# Software activities shaping the CHARA Array

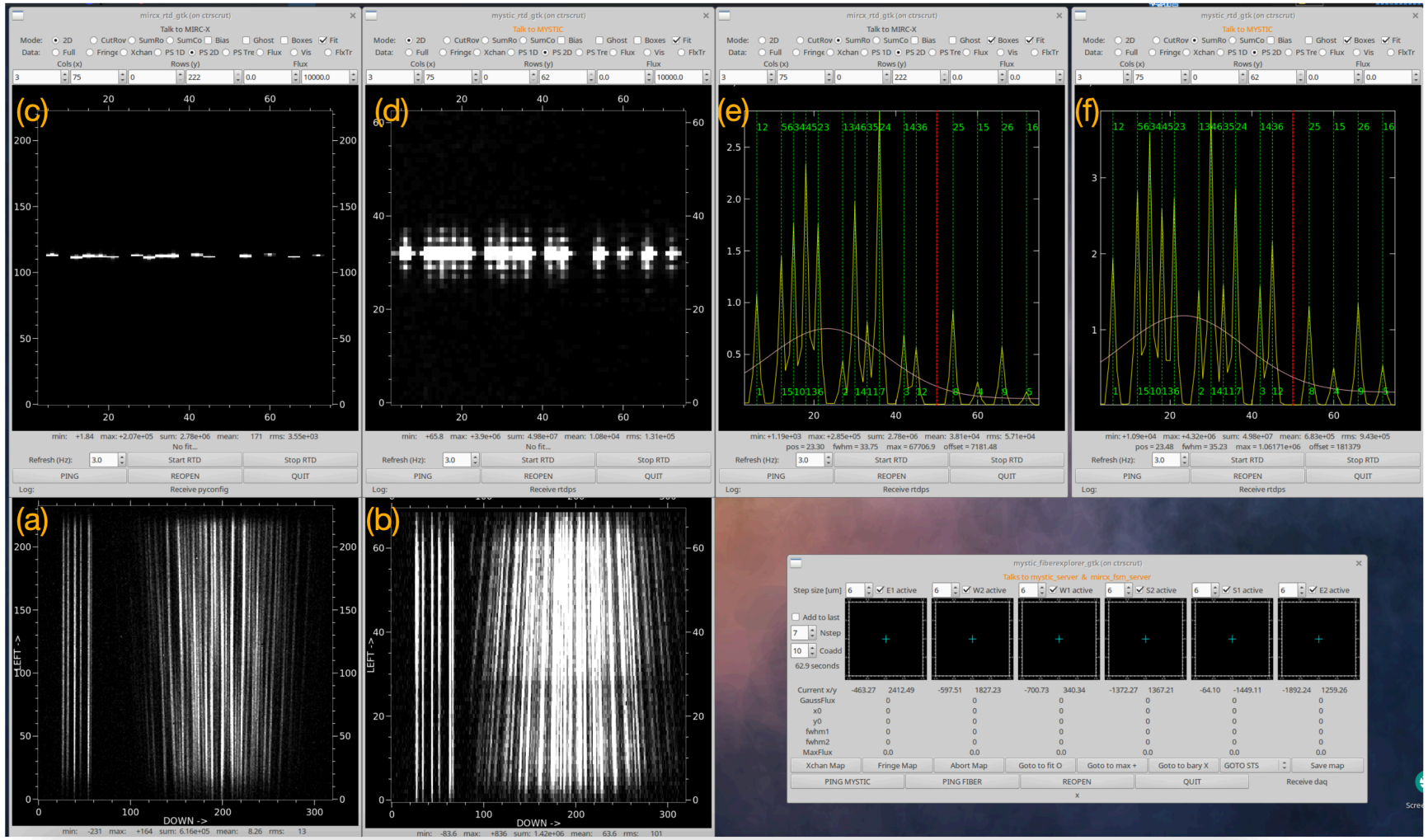
Narsireddy Anugu + CHARA collaboration

2022 Mar 13

# CHARA beam combiners

| | Wavelength | # of beams combined | Status |
|---|---|---|---|
| PAVO | R-band | 2 | In operation |
| CLASSIC/CLIMB | J+H+K | <= 3 | In operation |
| MIRC-X/MYSTIC | J+H+K | 6 | In operation |
| SPICA | R-band | 6 | Commissioning phase |
| SILMARIL | H+K | 3 | Commissioning phase |

# 1. MIRC-X + MYSTIC

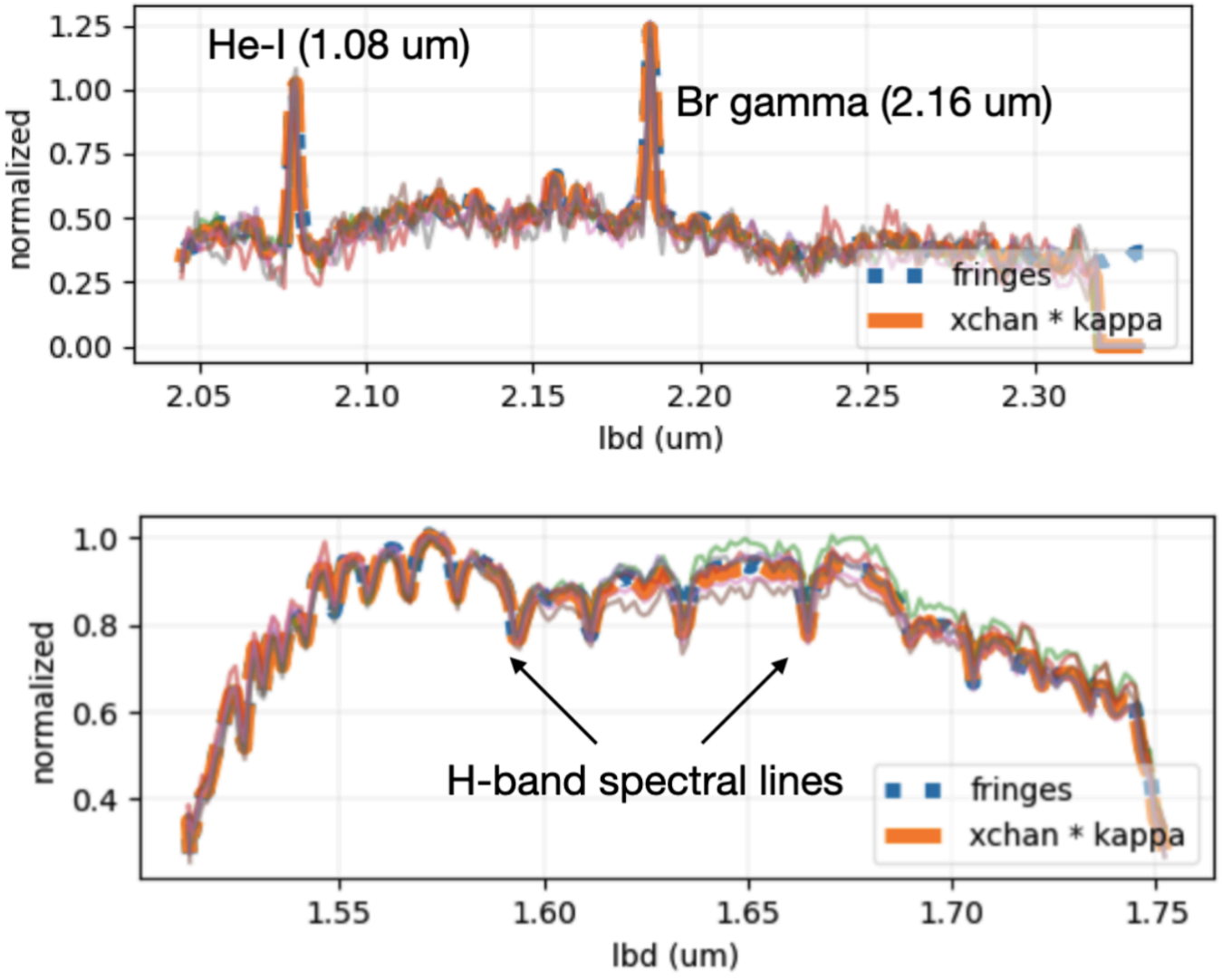



## Spectral resolutions:

| MIRC-X (R) | MYSTIC (R) |
|---|---|
| 20 | 20 |
| 50 | 49 |
| 102 | 100 |
| 198 | 278 |
| 1170 | 981 |
| | 1724 |

**(See John's talk)**

# 1. MIRC-X + MYSTIC



# 1. MIRC-X + MYSTIC: Two modes of fringe tracking

(1) Fringe tracker and science beam combiner

Low R — fringe track

High R — science

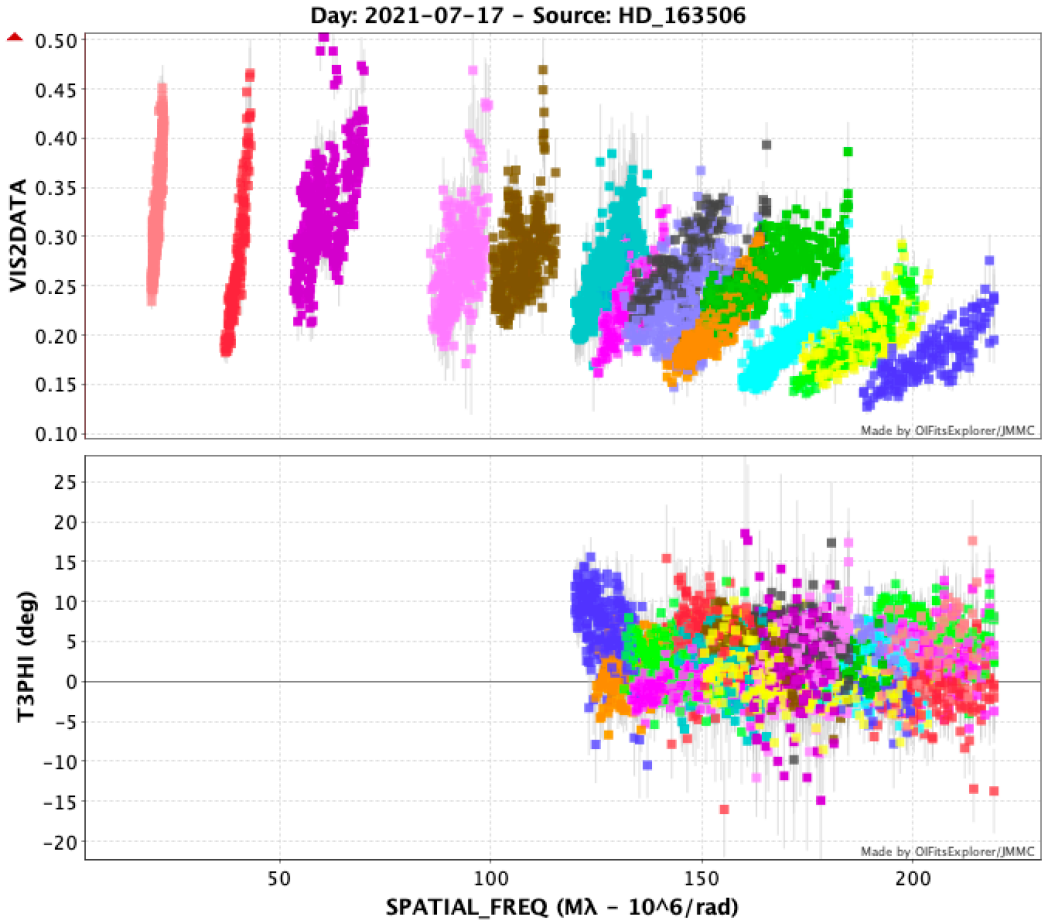
For example,

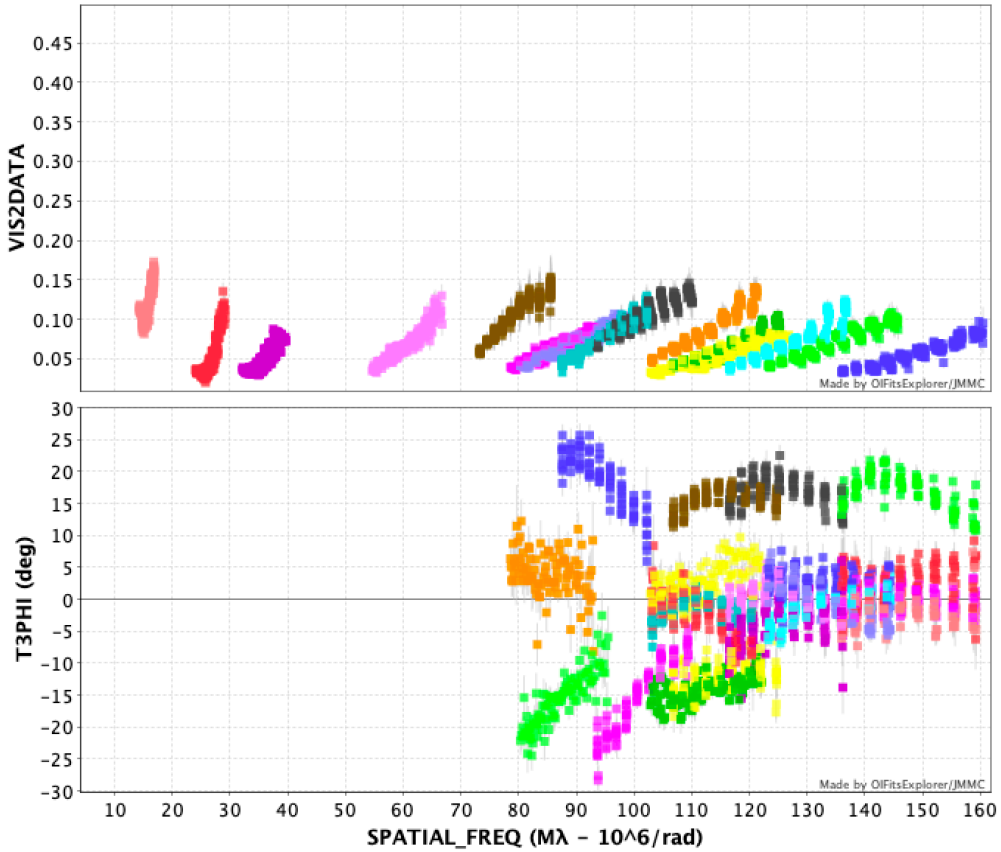
MIRC-X (low-R) and MYSTIC (high-R)

MIRC-X (high-R) and MYSTIC (low-R)

(2) Combined mode: all the information is used for fringe tracking

# 1. Combined mode for extended objects



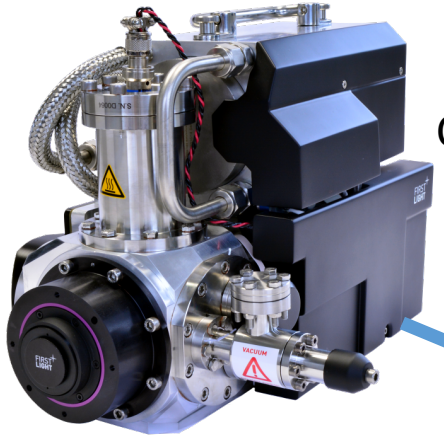
# 2. SILMARIL

- 3-beam combiner
- CRED ONE camera
- Aimed for sensitivity to observe faint stars
- PI: Theo ten Brummelaar

(See Cyprien talk)

- We chose minimum development approach by using tested and working code
- We use MIRC-X software and GUIs, since the same camera and also users most familiar with mircx user interface

# 2. SILMARIL current status



C-REDONE (will deliver in June 2023)

C-RED2 (currently in use)

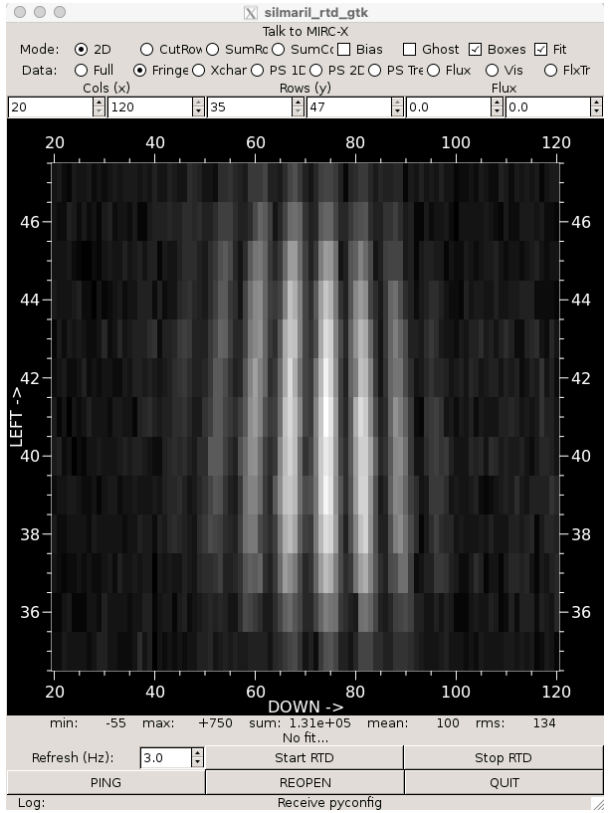
Shared memory

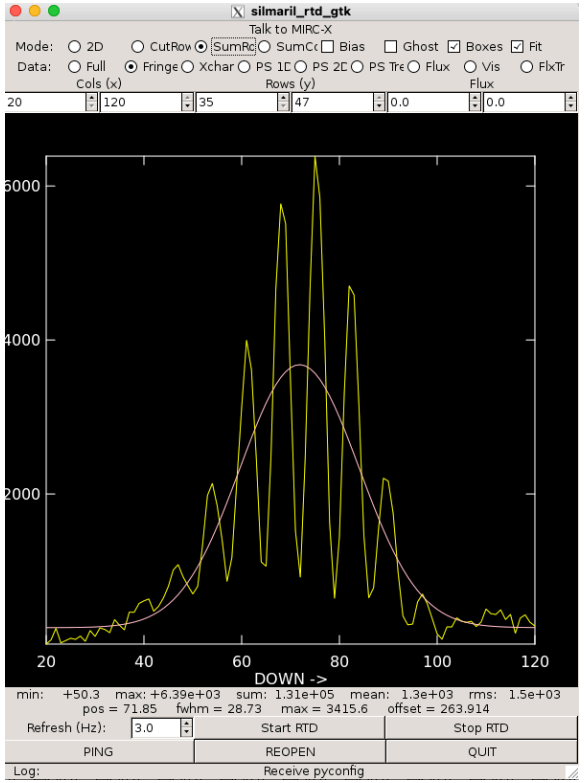
Silmaril server (Data processing, FFTs and fringe tracking)

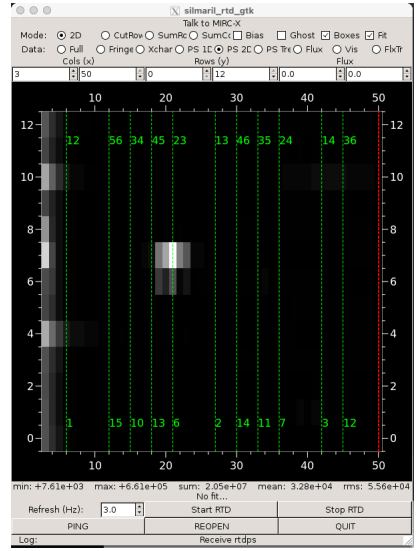
Operational GUIs

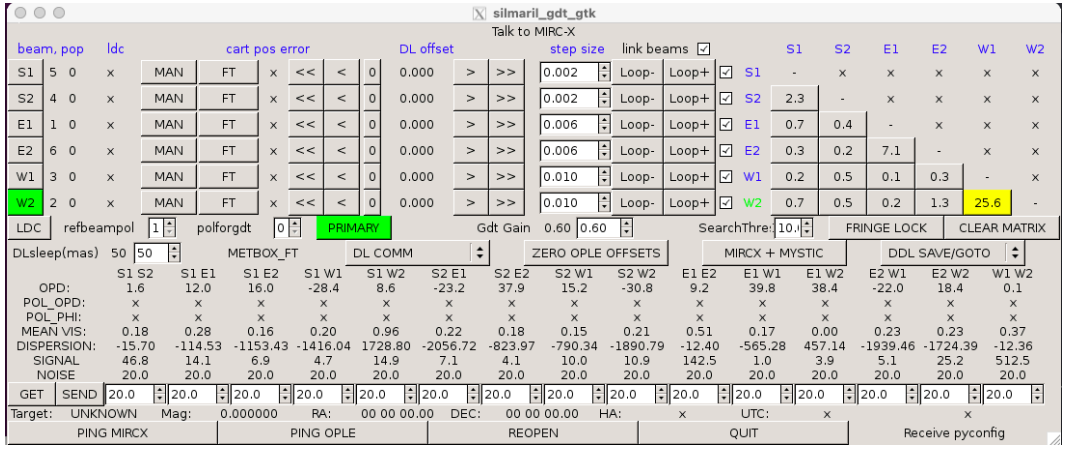
Other hardware servers (DDL, Picos)

# 2. SILMARIL software working with lab STS (see Cyprien talk more details)



# 3. Wavelength dispersion control

- With Denis, we developed a dedicated LDC (longitudinal dispersion correction) control
- This server can correct wavelength dispersion for SPICA and also J-band (MIRC-X) observations.
- Code adapted from ople to allow easy to play and for monitoring the computations.

**(See Denis talk for how its being used)**

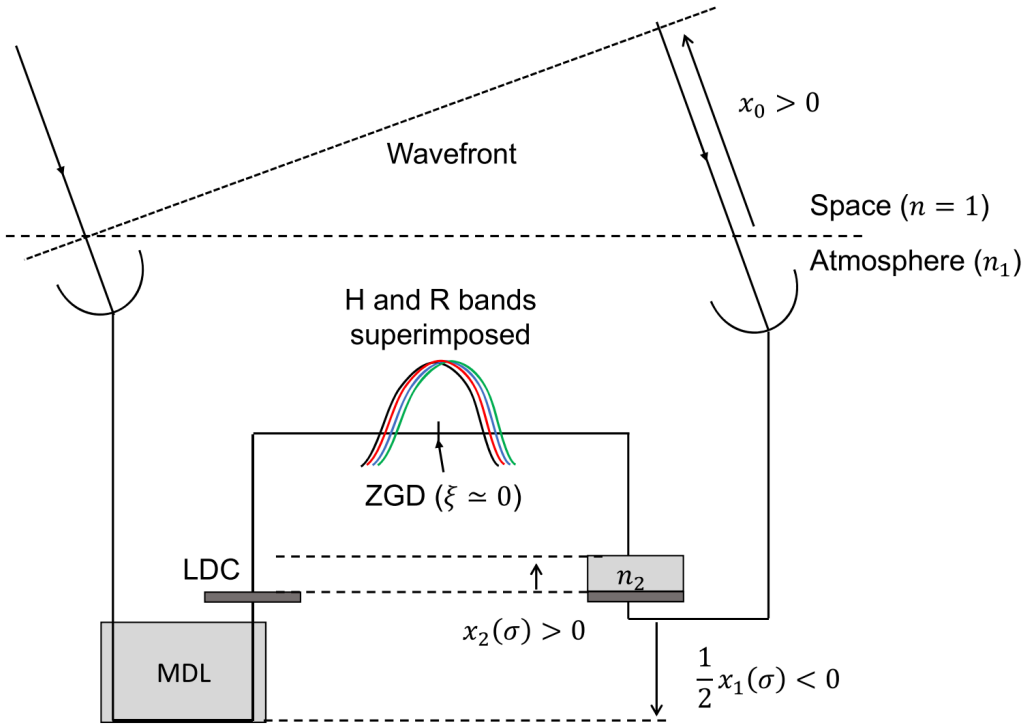
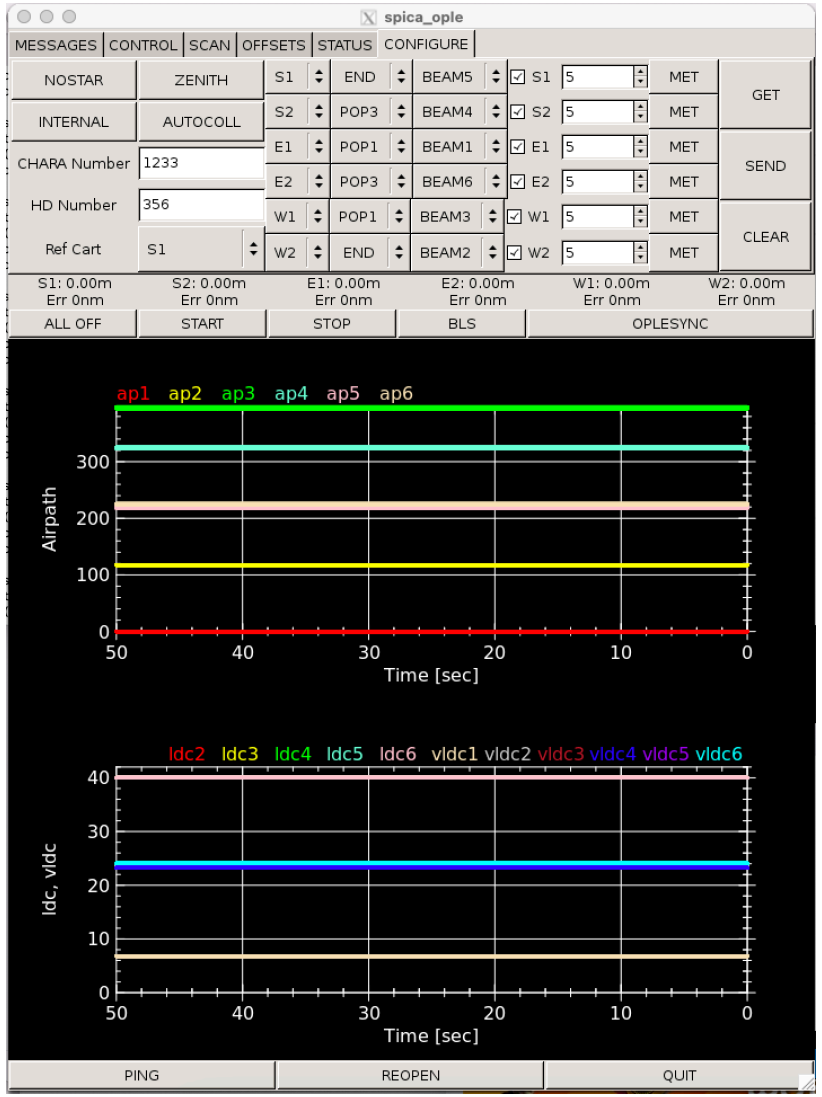
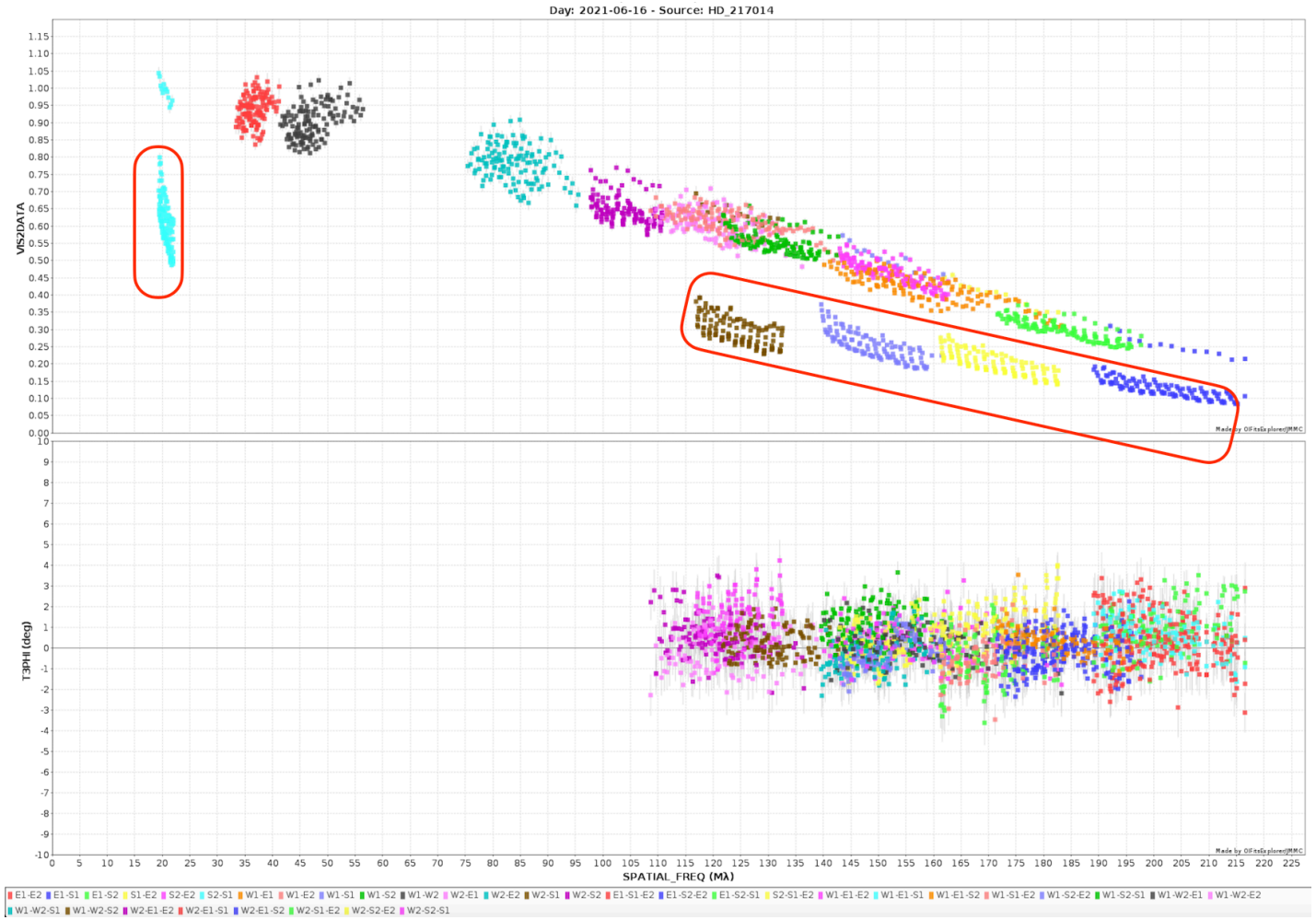



Image credit: Pannetier

# 3. Wavelength dispersion control



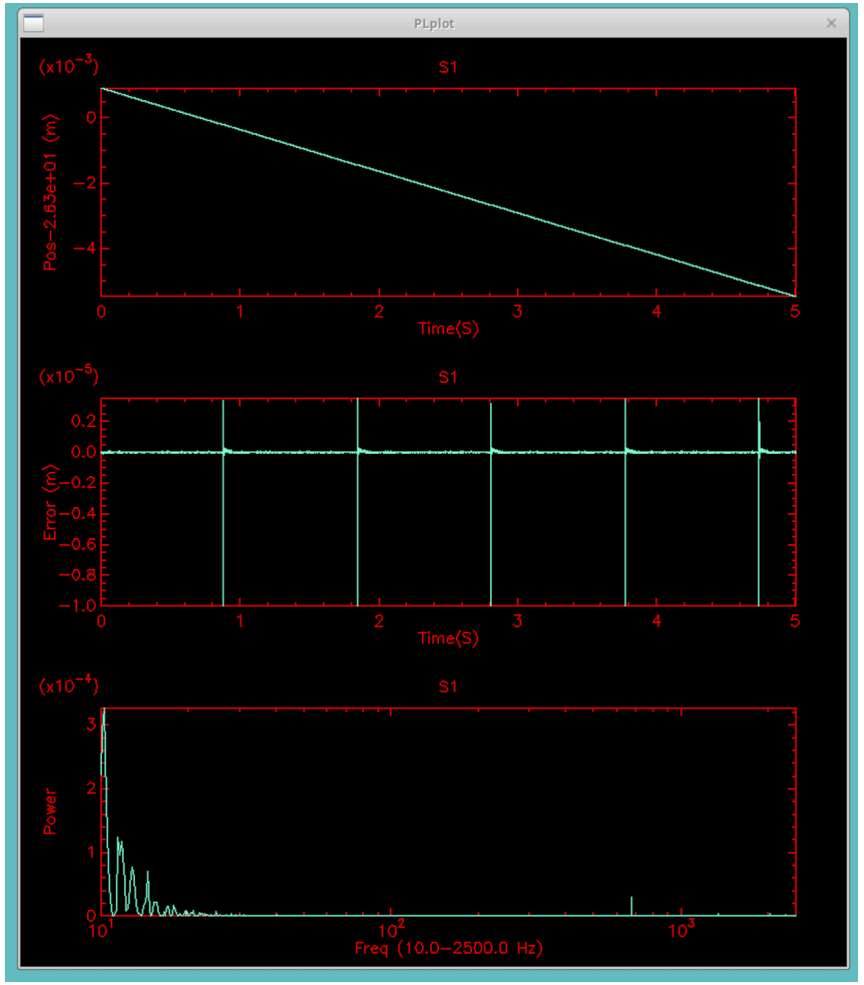
# 4. Visibility loss issues




**S1 visibility drops**

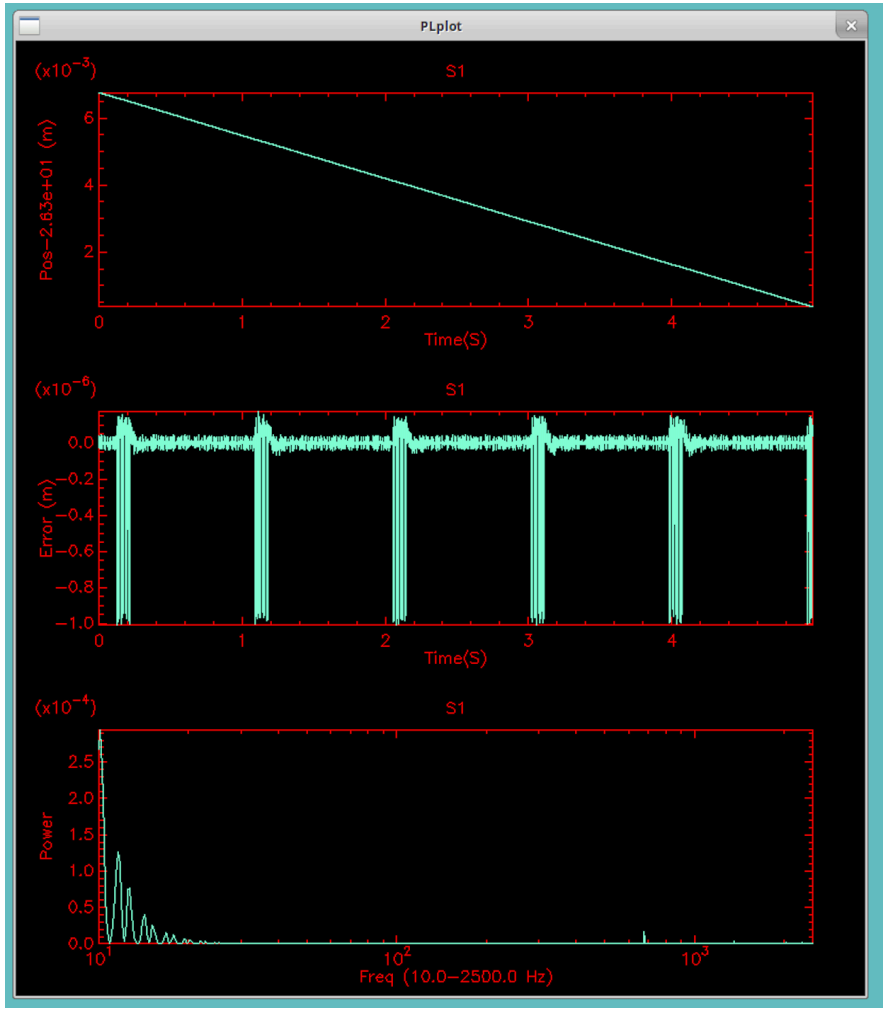
- Between elevation = 45 - 60 and Azimuth ~100
- We checked telescope area, tip-tilt and AO systems and they seem NOT introduce any vibrations.
- We narrowed it down to the S1 cart.
- Current solution is keeping S1 as REF

# 5. Fringe tracking improvements



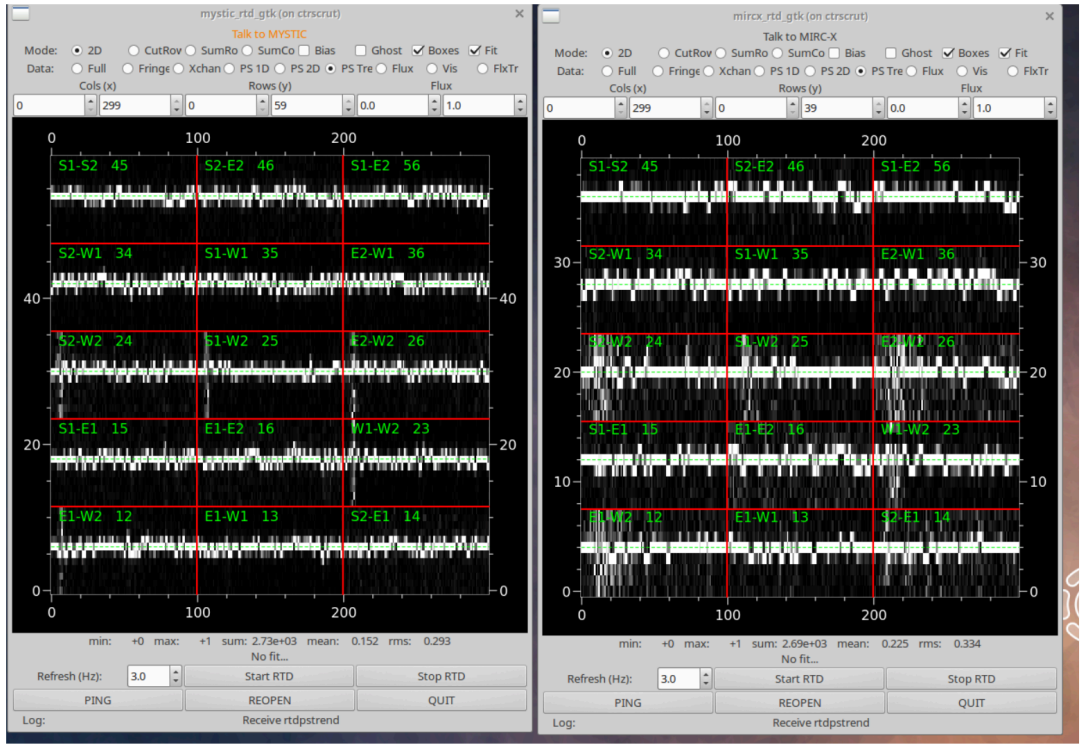

Overshoot > 2um

Ramp offsets ->

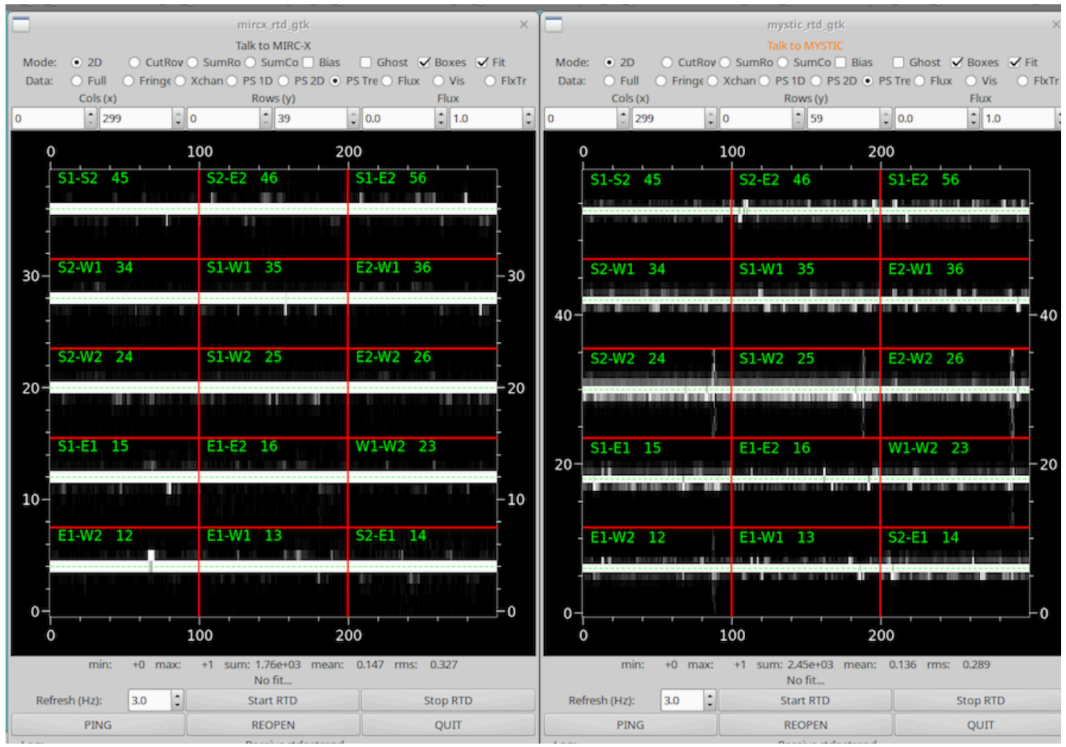



Overshoot < 0.1um

# 5. Standard (MANUAL) vs new (METBOX-RAMP-FT) fringe tracking

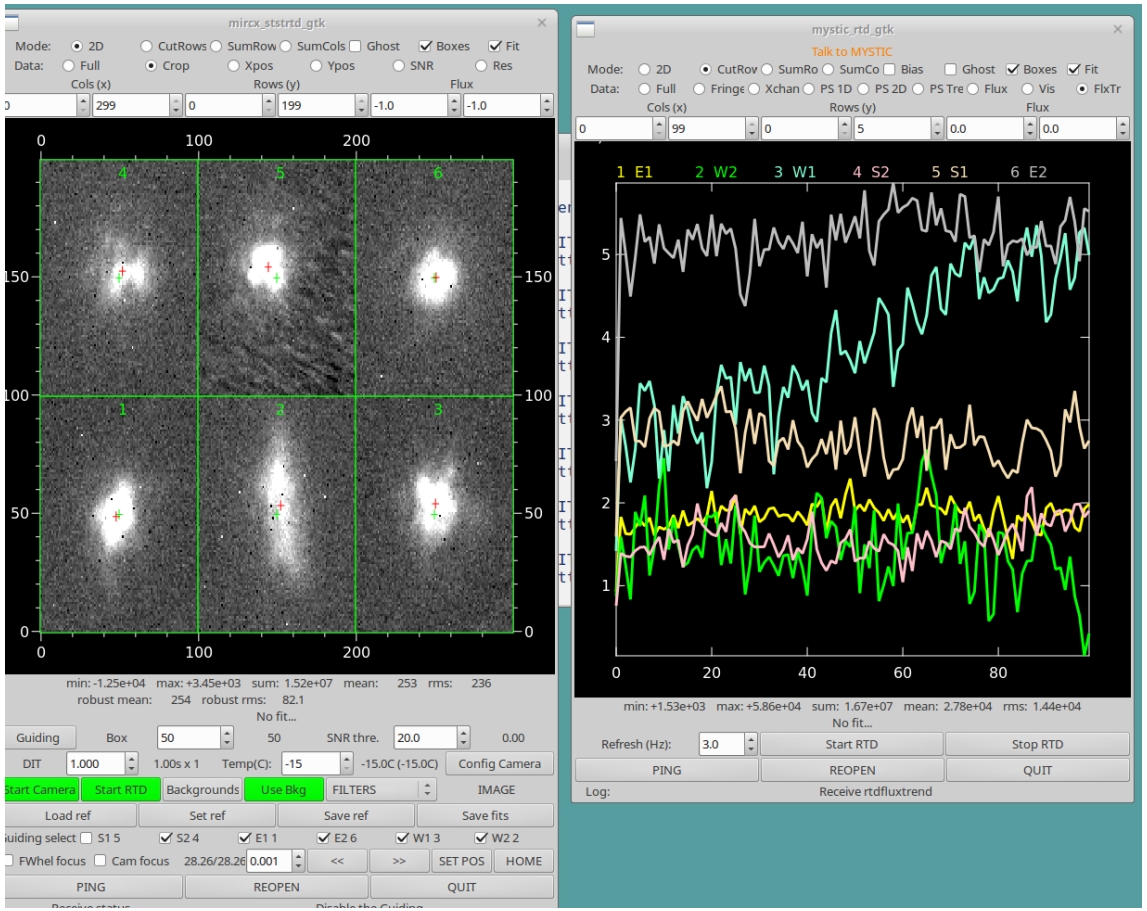



MYSTIC MANUAL target MIRC-X




MIRC-X FT target MYSTIC

# 6. Flux stabilization with Star Tracker

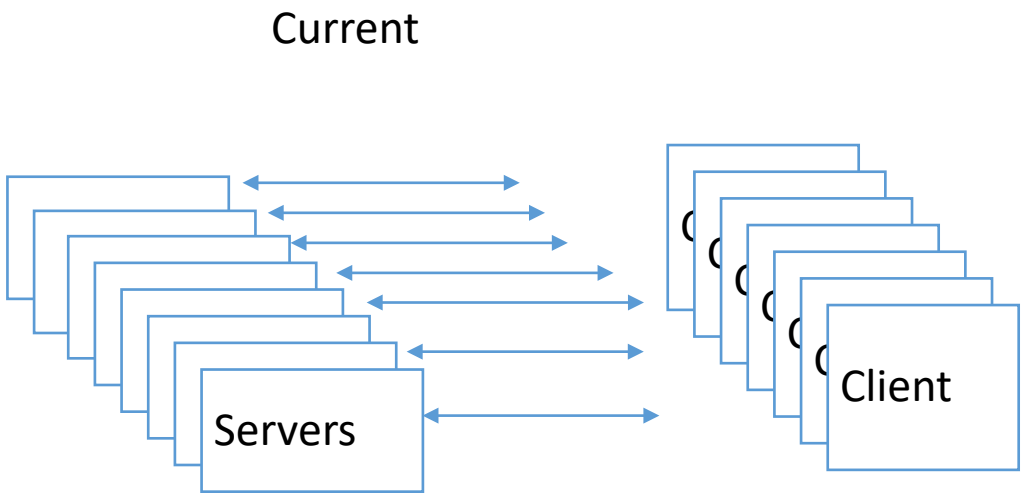


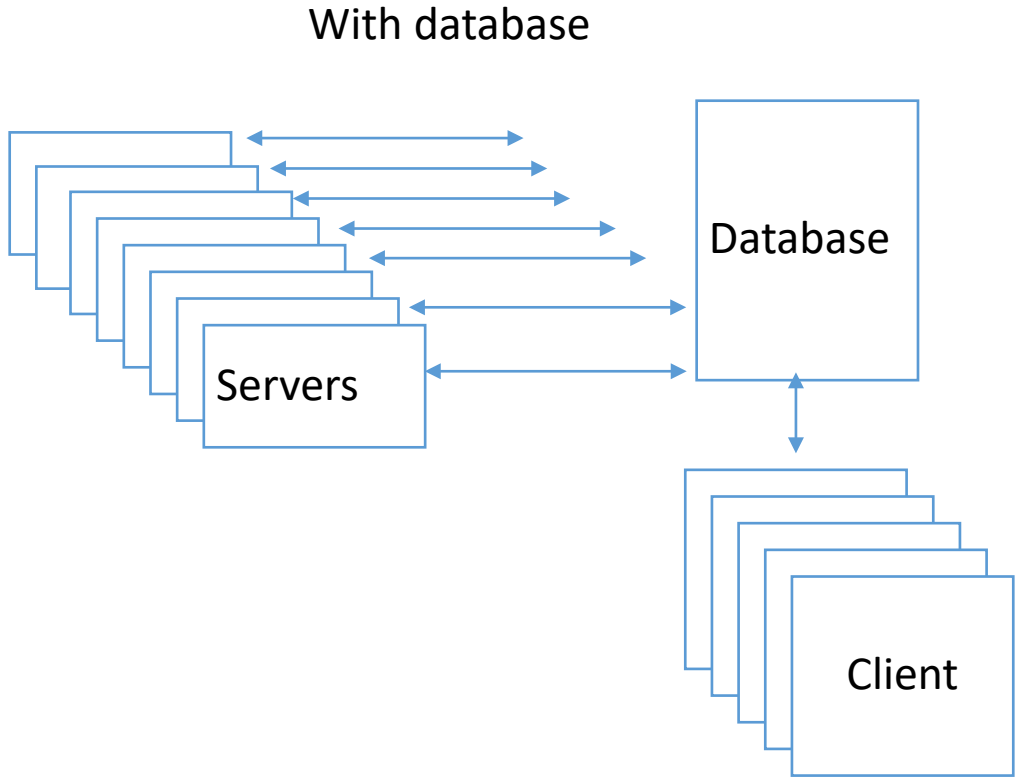

Demonstration of beam stabilization
(W1 loop was not closed)

- Along the beam train (>100m), all optics/actuators are in motion due to misalignments and temperature differences
- Which causes the beam drifts
- We track the beams using the Star Tracker and feedback to M7 actuator via labao sensor for stabilization

**(See John's talk for more details)**

# 7. CHARA database



# Future works

# 8. CHARA client-server library upgrade

- The CHARA client-server library works great in good network conditions but have problems in slow network
- To solve we attempted **zeromq**, open-source messaging library
- Zeromq is a high-speed, Muti-transport (TCP, UDP, IPC, and web socket ..)
- Zeromq being used for TMT common software
- The zeromq library is built into CHARA software and tested in the lab but need to be tested on-sky
- Rolling over between CHARA classic vs zeromq based client-server, unfortunately complex and abrupt because, we need to install and start 100 applications (including servers and GUIs)

# 9. CHARA software upgrade To ubuntu 22

**Currently we are using Ubuntu 16 LTS (support ended Apr 2021)**

- A straightway upgrade of computers will not work as we need to upgrade software of cameralink and DM computer software
- Recent version of Matrox and Bitflow frame grabber software support the Ubuntu 22 LTS. We need to buy license to upgrade them.
- The rest of them are easier but we need to install in one compute and test.