Developments in the CHARA Lab

Array-wide and CLIMB update since the 2009 meeting in Nice

Judit Sturmann

Outline

- Changes on the CHARA VIS table
- Choice of tip-tilt beam splitters
- Variable apertures for IR beams
- CLIMB news
- Plans

The CHARA VIS Beam Combiner

Important functions:

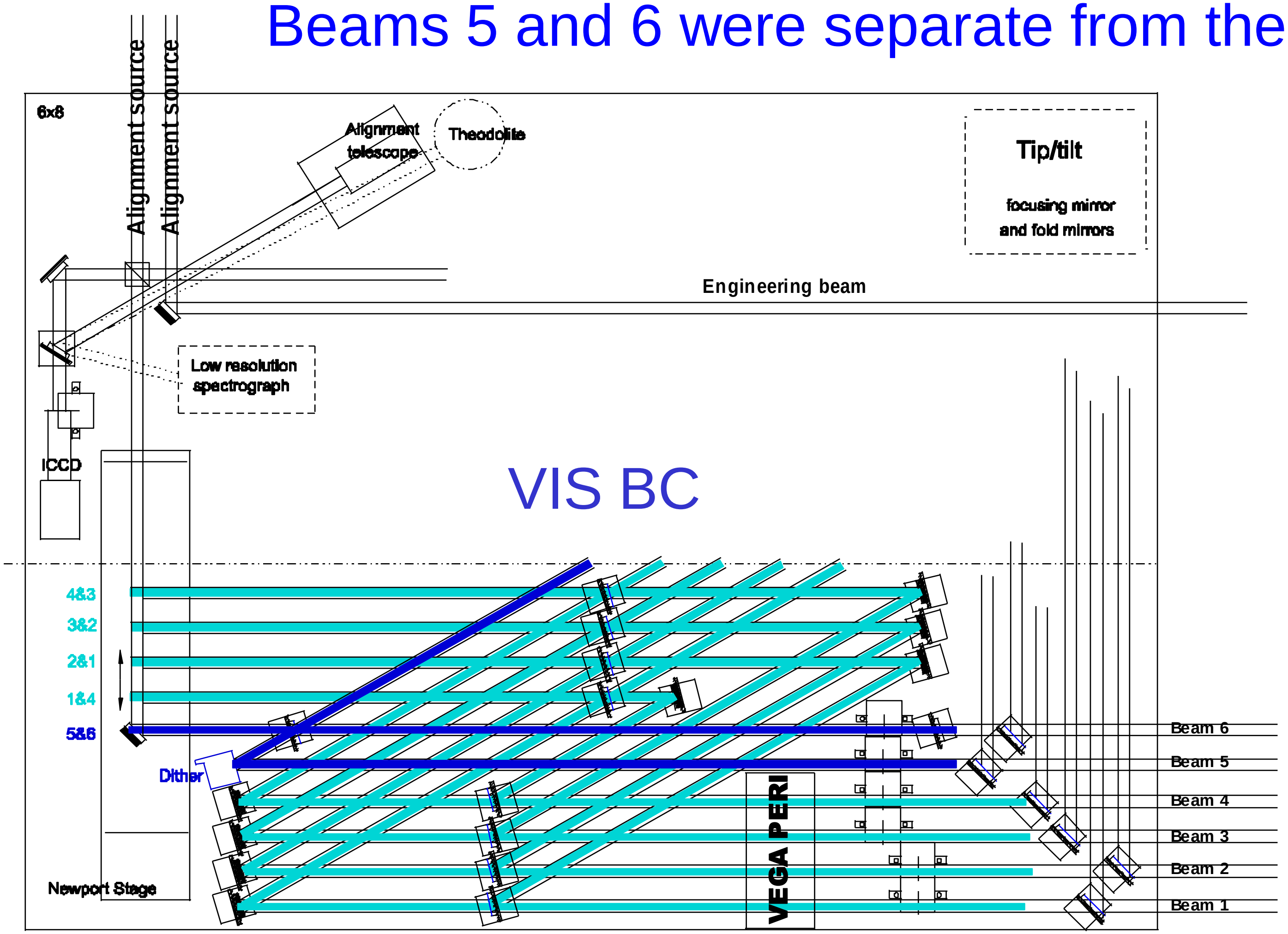
- Sends laser and white light alignment beams from the lab all the way to the telescopes

- Serves as the Array's phase reference

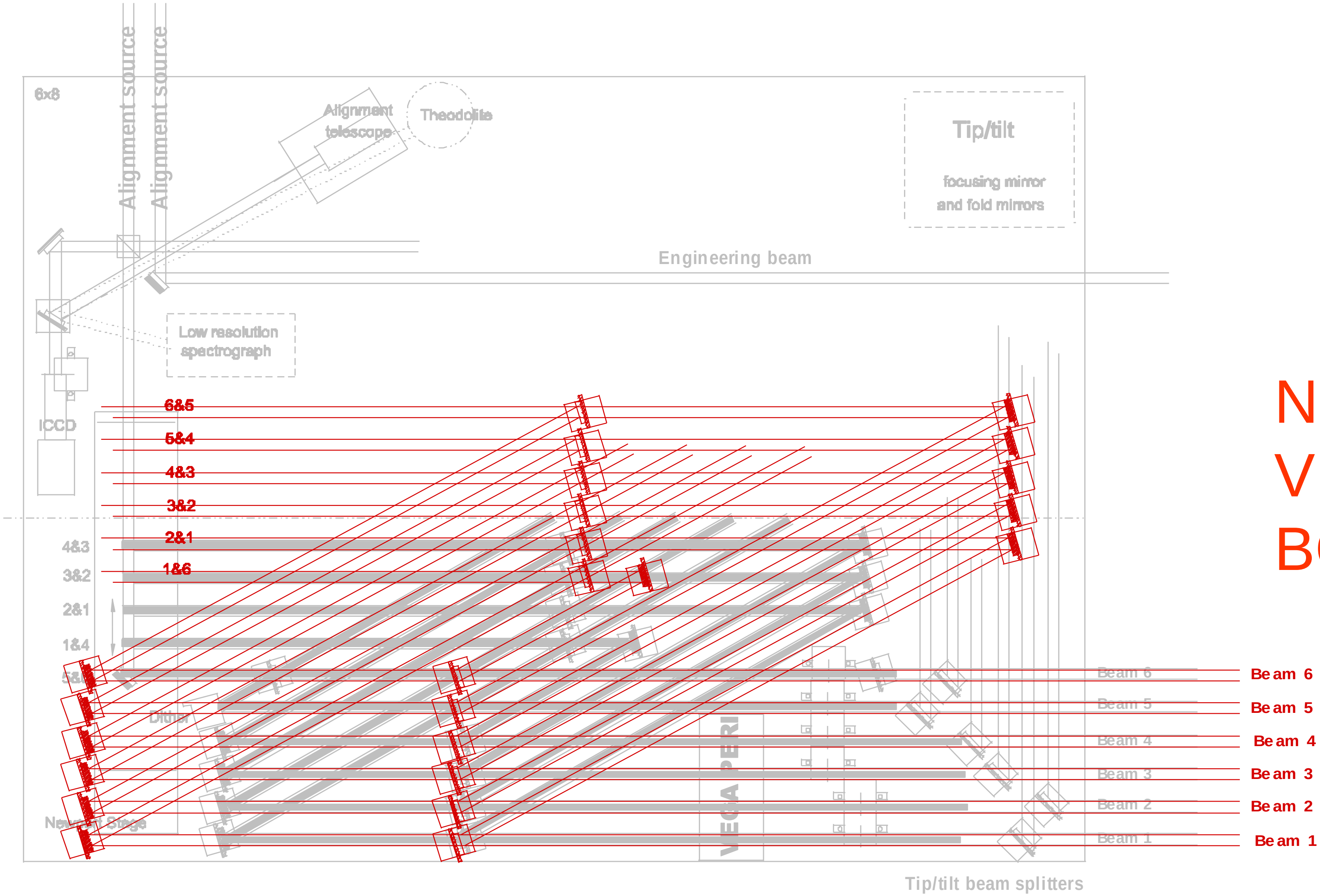
→ ***Now complete, as designed***

The VIS Table Before

Beams 5 and 6 were separate from the rest

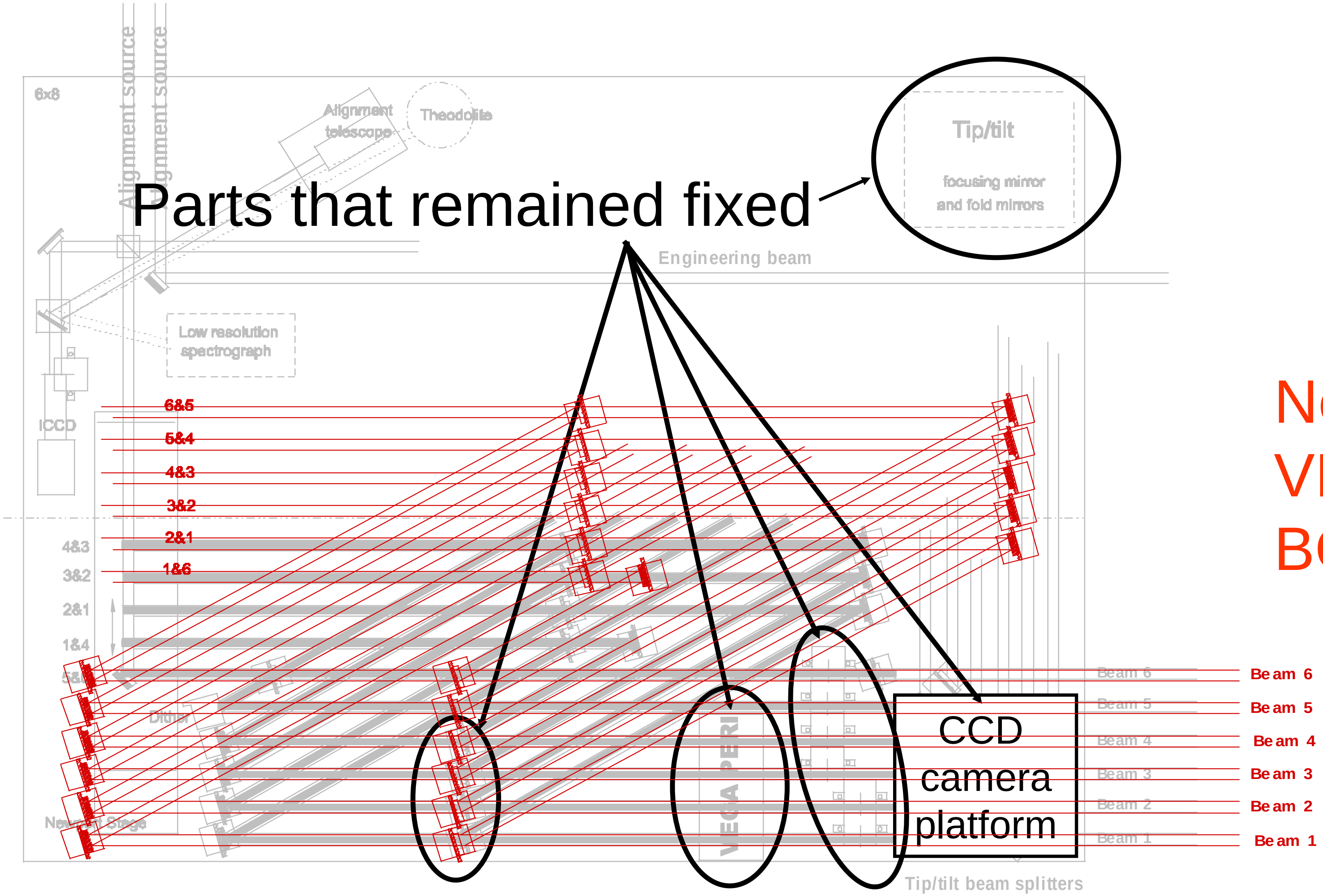


The VIS Table Before



New VIS BC

The VIS Table Before



New VIS BC

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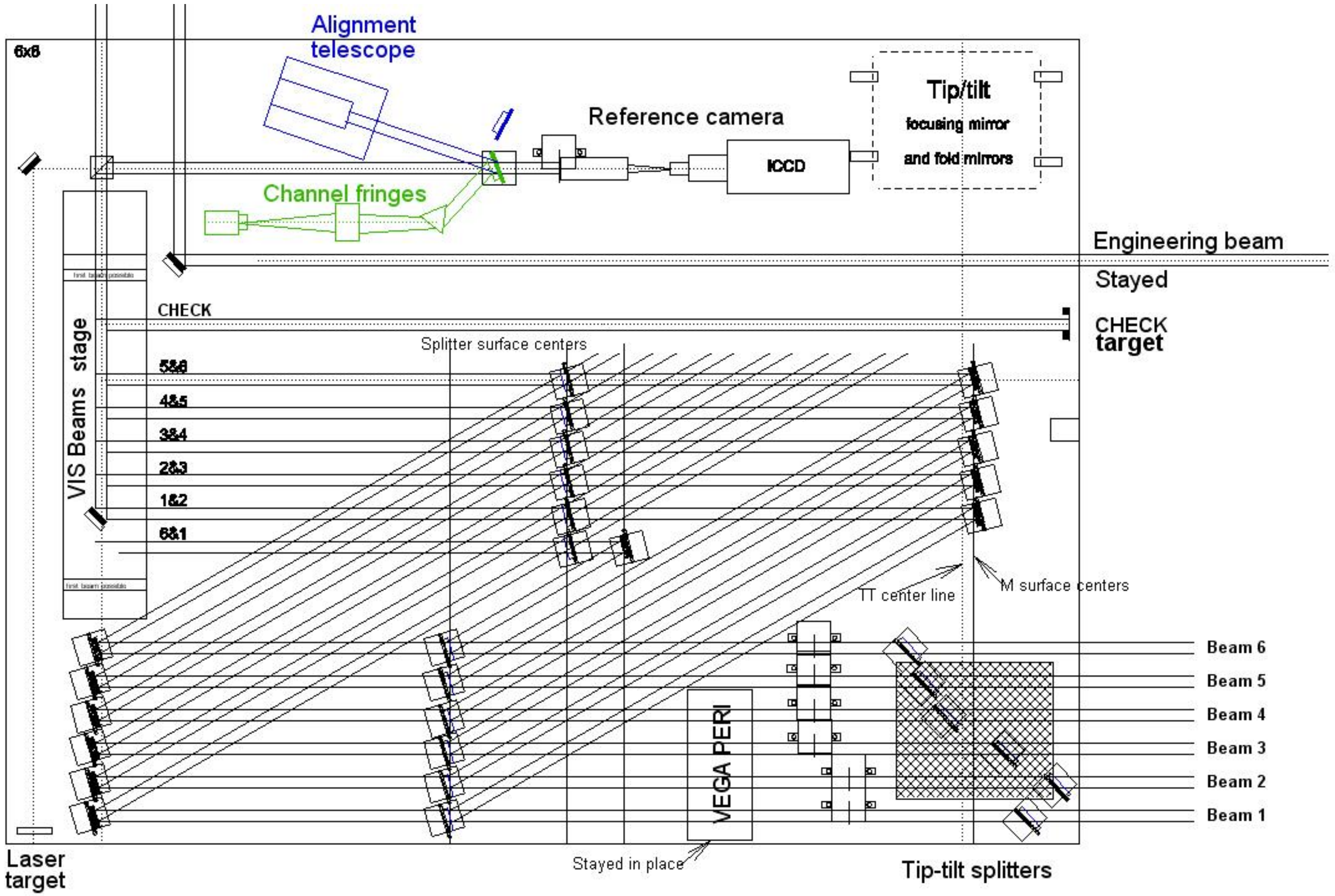
The VIS table Now



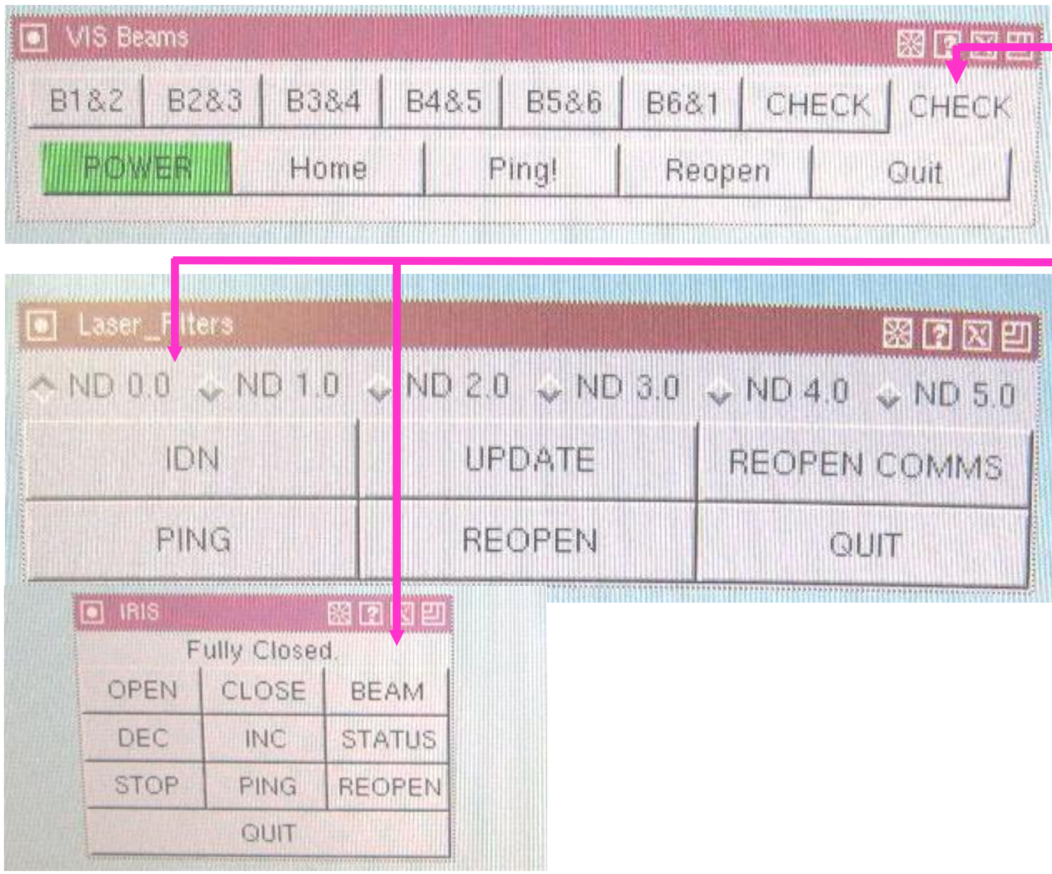
Changes Due to the New Arrangement

- Modified laser alignment check

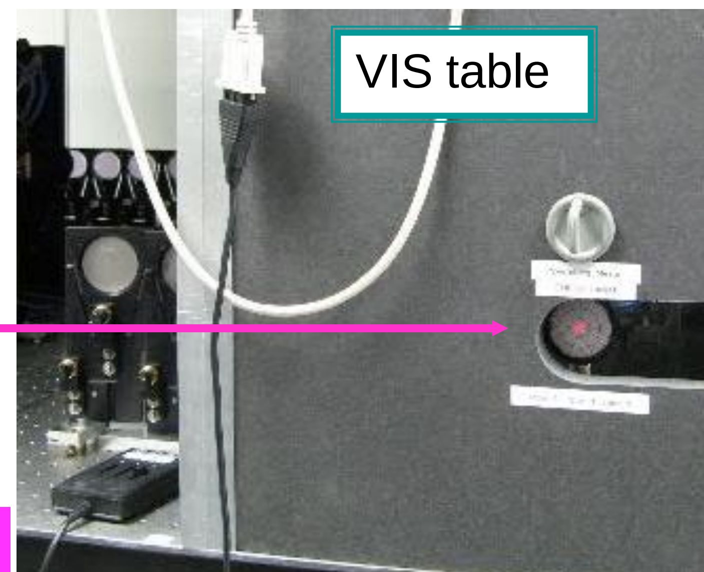
- New place for the alignment scope
- New place for reference camera
- New place for spectrograph to see channel fringes

- New positions for internal channel fringes

Modified Routine Before Using the Alignment Laser



1. VIS Beams to CHECK
2. Select best ND and IRIS size
3. Look at "CHECK" target, use Pico3 to adjust "CHECK" mirror if necessary



4. Proceed as before: target E1 table ...

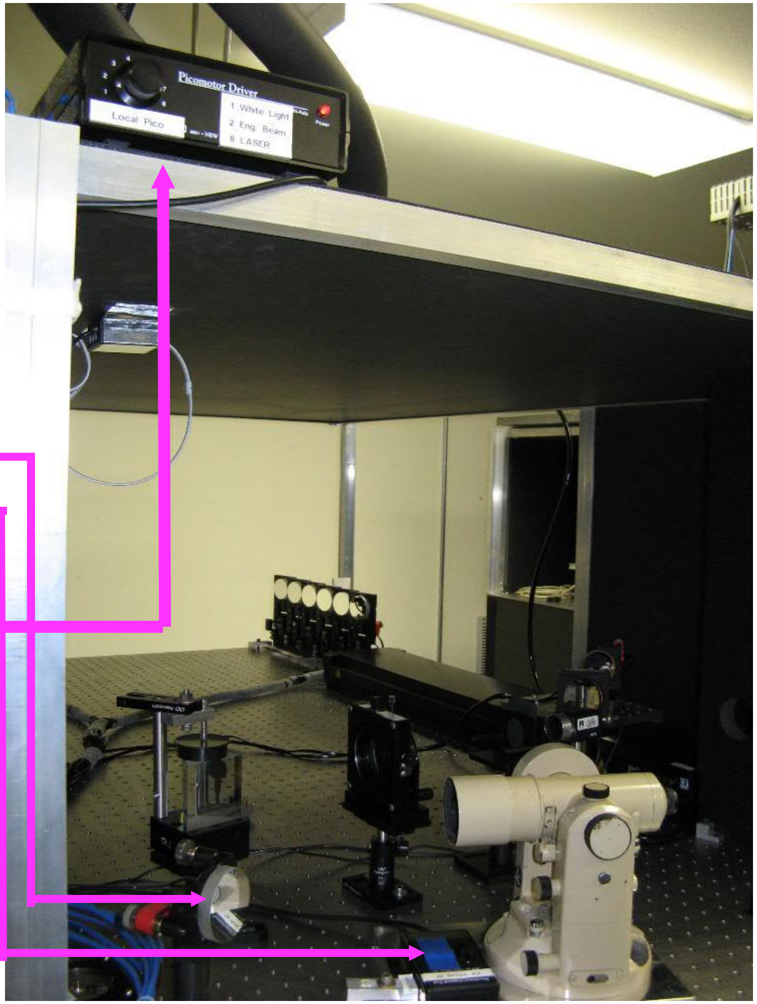
The Alignment Scope

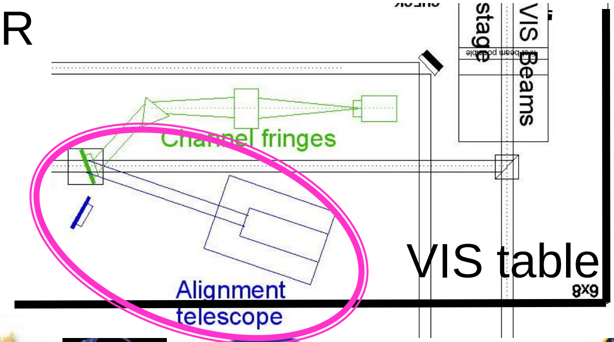
This scope is routinely used for checking the overlap of laser and white light alignment beams.

Alignment beams have to be retro reflected to reach it.

Fold mirror to place on the kinematic base
Paddle to move the image horizontally

Pico controller “Local Pico” to move white light source beam. WL = position 1
Look for the OTHER paddle labeled: “Local Pico”



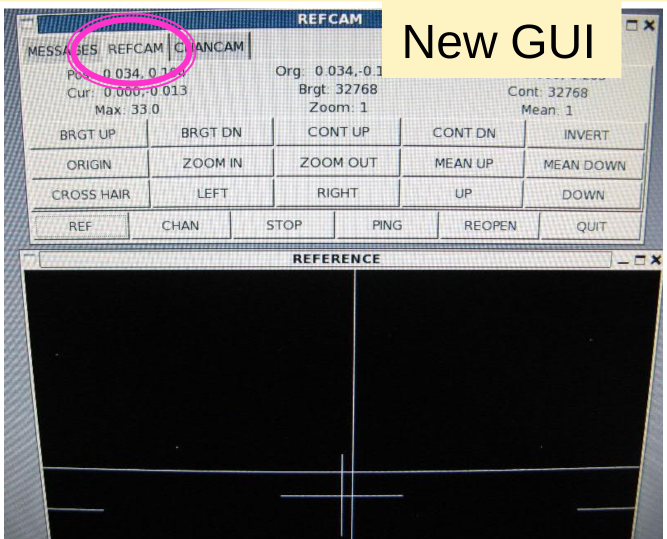


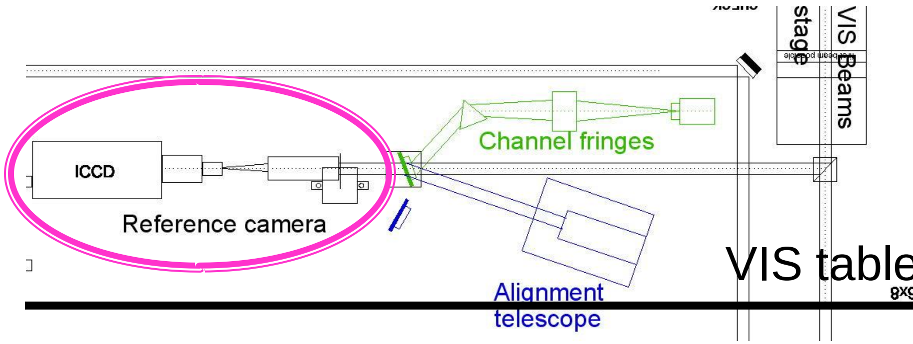
The Reference Camera

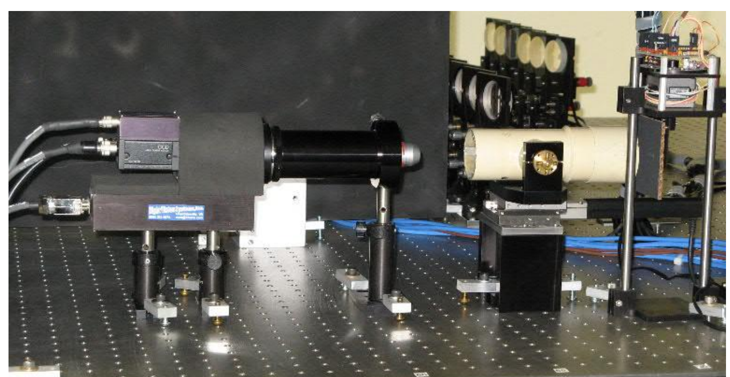
The RefCam detector is an intensified CCD. The camera can be remotely focused along the beam paths from infinity to targets within the BC lab.

It is most frequently used to maintain the correct beam path in the vacuum pipes by checking pop and M10 alignment LEDs,
they are in focus at ~ 6 mm on Esp controller: BC2, RefCam stage.

Before use, make sure that the path is clear in front of it, and the new REFCAM server is running on OPLE comp.

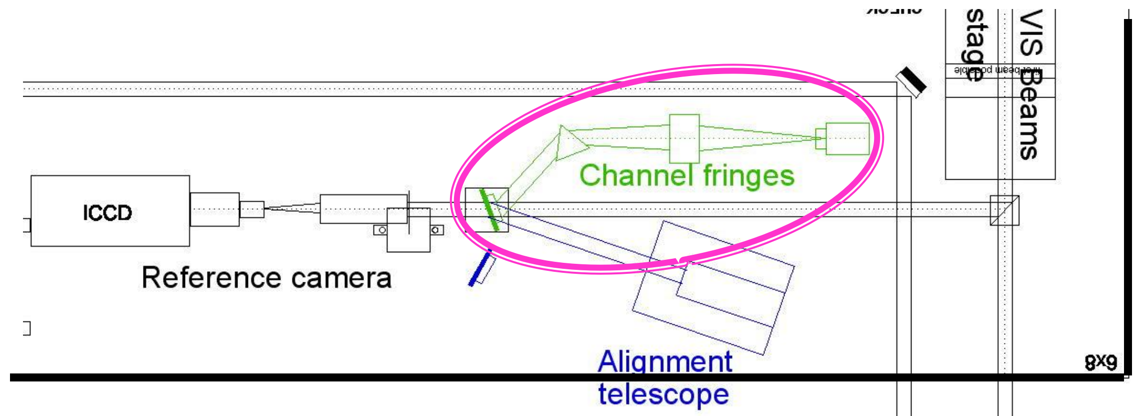






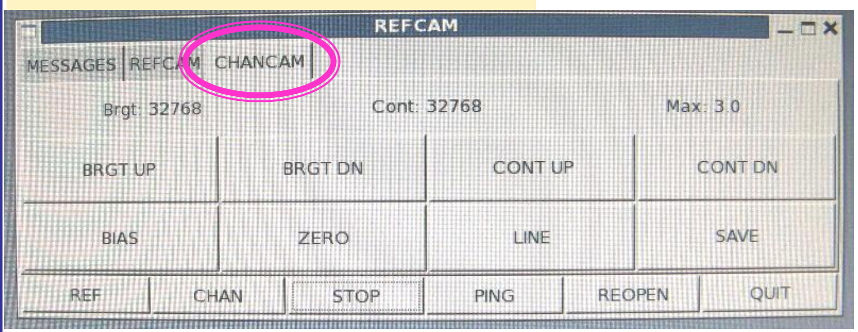
The Low Resolution Spectrograph for Finding Channel Fringes

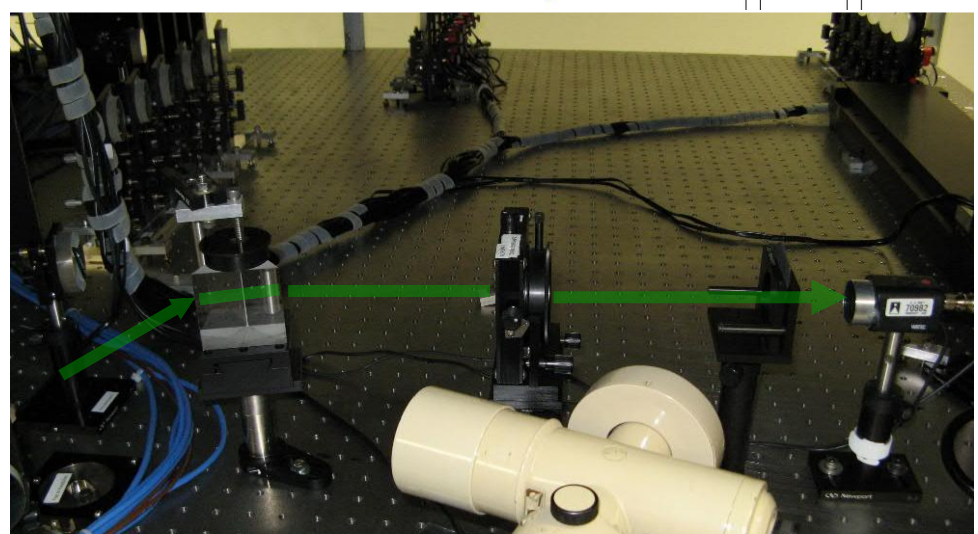
Before use, it's fold mirror has to go onto the kinematic base. The channel fringes are imaged onto a video camera.



REFCAM server on OPLE computer has to be running, to see the image.

GUI to run CHANCAM:



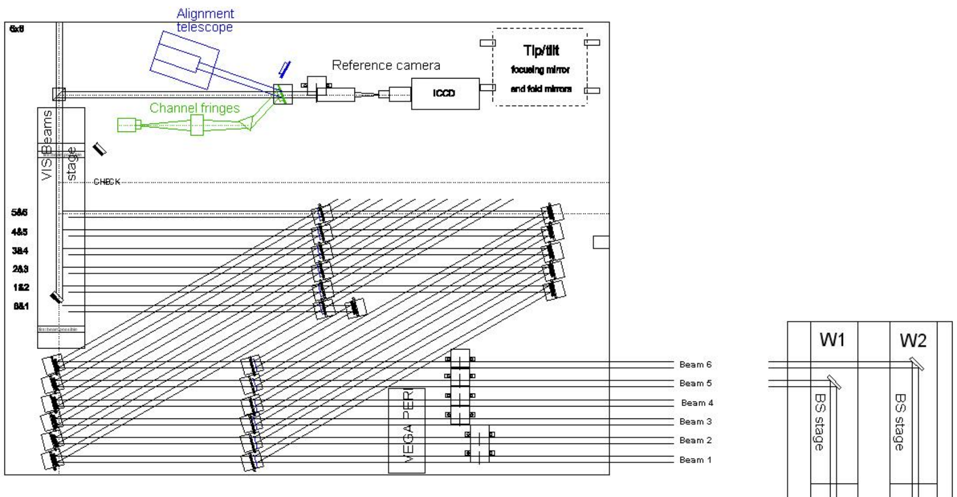


VIS BC Zero OPD Positions

Comparison Between Pairs Based on Internal Channel Fringes

Your offsets changed!

Pairs of consecutive beams were retro reflected from the W table



“RETRO” on encoded translation stage

2008

Beams	RETRO **before** [mm]		
1 & 2	8.384		
2 & 3	5.603		
3 & 4	6.842		
4 & 5	N/A		
5 & 6	7.507		

CLASSIC 5-6 was phased with this

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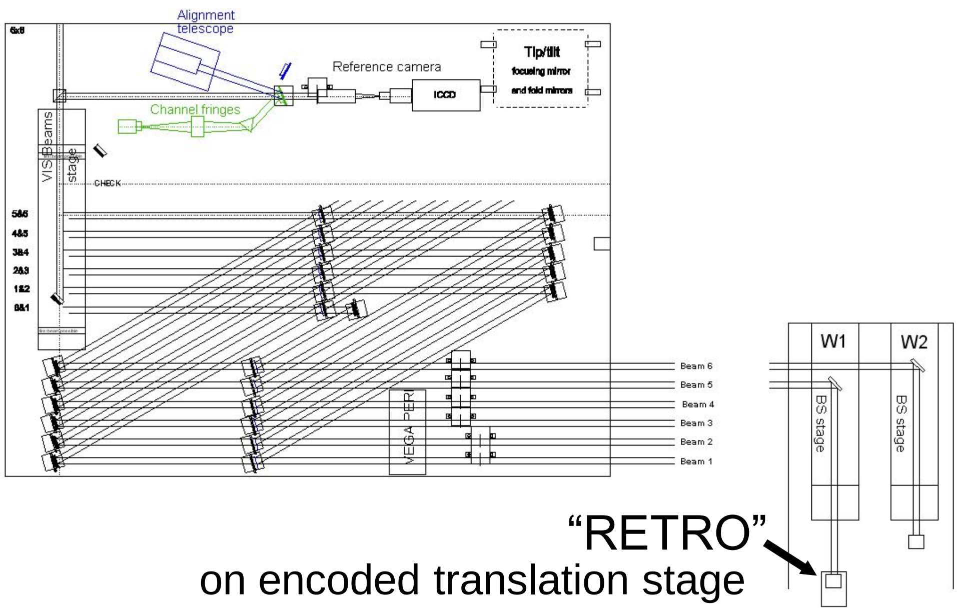


"RETRO" on encoded translation stage

	2008	2010	
Beams	RETRO **before** [mm]	RETRO new [mm]	Δ to 1&2 [mm]
1 & 2	8.384	5.024	0
2 & 3	5.603	5.940	0.916
3 & 4	6.842	5.375	0.351
4 & 5	N/A	5.841	0.817
5 & 6	7.507	5.720	0.696

CLASSIC 5-6 was phased with this

Your offsets changed!

Tip-Tilt Beam Splitters

Two sets of 6 pieces are at hand

- 50 – 50 % gray split
- R~13 % to tip-tilt, gray split →more light downstream to VEGA

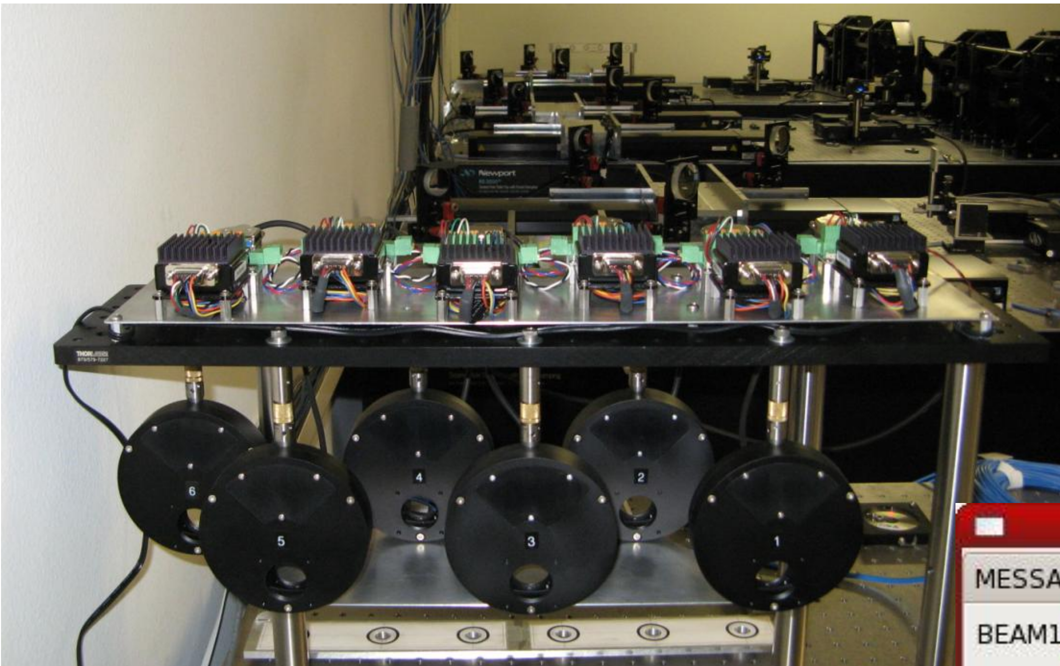
The second set provided by the VEGA group is free of polarization problems unlike the other set.

In beams 1,2,3, and 4:
Modified flex mounts on kinematic bases were installed →both choices are available to use.

In beams 5 and 6:
Only 50-50 can be used for now.

Changing splitters requires alignment check / small adjustments, ~10 minutes time.

The IR Aperture Wheels



An aperture wheel (Thorlabs) is installed in each infrared beams before they enter the beam combination area.

The aperture switching is remotely controlled.

(Control electronics by Laszlo, user interface by Theo.)

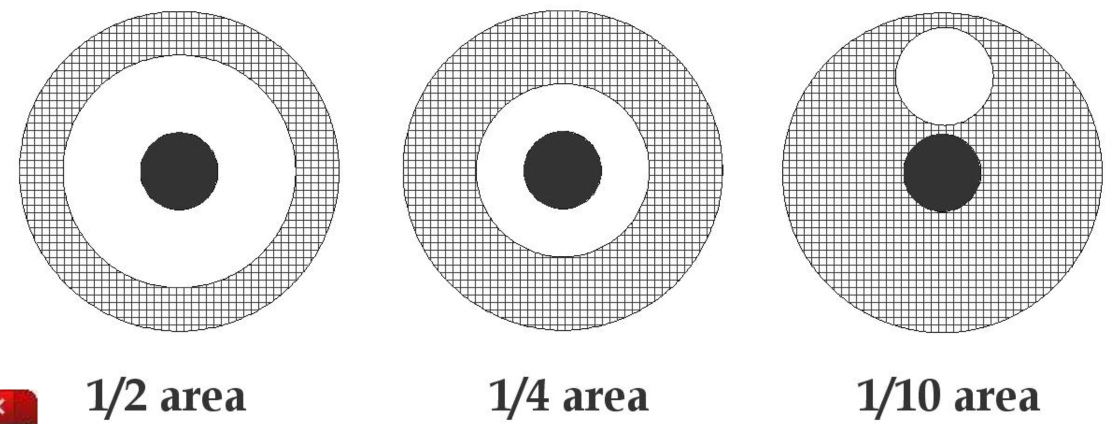
The IR flux can be cut to be a fraction of the full beam:

1 / 2
1 / 4
1 / 10

The IR Aperture Wheels

The apertures are well aligned to the proper IR beam paths, the user only needs to click on the GUI to select an aperture.

Projections of available apertures to the primary mirror



In place of the filters there are stainless steel masks in the wheels:
14 mm, 10.6 mm, and 7.6 mm in diameter

Masks were machined by Laszlo.

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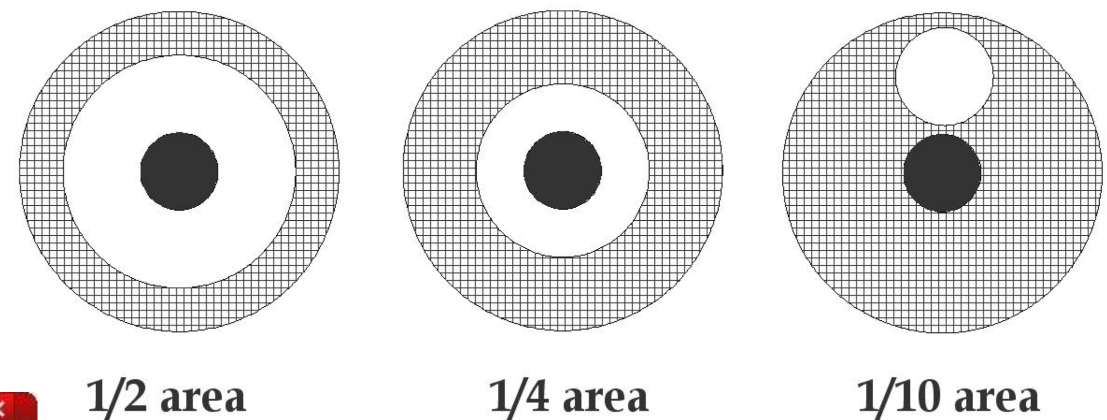
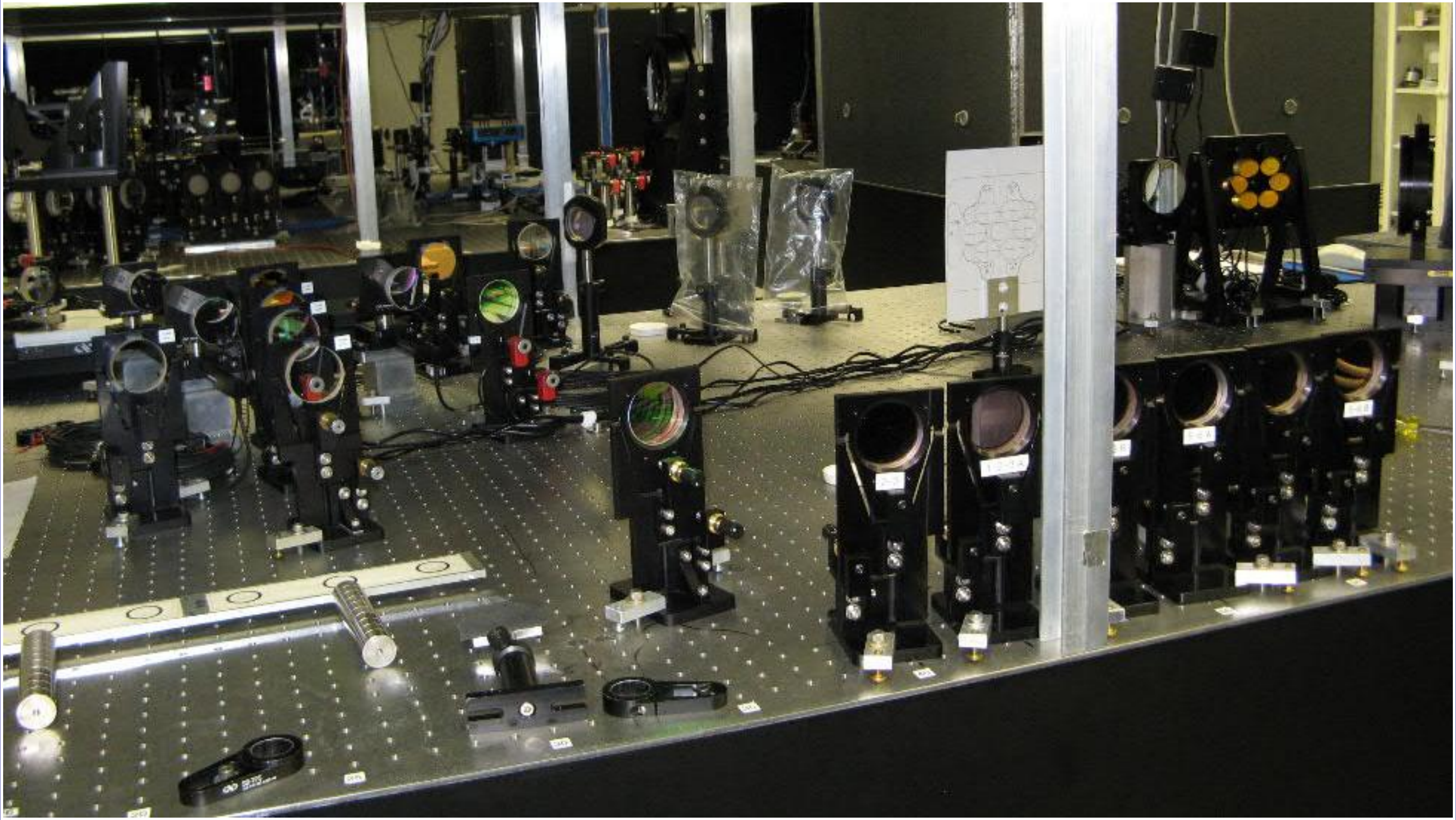


CAUTION:

• Before the night, the usual IR beam alignment check has to be done with the wheel in OPEN position.

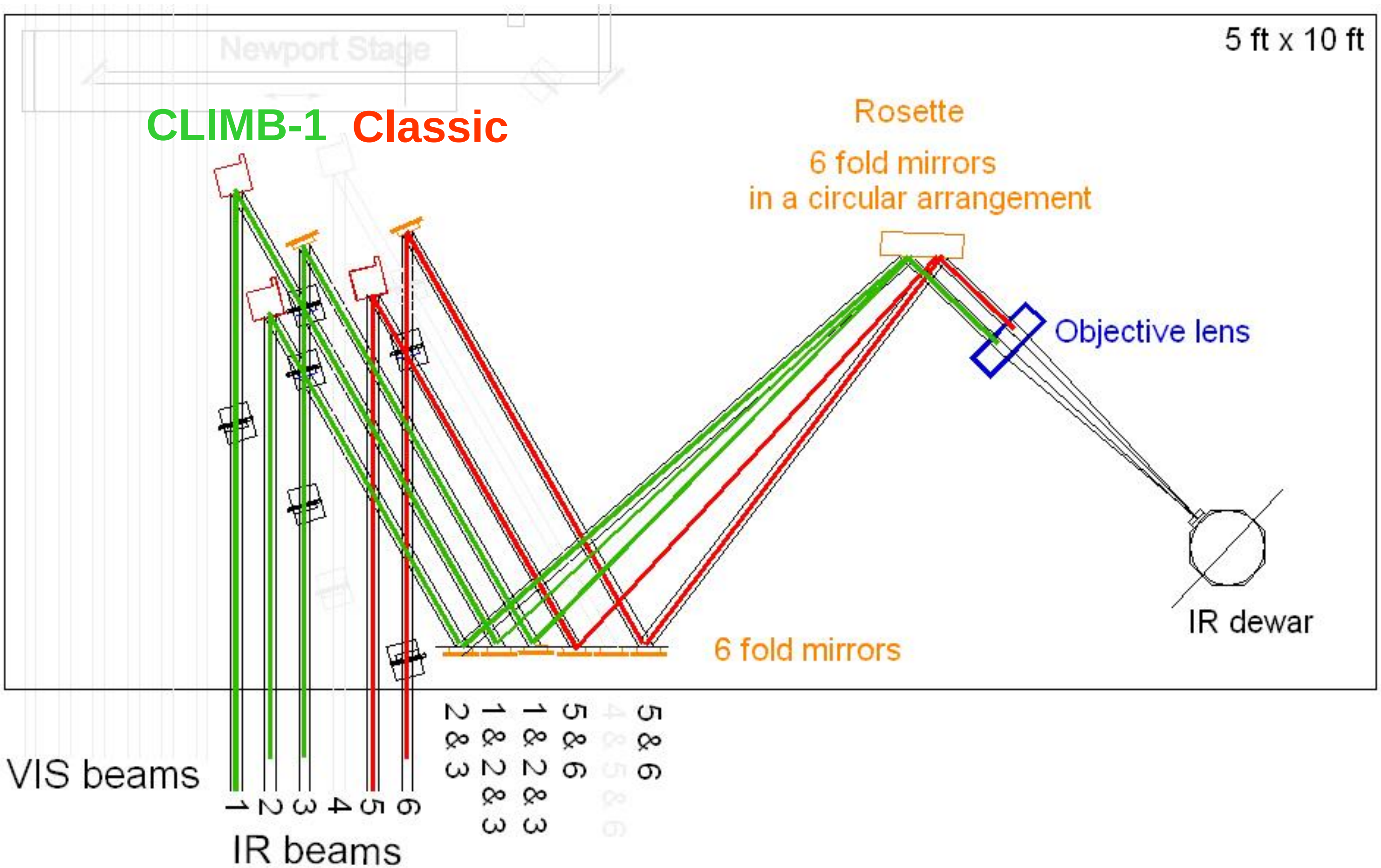
• After selecting a different reduced aperture, NIRO spots better be checked.

CLIMB and Classic



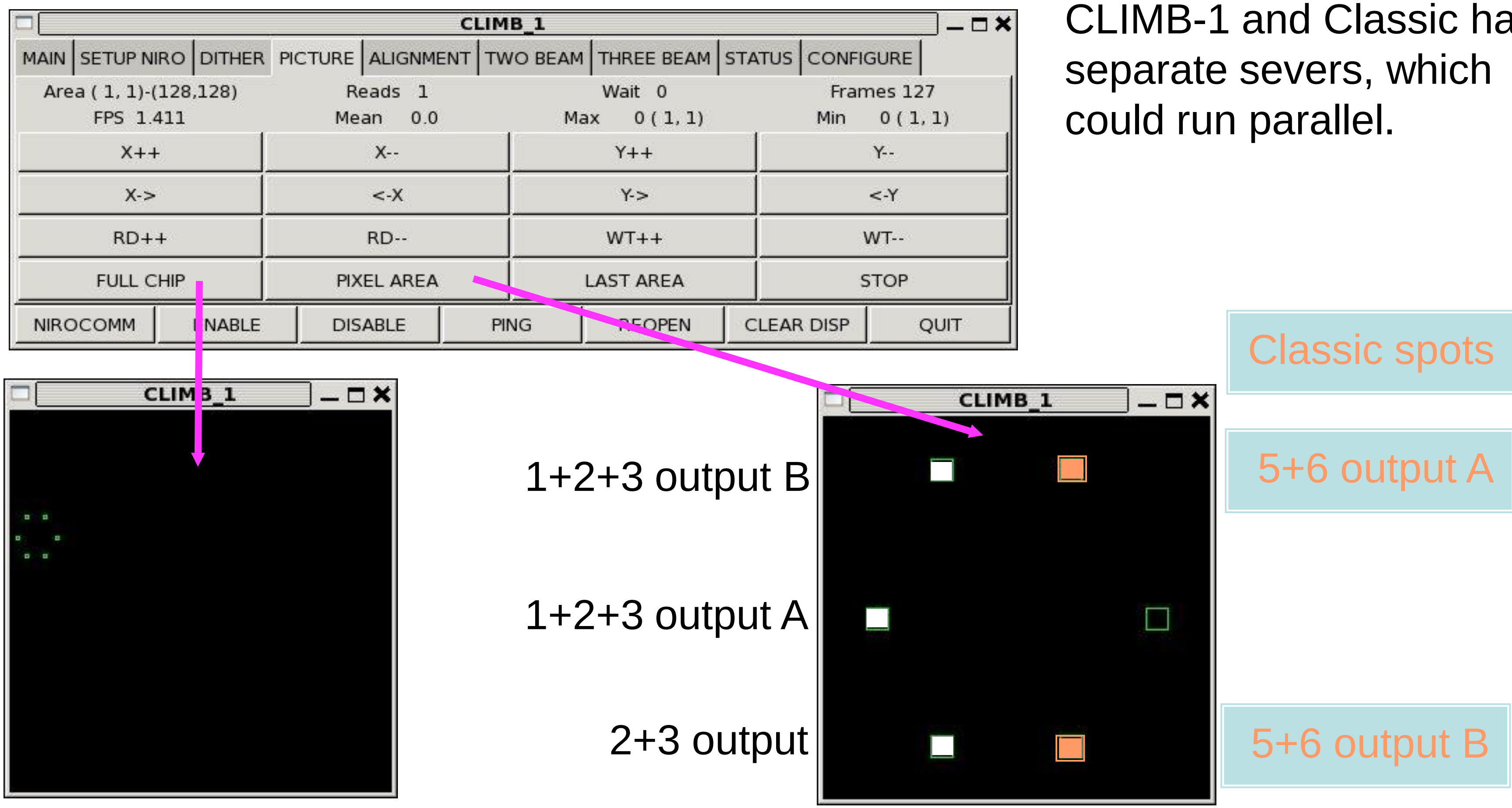
CLIMB-1 and Classic Setup

The setup is the same since last year and stays for the upcoming observing season.



NIRO Images with the New Software

CLIMB-1 and Classic have separate severs, which could run parallel.



NIRO Performance Improvement

Classic observations (old software, new spots)

"

UT 2009 23-06 Observing Report
Program: C6 - Millan-Gabet [sharing with MIRC - Yamina / Gail]
Observers: Chris, Xiao, Rafael / Gail on MIRC

Weather: clear; Seeing: 2-5cm
Targets / Baselines: S2E2 POPs 1/4 K band

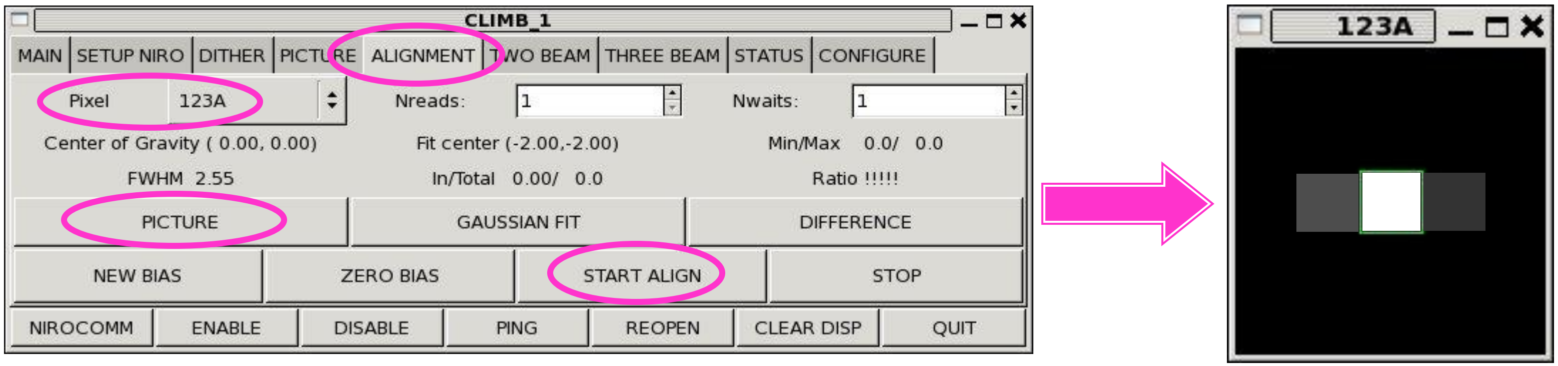
...

NIRO sensitivity tests:
ut 09:14 HD192575 V=6.8 K=6.6 sync 500Hz 1x1
ut 09:22 HD205372 V=7.0 K=6.9 sync 500Hz 1x1
ut 09:31 HD206821 V=7.9 K=7.6 sync 250Hz 1x1
ut 09:40 HD239544 V=9.0 K=7.9 sync 250Hz 1x1 - no fringes found
ut 10:04 HD206135 V=8.3 K=7.8 sync 250Hz 1x1
pretty good!! "

Thank you for the tests Rafael !

NIRO Performance Improvement

Laboratory tests using the engineering beam



NIRO Performance Improvement

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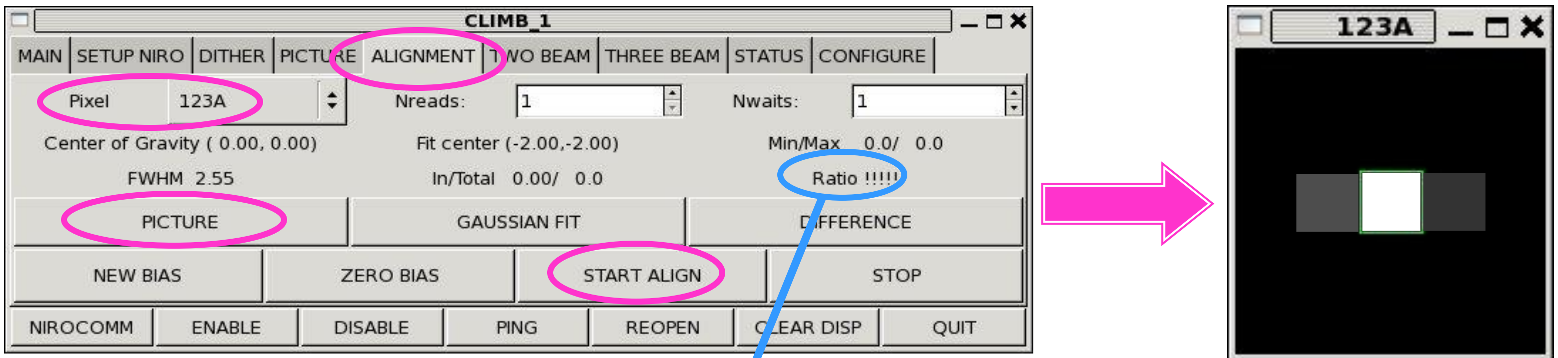
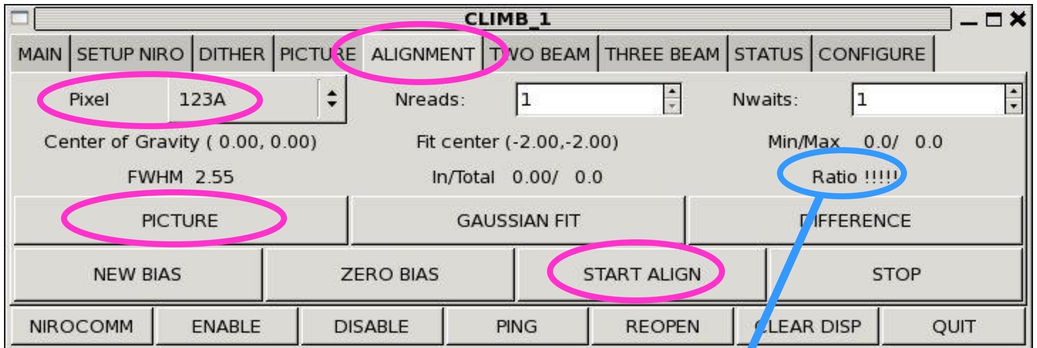
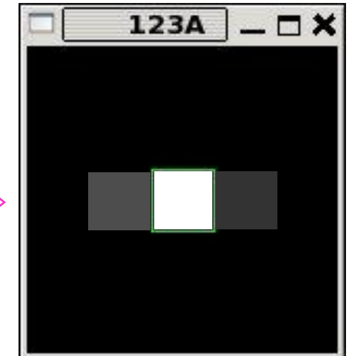


March 3, 2010 using ENG beam though 123 B K cont narrow band (24 nm) filter	B1 only	B2 only	B3 only
123 A In/Total = Ratio [%]	62-64	64-68	65-70

NIRO Performance Improvement

Laboratory tests using the engineering beam



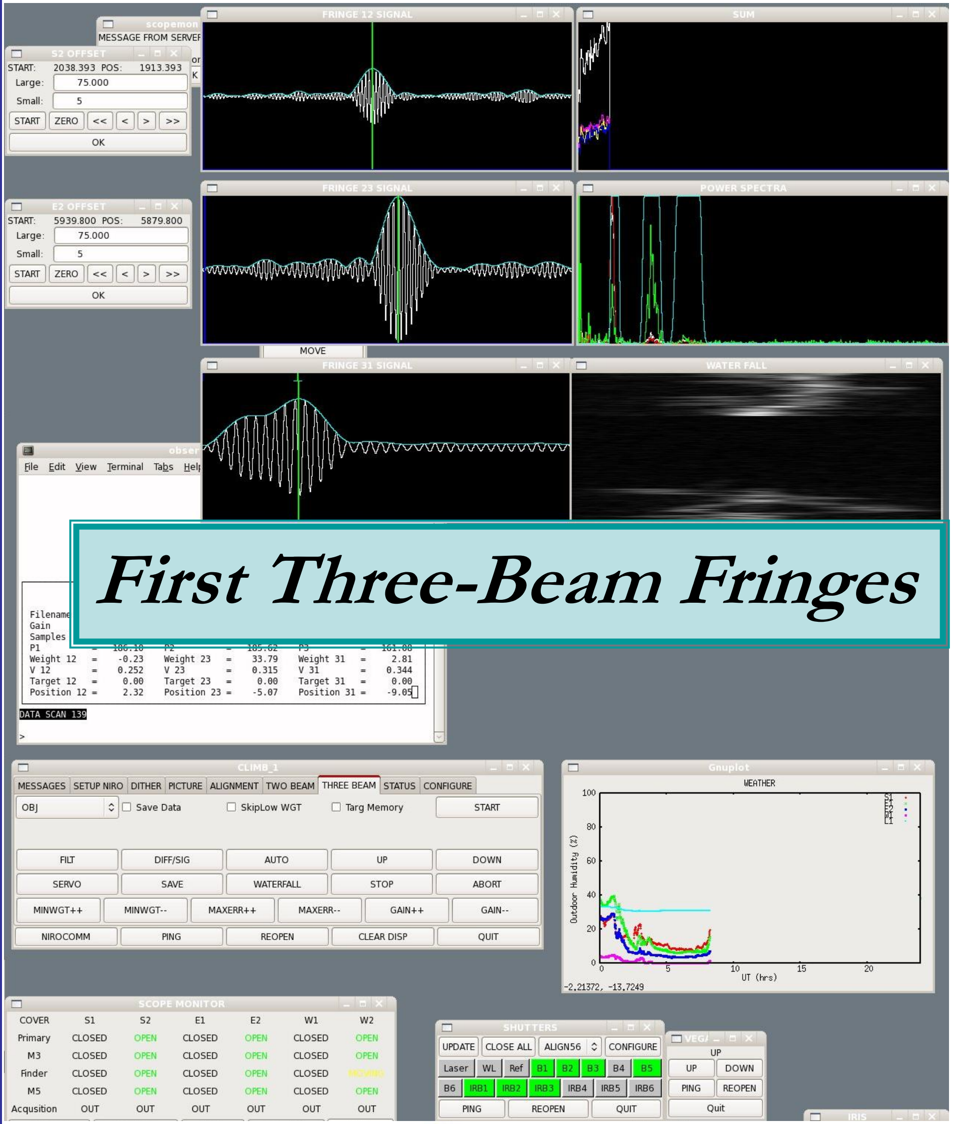


March 3, 2010 using ENG beam though 123 B K cont narrow band (24 nm) filter	B1 only	B2 only	B3 only
123 A In/Total = Ratio [%]	62-64	64-68	65-70

Similar setup in 2006, NIRO imaging with OAP: ~40% in 1 pixel.

NIRO image quality is better, but may be there is still room for improvement.

CLIMB-1



First Three-Beam Fringes

Zoot screen shot taken
July 7, 2009

Promising!

But there are more things to do:

- Dither calibration:
  setup is ready and tested,
  need data and data reduction
- New CLIMB software is still under development toward user friendliness.
- Needs more testing, lab and on-sky
- NIRO optics possible settings not yet fully explored.

Problem #1: Delay Line Carts

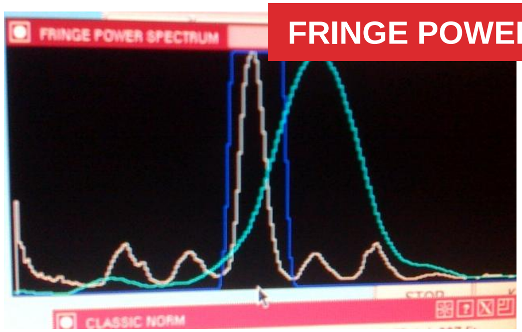
The rotor in the driving stepper motor looses sync with the rotating EM field, probably due to excessive load → as a result the cart sits in place and vibrates.

We measured that the motor receives the specified voltage. ✓

Possible solutions:

a) changing the motor control scheme
b) lightening the load on the motor

FRINGE POWER SPECTRUM



Picture by Tabetha Nov. 11, 2009

Plans to lighten the load:

1. Laszlo is planning to buy power supply for the cable puller motors, and to design control electronics to drive the motors both ways to take off the burden of the cart driving motor having to rotate the passive cable puller when the cart is moving forward.

2. The drive rail joints represent unnecessary balk, they should be smoothened out by properly machining the ends. (W and E lines).

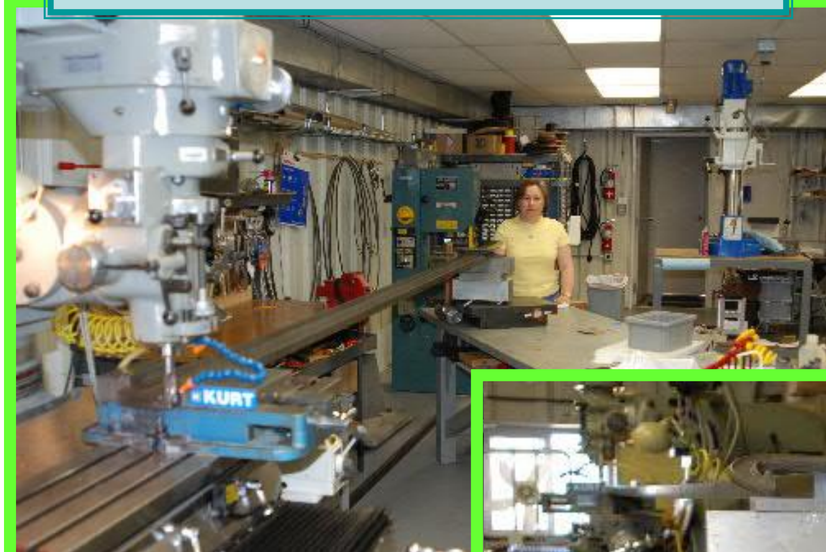
We fixed one joint so far, it seems to help.

Problem #1: Delay Line Carts

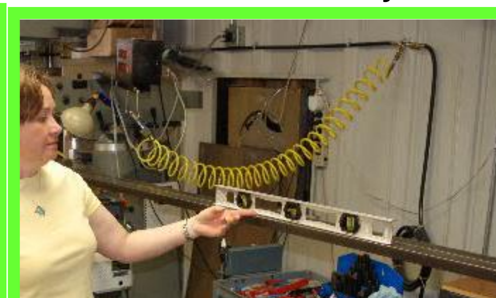
May, 2009

1) Rough cut with the horizontal band saw

Setup for machining rail ends



2) Getting ready to mill two in one setup, making two sides of the same joint

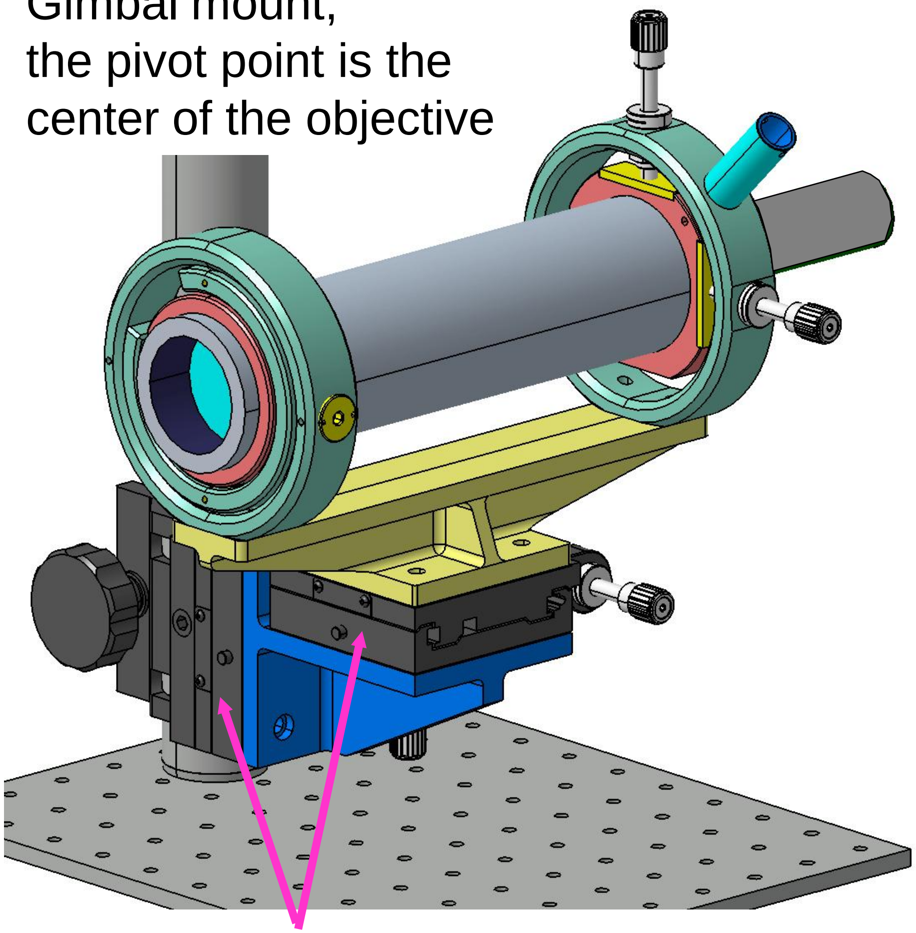


3) Taking it back to the delay line, aligning

~ 90 pounds a piece

For Better Cart and BRT Alignment

Gimbal mount,
the pivot point is the
center of the objective



Fine translations in X and Y

Another tool is ready for refining and maintaining the alignments of the
- beam reducing telescopes
- delay line carts

This solid mount makes it possible to set up the new alignment scope precisely on a predefined axis in the lab too.

The mount was primarily designed to replace inadequate commercial mounts in the telescope alignment setup.

The parts drawn here in color were designed by Laszlo and made by him and the GSU machine shop.

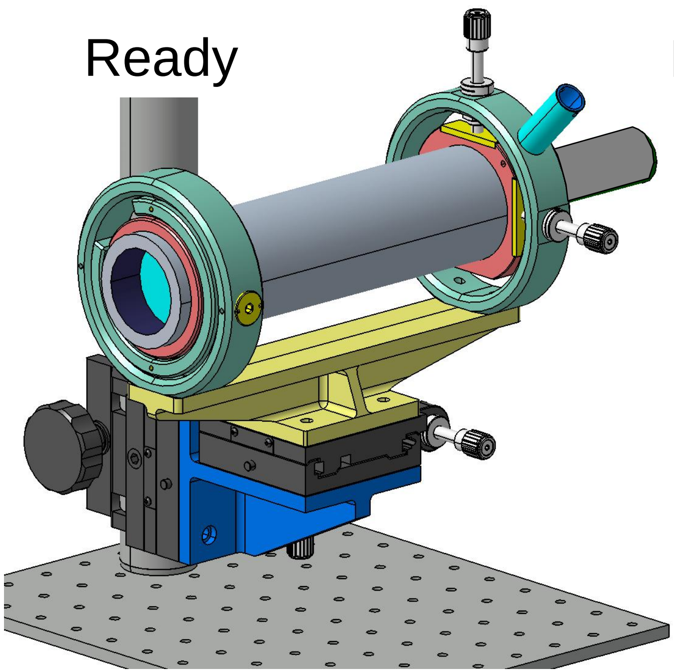
For Better Cart and BRT Alignment

Still needed, and nearly ready: a collimated 5” reference beam.

We are planning to use the
- rail telescope ✓ and a
- pinhole illuminated by the
- small white light source with fiber output ✓

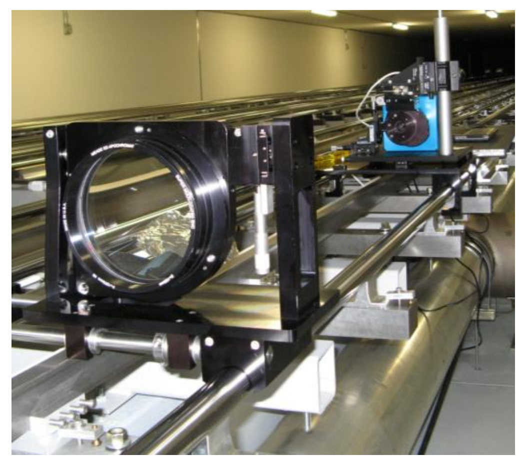
to form a collimator.

Ready



Ready

NEW DIAGNOSTIC TOOLS AND PROCEDURES



Uses of the rail scope
- Visual inspection through an eyepiece
- Hartmann tests (masks exist) to perfect cart, BRT alignment
- Curvature sensing to verify proper alignment