

Evaluation of Laser Stabilization and Imaging Systems for LCLS-II

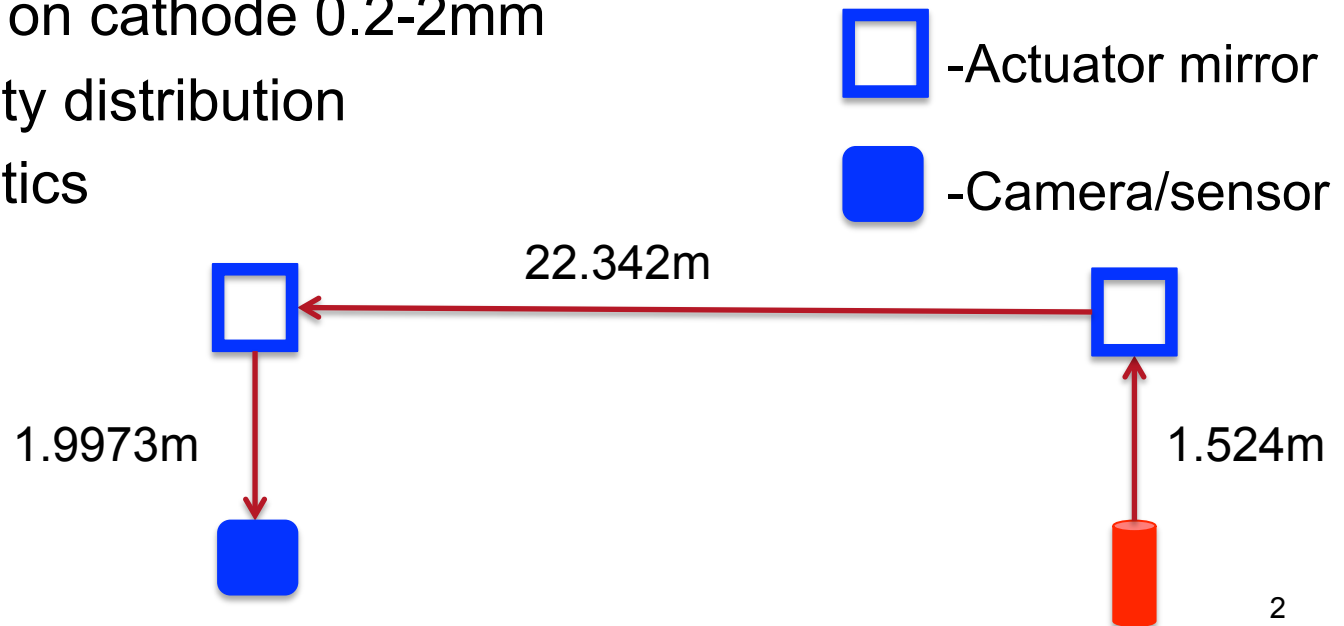
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Internship (SULI) Program

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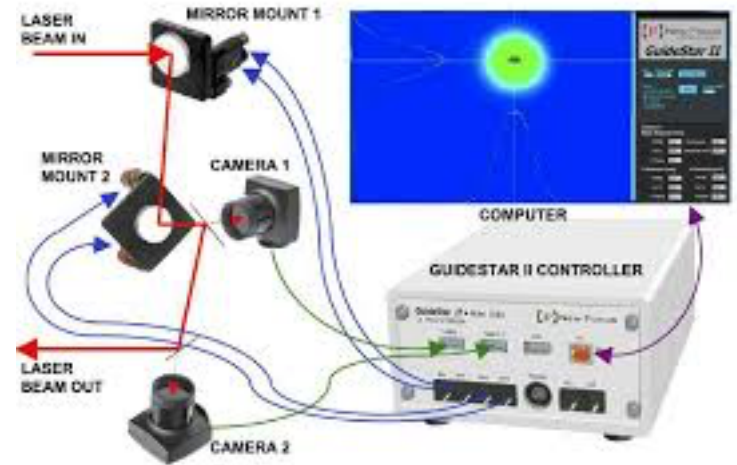
LCLS-II Laser Beamline

- Delivering a high quality beam to the cathode
- Stability:
 - 26m of transport vs. 10m in LCLS-I
- Imaging:
 - Beam size on cathode 0.2-2mm
 - Flat intensity distribution
 - Minimal optics



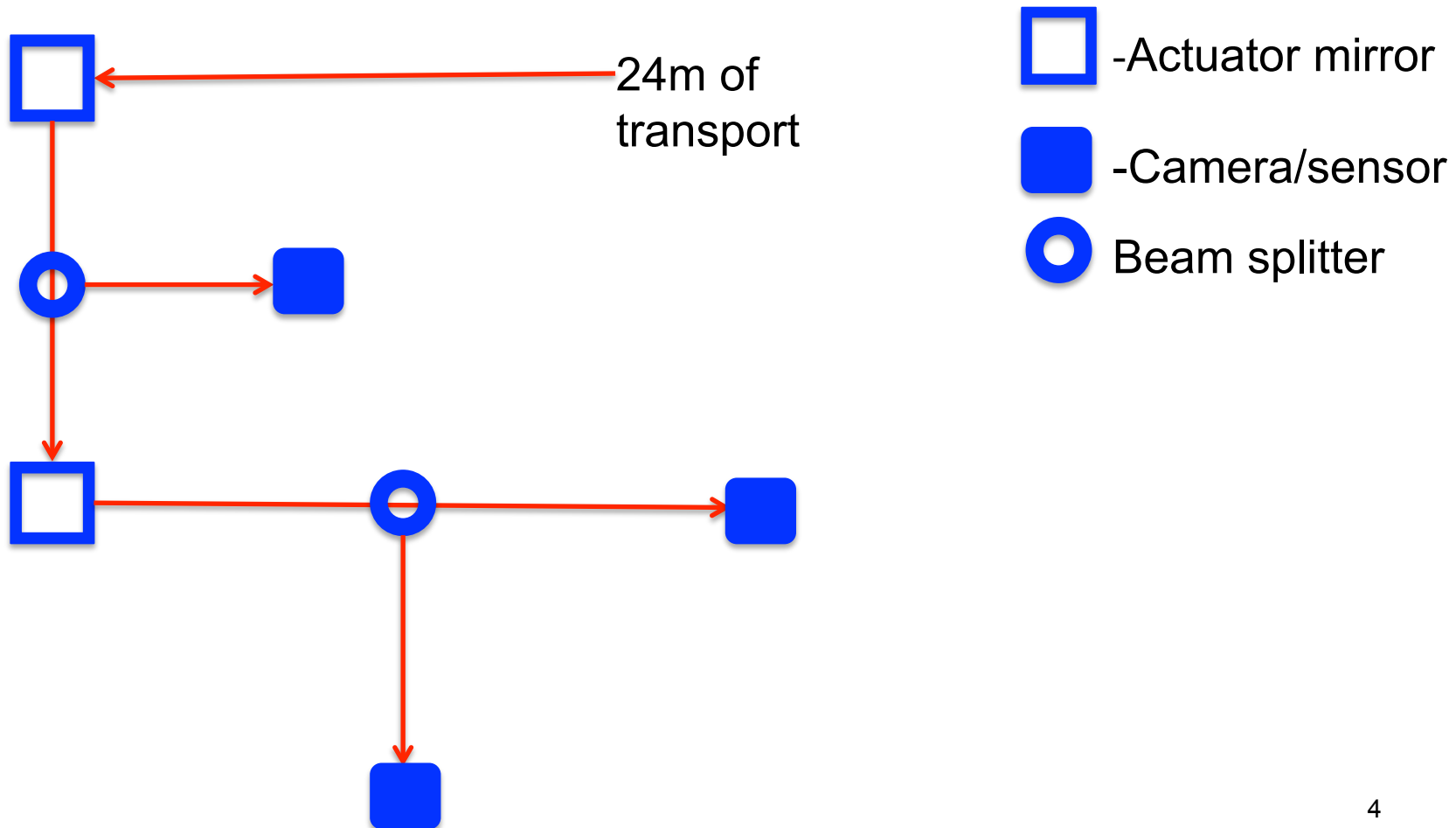
Stability Systems

- Currently use a SLAC developed system in LCLS
- Considering two commercial stabilization systems
 - Guidestar-II
 - Camera based system
 - Laser Wavelength 355nm-1200nm
 - Graphical User Interface (GUI)
 - MRC
 - Quad based system
 - UV, IR, and visible light quads



Optimal Configuration

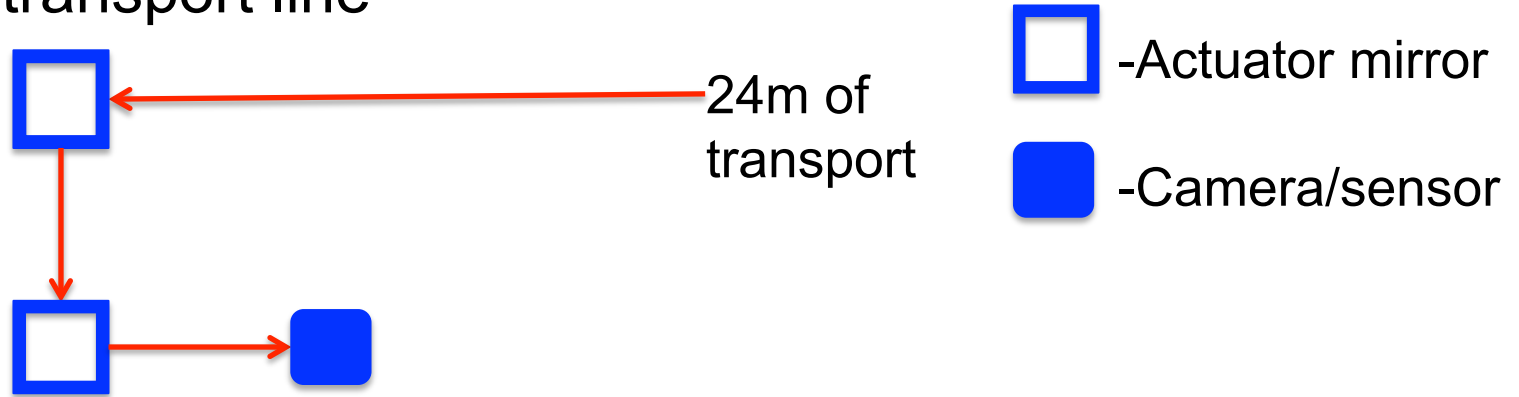
Sensor after each mirror vs. both sensors after both mirrors



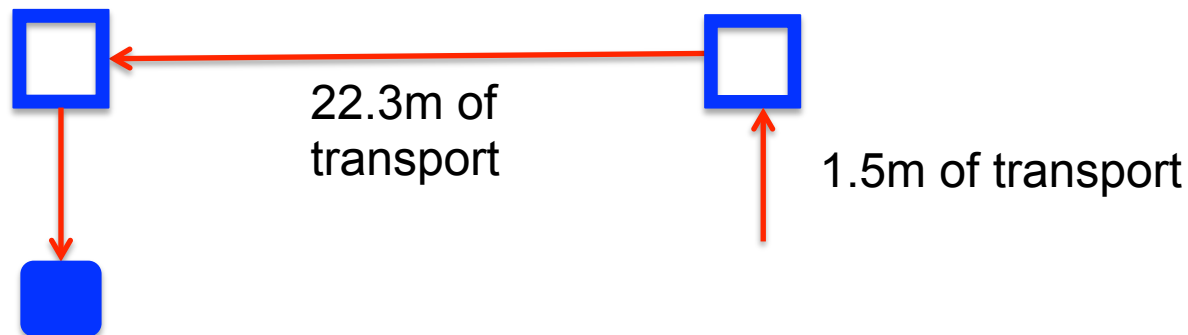
Optimal Configuration

Location of Actuator Mirrors

- After transport line

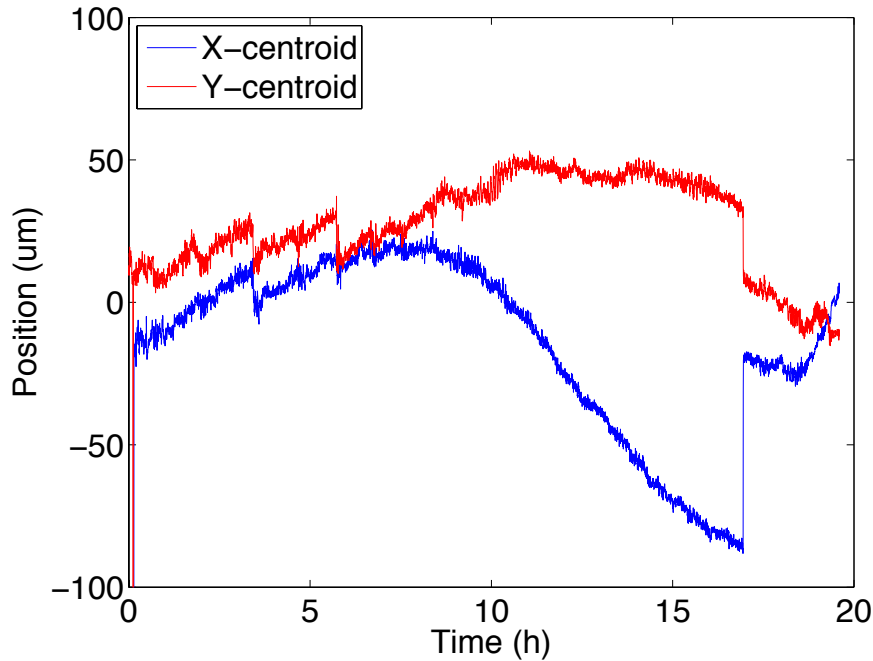


- Across transport line

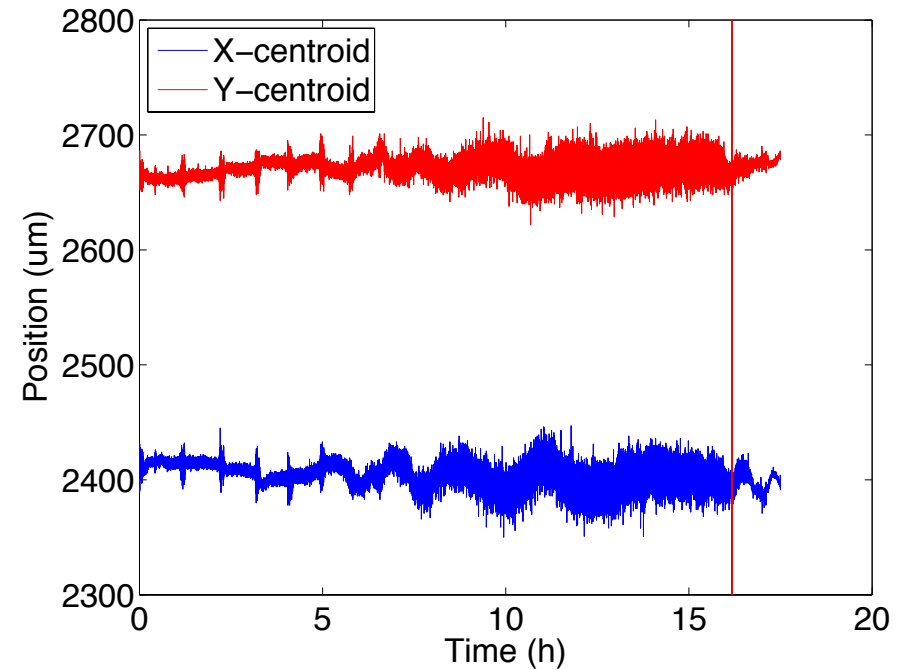


Guidestar-II or MRC?

Guidestar-II at Cathode



MRC at Cathode



- Long-term range:

- X- 113.6um
- Y- 68.4um

- Long-term range:

- X- 97um
- Y- 93 um

Can we Combine the Systems?

SLAC

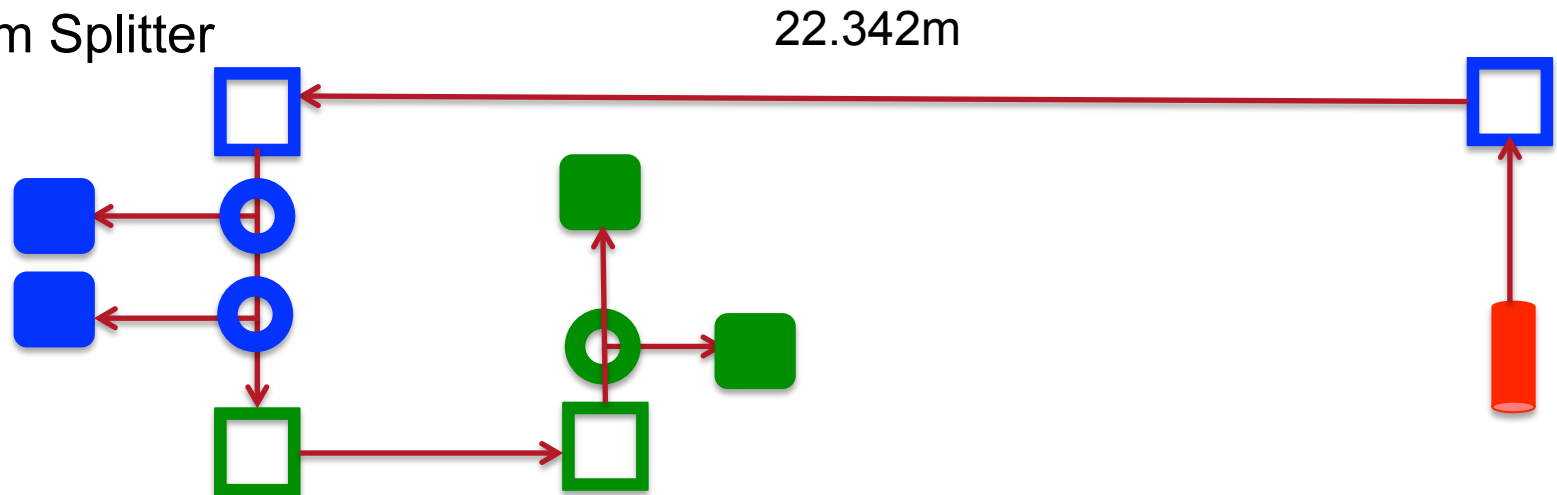
 -Guidestar-II Actuator mirror

 -Guidestar-II Camera

 -MRC Actuator mirror

 -MRC sensor

 -Beam Splitter



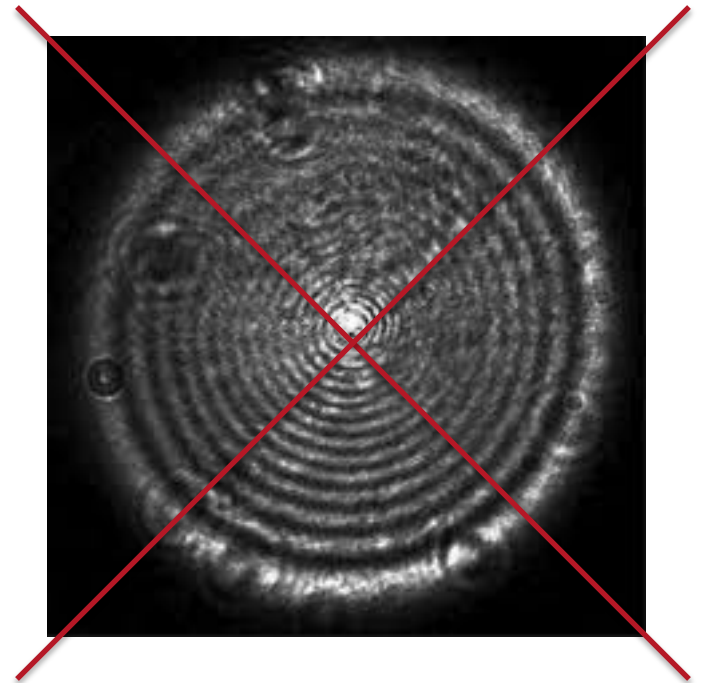
Imaging

Goals:

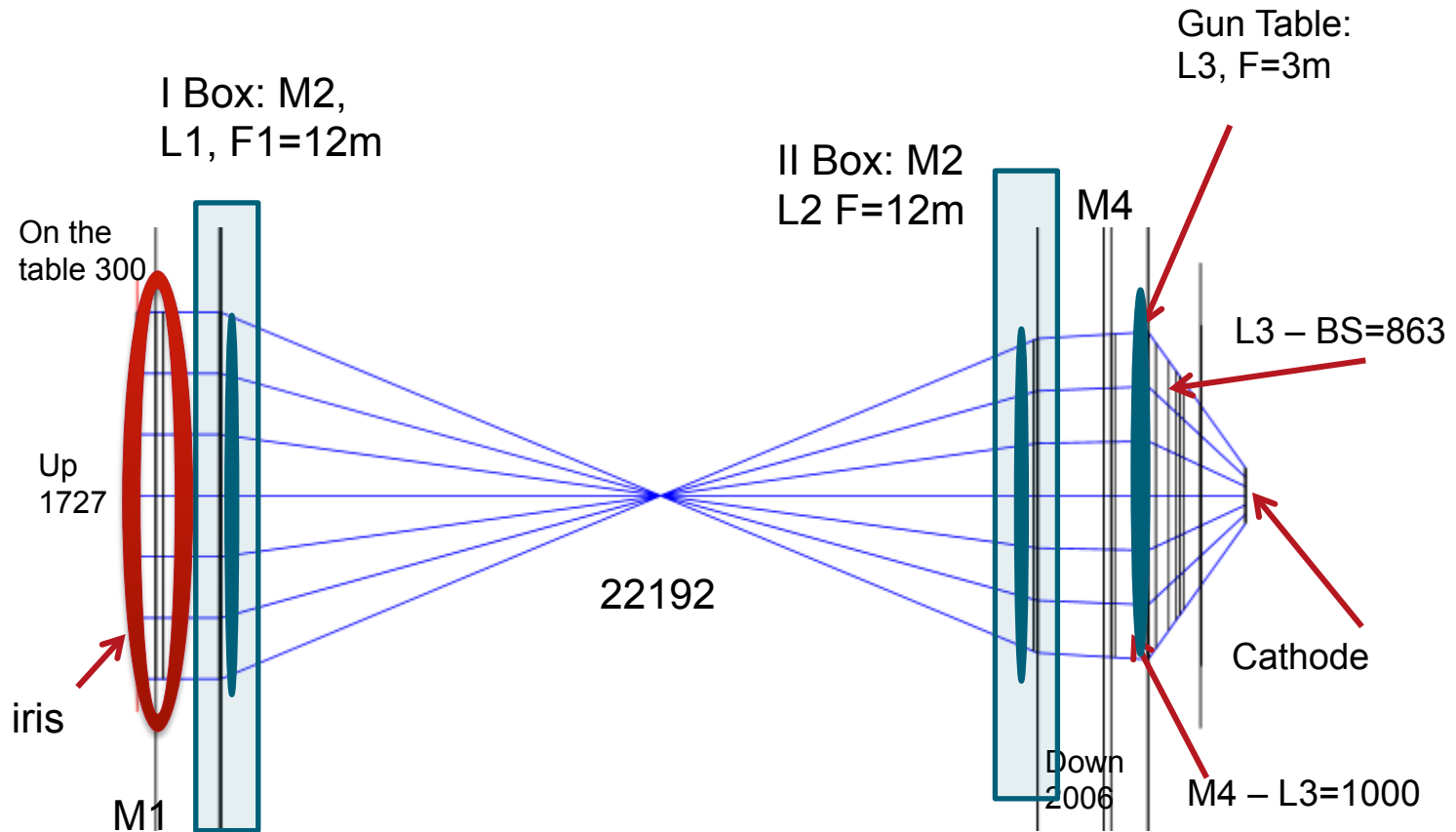
- Flat intensity distribution
- Defined image
- Maximum de-magnification
- Stability without stabilization system
- Minimal optics

Options:

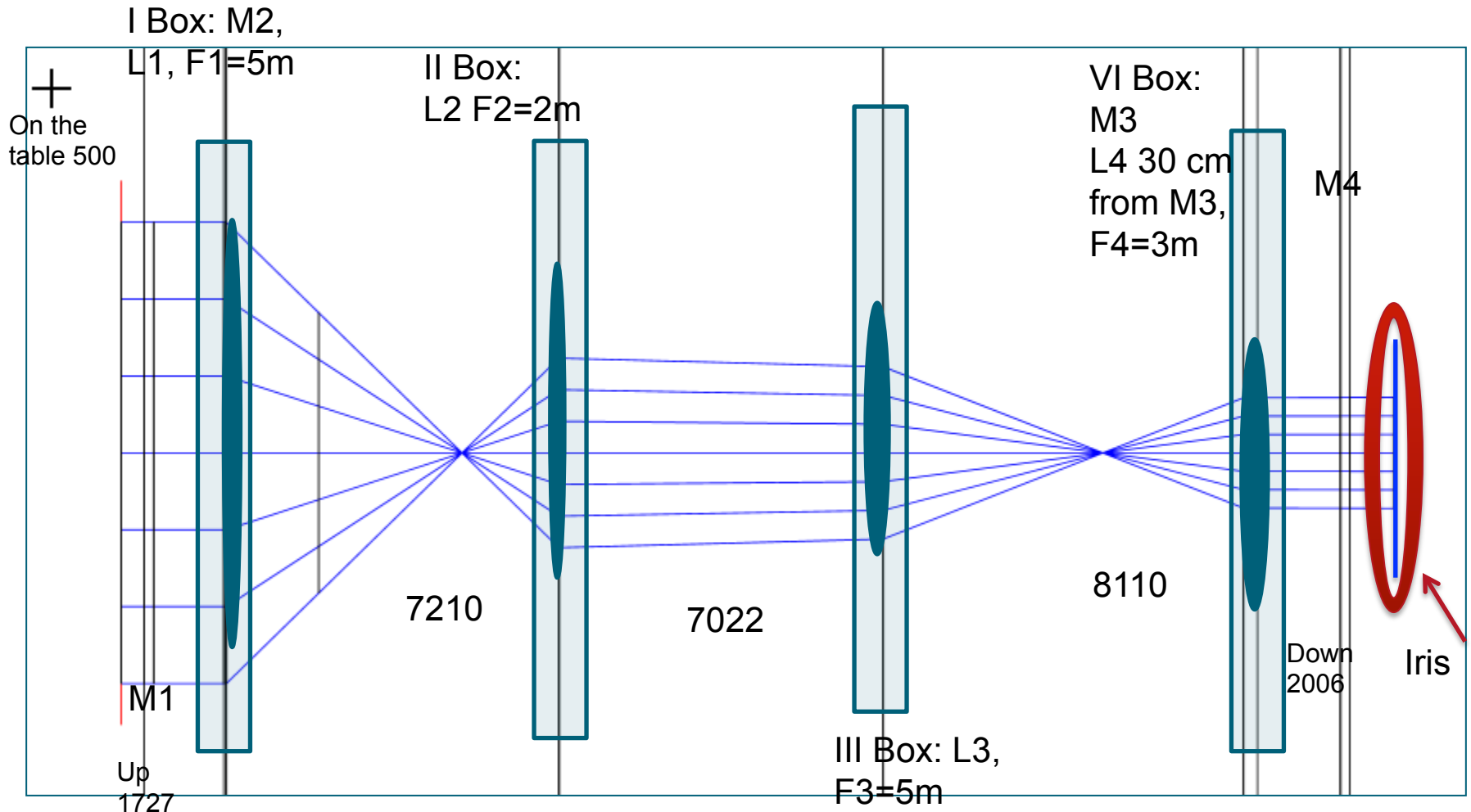
- 2 box and 4 box system



2 Box system



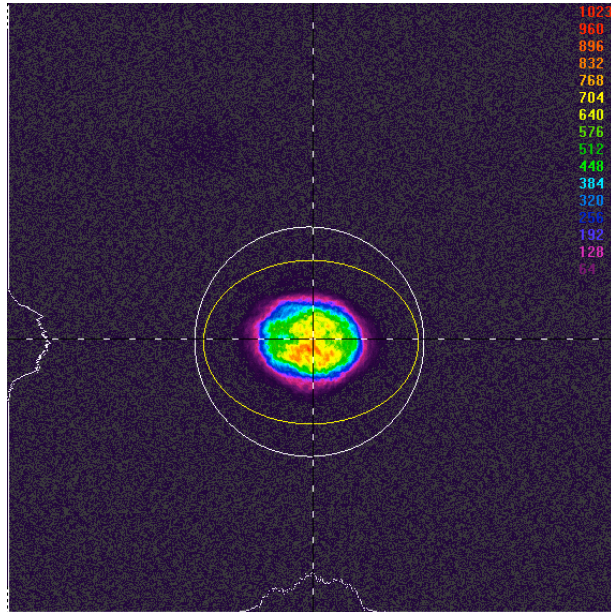
4 Box System (Imaging to Vault)



2 Boxes or 4 Boxes?

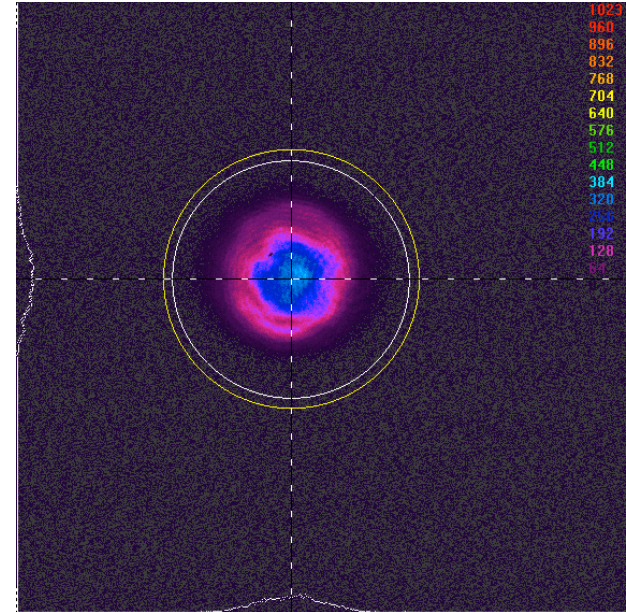
SLAC

2 Boxes



- 5mm iris->.732mm image
- Expected magnification: 6.7:1
- Actual magnification: 6.8:1
- ~ 55um stability range

4 Boxes ✓



- 2mm iris-> 1.01mm image
- Expected magnification: 2.1:1
- Actual magnification: 2:1
- ~ 70um stability range

Conclusions and Moving Forward

- Both stability systems have similar ranges over extended periods of time
- Guidestar-II is more stable over shorter periods, but is more susceptible to drift
- MRC is less stable over shorter periods, but is less susceptible to drift
- 2 Box imaging system is slightly more stable, but 4 box system has a flatter image
- Final test with both systems active through the 4 box system

Acknowledgement

- Mentor: Sharon Vetter
- Sasha Gilevich
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Abstract

This presentation covers data collected on two commercial laser stabilization systems, Guidestar-II and MRC, and two optical imaging systems. Additionally, general information about LCLS-II and how to go about continuing testing is covered.