

IMPROVING THIN FILM THICKNESS UNIFORMITY

By:

Jordan Bell

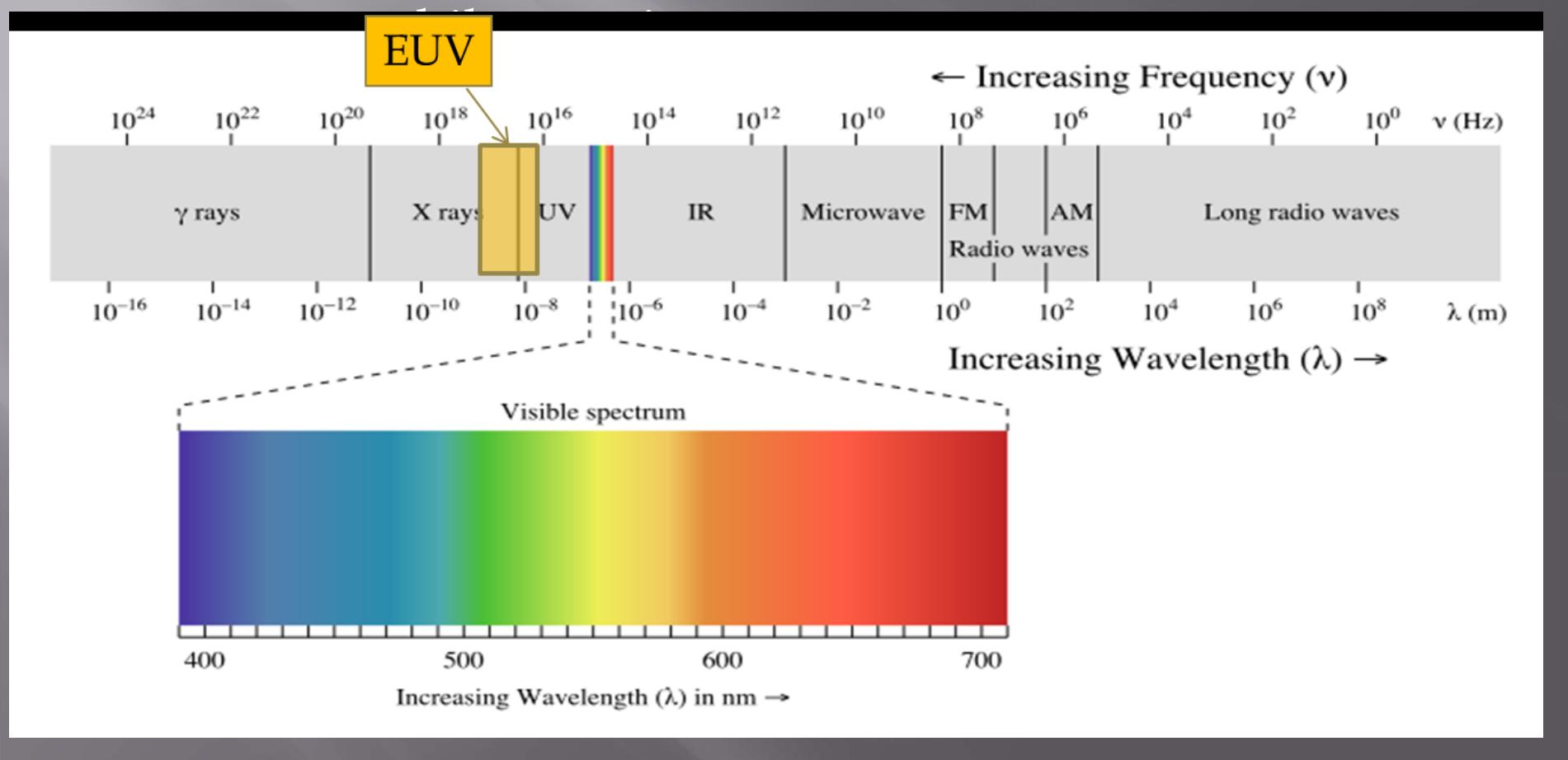
Cody Petrie

Background

- We sputters mirrors/thin films that reflect extreme ultra violet (EUV) light
- Uniform thickness sputtering
- Process of making uniform thin films
 - Planetary system
 - Distance from target to substrate
 - Measuring the entire chamber

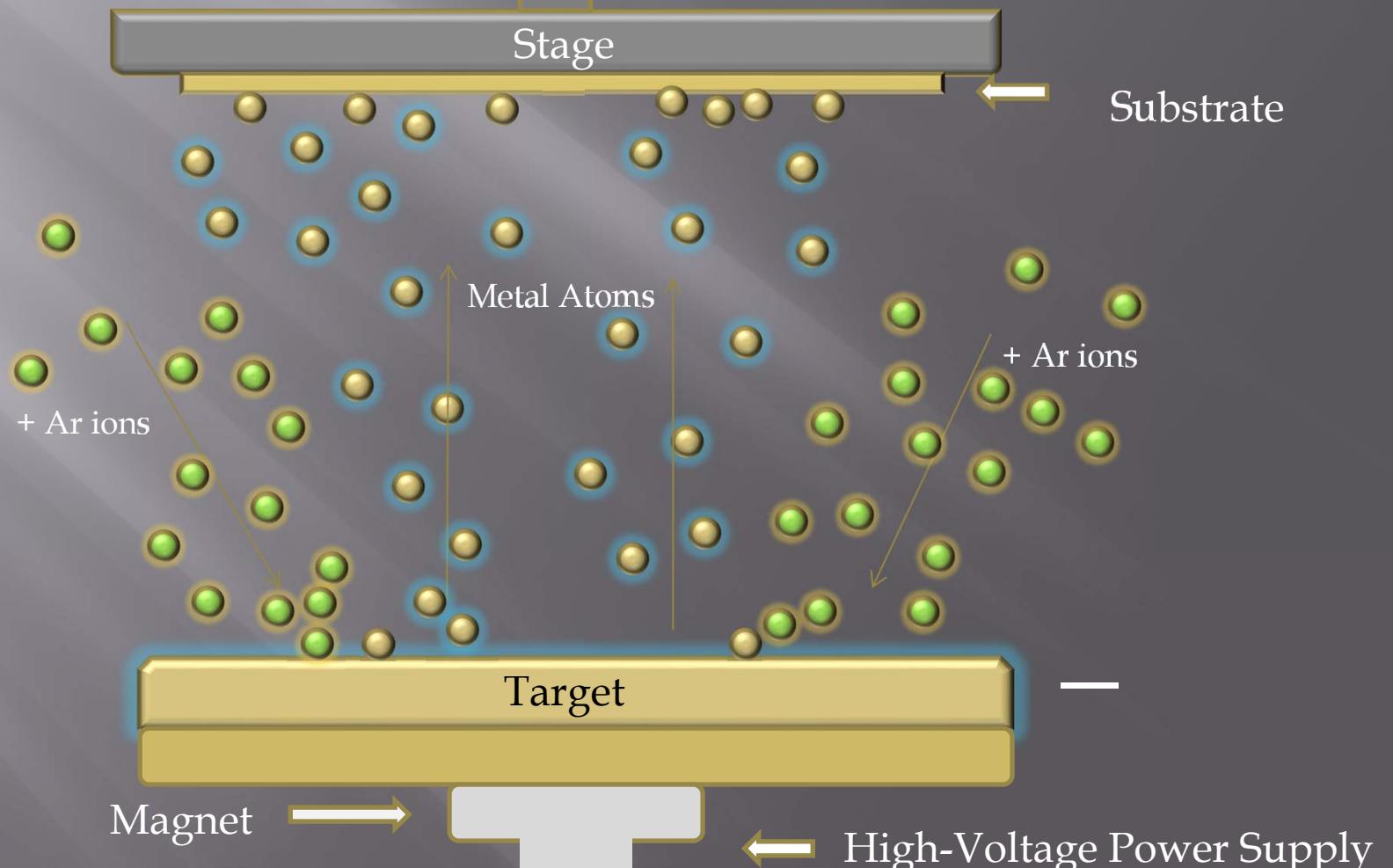
What We Are Doing

- Sputtering Uranium Oxide Thin Films for applications in the EUV

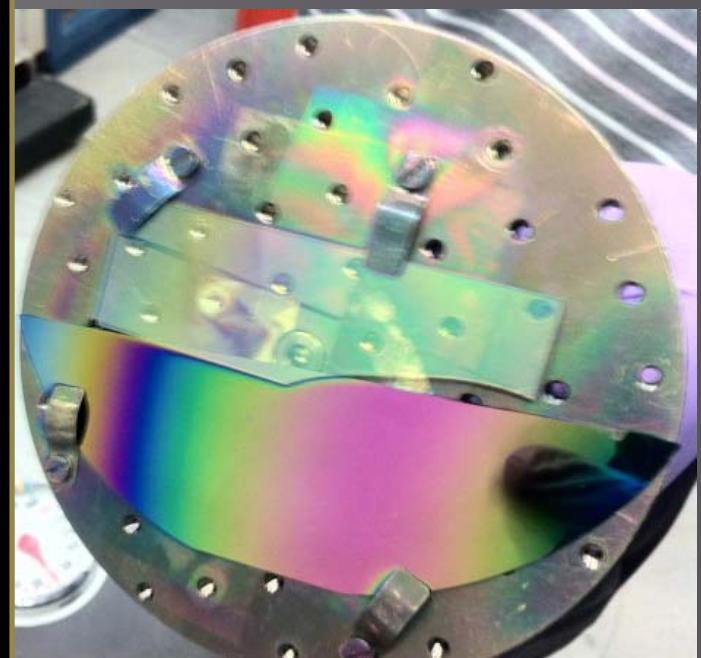
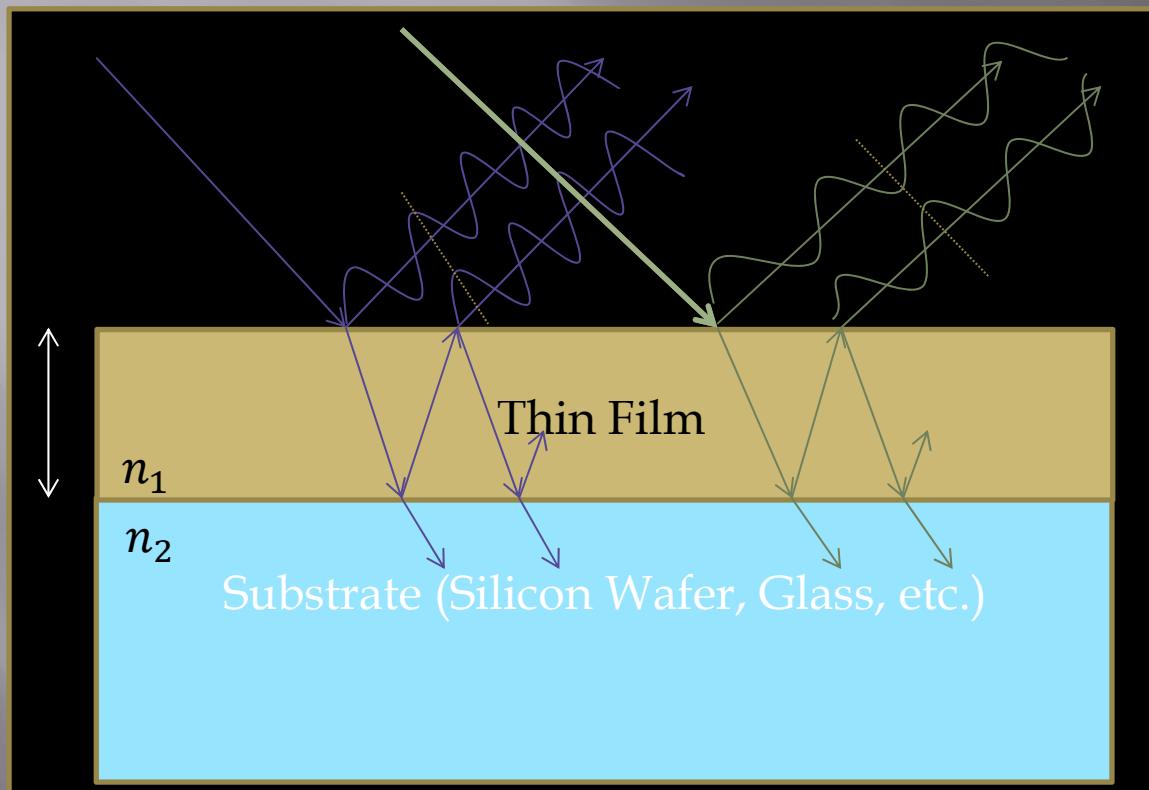




Uranium Target

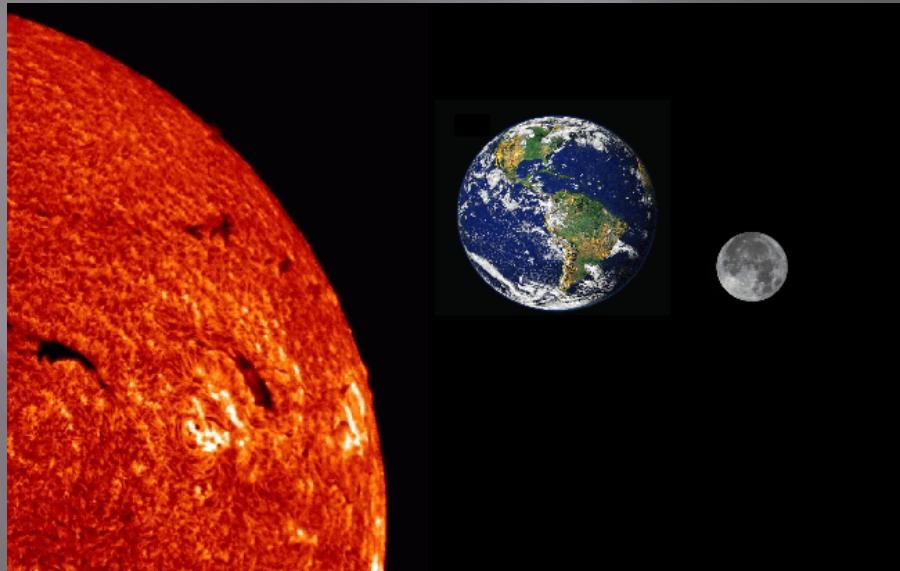


Uniformity

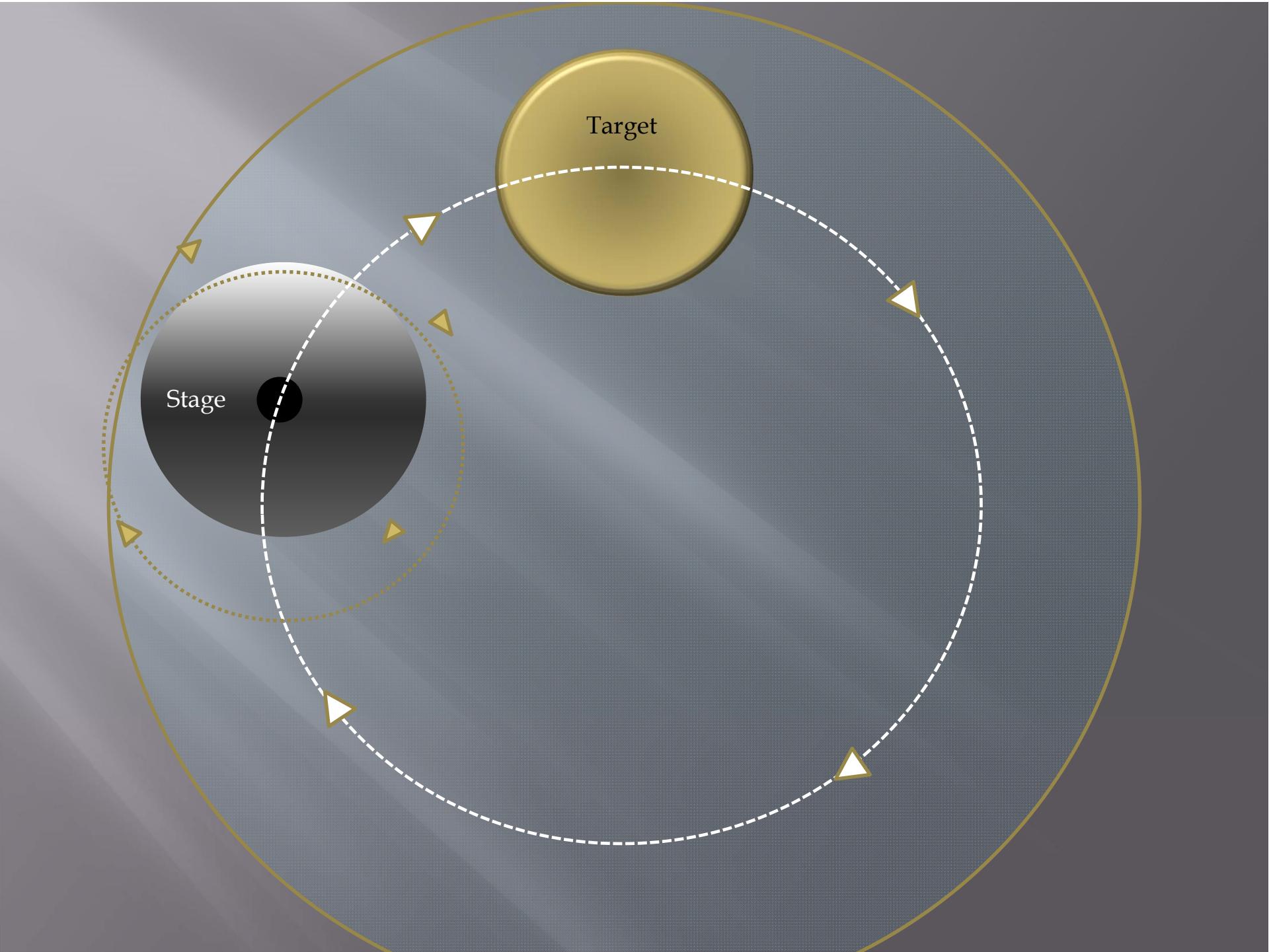


Improving Uniformity

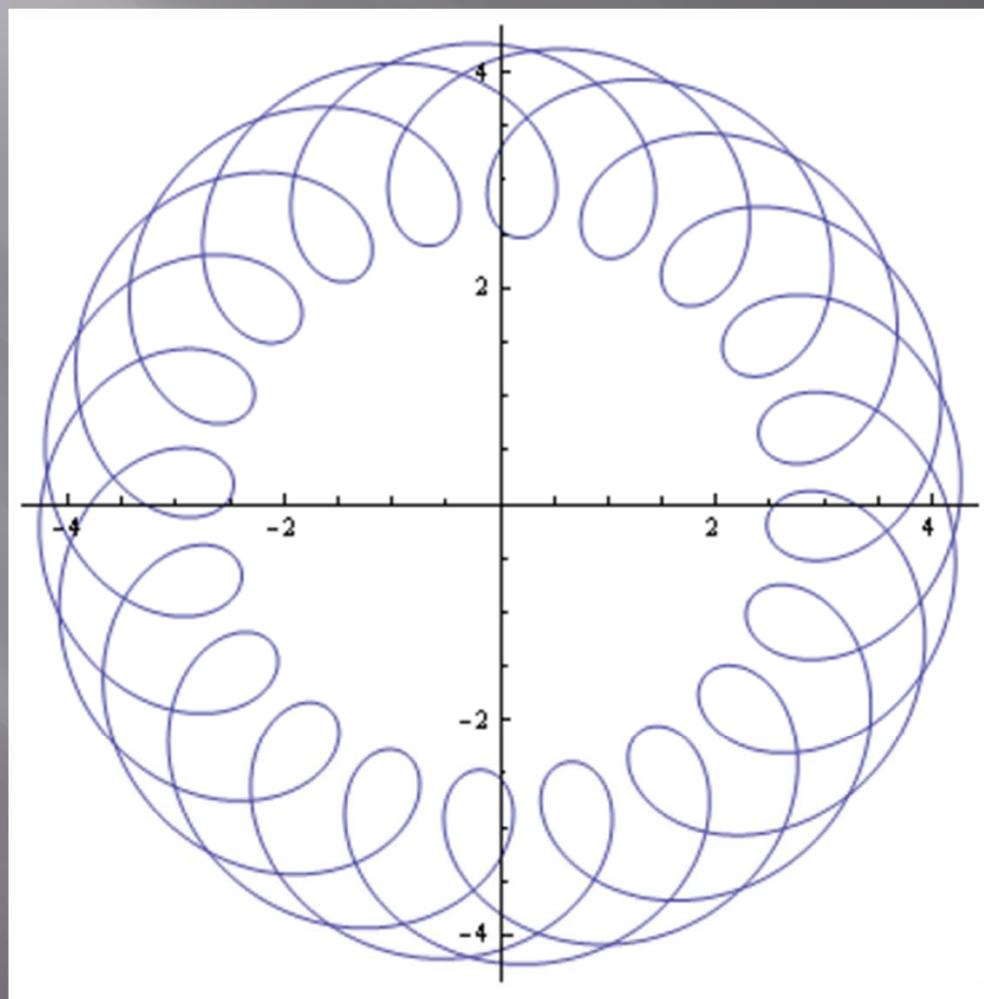
- ❑ Move the sample across the target (revolution)
- ❑ Rotate the sample above the target (rotation)
- ❑ Planetary Motion (revolution and rotation)



Earthshine Project, BBSO

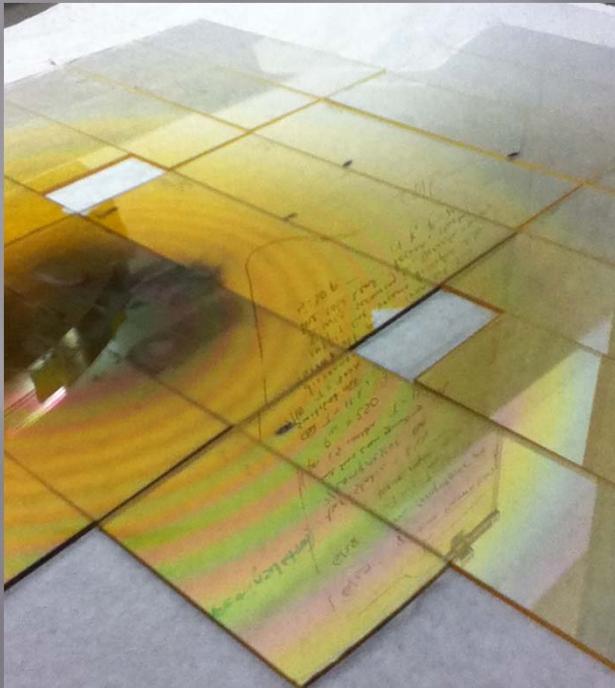


Trajectory of one point on substrate



Simulations

- ❑ Simulations help us know how to improve our results



Thickness pattern created by our sputtering target

Thickness Profile Across Stationary Substrate

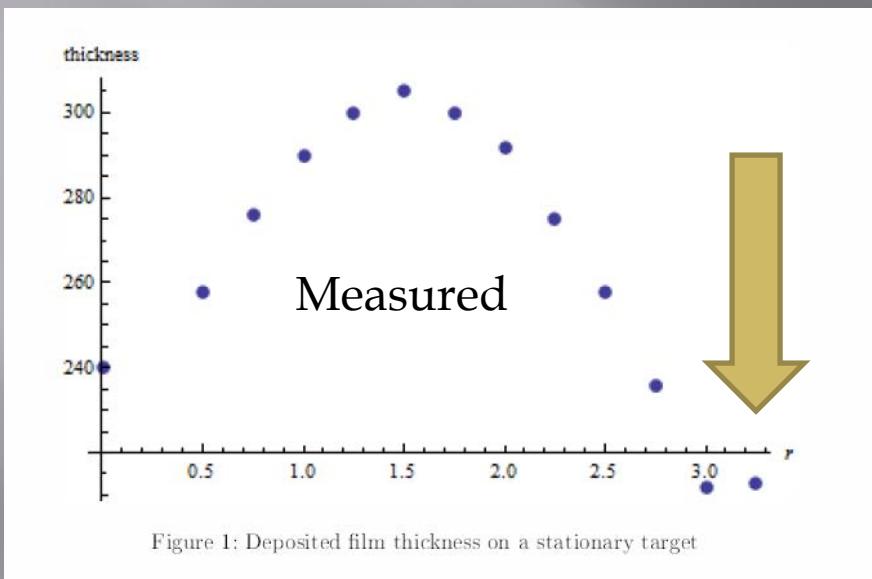


Figure 1: Deposited film thickness on a stationary target

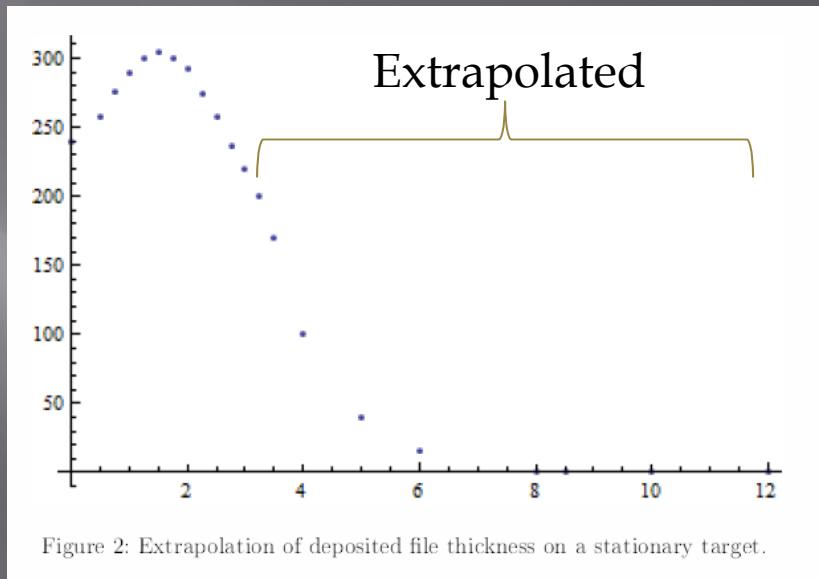
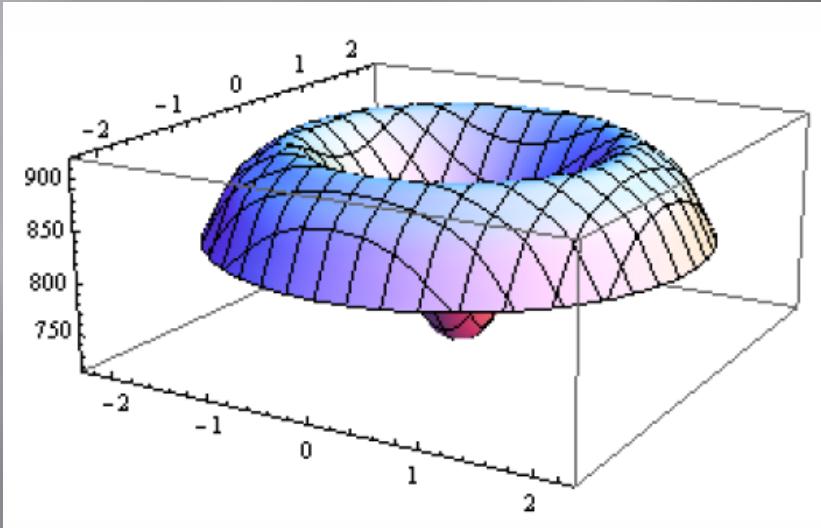


Figure 2: Extrapolation of deposited file thickness on a stationary target.

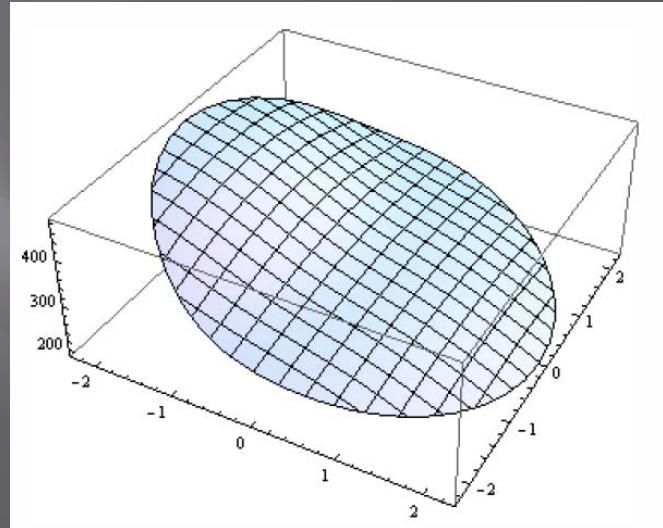


Theoretical Predictions

- Dr. Steve Turley's Matrix Rotation Program



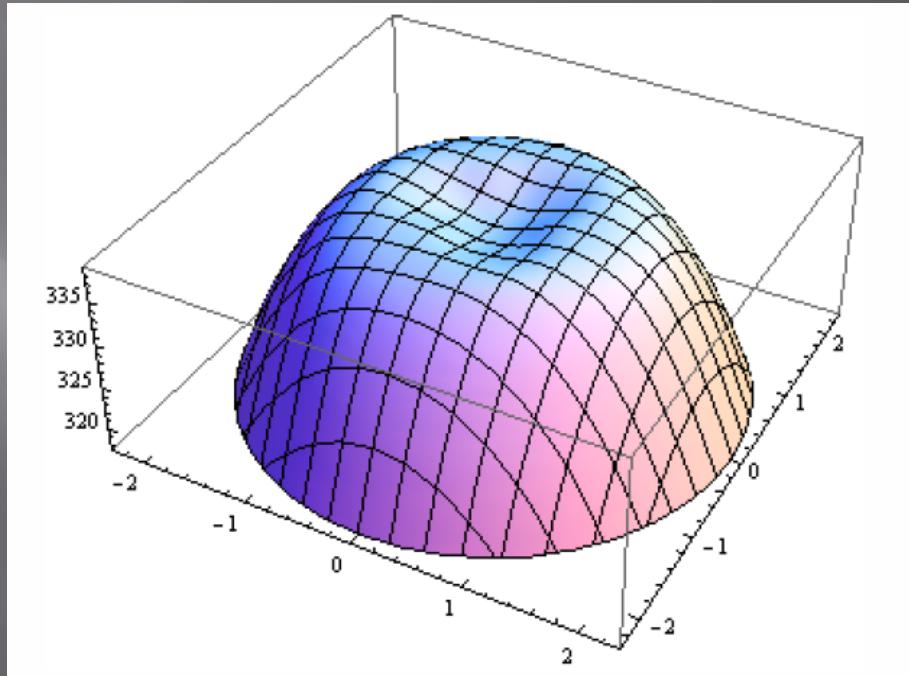
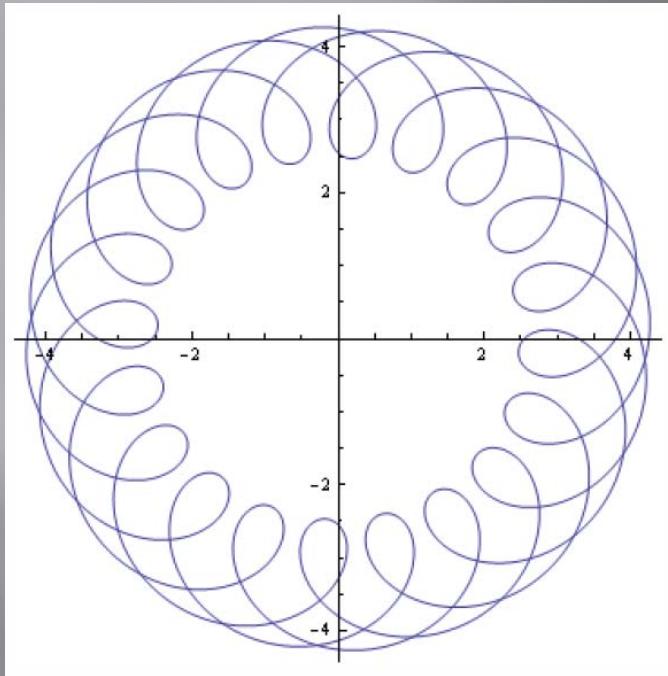
Stationary



Revolution Only



With Planetary Motion

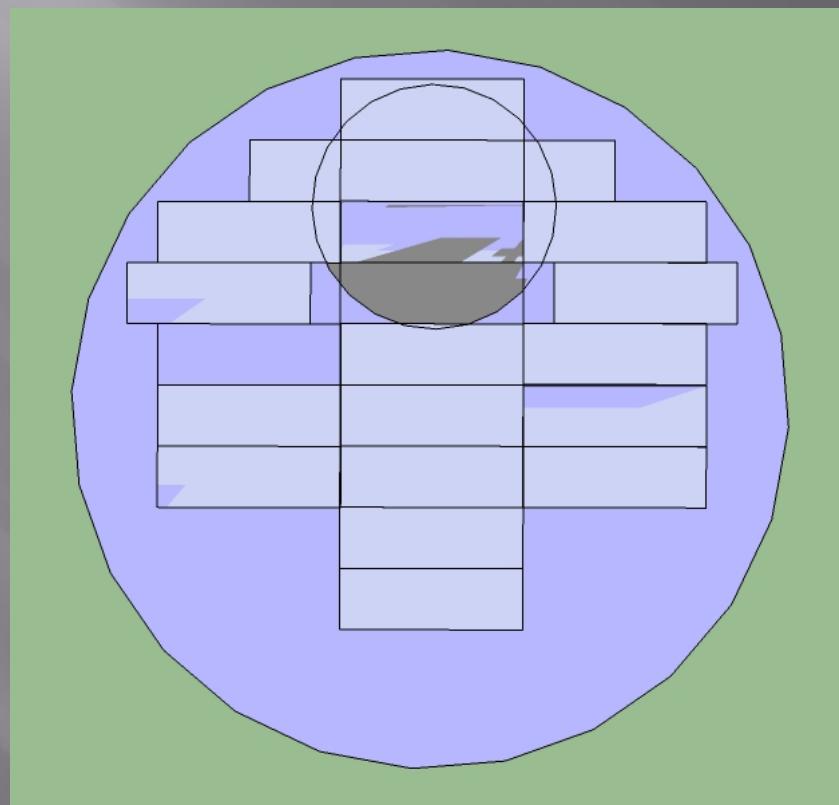


About 6% over 4 inches

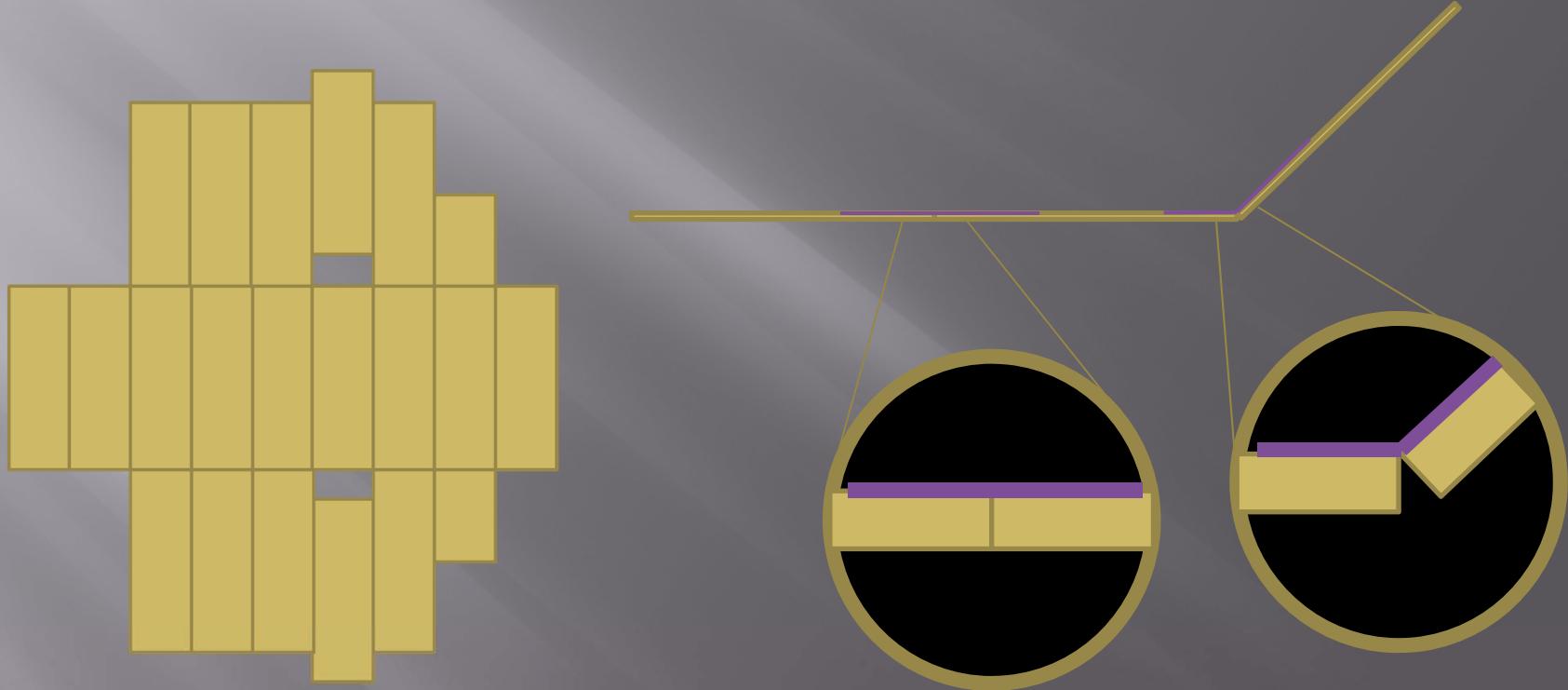
About 1-2% over 2 inches

Actual Result: 1% over 2.5 inch sample, but difficult to setup and replicate.

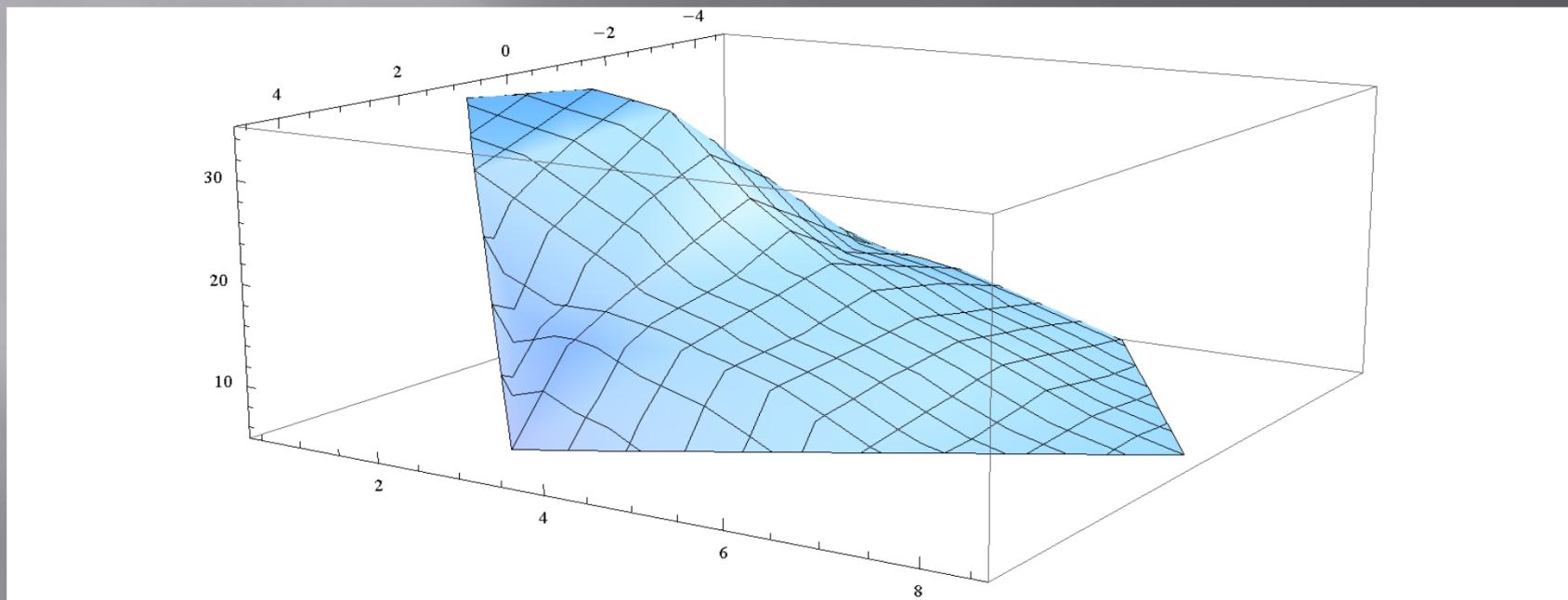
Bird's Eye View of Chamber, Target, and Substrate



Measuring the Stationary Profile

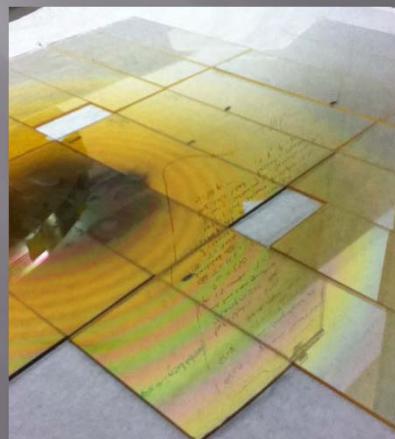


Maximum target-substrate distance \sim 16cm



Summary

- Planetary System shows improved thin film uniformity
- Profile has been measured at max distance from substrate
- Sample has also been made at close proximity
- We should be able to predict optimal parameters for maximal uniformity



Acknowledgements

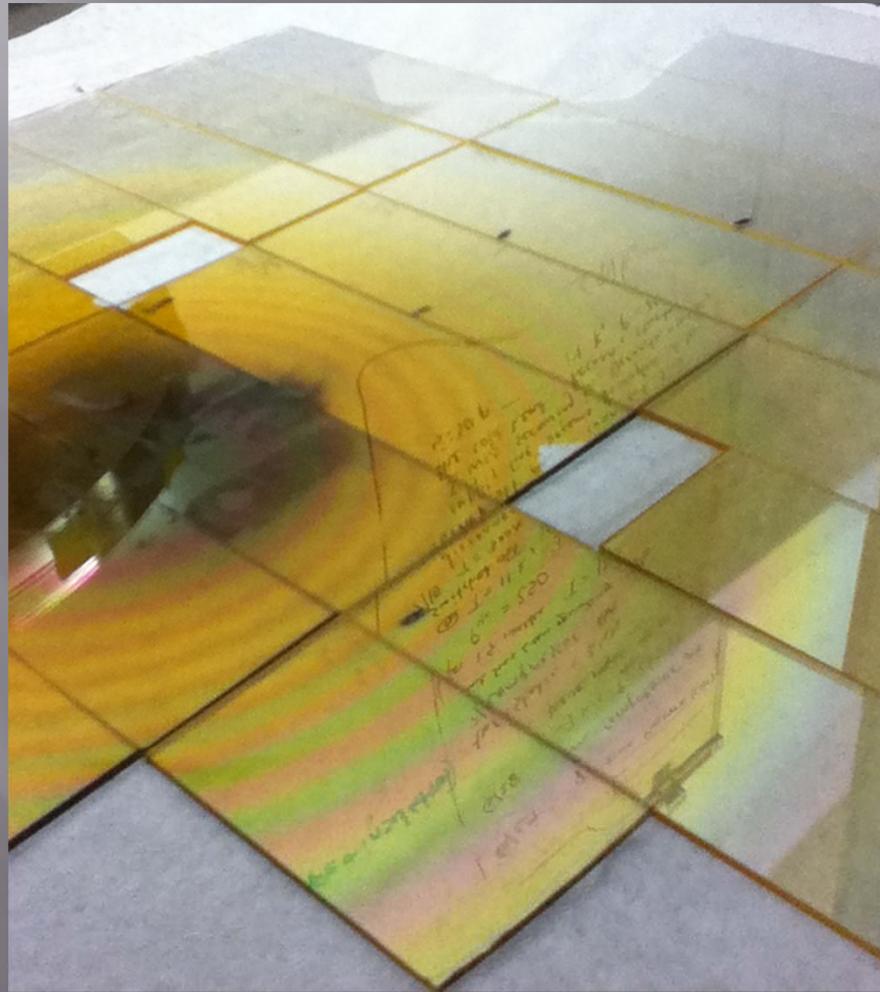
Brett Bostrom

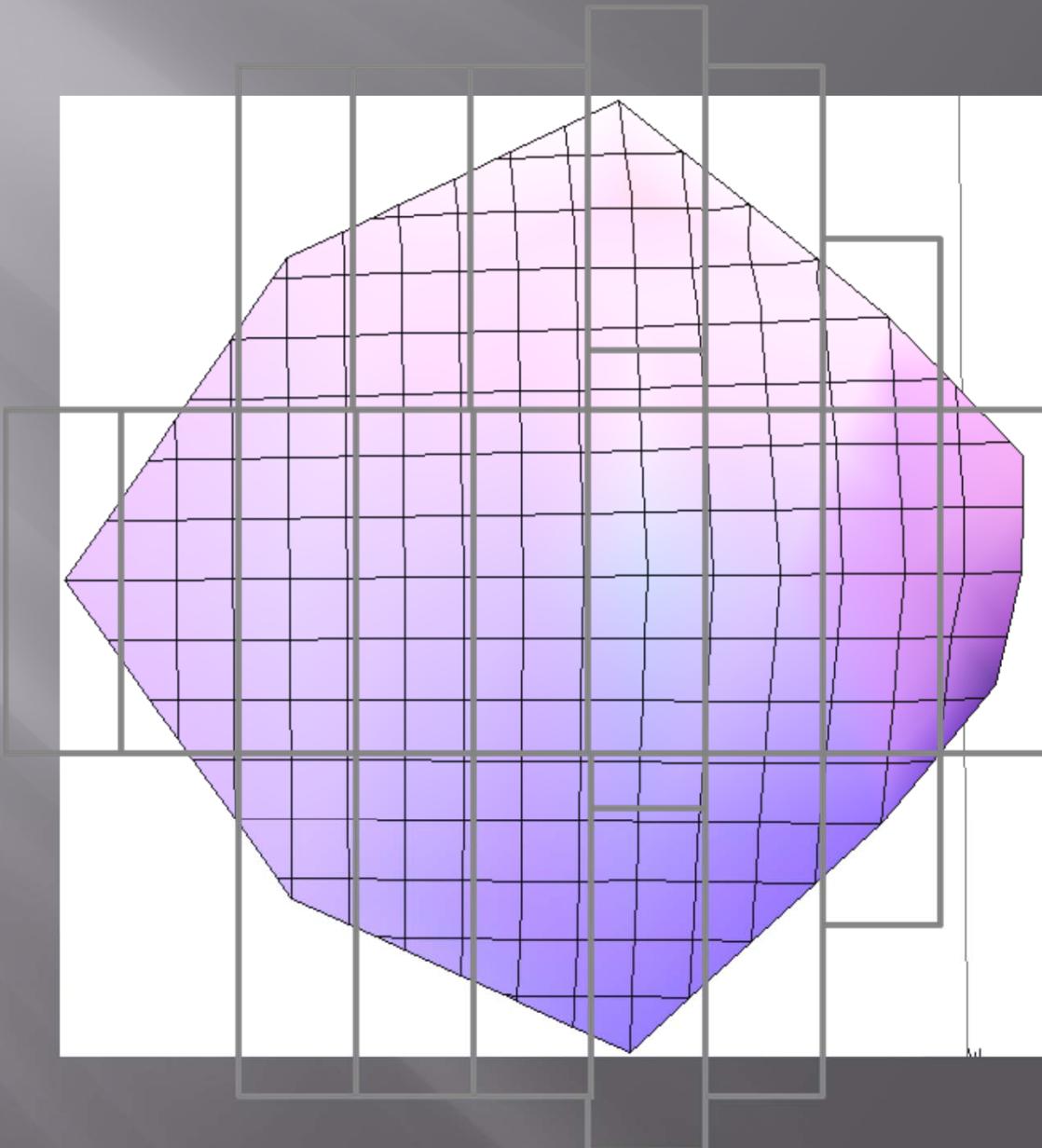
Wes Lifferth

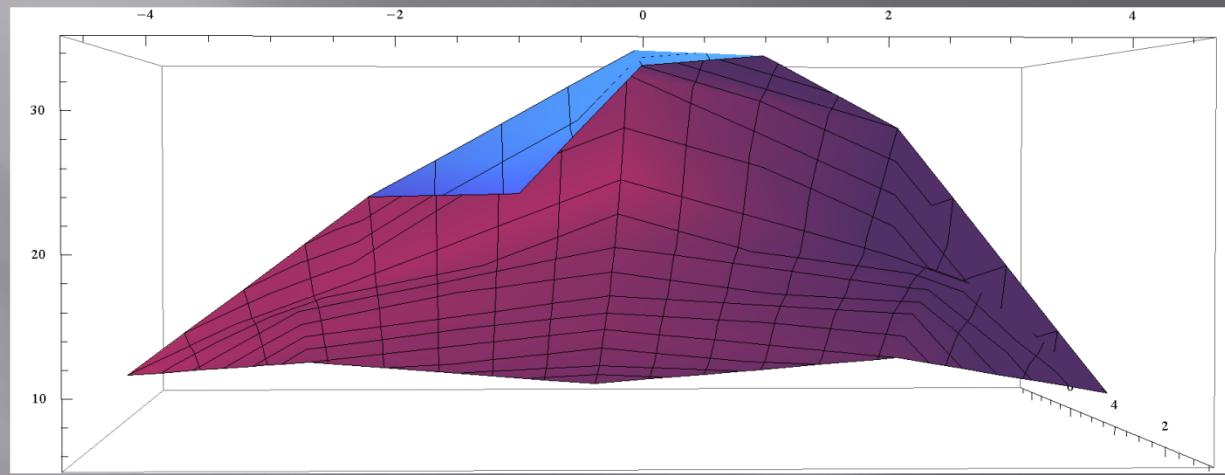
Dr. David Allred

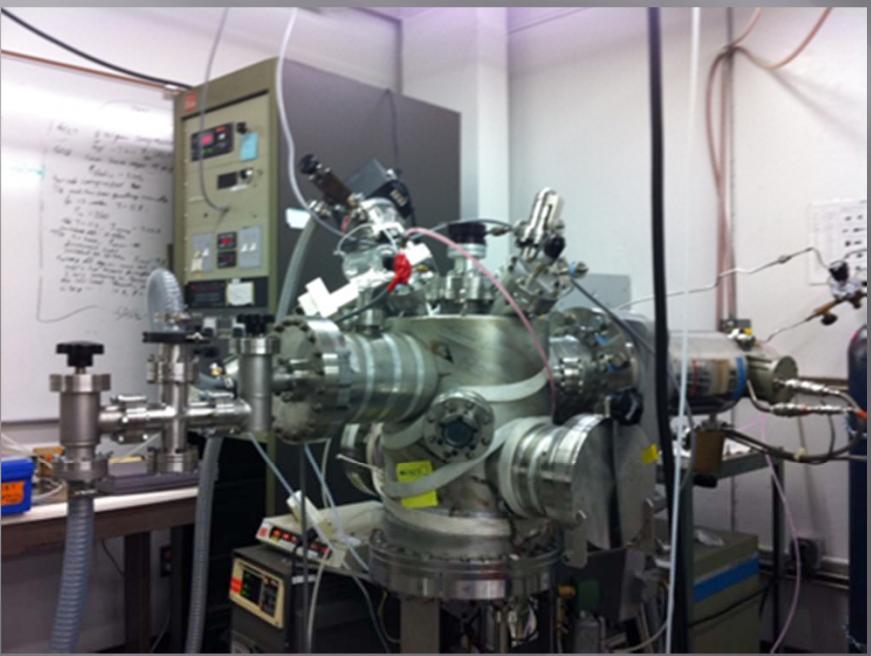
Dr. Steve Turley

BYU Physics and Astronomy









- ❑ Background: Our group makes mirrors that reflect EUV light
- ❑ Sputtering is how we make our mirrors
- ❑ Uniform coatings are important for optics
- ❑ How to make coatings more uniform
(planetary system)
 - Various iterations. Distance from target to substrate, measuring across the whole chamber
- ❑ It works, but more work to do