Cesium Evaporation Rate on Tungsten Photocathodes

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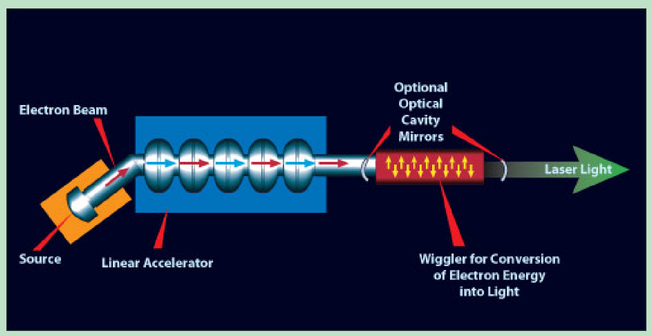
Introduction

- Created a shutter, to be inserted into a vacuum chamber.
- Experimentally found the evaporation rate of Cesium on a Tungsten Photocathode.

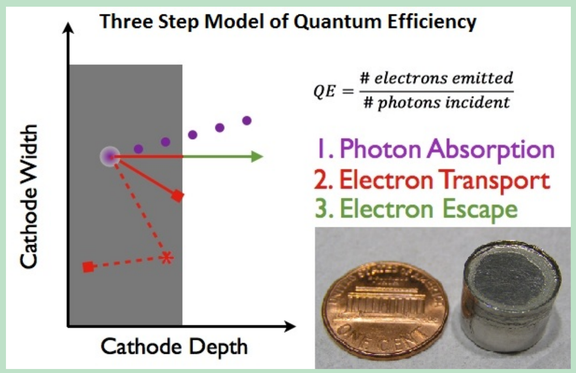
Motivation

- A High Power Free Electron Laser.
- High QE and decent lifetime Photocathode. (Cesium Dispenser Photocathode)
- More accurate model of Cesium evaporation.

The Free Electron Laser and Needed Improvements: Cathode and Mirrors.



What is a Photocathode?



Experimental Setup

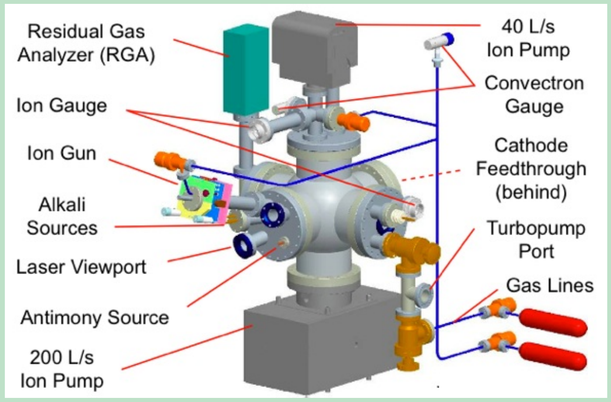


Diagram of Vacuum Chamber

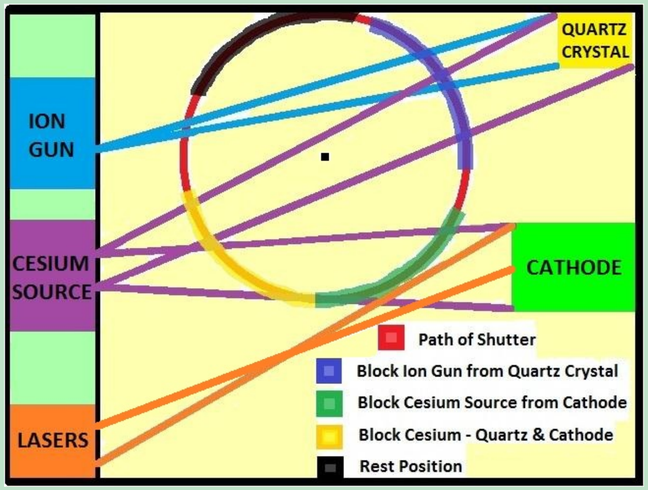
Shutter Design Constraints:

- Vacuum chamber compatible.
- One rotational feed through.
- Three available ports.
- Must not block lasers.
- Four required operating positions (See diagram below).

Specifications:

- Made of Aluminum.
- Radius of curve: 2in.
- Rough Dimensions (Can fit in box of): 2in x 8.5 x 2.5
- Connected to rotational feed through.

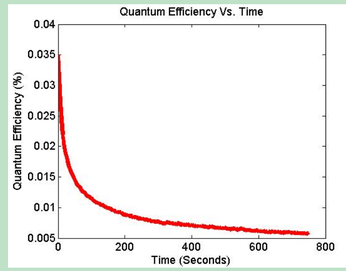
- Note: Shutter adds experimental capability to measure Cesium evap. rates.

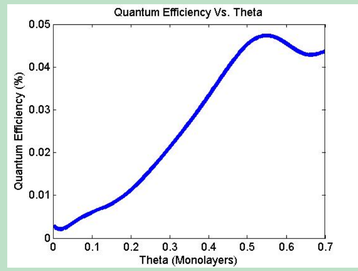


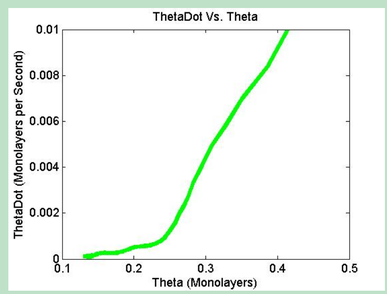
Sketch of Shutter Path in Vacuum Chamber.

Experimental Results

- Designed/created shutter, inserted in vacuum chamber.
- Raw output: Quantum Efficiency (QE) and time. Pair with coverage value.
- Flip shutter to shut off cesium source, measure QE as time progresses.
- Match each second group QE data with equal first QE measurement, and its corresponding coverage value.
- Polyfit second group coverage value with its timestep and differentiate.







Conclusion

- New Shutter tested and meets all design constraints.
- Evaporation rate measurments as a function of coverage and temperature demonstrated.

Future Work

- Repeatability/Benchmark with literature.
- Integrate data into dispenser optimization models (and better fitting methods.)
- Long run: Separate evaporation/surface diffusion from bulk diffusion problem.
- Long run: Cesium supply rates for dispenser cathodes and optimal run temps.

Acknowledgements

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