



# *Upgrades in the Laboratory*

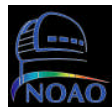
*Judit Sturmann*





# Outline

- *CLIMB 2, the 9<sup>th</sup> beam combiner*
- *Encoded motors for tip/tilt adjustments*
- *Main source of pupil motion*
- *J band update*





# Overview of Beam Combiners

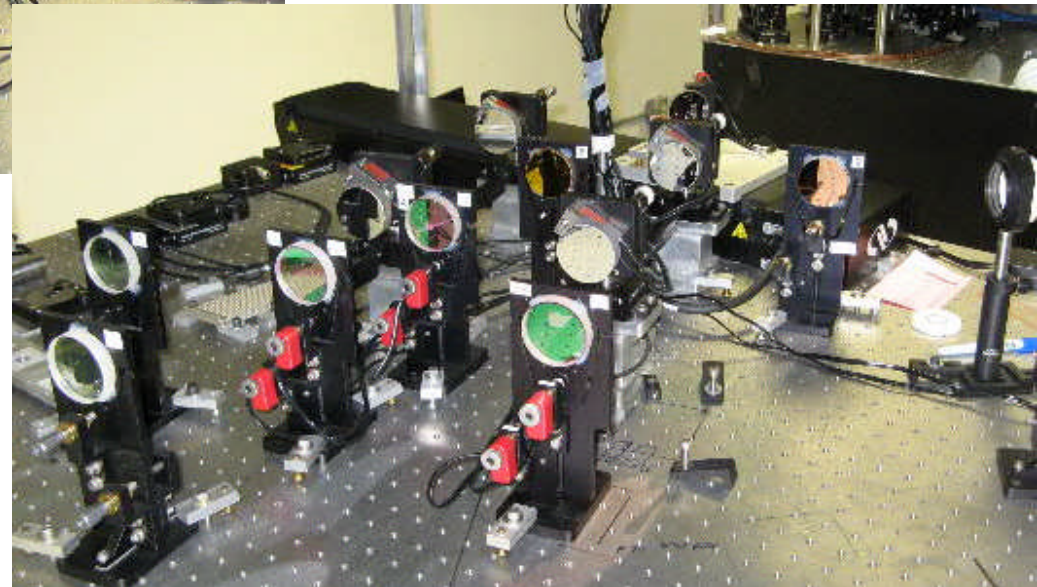
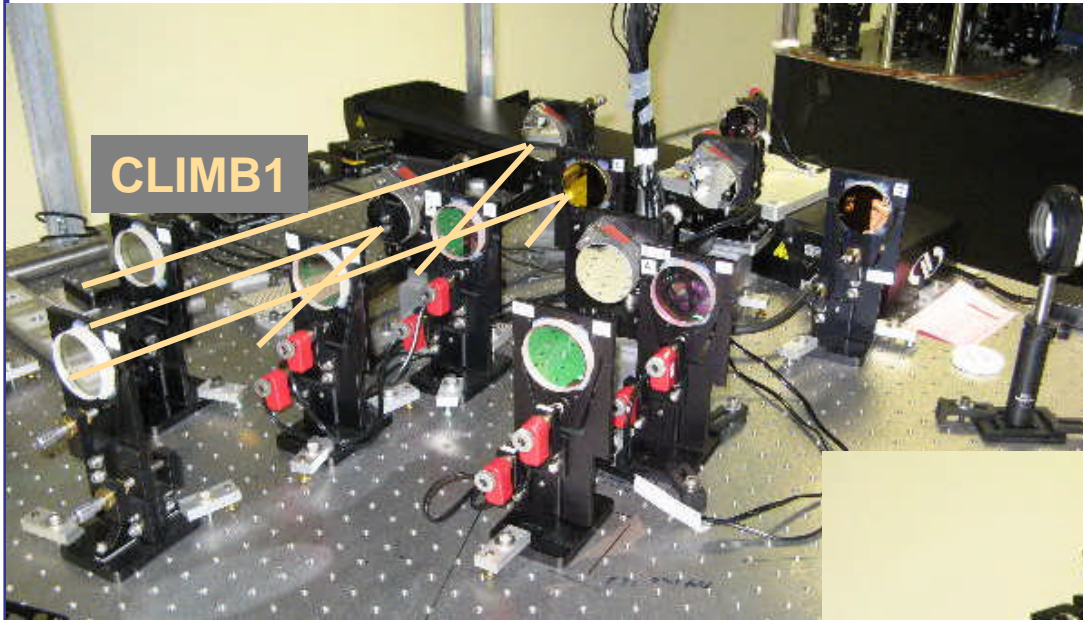
V1	V2	V3	V4	V5	V6	IR1	IR2	IR3	IR4	IR5	IR6
CHARA VIS for alignment beams											
VEGA				CHAMP							
PAVO								MIRC			
						CLIMB 1		CLIMB 2			
										Classic	
								JouFLU		JouFLU alt. place	

*New* →



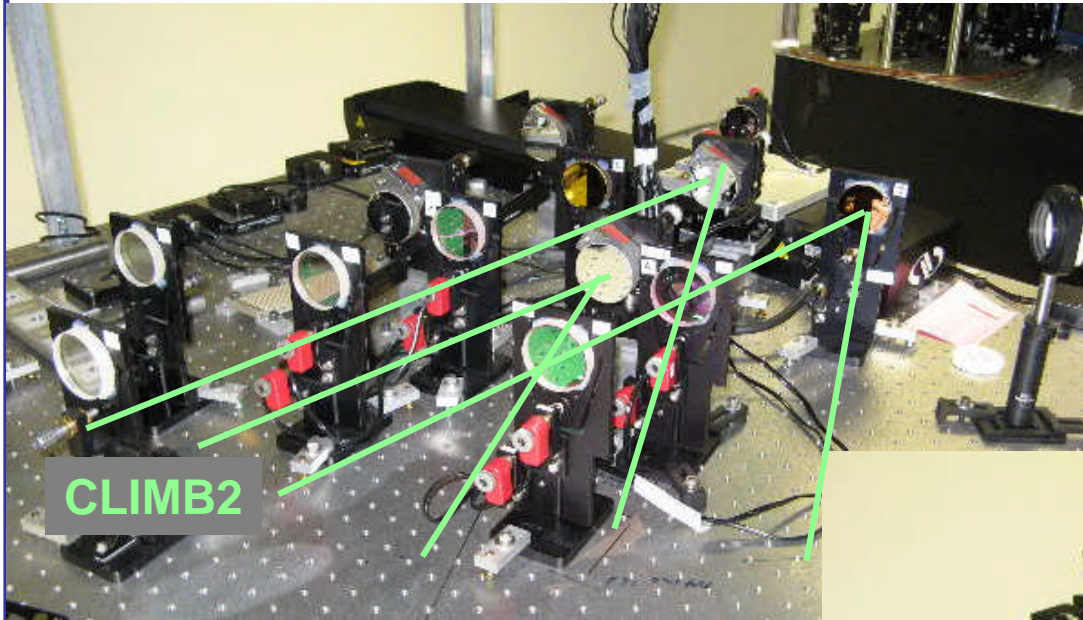


# CLIMB 1

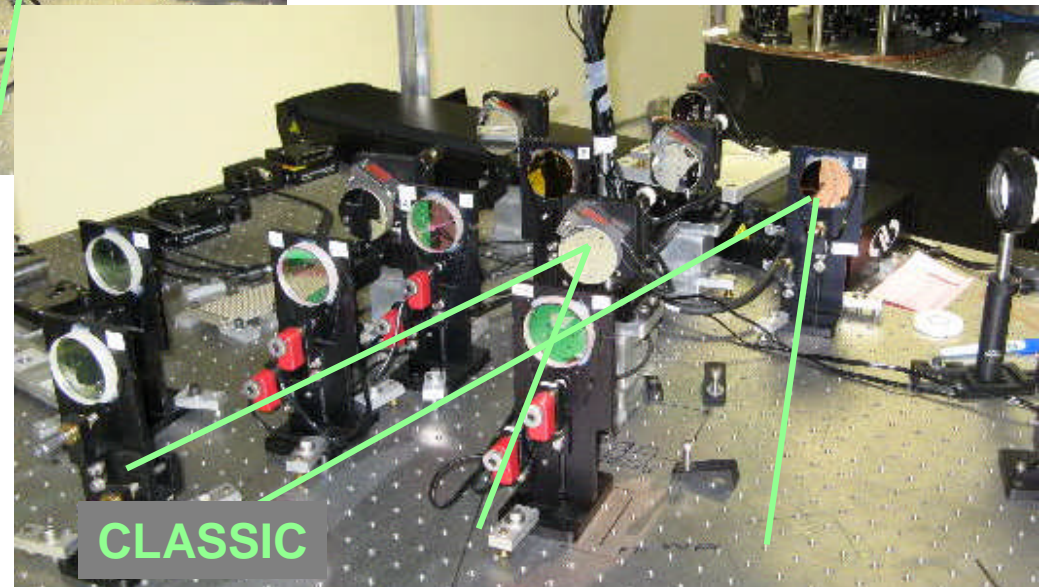




# CLIMB2 or Classic Setup



CLIMB2

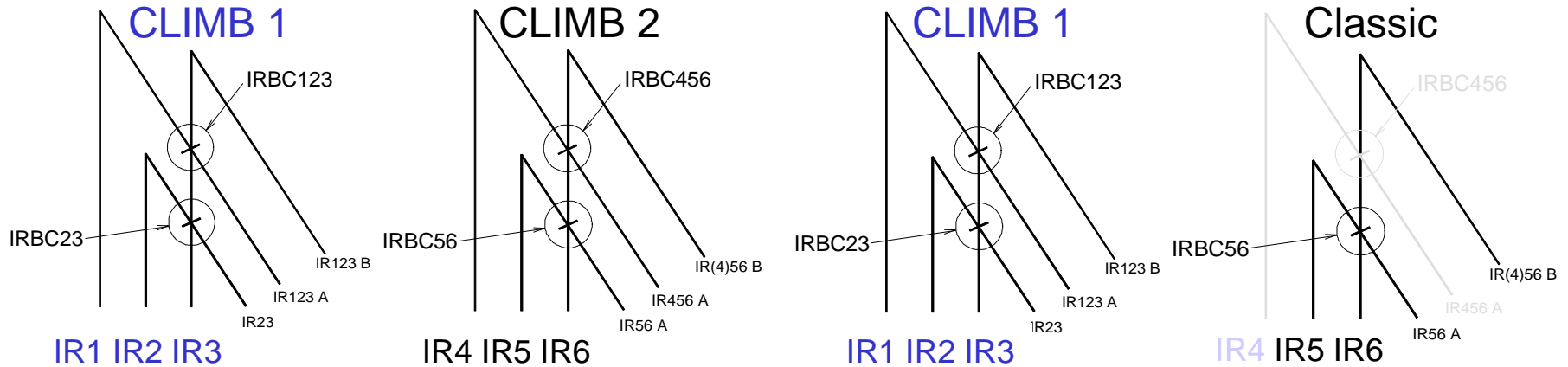


CLASSIC



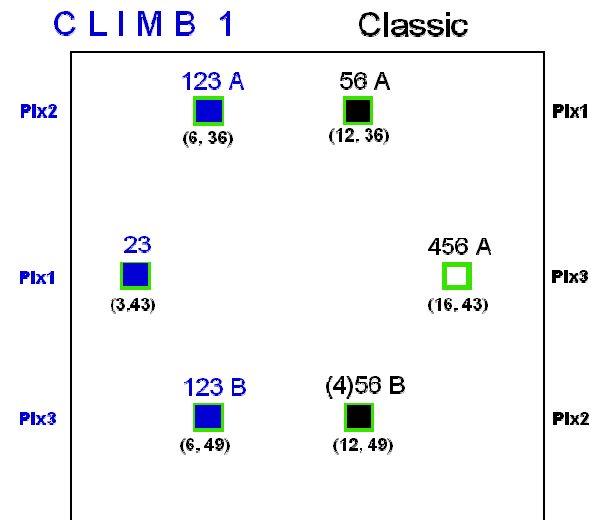
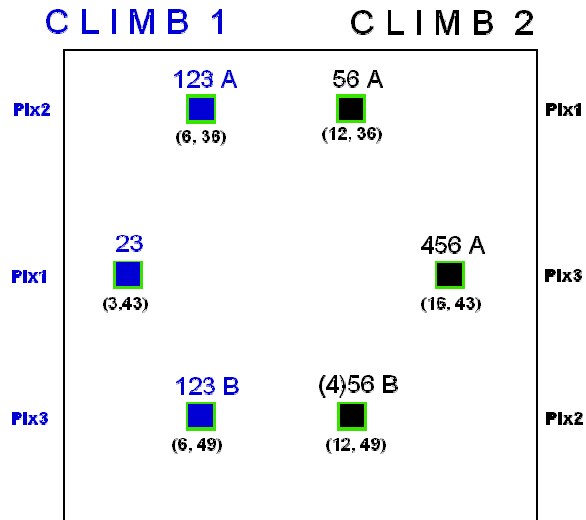


# CLIMB Outputs on Detector Pixels



As of January 25, 2012

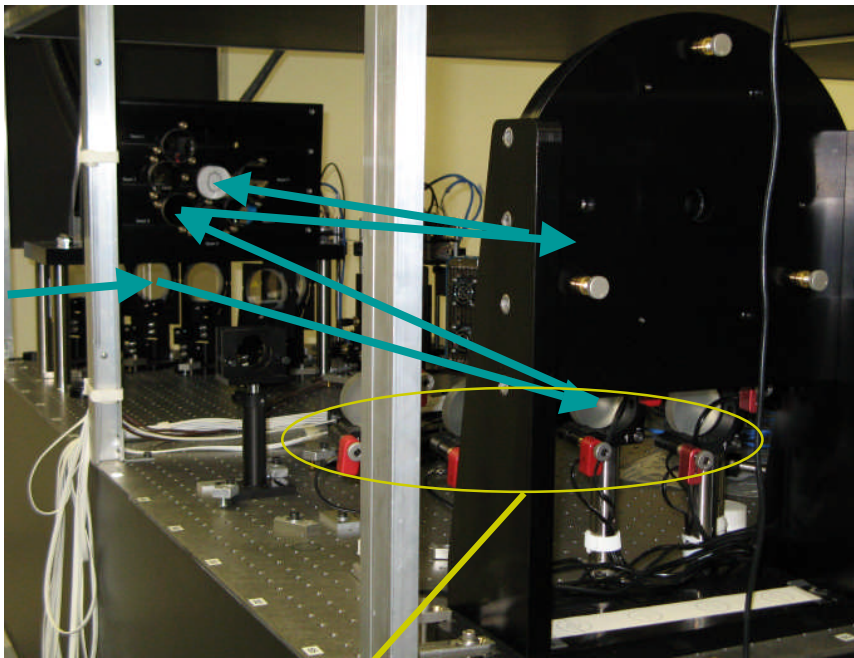
As of January 25, 2012





# Tip/tilt Detection System

Picture taken in 2007,  
when 6-beam tip/tilt was first installed



Remotely controlled adjustments using  
open loop pico-motors.

- Tip/tilt detection is in the VIS band – many combiners in IR
- There is angular difference between IR and VIS beams depending on elevation → IR star image changes position on IR detectors

- If you try adjust the tip/tilt beam to keep the IR image, tip/tilt could loose the star easily
- Once a beam is lost from the designated four pixels, the pico-motors cannot take it back

The field of view of a quad-pixel  
on the tip/tilt detector is 7 arcsecs  
(Acquisition ~ 3 arc minutes)

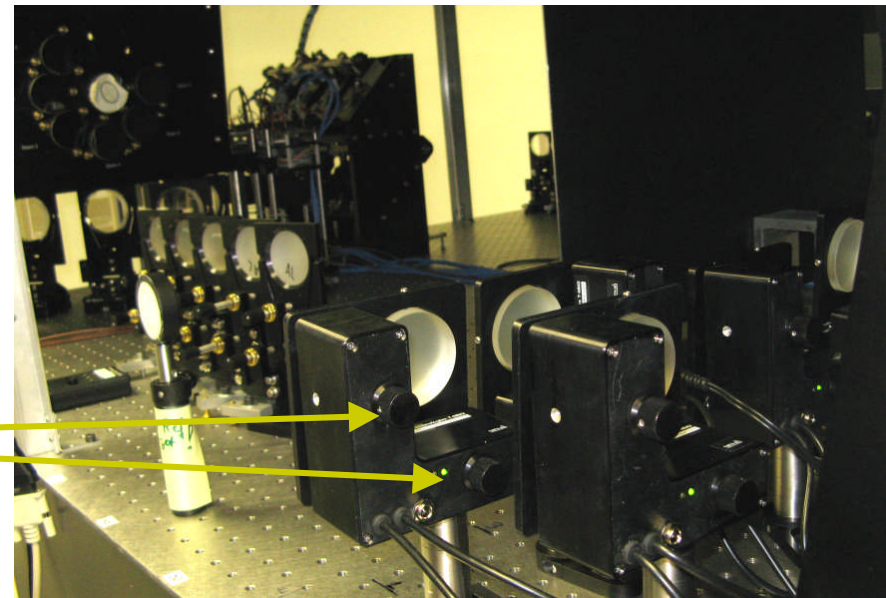


# Tip/tilt Detection System

## Upgraded

Picture taken in 2012

Mirror mounts were replaced with mounts with encoded actuators. (Zaber)







# New User Interface to Adjust Tip/Tilt Beams

“Zaber 2” is for Tip/tilt and runs on the GPS computer.

Positions for each mirror in the configuration file

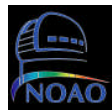
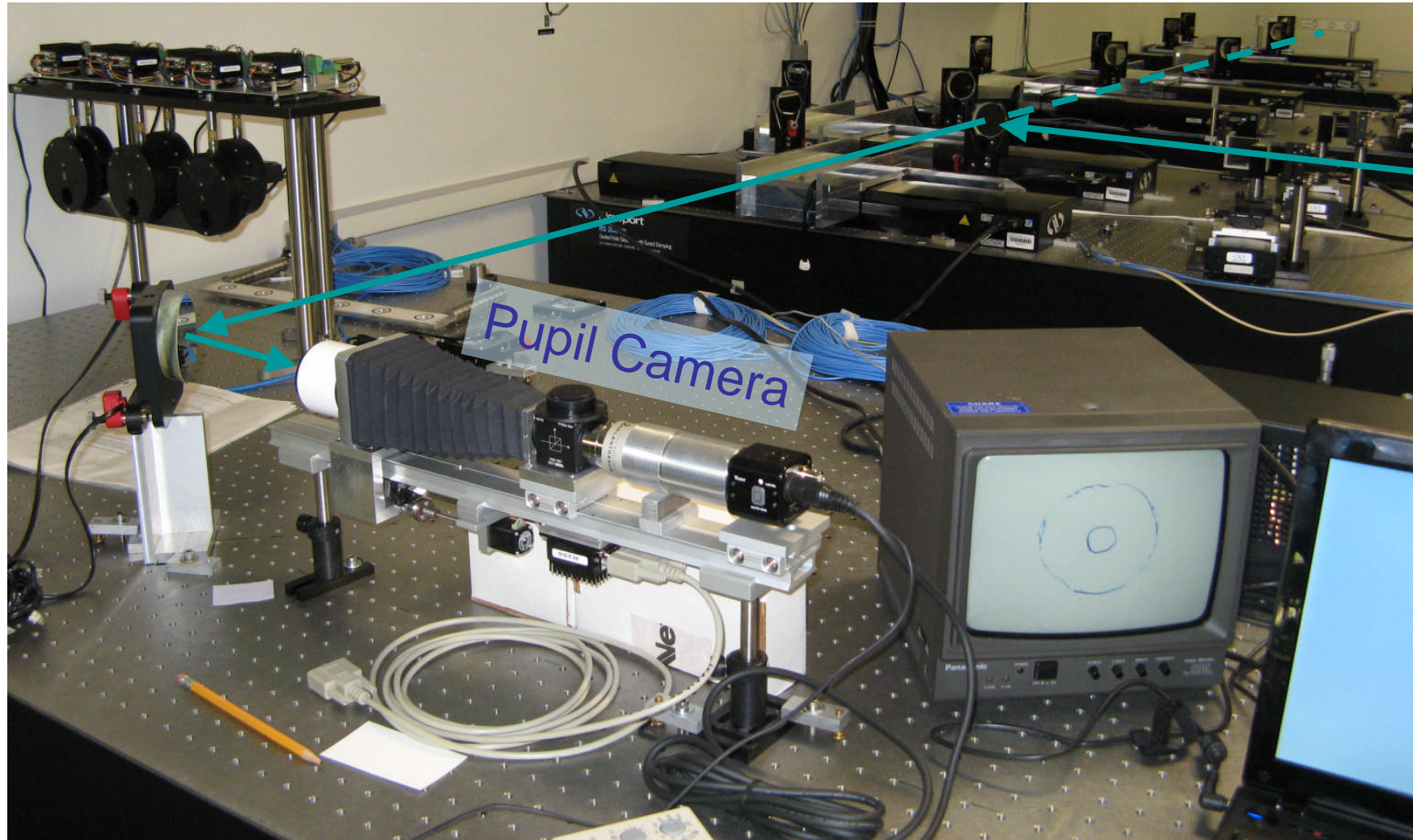
The screenshot shows a graphical user interface for the ZABER\_2 system. On the left is a vertical menu with the following items: Servers-2, Pico Controllers, Zaber Controllers (highlighted), ESP Controllers, Telescope GUIs, Telescope Monitor, GTKs, Cosmic Debris, Socket Manager, and Power. A sub-menu for 'Zaber Controllers' is open, showing 'Zaber 1' and 'Zaber 2'. The main window is titled 'ZABER\_2' and contains a control panel with the following elements:

- Buttons for 'MAIN', 'TT\_B1', 'TT\_B2', 'TT\_B3', 'TT\_B4', 'TT\_B5', and 'TT\_B6'.
- Current position values: X = -1468 and Y = -42860.
- Control buttons: LEFT, SETPOS (highlighted with a red box), HOME, RIGHT, SMALLER, DOWN, and BIGGER.
- Step indicator: Step 10.
- Configuration values: SSPX -1468 and SSPY -42860 (highlighted with a red box).
- Bottom row of buttons: PING, REOPEN, COMMS, FLUSH, INIT, and QUIT.

Red arrows point from the 'SETPOS' button to the X and Y position values. A red line points from the text 'Positions for each mirror in the configuration file' to the SSPX and SSPY values.



# Checking Pupil Motion





# Checking Pupil Motion

## Findings:

- Telescope moving in EL or AZ → pupil motion is small ( $< 10\%$  of diameter), if the Coude alignment is within the usual tolerance (laser spot moves  $< 25$  pixels in Acquisition TV)
- Cart is moving on the rail → Rail trouble spots could cause significant pupil motion.



It is possible to keep the rails well aligned with some adjustments a few times a year, except the front part between the periscope and home sensor.

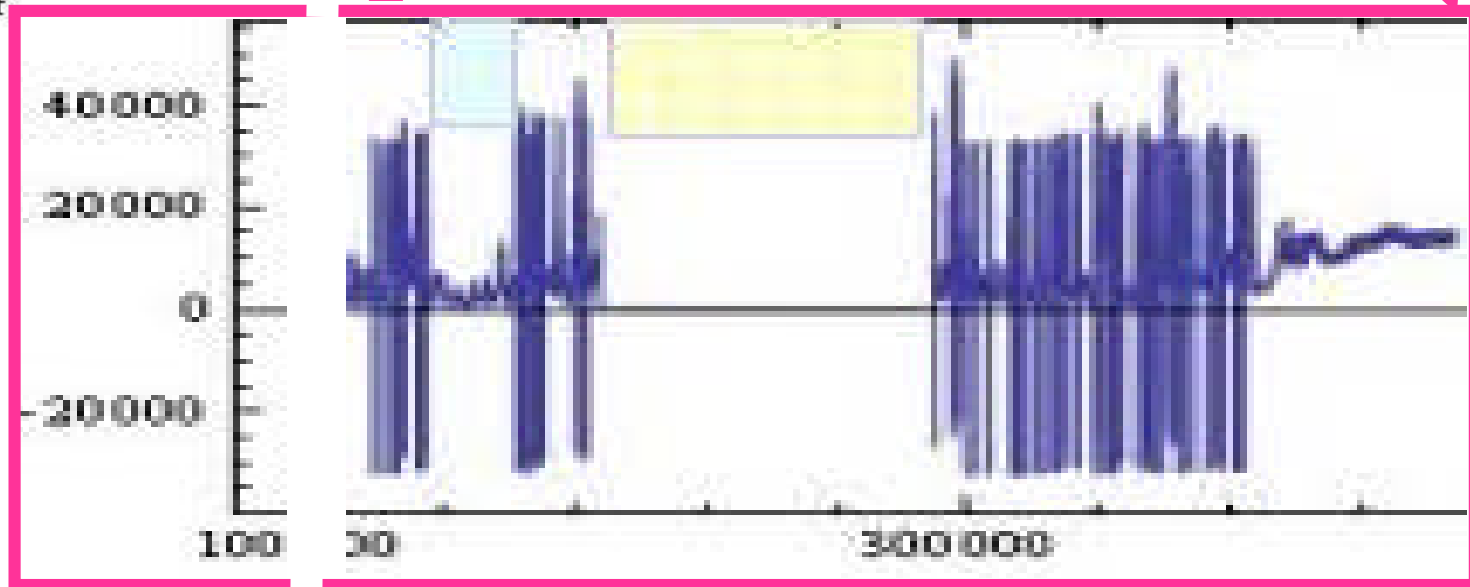
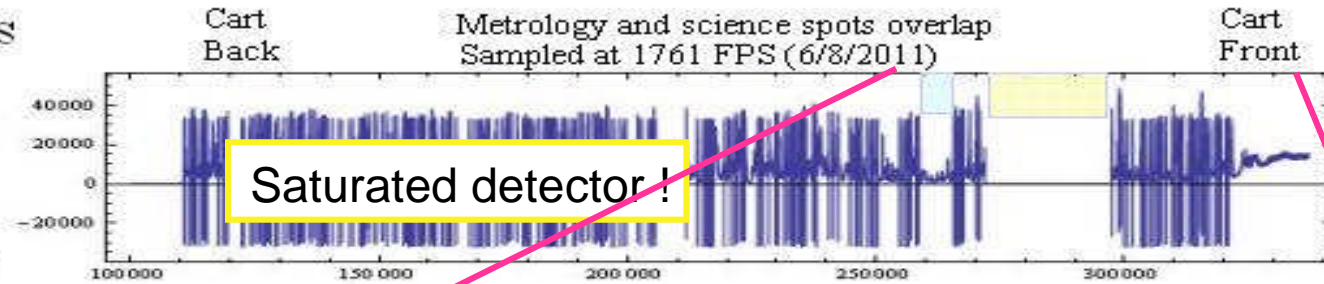




# Metrology Laser: $\lambda=1319\text{nm}$ Kills J-Band Observations

J Band Counts  
in CLIMB  
Pixel 2

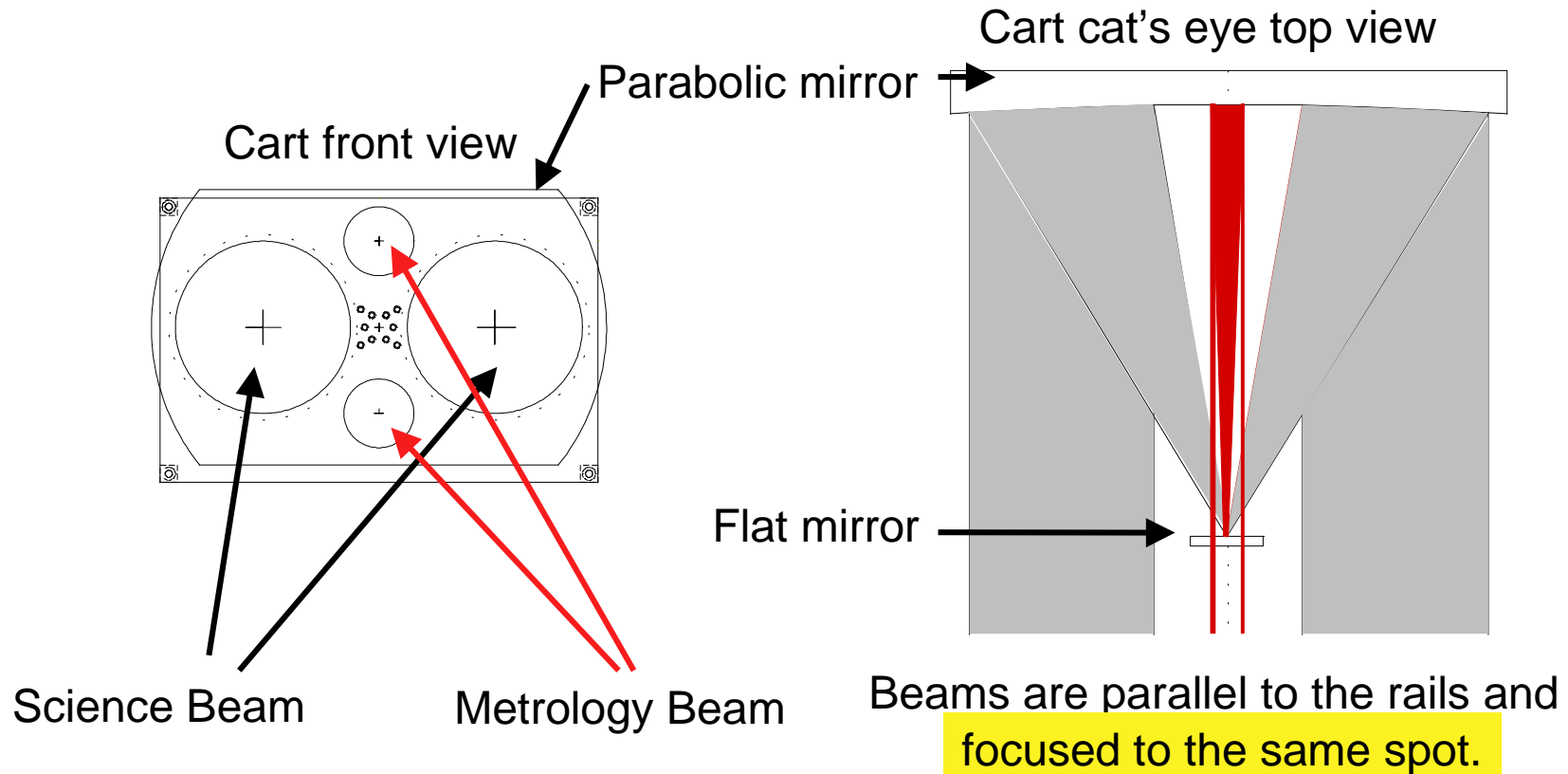
 IR shutter closed  
 Metrology off





# Metrology Laser: $\lambda=1319\text{nm}$ Kills J-Band Observations

Original arrangement of metrology and science beams



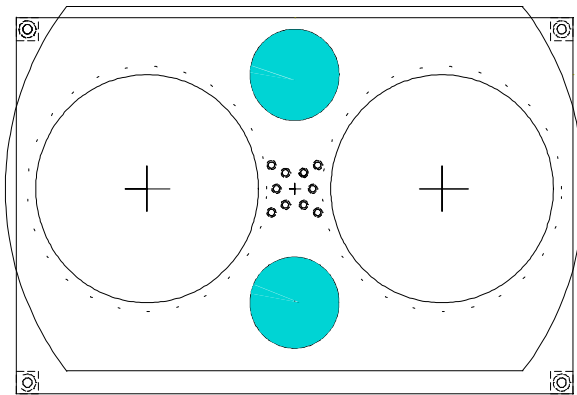


# Changing the Metrology Path Inside the Cart

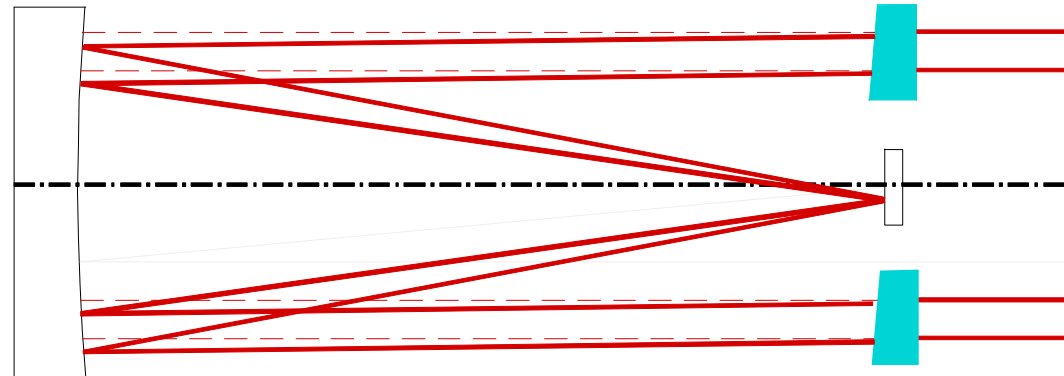
Modified metrology beam path:

The metrology beam enters and exits the cart through a slight wedge.

Cart front view



Cart cat's eye side view



The metrology beam is focused to a different spot on the flat mirror.

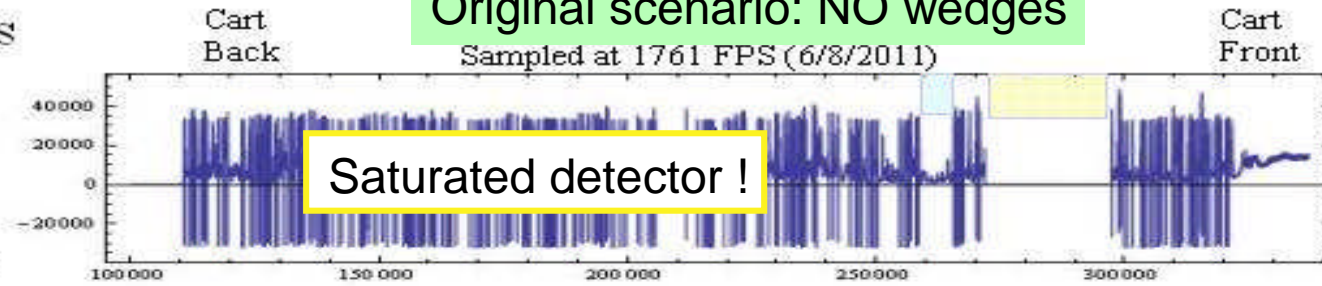


# Greatly Reduced Counts With Test Wedges

J Band Counts  
in CLIMB  
Pixel 2

Original scenario: NO wedges

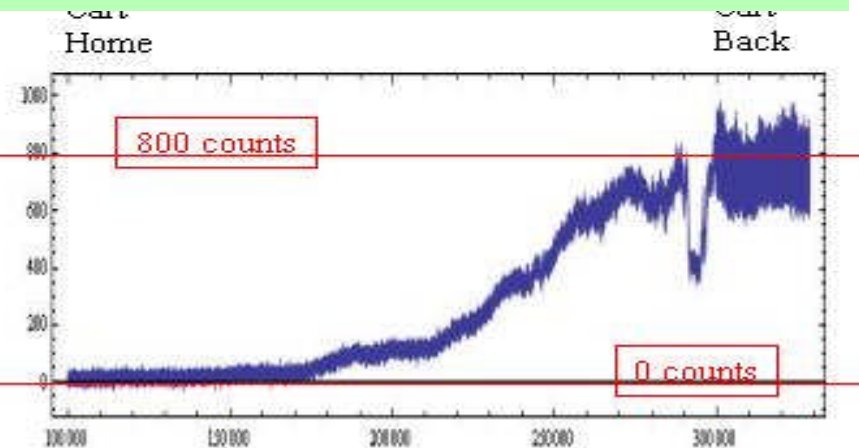
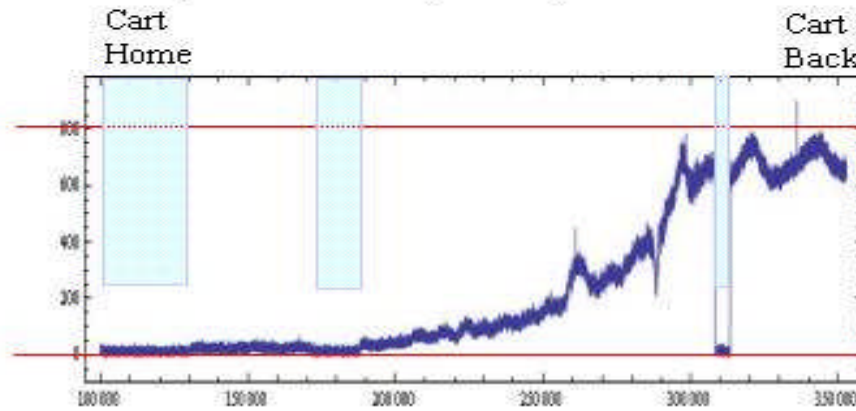
Sampled at 1761 FPS (6/8/2011)



- IR shutter closed
- Metrology off

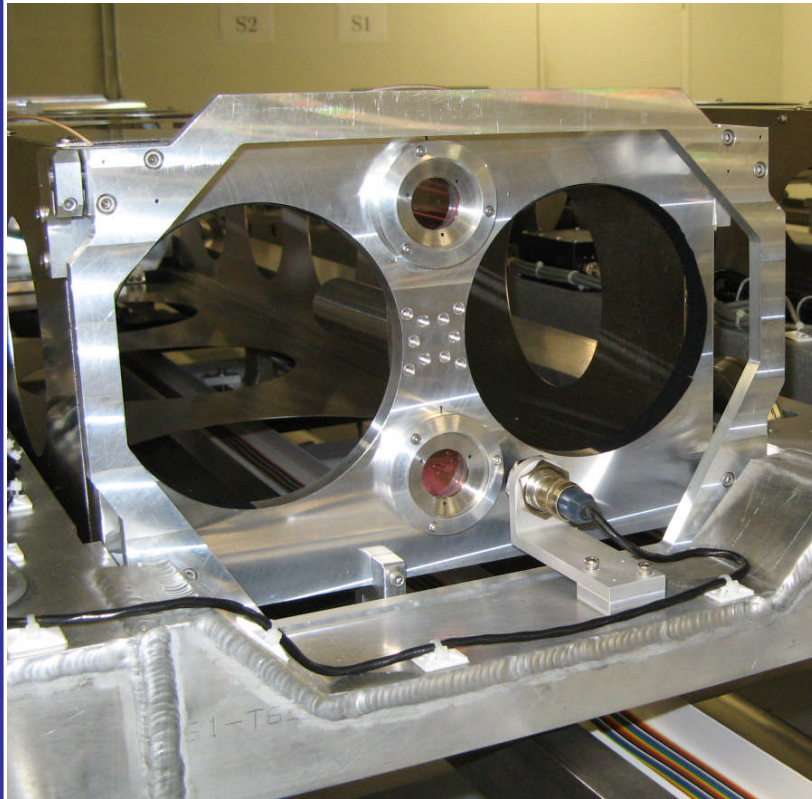
Using the wedges eliminated the main source of metrology light leak.  
Counts down from over 32000 to max 800

Metrology spot vertically displaced  
Sampled at 480 FPS (6/8/2011)





# Custom Wedges Installed at W2



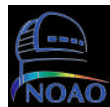
- Science and metrology beam spots are now ~ 5 mm apart on cart secondary.
- AR coating on wedges optimized at 1319 nm. Wedges produced by ARW Optical Co.
- Wedge mount  
Design by Laszlo Sturmman  
Fabricated at GSU Machine Shop





# Experiments with Custom Wedge

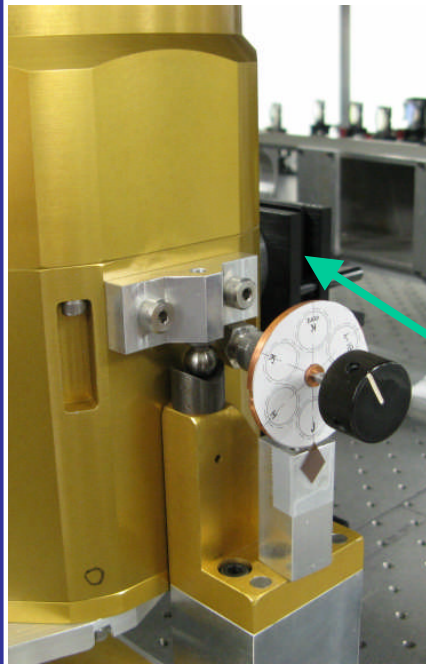
- No detectable counts in NIRO above the noise in J band when the metrology is ON, and the cart is closer than 20 m to the Home sensor.
- Counts gradually increase as the cart moves toward the back.
- Masking cannot eliminate the counts seen when the cart is at the back of the rail.



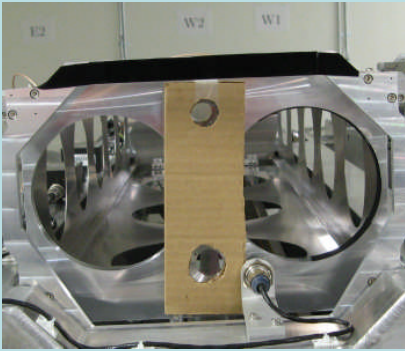


# Testing with ND filters


Cart is at 45 m in all pictures, NIRO read at 618 Hz, CLIMB 1 was aligned (W1,W2,E2) with WL source, Corner cubes out Met OFF → Lab background  $-50 < \text{Counts} < 50$



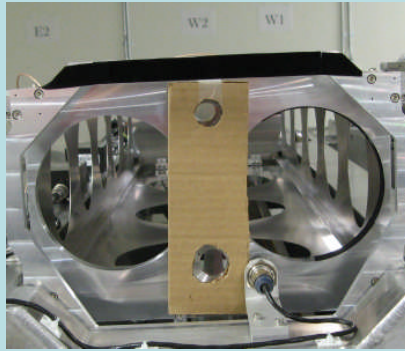
**NO ND** filter at camera window.



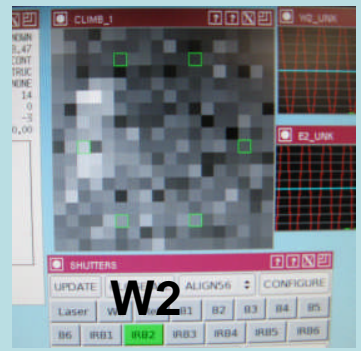
~ 77  
~266  
~ 41



**ND = 2** filter at camera window.



~ 0  
~14  
~ -3





# Options in J-band

- *Wedge + Masking + OD  $\geq$  2 Notch Filter*

*Not ideal, but fastest solution*

*loosing otherwise usable photons,  
narrow one may be doable at reasonable cost.*

- *Wedge + Fixing the metrology “Black Box” for better beam quality*
- *Wedge + Lowering metrology beam power*
- *Finding a different  $\lambda$  for metrology outside science bands*

*The End*

