
I think so, Brain, but there's
still a bug stuck in here from last time.
Pinky, are you pondering
what I am pondering?

University of Chicago

Argonne NATIONAL LABORATORY

LAPPD

Studying the Effects of External Alkali Introduction on MCPs

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U.S. DEPARTMENT OF ENERGY

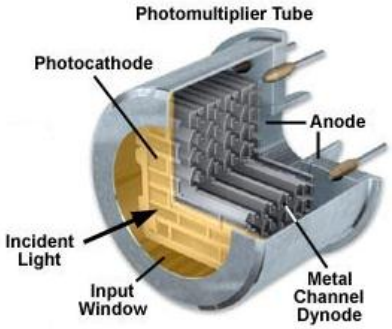
Introduction: Why this route?

- Photocathode for MCP-stack detectors are traditionally made ex-situ (transfer photocathode).

Some issues:

- Vacuum manipulators/transfer
- Multi-layer production
- Time consuming bake-out at every layer of formation of alkali-Sb
- Reliable Sealing afterwards
- Low production rate

Motivation

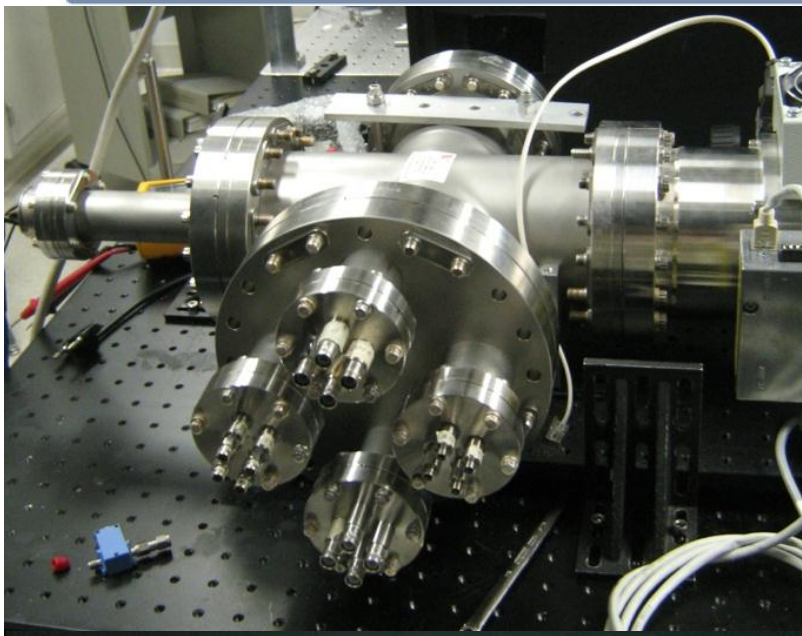


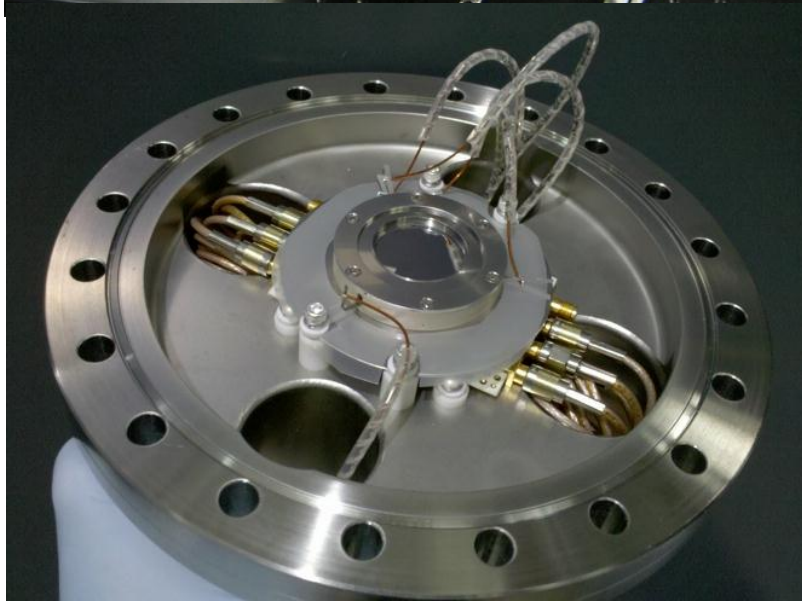
- One ‘crazy’ idea is to imitate the photomultiplier tube Cesiation techniques. This is related to the idea that one could seal an MCP detector in air and activate the photocathode through the pump-out tube.
- PMTs are essentially a photocathode ‘lab’.
- Bialkali is deposited in-situ.
- Can we do the same for our MCP stack?
- What are the drawbacks?
  - No line of sight
  - Change in MCP gain to Cesiation?
  - Less control over the photocathode after Cesiation

To answer these questions, we revived the old 33mm program

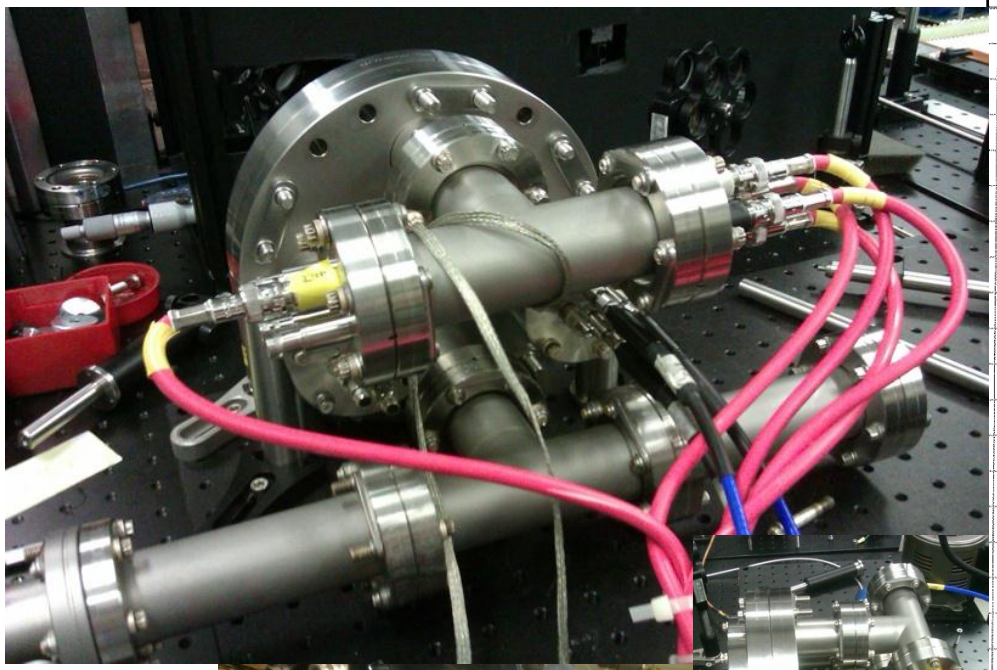
33mm Program

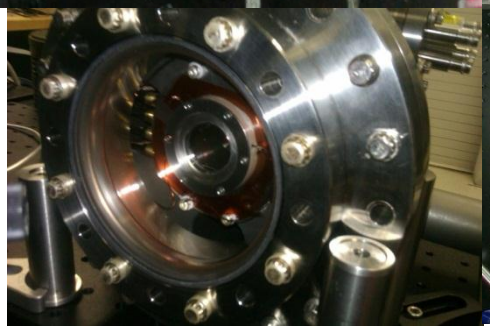
- Played a critical role in demonstrating our LAPPD ALD-MCPs
- Also critical in developing operational experience and refining our measurement techniques.
- 33mm format with ALD coating enables low cost, rapid testing of many MCP designs/chemistries/parameters for comparison with simulations

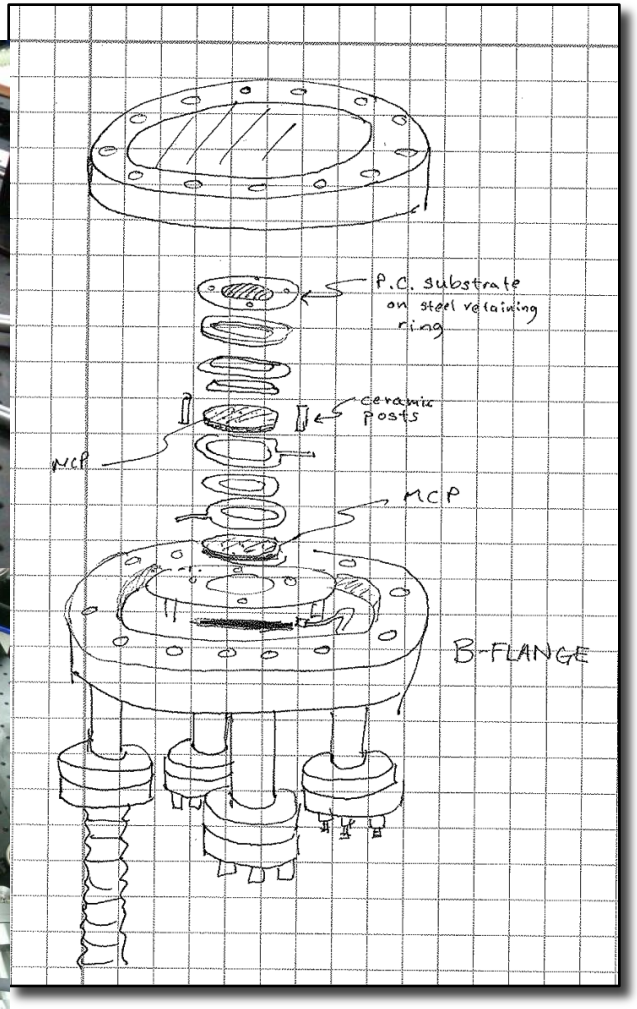




Return of the 33mm Program







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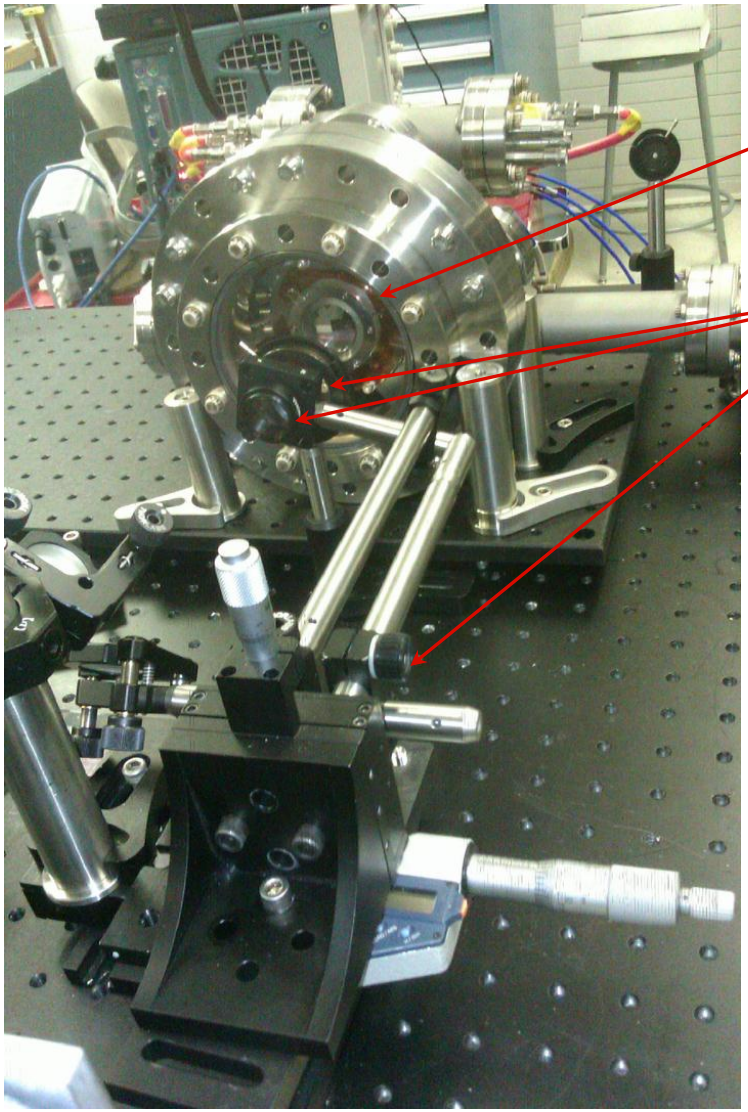
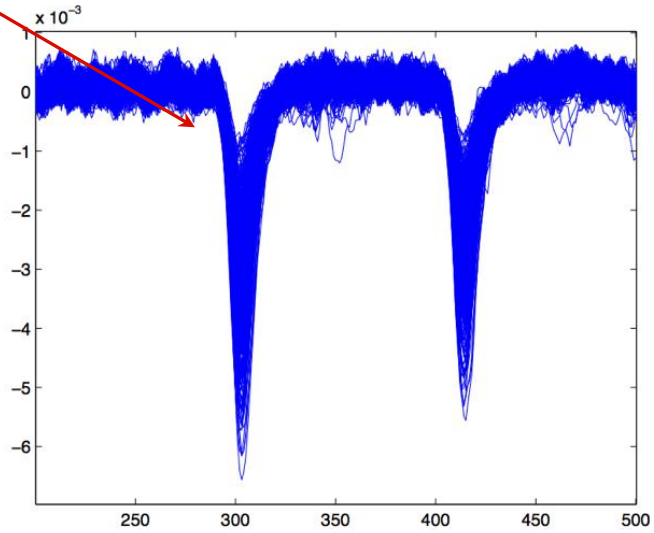
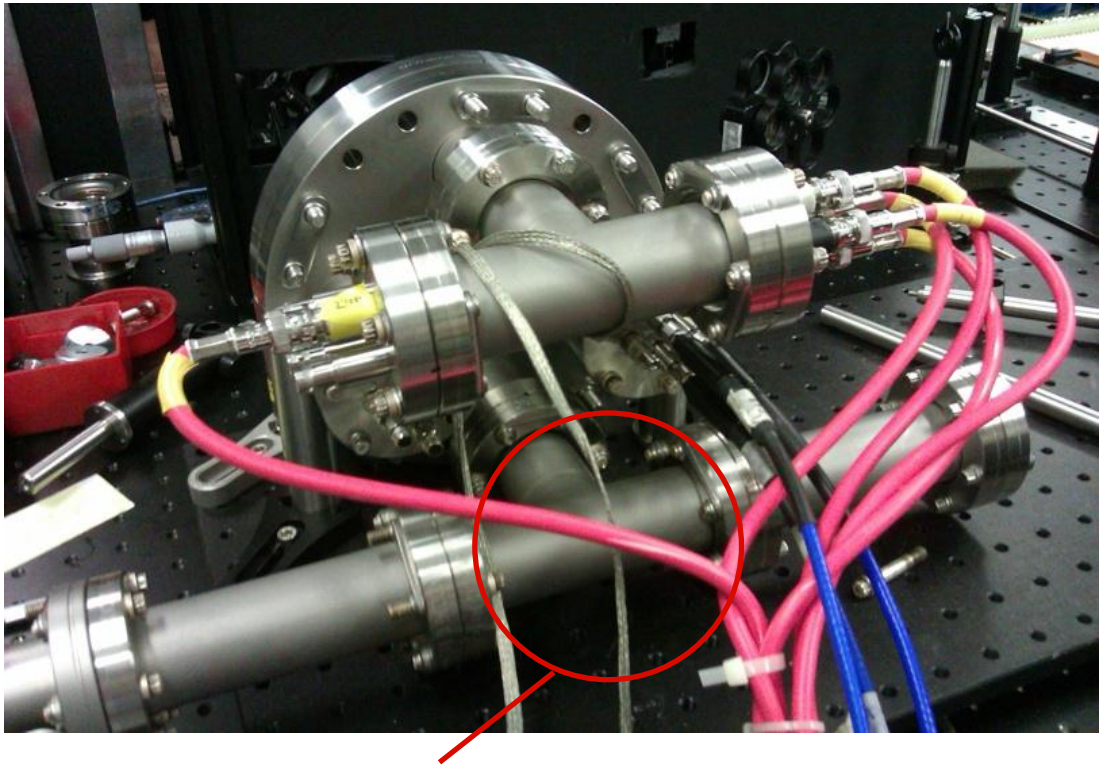


- More compact - window is closer to the window: better able to focus the laser, potentially capable of addressing single pores.
- Precision x and y translation, irises and lens to define a finer spot-size(0,0): better precision and repeatability of position scans.
- Uses reflected pulse from opposite end of strip-line to give parallel component of position: more effective channels per readout channel on the scope.

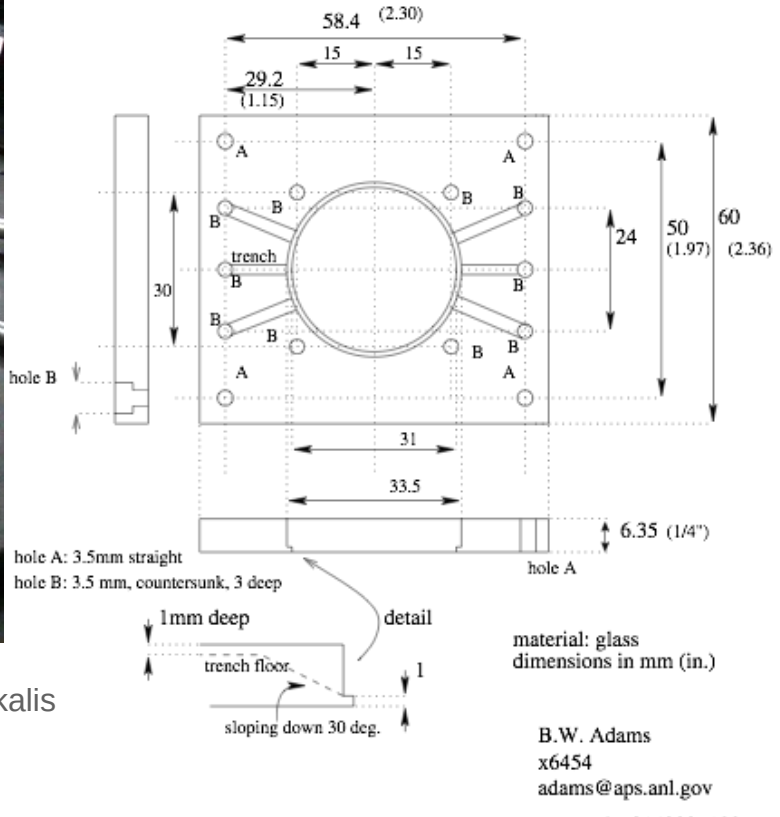


Cesium/Potassium Exposure Studies

- We have AL2O3 samples and we are awaiting MgO samples
- Our main delay - we want to make our own version of Bernhard Adam's glass MCP holder design. Will take ~1 mo (and cost ~1k$). But, glass is easier to clean after alkali exposure...



To be replaced with a 4-fold cross with a valve and an inlet for bringing in alkalis



Chamber side-view

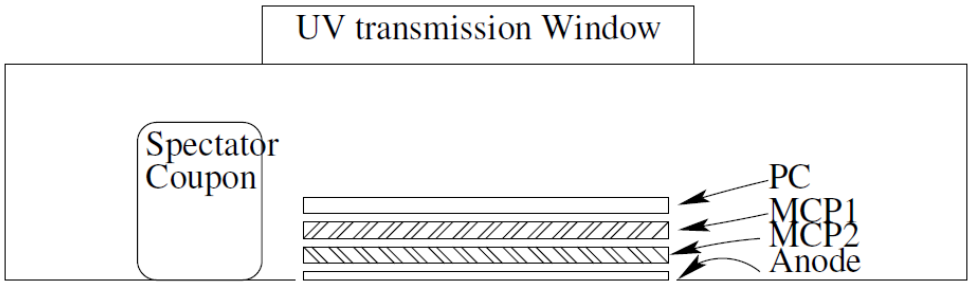
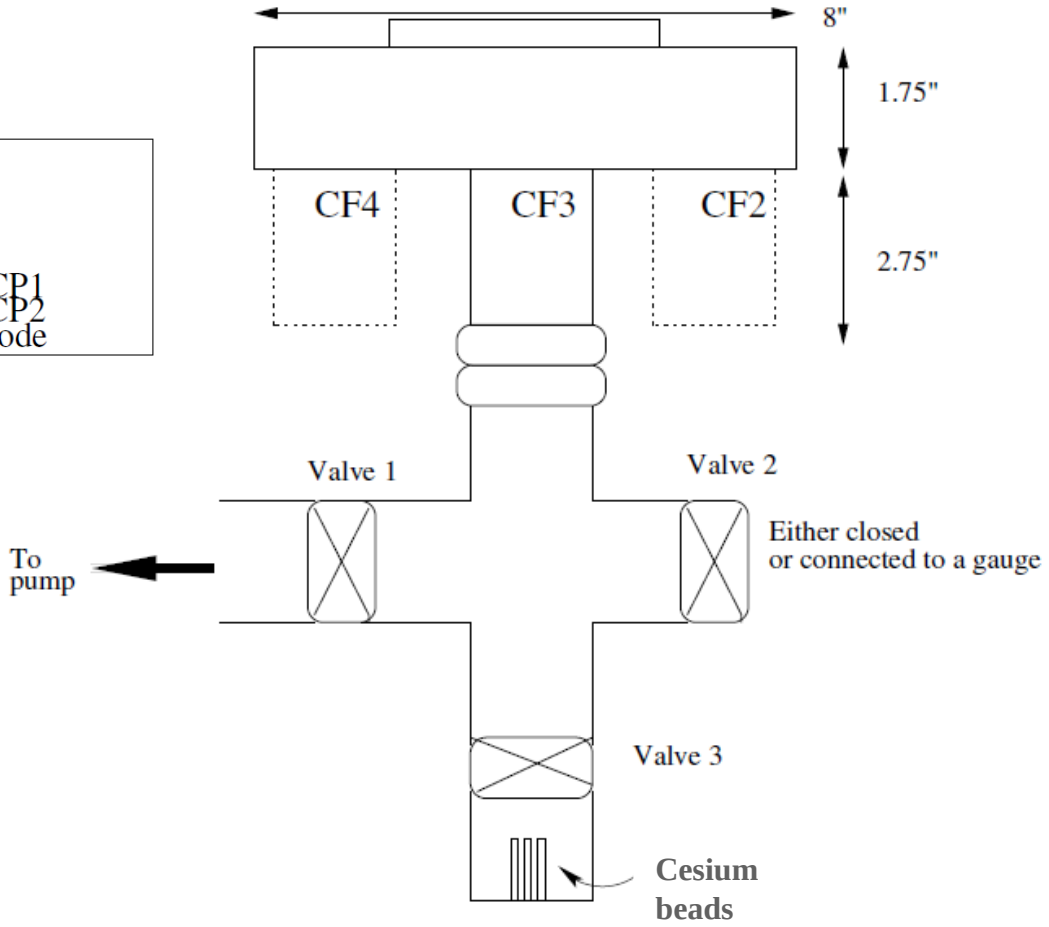


Table top-view



Cesium/Potassium Exposure Studies

Interesting Observables/Protocol before and after bialkali deposition

- Gain-voltage behavior
- Shape of signal pulse-height distribution
- Dark-current rates of the MCP
- Shape of dark-current pulse-height distribution
- After pulsing

Parameter dependencies

- Concentration and duration of alkali exposure
- Temperature before and after the alkali exposure
- Operational lifetime after alkali exposure

Other 33mm measurements

- In the mean time, we have a full month and plan to perform a lifetime, scrubbing, and long-term HV study on one pair of Al2O3 MCPs. We will develop the process for future use, as well.
- We are also interested in characterizing a series of different L/D substrates.
- We would also like to revisit our studies of different SEY chemistries and thicknesses.

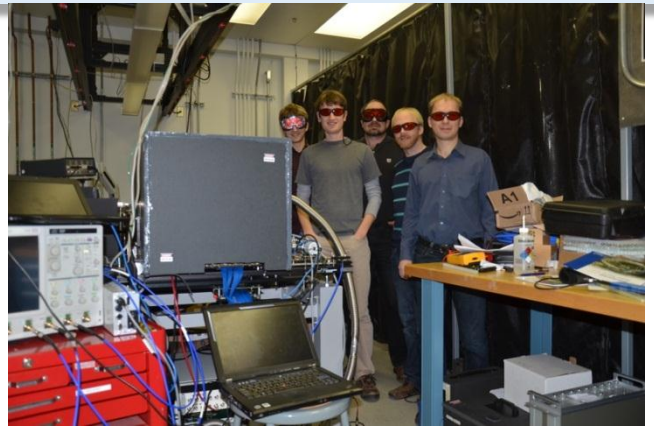
Timeline

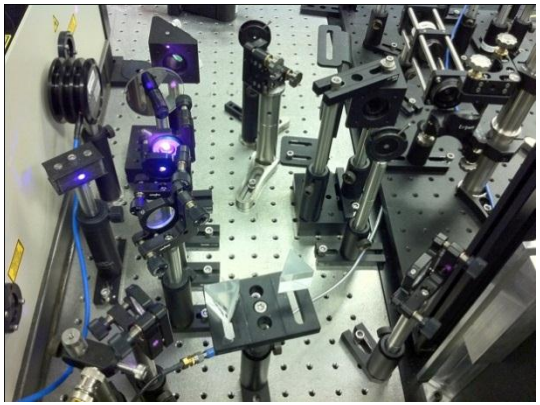
April 2013	• Finish acquiring and analyzing pre-alkali deposited MCP characterization data • Preparation for alkali deposition (Start with Cs)
May 2013	• Perform alkali deposition • Repeat the MCP characterization protocol after deposition • Measure QE of the ‘spectator coupon’ • Compare
June 2013	• Repeat the processes (of May) with K • Cleanup • Follow up with a stoichiometric combination K, Cs deposition
July 2013	• Continuation of K, Cs deposition and MCP characterization
August 2013	• Other studies?

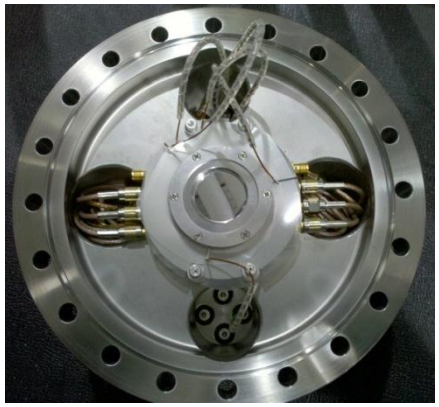
Conclusion

- Discussion?

- We’ve developed a pool of resources for the external introduction of alkali study
  - Hardware
  - Software
  - Techniques and procedures
  - Portable feature of the B-flange (possibilities of other studies such as XPS, EXAFS, and other?)







https://psec.uchicago.edu/Code/ANL/

Thank You