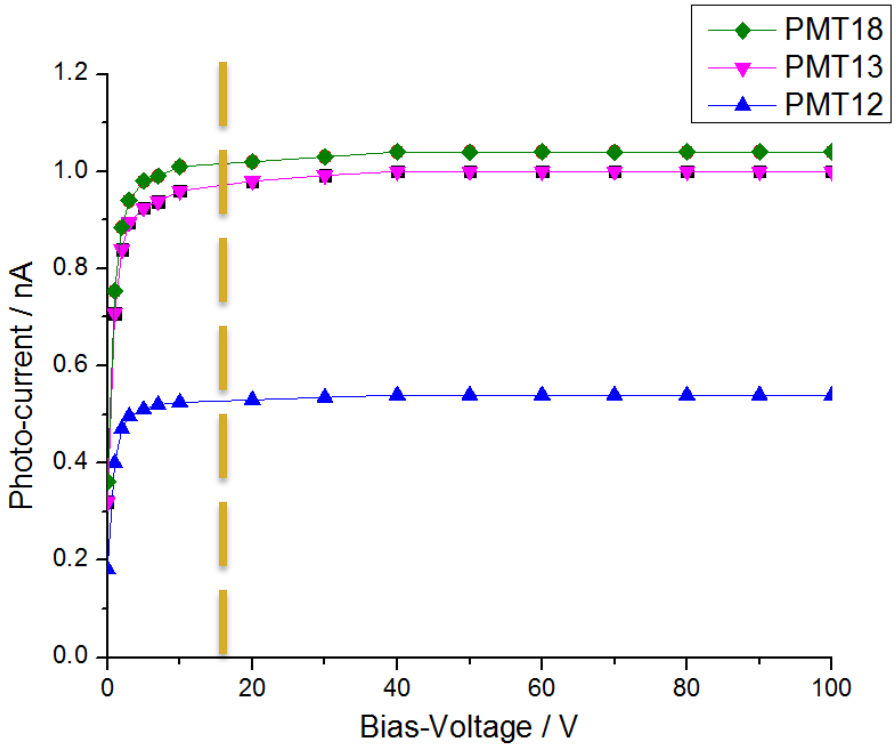
Bi-Alkali Photocathode Deposition Process



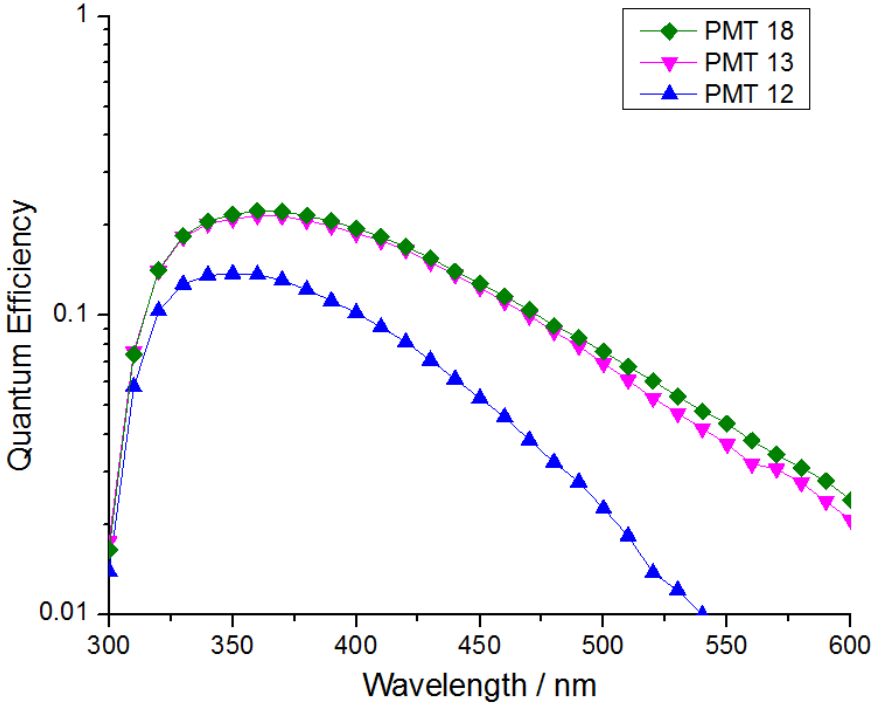
Learn how to deposit photocathode and apply these to the fabrication of large area photocathode.

Small PMT Photocathode Characterization

I-V Characteristic

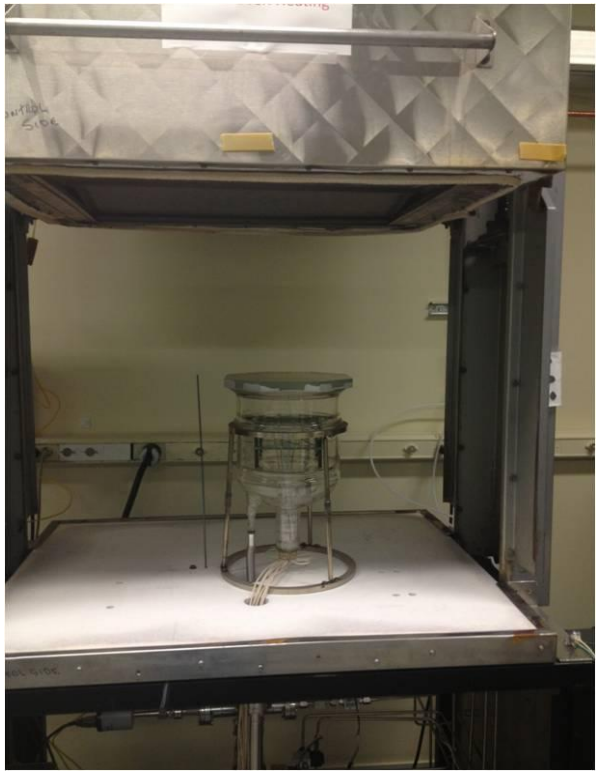


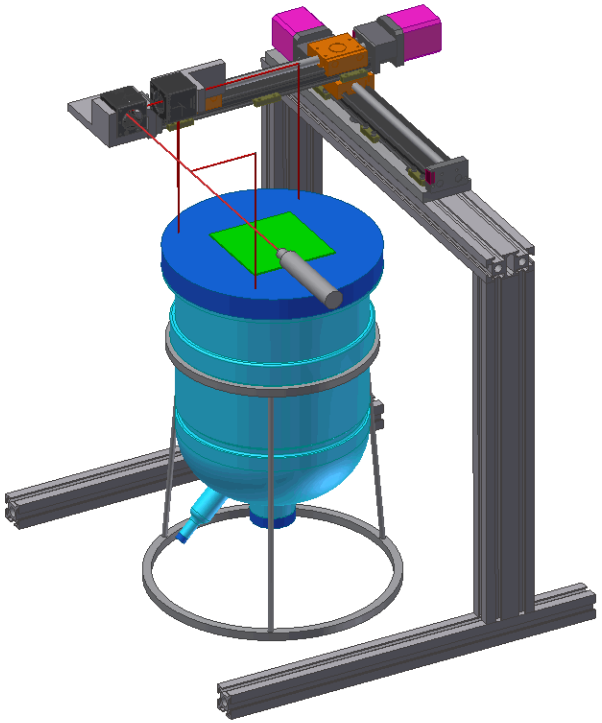
QE Measurement



- Cathodes exhibit characteristic I-V behavior, with QE as high as 24% at 370 nm.
- The quick drop at short wavelength is due to glass absorption.

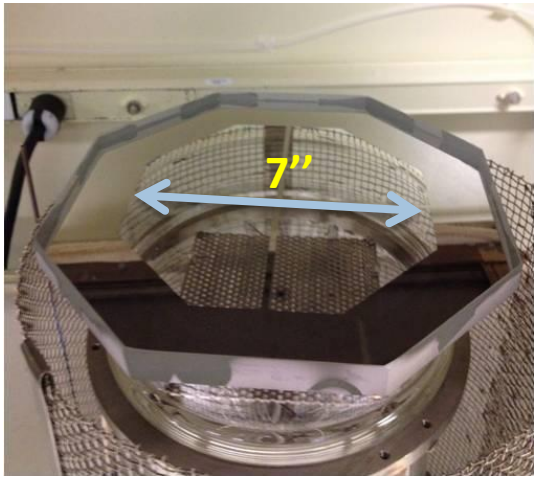
The Chalice Design

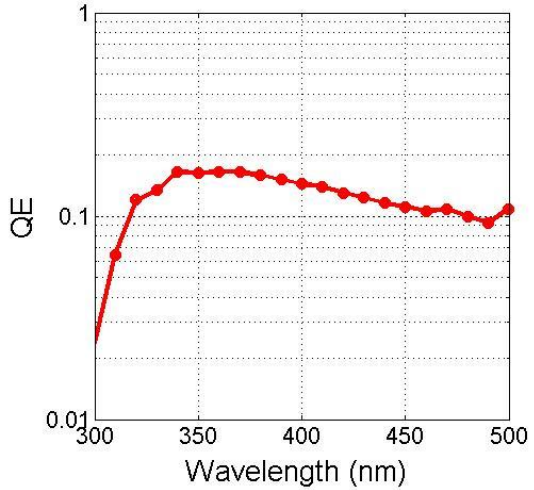




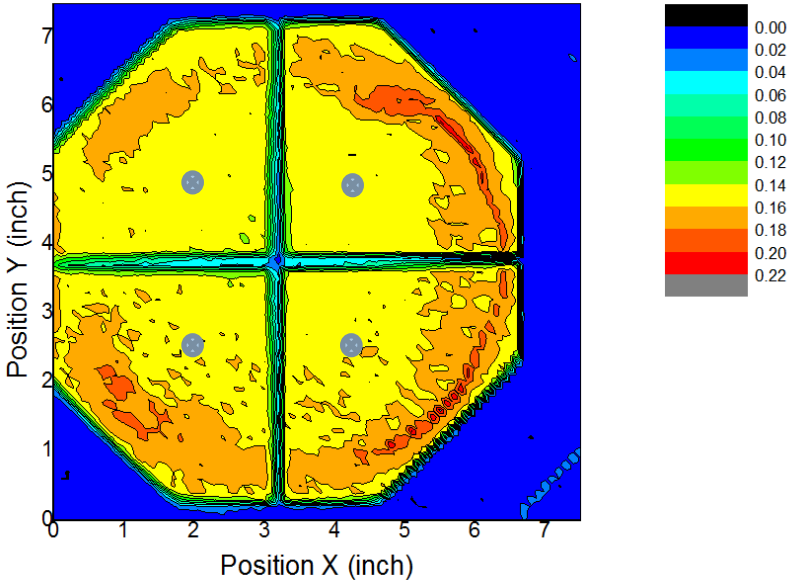
- Design is based on the small PMT tube, the chalice can be seen as a LARGE PMT tube.
- Top glass plate is replaceable for reuse.
- Chalice structure is supported by external legs.
- An X-Y scanner was designed and built for QE scan.

Chalice Photocathode Characterization (7’’)

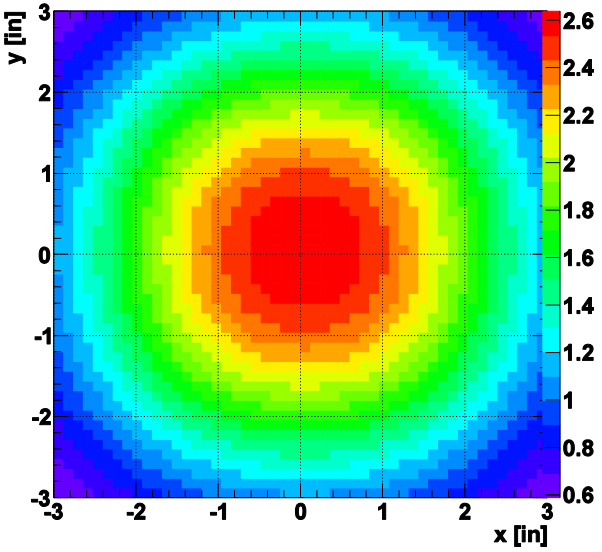




QE Map

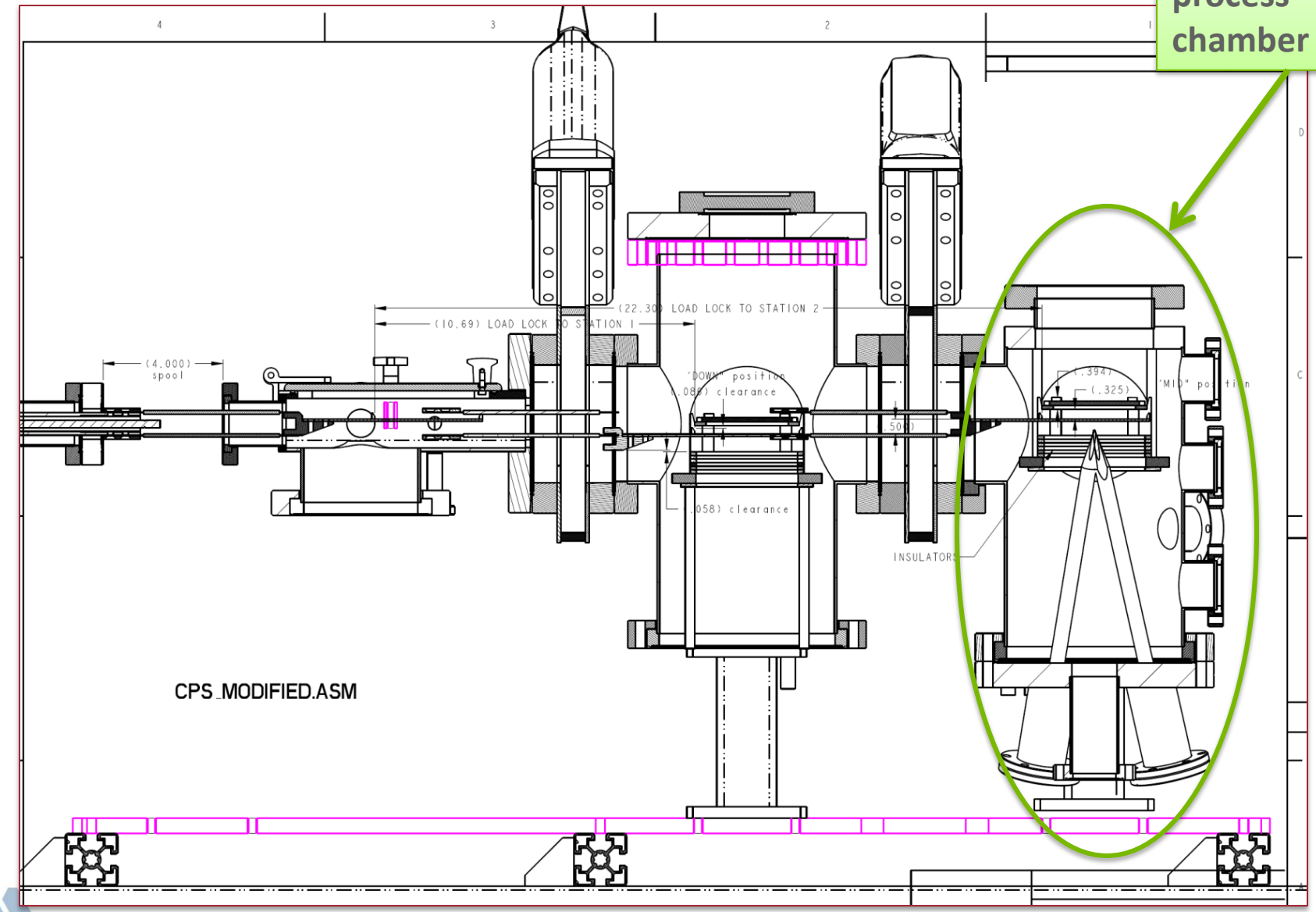


Simulation of Sb layer thickness



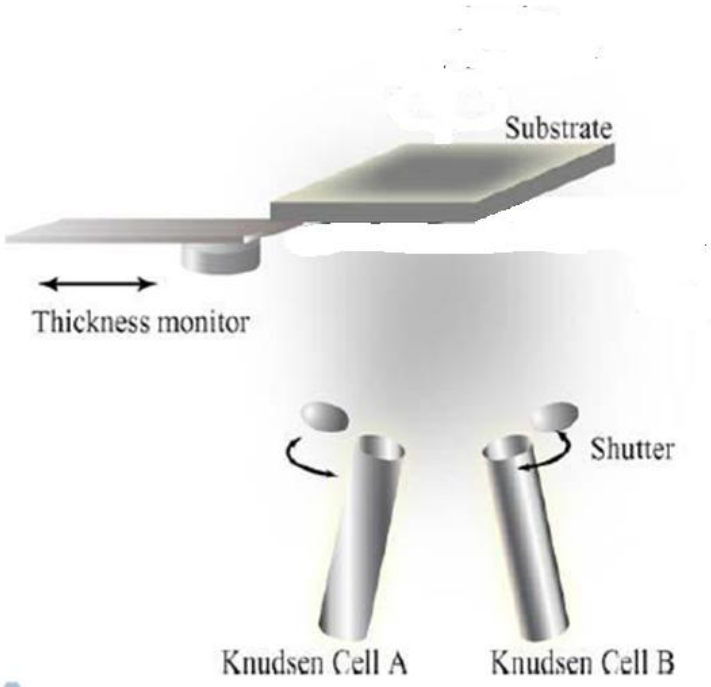
- Large area cathode with uniform QE distribution
- The highest QE spot reaches over 22%

4’’ Single Tile Facility



Photocathode Deposition in Tile Facility

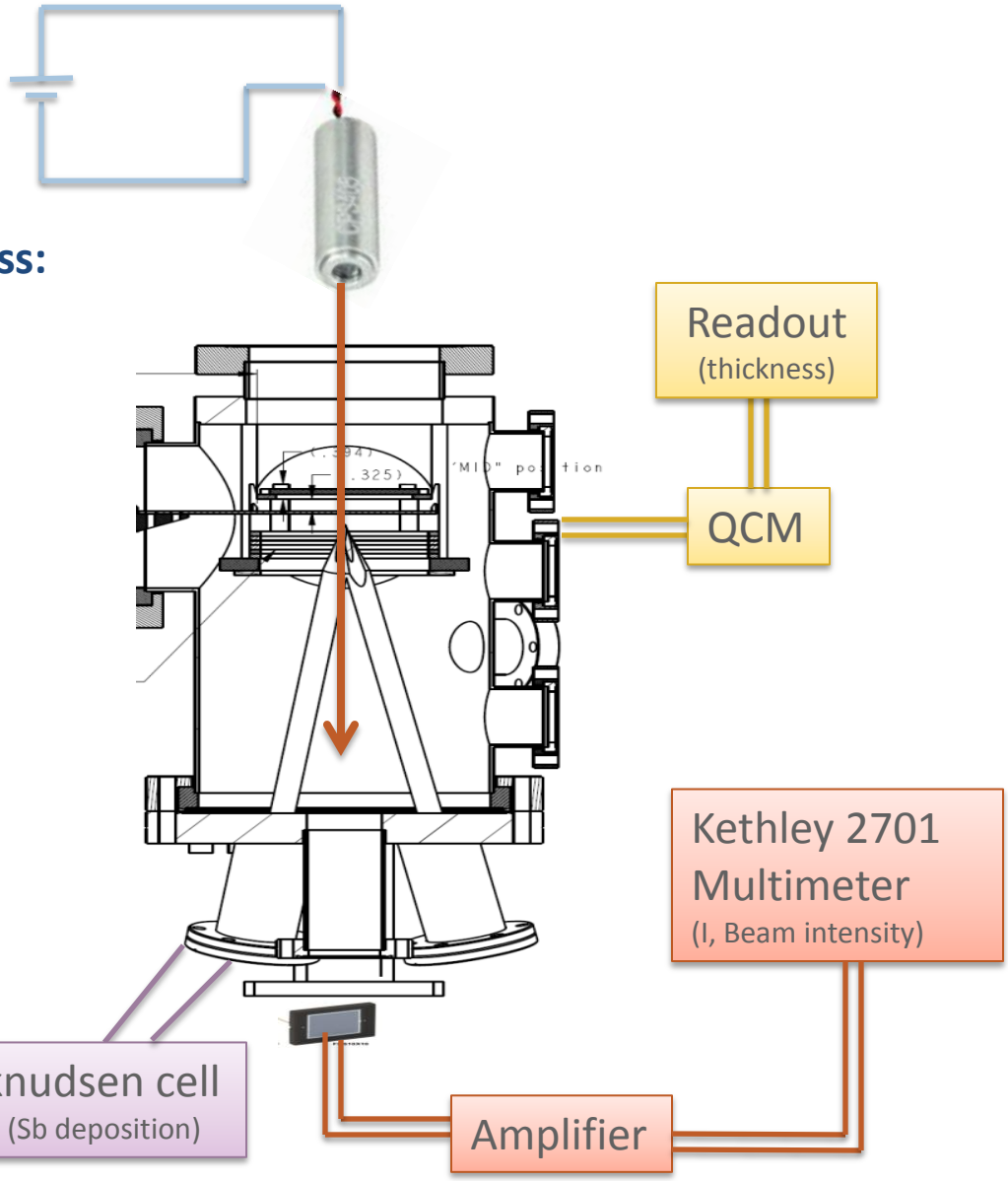
- Effusion cells (Knudsen cells) will be used for Sb, K, Cs deposition.
- Effusion cells are widely used in ultra-high vacuum (UHV) evaporation systems to generate ultrapure molecular and atomic beams from a large variety of elements and compounds.
- A typical Knudsen cell contains a crucible (made of pyrolytic boron nitride, quartz, tungsten or graphite), heating filaments (often made of metal tantalum), water cooling system, heat shields and orifice shutter.



Sb Thickness Monitor

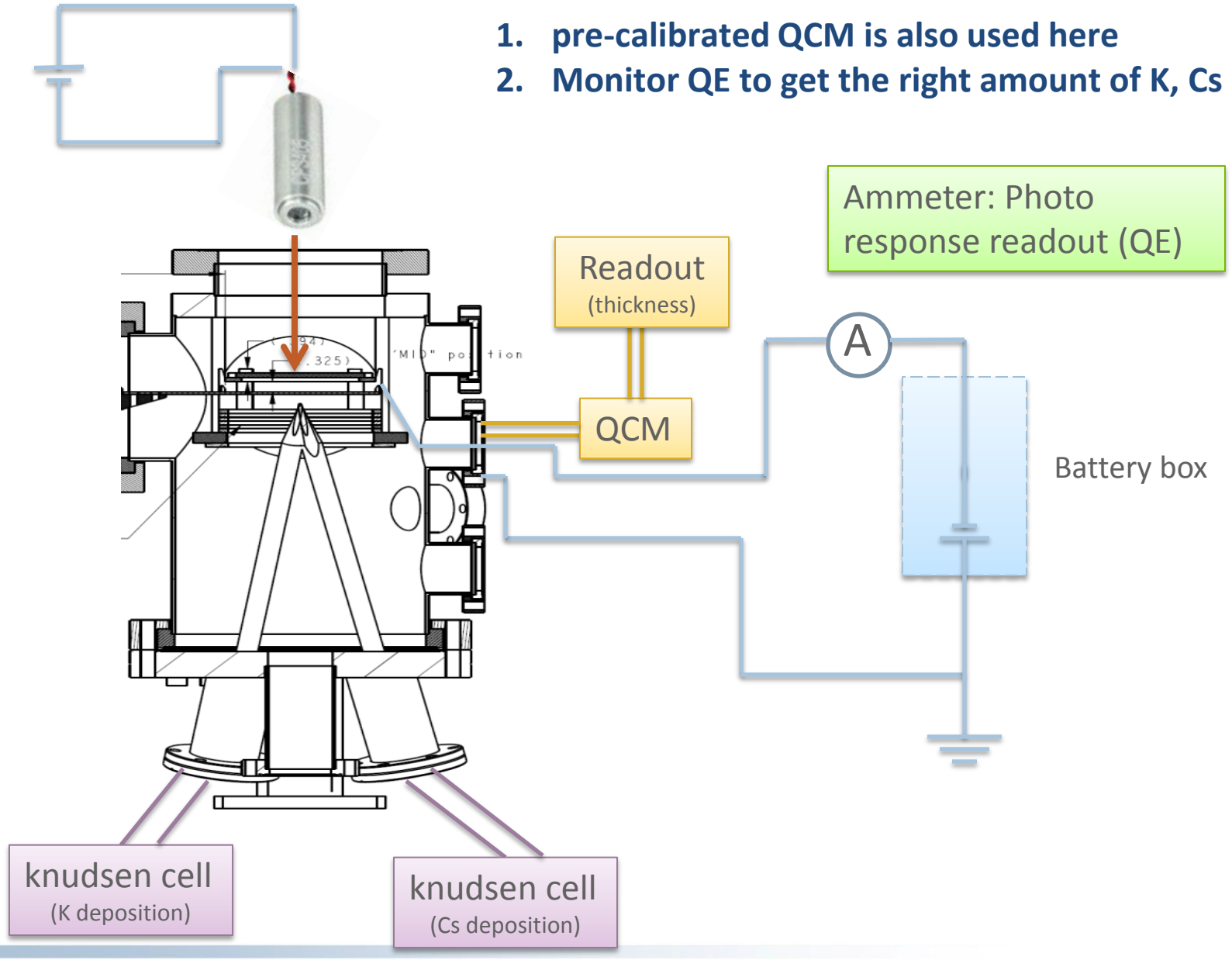
Two methods are used here for Sb thickness:

1. **pre-calibrated quartz crystal microbalance (QCM)**
2. **400 nm wavelength transmission measurement (~78% T for Sb)**



QE Monitor During K, Cs Deposition

1. **pre-calibrated QCM is also used here**
2. **Monitor QE to get the right amount of K, Cs**



Summary

1. High QE photocathode has been achieved in small PMT tube
2. Uniform photocathode at large area has been achieved in chalice
3. 4’’ single tile facility has been designed and under construction
4. Photocathode growth and monitor system was designed and under construction

Future Work

1. Complete photocathode growth and monitor system
2. Deposit bialkali photocathode in 4’’ single tile facility