Spain Actuator Testing and Results

Actuator I Session

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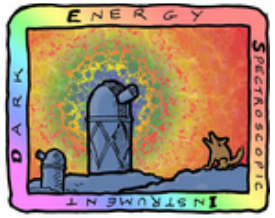
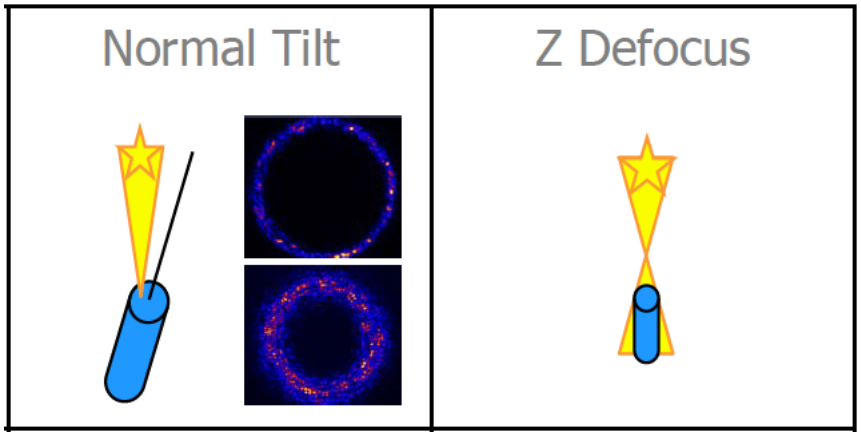
Francisco Prada (IFT-UAM/CSIC & IAA-CSIC)

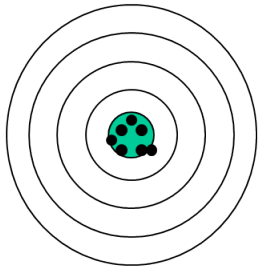
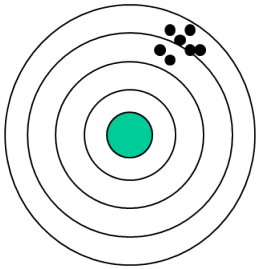
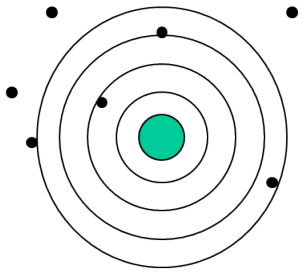
17 July 2013 | DESI Berkeley Meeting

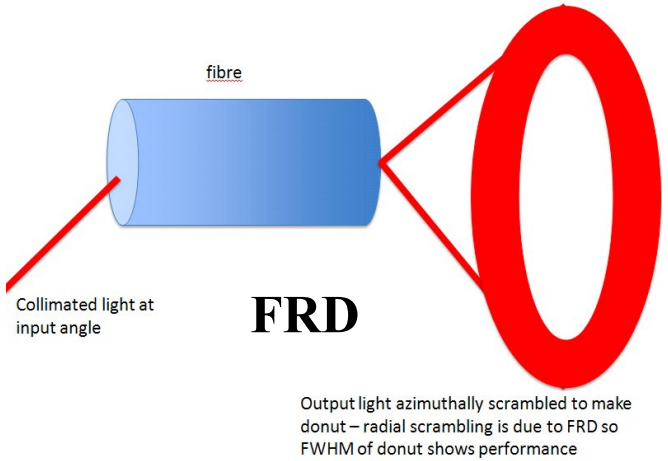
Performance tests



- Repeatability @IAA
- Focus and Tip/Tilt testing @LBNL
- XY Accuracy testing @LBNL
- Focal Ratio Degradation @LBNL

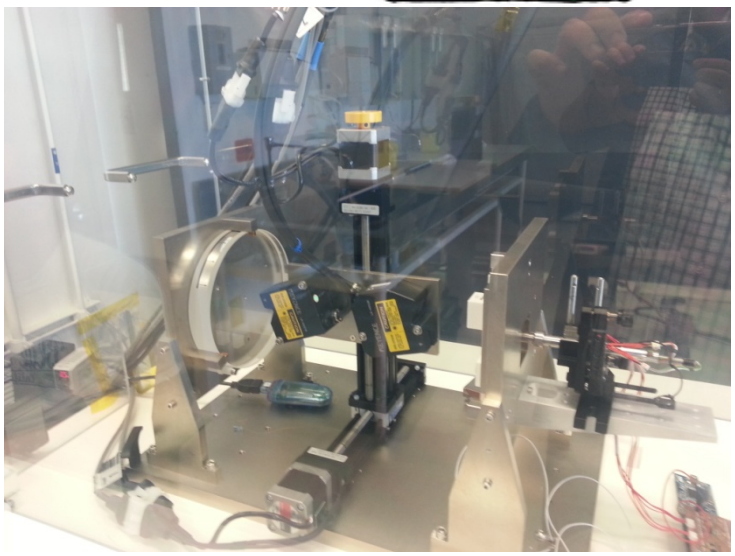


	Accurate	Not Accurate
Repeatable		
Not Repeatable	N/A	

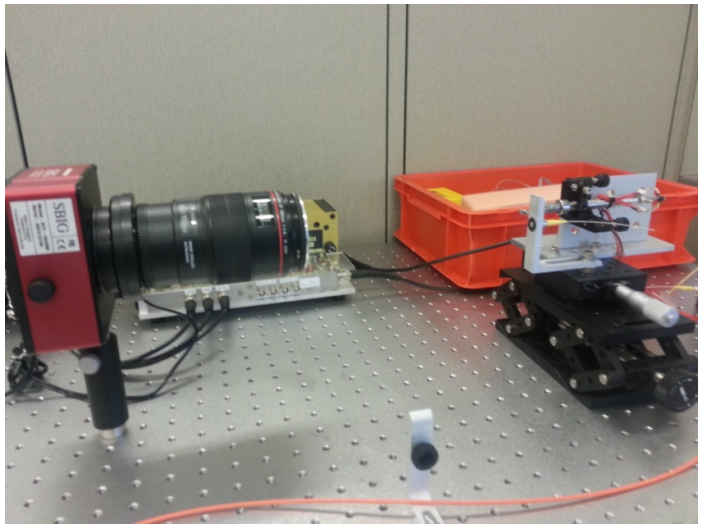


LBNL Testing and Results

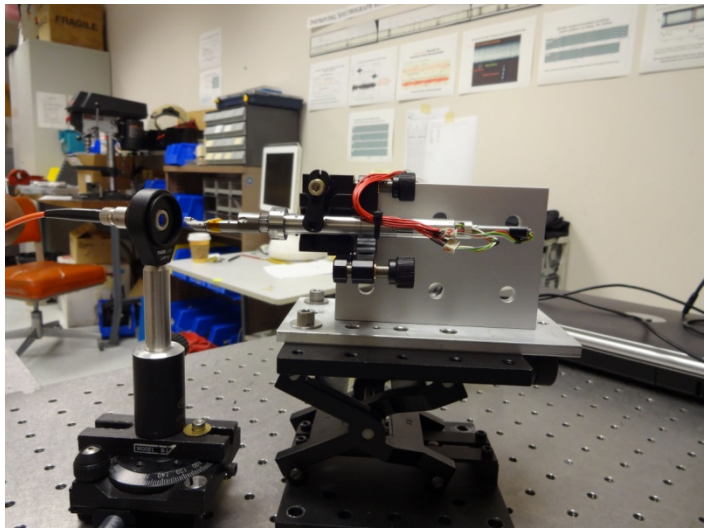
IAA actuator testing at LBNL
Mar 11-15 & July 15-16 2013



Focus and Tip/Tilt testing



XY accuracy testing



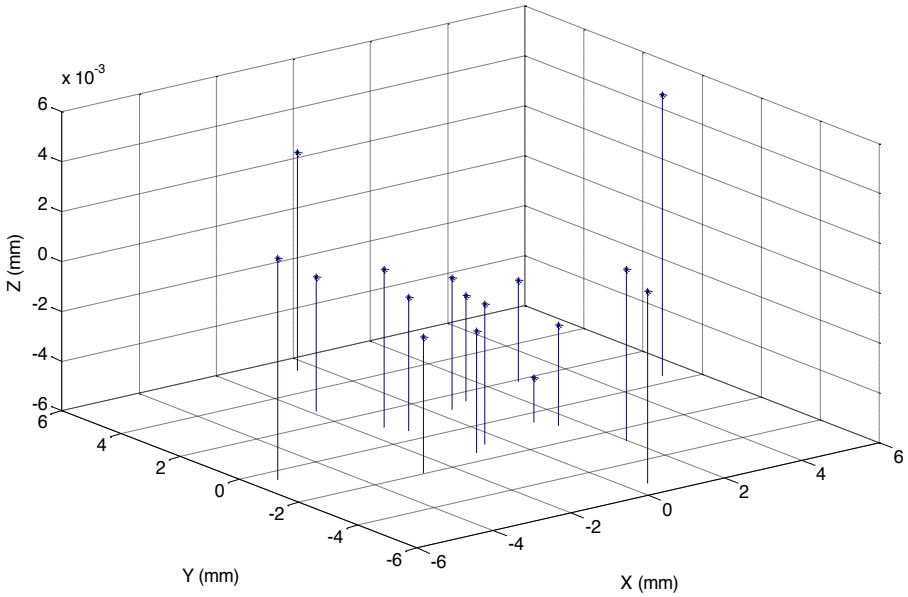
Focal Ratio Degradation

Focus & Tip/Tilt testing (March 2013)

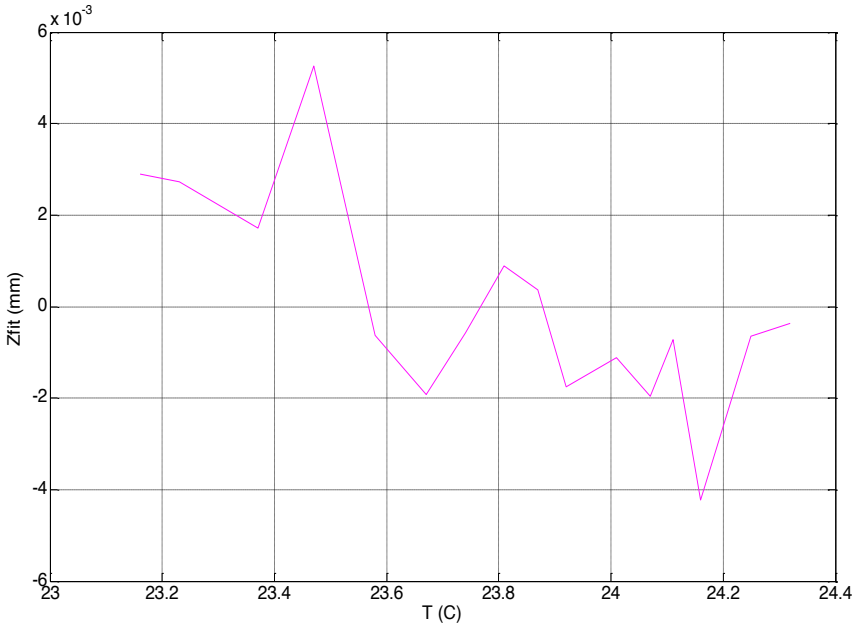
Z location versus radius:

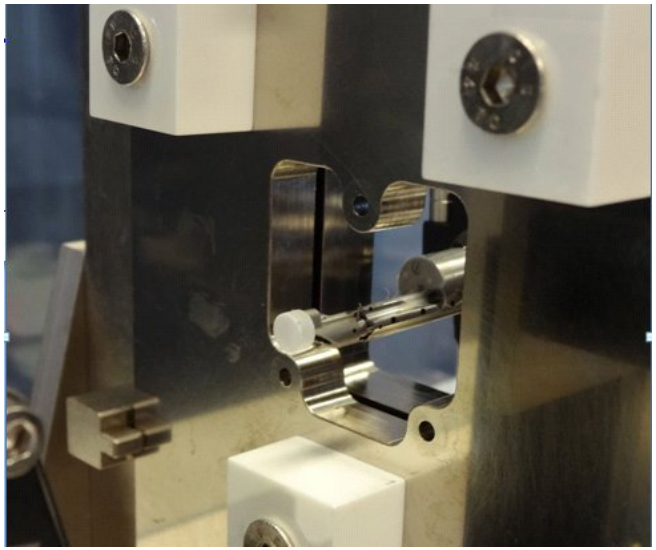
- When the plane is removed P-V = 9.5 μm
- Main variation seems due to temperature
- **If the temperature variation is removed P-V = 6.4 μm**

3D plot of fit data

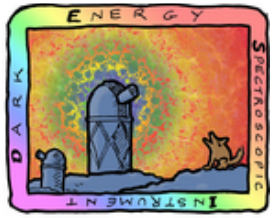


Z versus Temperature



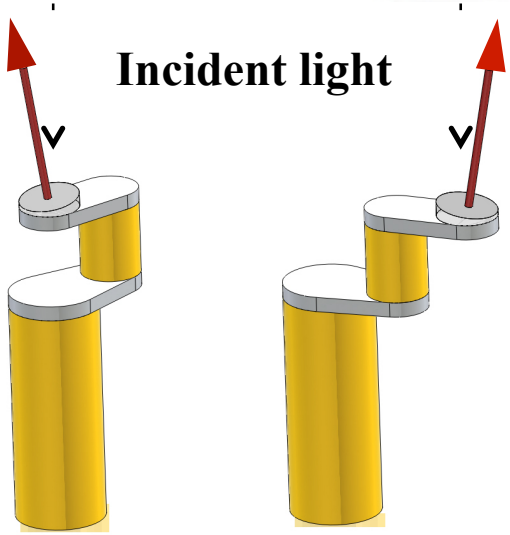


Focus & Tip/Tilt testing (March 2013)

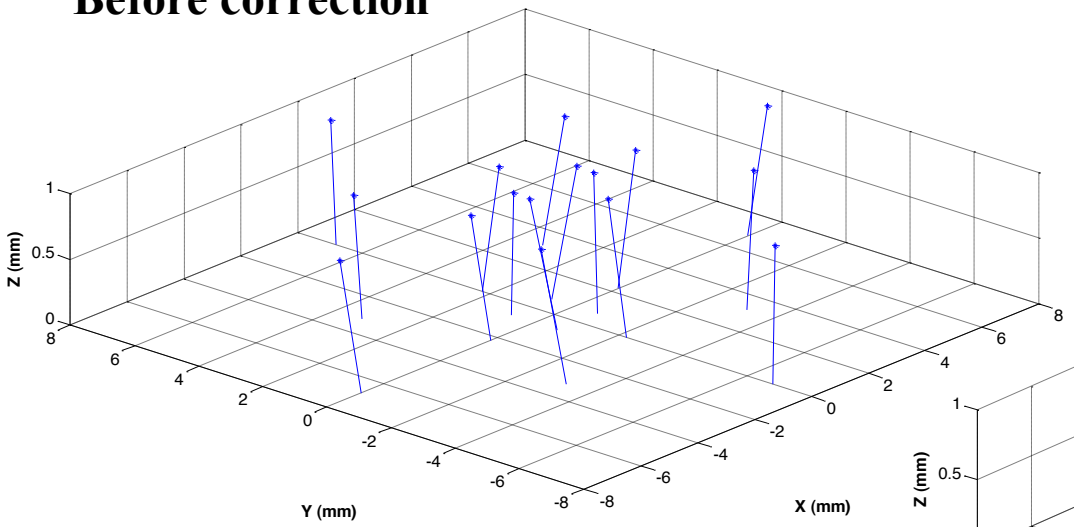


Tilt versus Location

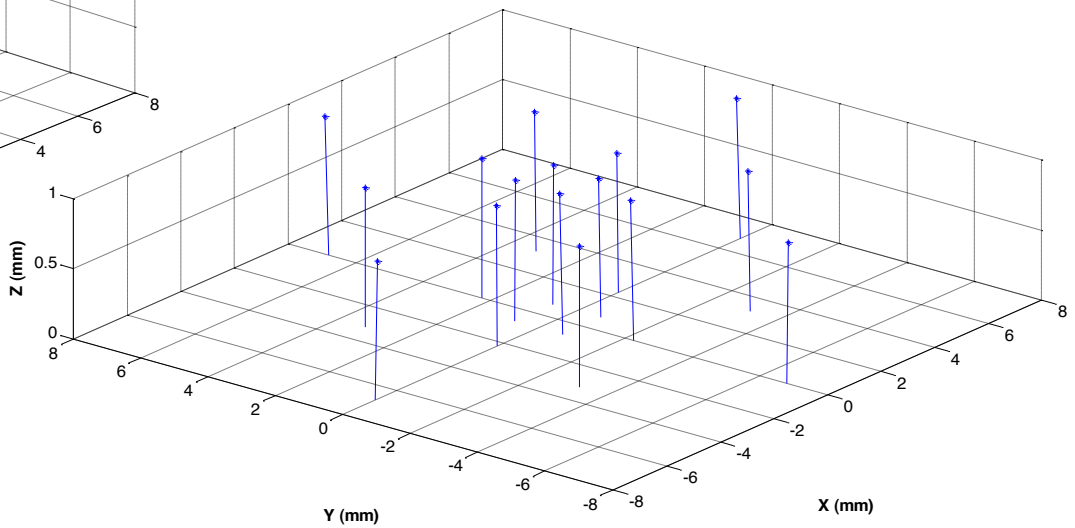
- The mirror was tilted 0.32° to the axis
- Before correction the maximum tilt was 0.36°; average = 0.322°; RMS= 0.032°
- **After Correction the maximum tilt was 0.06°; average = 0.035°; RMS= 0.019°**



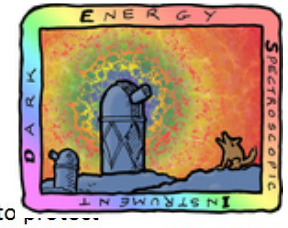
Normal Vector (x 100)
Before correction



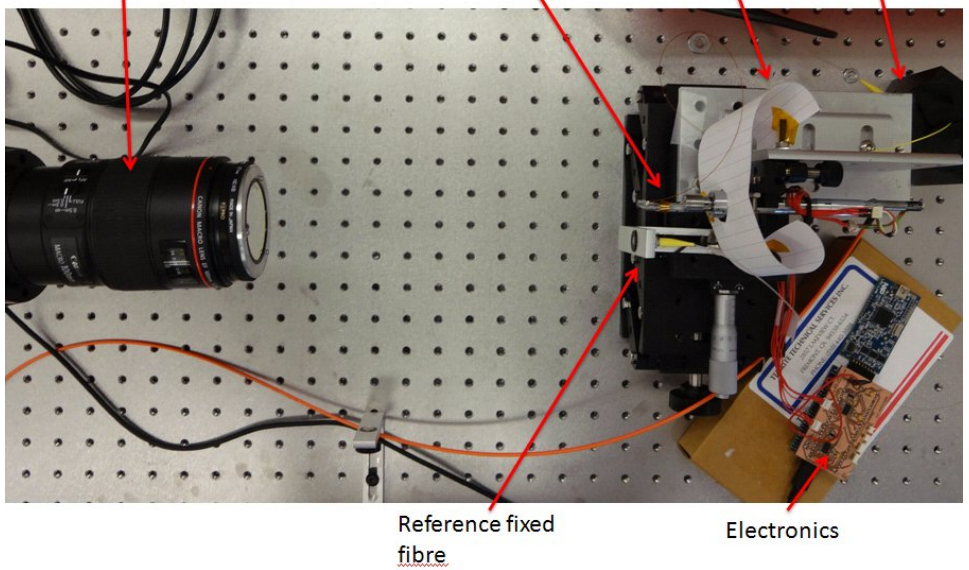
Normal Vector (x 100)
After correction

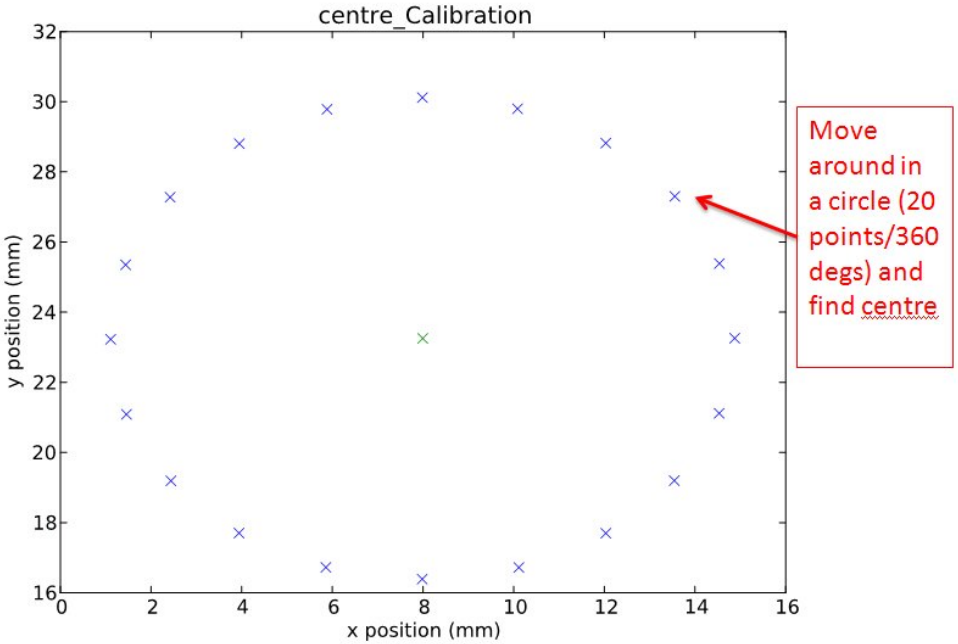


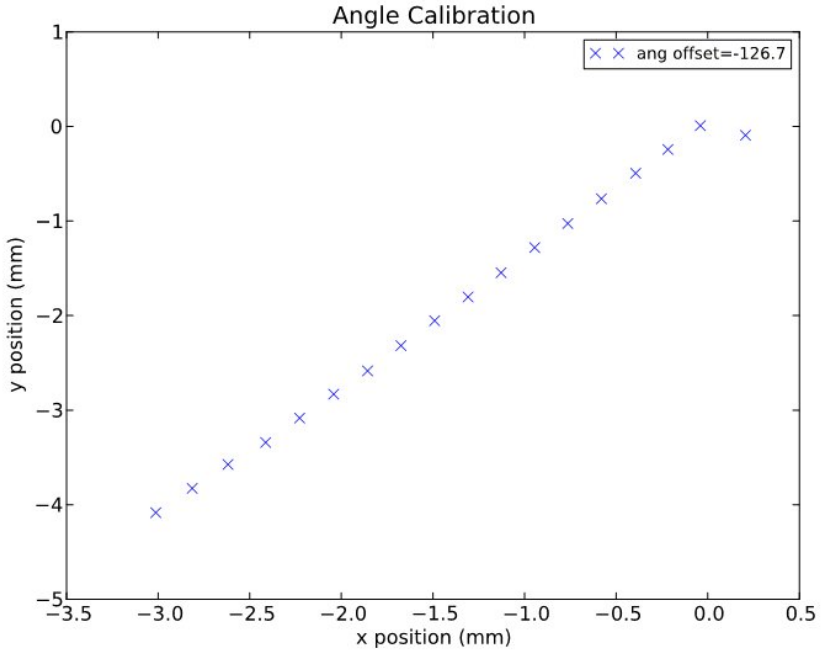
XY Accuracy Testing (July 16th 2013)



- Testing procedure
  - Calibration find center
  - Calibration find angle
  - Grid of targets







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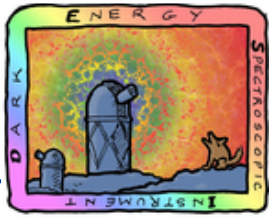
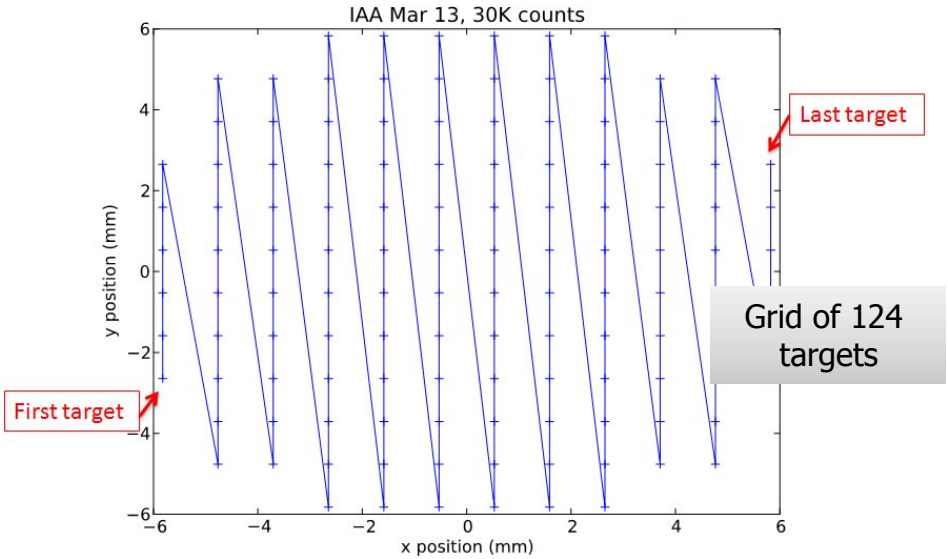
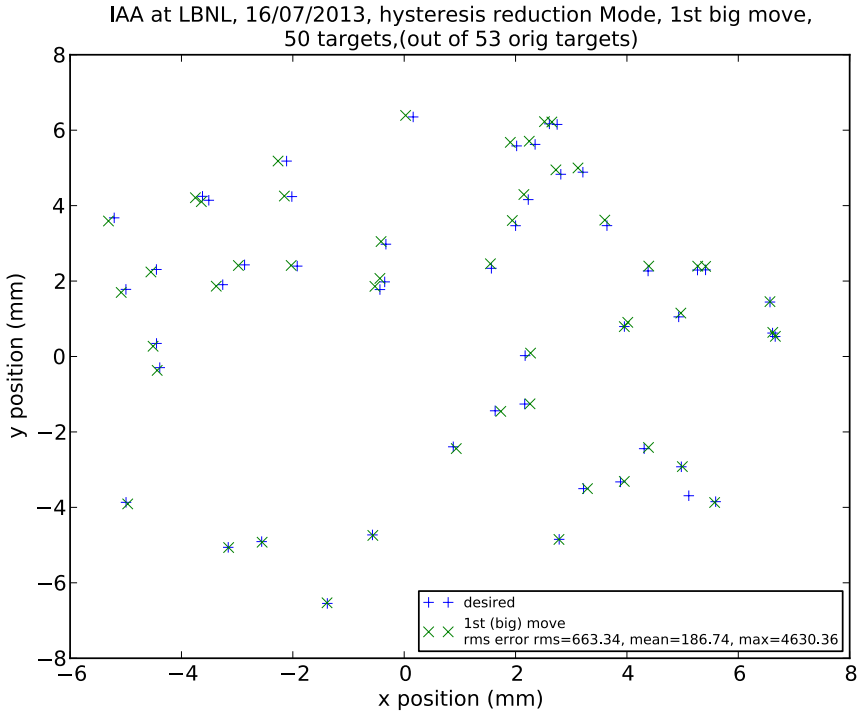
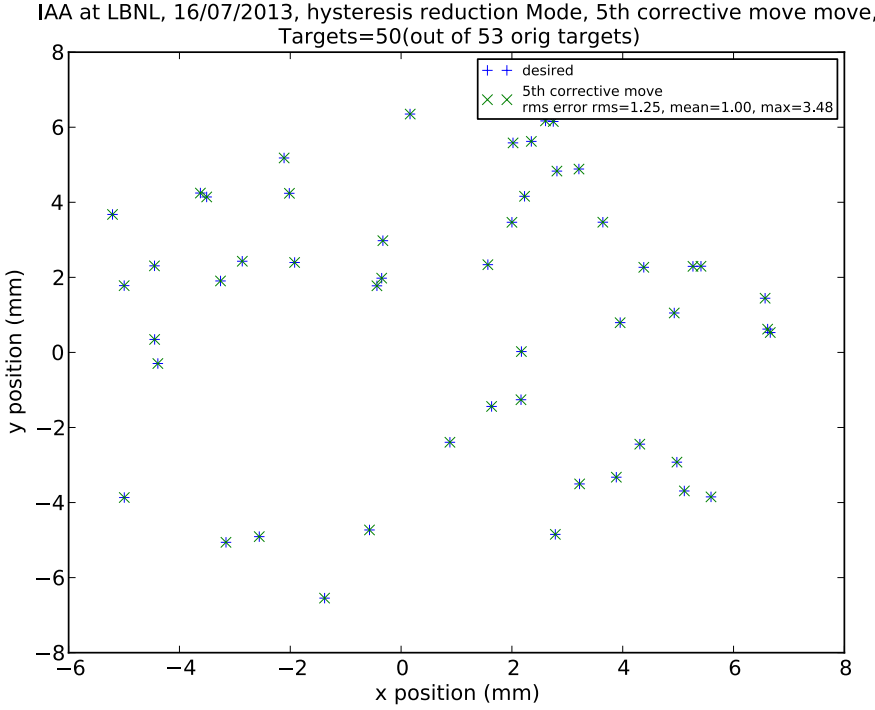




Grid of targets over the Patrol Disc





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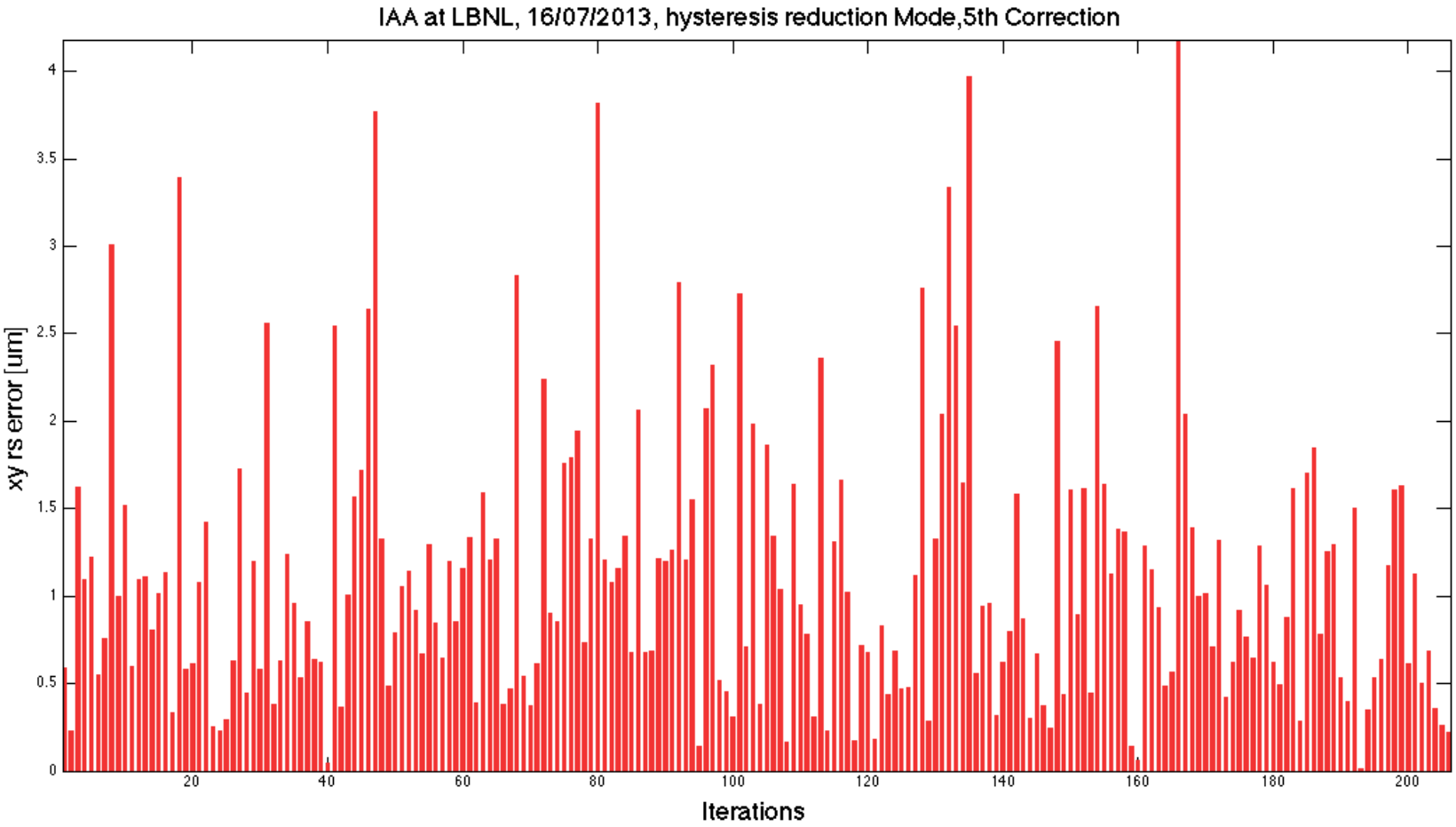

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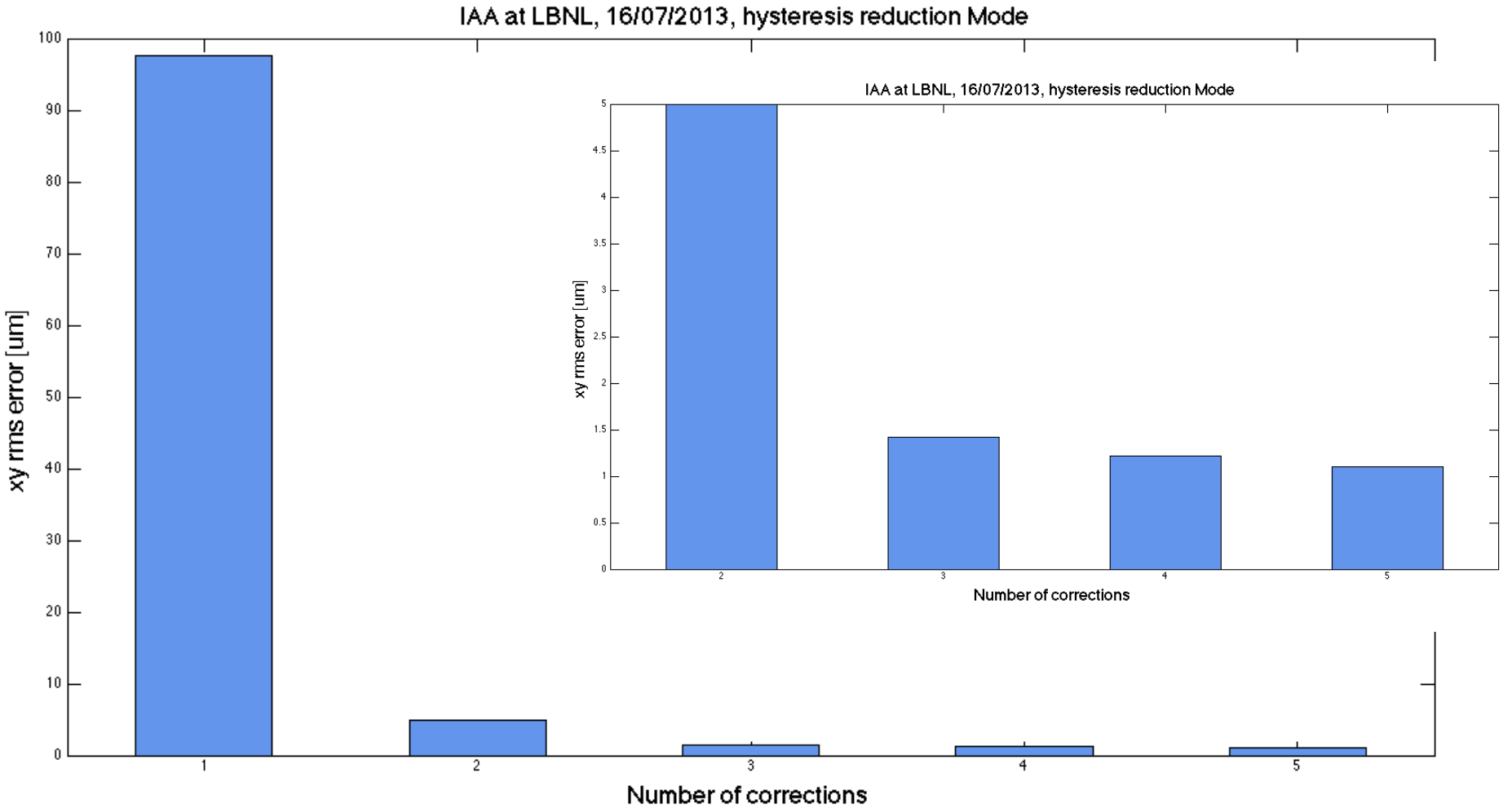
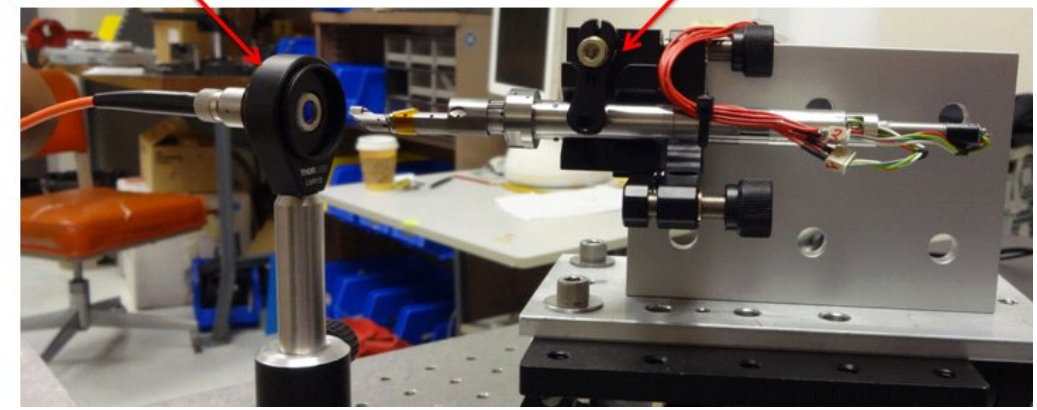
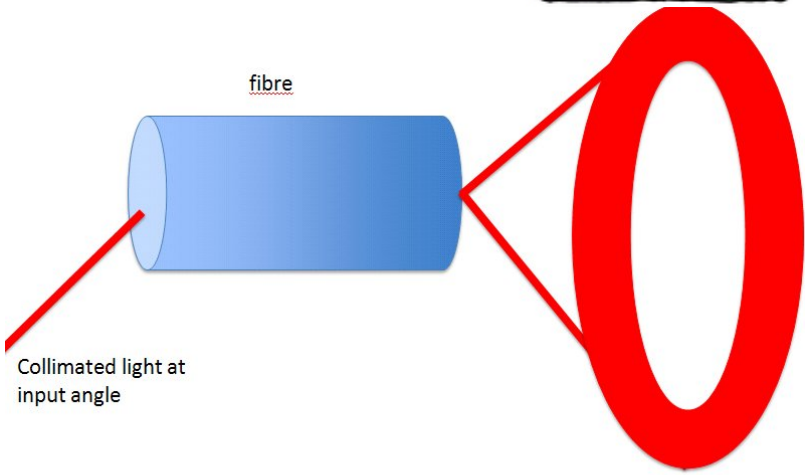


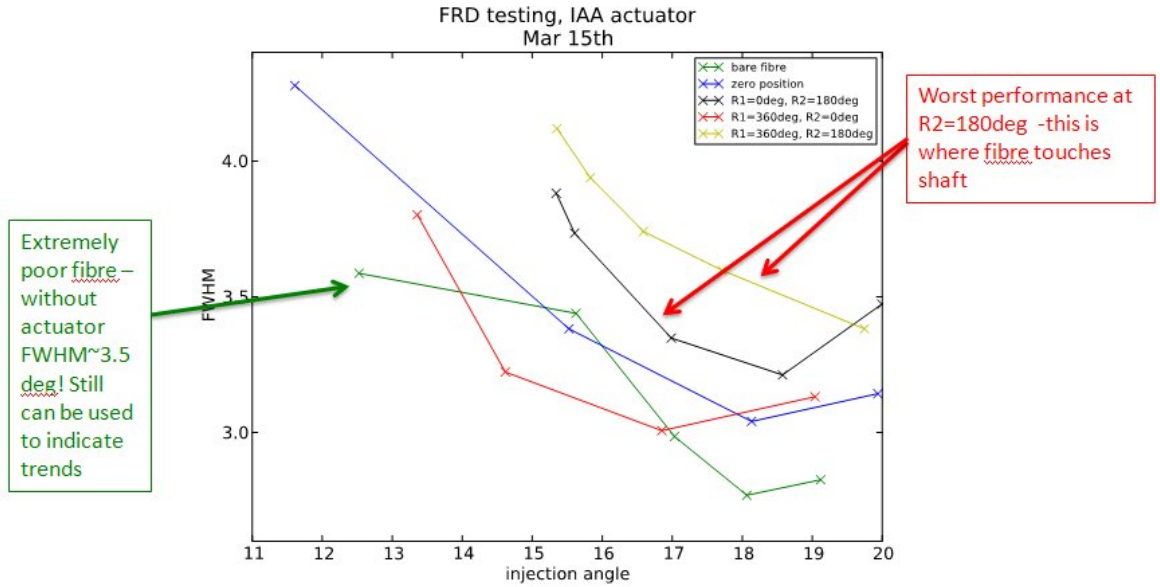
Focal Ratio Degradation (March 2013)





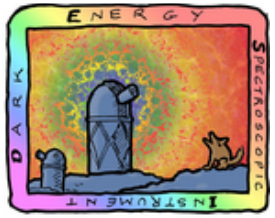
Results:

- At f/3.5, increase in FWHM is ~0.5 degrees, a single splice is ~0.2 degrees for comparison
- This shows that the design needs to be updated in order to minimize FRD
- Furcation tube to protect fibre



New tests will be done with the good fiber

SUMMARY ON RESULTS



Test results at the IAA & LBNL:

- The Spain positioner prototype meets the defocus and tilt requirements easily
- Grid X-Y results show fast decay WELL BELOW the requirements, i.e.

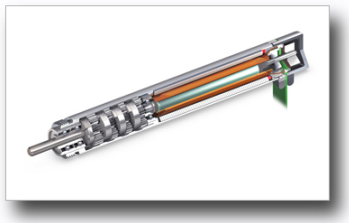
RMS X-Y error: 5.0um (2nd move); 1.4um (3rd move), 1.25um (4th move)
MAX X-Y errors with less than 5um: 47% (2nd move); 93% (3rd move); 95% (4th move)
MAX X-Y errors with less than 1um: 6% (2nd move); 42% (3rd move); 48% (4th move)

- The design needs to be updated in order to minimize FRD

Performance	Value	Unit	Rationale	
1st Move XY Error	< ±200	[µm] P-P	Required to window fiber view camera and collision avoidance	**98**
Final Move XY Error	< ±5	[µm] RMS	Required for throughput S/N and exposure cadence	**1.25 (4th move)**
Z Mount and Dynamic	< ±30	[µm] P-P	Required to control throughput loss from de-focus	**6.40**
Tip/Tilt Mount and Dynamic	< ±0.20	[°] P-P	Required to control throughput loss from FRD	**0.06**
Temperature: Survive	-20 to +60	[°c]	Required to function after shipping and installation environment	TBC
Temperature: Operation	-10 to +30	[°c]	Required to meet after shipping and installation environment	TBC
Power Moving	< 1.200	[W]	Required to size cooling for Focal Plate figure	**0.40**
Power Stationary	< 0.005	[W]	Required to size cooling for Focal Plate figure and seeing contamination	**0.005**
Reposition Time	< 45	[s]	Required to maintain survey speed	**17.00**
Lifetime Reconfigurations	100,000	[-]	Required to operate and calibrate for 500 nights	**25,000 up-to-date**

“12-mm Pitch” World Championship

Looking forward to the “10-mm Pitch” Challenge!



Current Faulhaber 6mm stepper motor
drilling a hole along the central axis is possible

Using new 4mm brushless motors
(e.g. Namini used at LBNL)

THANK YOU!