# New Developments and Future Plans at the CHARA Array

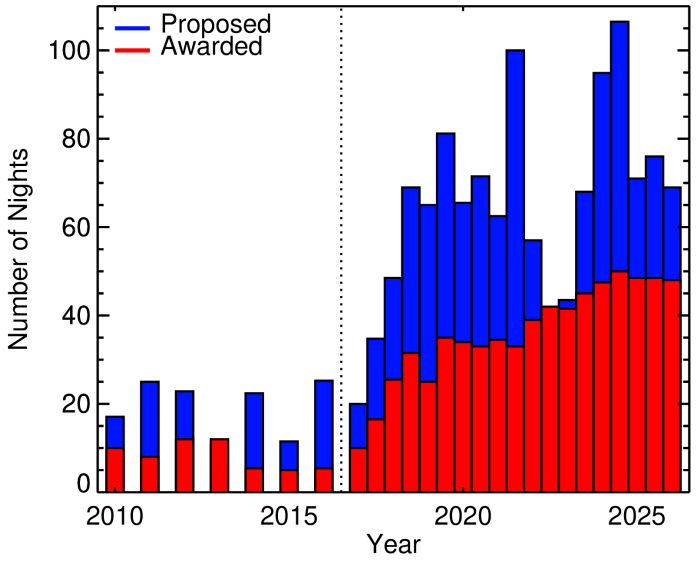
**Gail Schaefer**

Director of the CHARA Array
Georgia State University

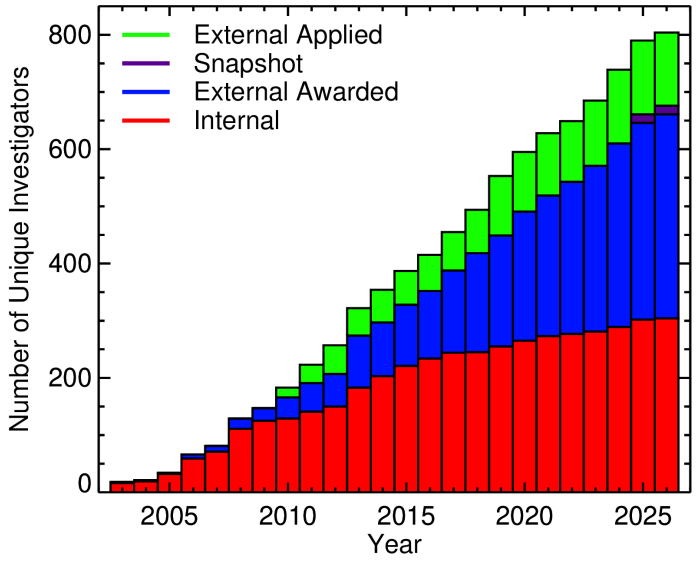
# Open Access Program

## Supported through NSF AAG Program through 2027 ($3.5M)

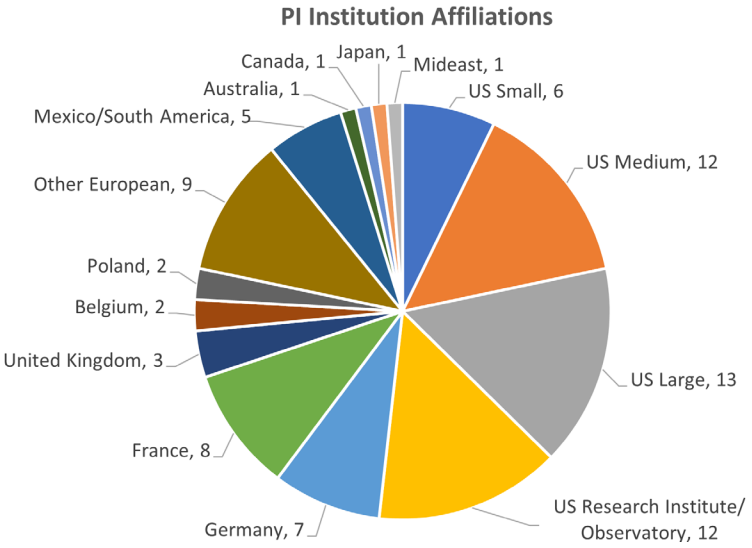
Average Oversubscription ~ 2




Over 470 astronomers have applied for open access time (PI + CoI)




Open Access PI



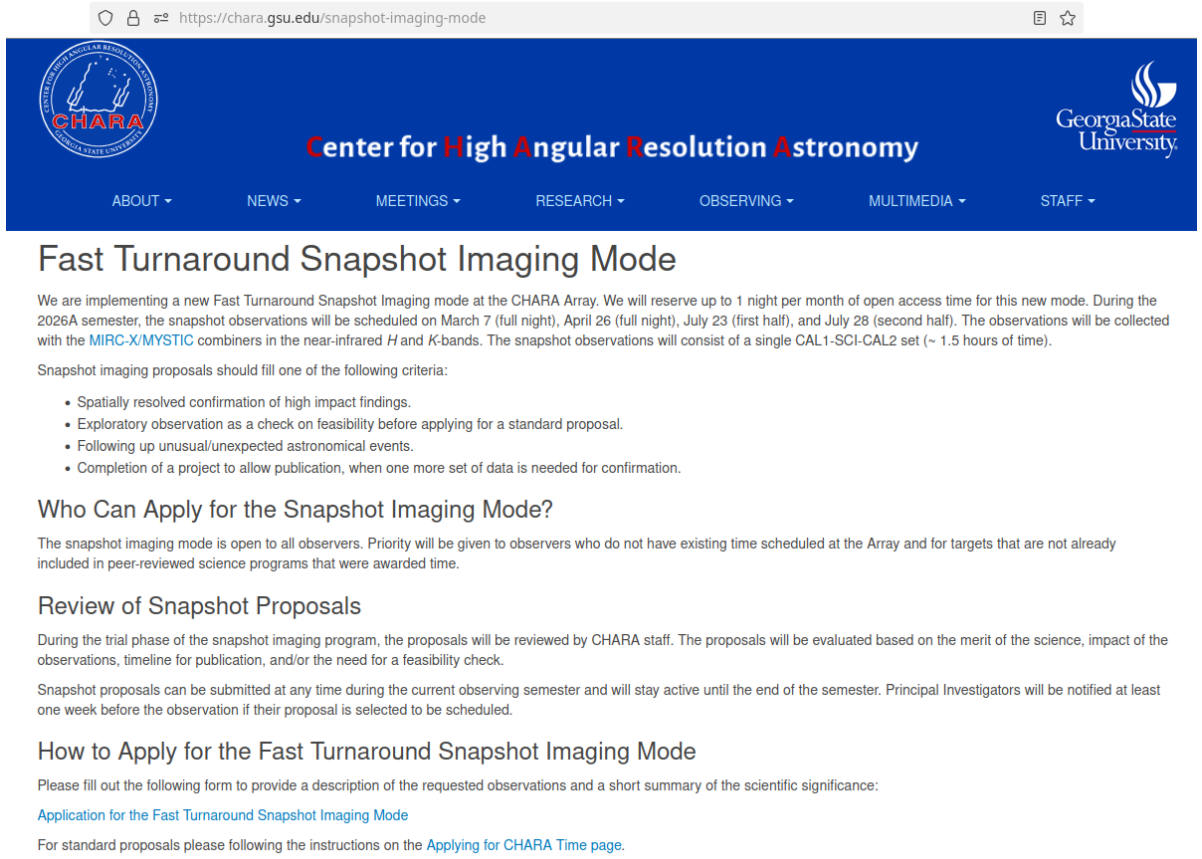

50 nights per semester open to broader community

Time allocated through NOIRLab

- 440 open access proposals submitted since 2010
- Open access PIs from 84 distinct institutions

# Fast Turn Around Snapshot Imaging Mode

- Reserve up to 5 nights per semester
- Science Motivation
  - High impact findings
  - Exploratory epoch for larger proposal
  - Completion of project
  - Unusual/unexpected events
- Who can apply?
  - Priority for those without time scheduled
  - Targets not already in approved programs
- www.chara.gsu.edu/snapshot-imaging-mode



https://chara.gsu.edu/snapshot-imaging-mode

Center for High Angular Resolution Astronomy

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## Fast Turnaround Snapshot Imaging Mode

We are implementing a new Fast Turnaround Snapshot Imaging mode at the CHARA Array. We will reserve up to 1 night per month of open access time for this new mode. During the 2026A semester, the snapshot observations will be scheduled on March 7 (full night), April 26 (full night), July 23 (first half), and July 28 (second half). The observations will be collected with the MIRC-X/MYSTIC combiners in the near-infrared *H* and *K*-bands. The snapshot observations will consist of a single CAL1-SCI-CAL2 set (~ 1.5 hours of time).

Snapshot imaging proposals should fill one of the following criteria:

- Spatially resolved confirmation of high impact findings.
- Exploratory observation as a check on feasibility before applying for a standard proposal.
- Following up unusual/unexpected astronomical events.
- Completion of a project to allow publication, when one more set of data is needed for confirmation.

### Who Can Apply for the Snapshot Imaging Mode?

The snapshot imaging mode is open to all observers. Priority will be given to observers who do not have existing time scheduled at the Array and for targets that are not already included in peer-reviewed science programs that were awarded time.

### Review of Snapshot Proposals

During the trial phase of the snapshot imaging program, the proposals will be reviewed by CHARA staff. The proposals will be evaluated based on the merit of the science, impact of the observations, timeline for publication, and/or the need for a feasibility check.

Snapshot proposals can be submitted at any time during the current observing semester and will stay active until the end of the semester. Principal Investigators will be notified at least one week before the observation if their proposal is selected to be scheduled.

### How to Apply for the Fast Turnaround Snapshot Imaging Mode

Please fill out the following form to provide a description of the requested observations and a short summary of the scientific significance:

Application for the Fast Turnaround Snapshot Imaging Mode

For standard proposals please following the instructions on the Applying for CHARA Time page.

# Fast Turn Around Snapshot Imaging Mode

- 2025A
  - 5 proposals, 12 investigators (PI + coI)
  - 6 of these investigators had not applied for CHARA time previously.
  - Gaia binary, mass loss in evolved variable star, exoplanet host star, M-dwarf angular diameter
- 2025B
  - 8 proposals, 31 investigators (PI + CoI)
  - 14 of these investigators had not applied for CHARA time previously
  - Young binary star, calibrator angular diameters, Be star triple, O-star triple, interacting binary, Gaia binary, rapid rotator
- Open for proposals in 2026A!
- See talk by Russ Genet

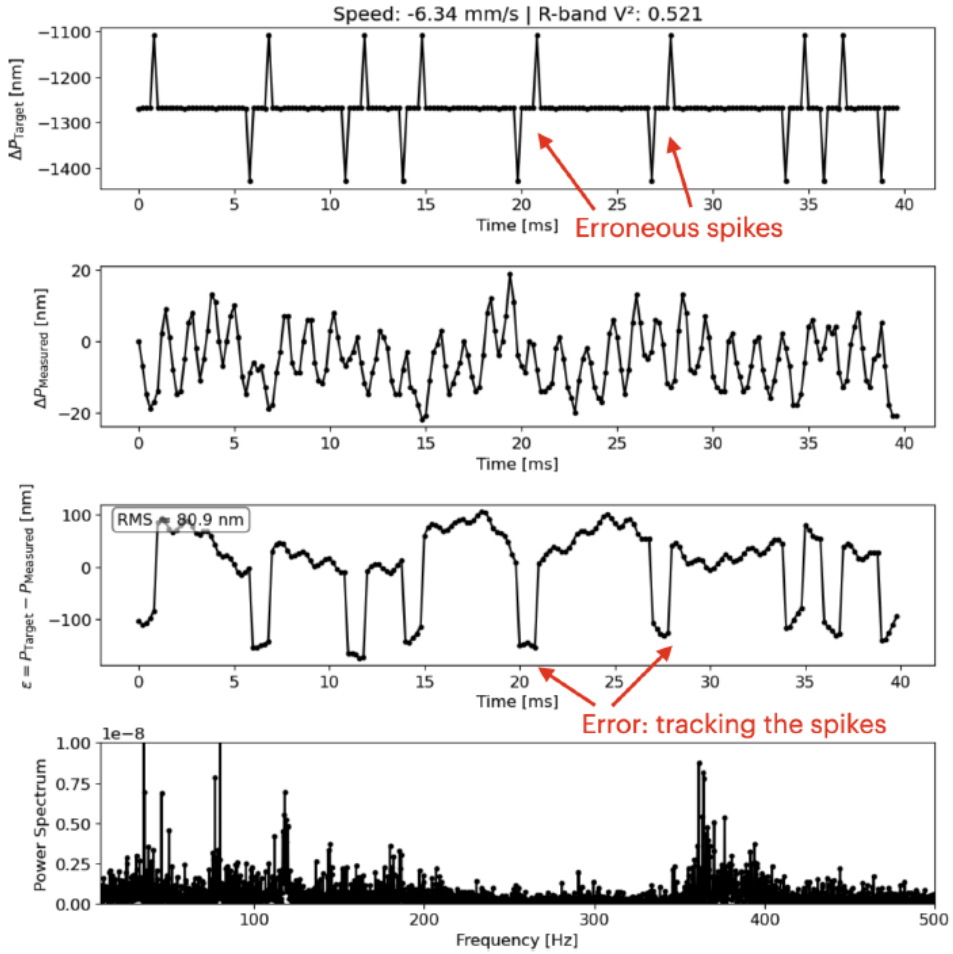
# CHARA Delay Line Performance

## Anugu et al. 2026, JATIS


- Delay line control system upgraded in mid-2021
- Replaced legacy VME-based architecture
- Modern hybrid FPGA and Linux-based system
- Designed by AZ Embedded Systems

# Software Fix for Time-Tick Jitter

## Anugu et al. 2026, JATIS



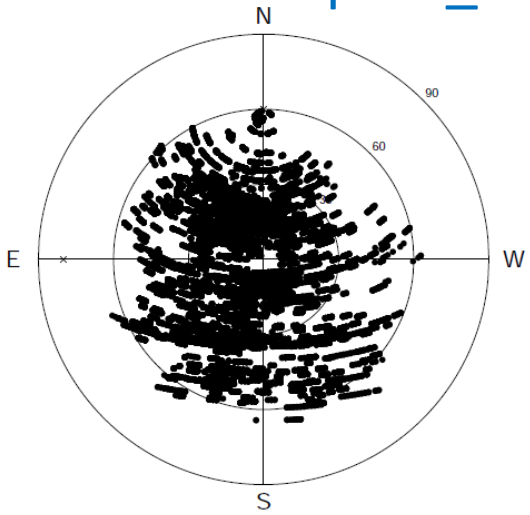

- New system experienced timing glitches that caused 80-100 nm spikes in tracking errors.
- Time synchronization between 25 µs tick and 5 kHz servo control loop.
- Software workaround – round each 25 µs tick value to the nearest multiple of 8.
- After fix new system achieves 12 nm tracking errors

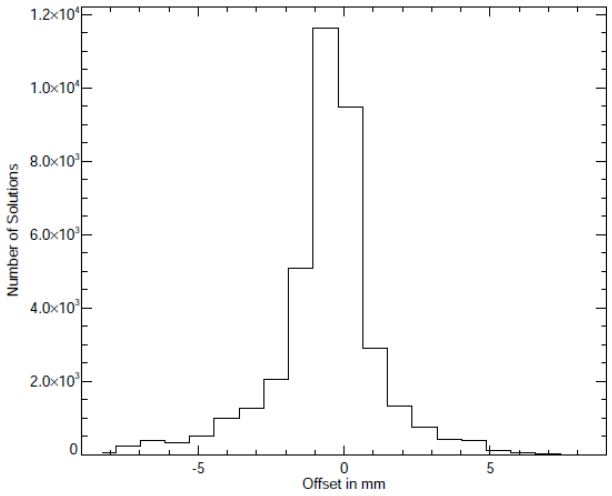
**Table 4** Comparison of Legacy and Upgraded Delay Line Systems.

| Parameter | Legacy System | Upgraded System | VLTI | KI[39] |
|---|---|---|---|---|
| Residual cart tracking RMS error, $\epsilon(t)$ [nm] | 10-20 | $< 12$ | 20[46] | 10-20 |
| Fringe tracker RMS residuals, $\Delta$OPD [nm] | 260[47,48] | 90-230[33] (Sec. 6.2) | 75-250[49] | 63-171 |

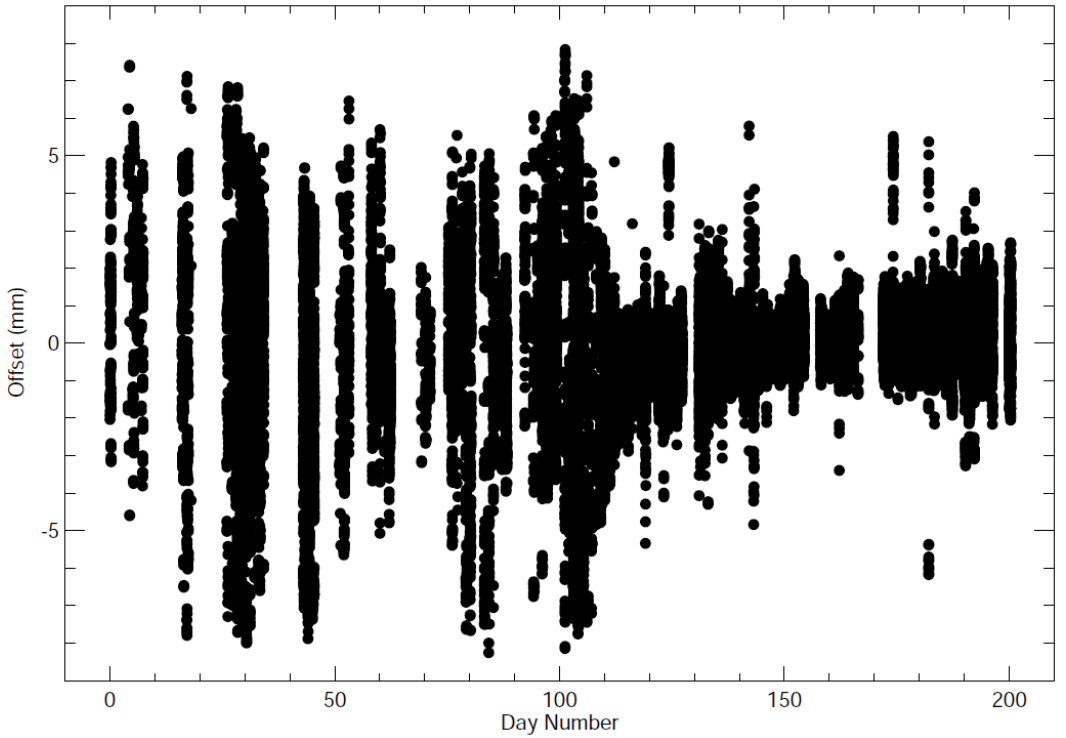
# New Baseline Solution Code

- Code used to predict position of delay line carts
- New Features:
  - Sigma Clipping
  - Time weighting (length of time, scaling factor for errors)
  - New plots
- IDL Code: compute_baseline_solution.pro



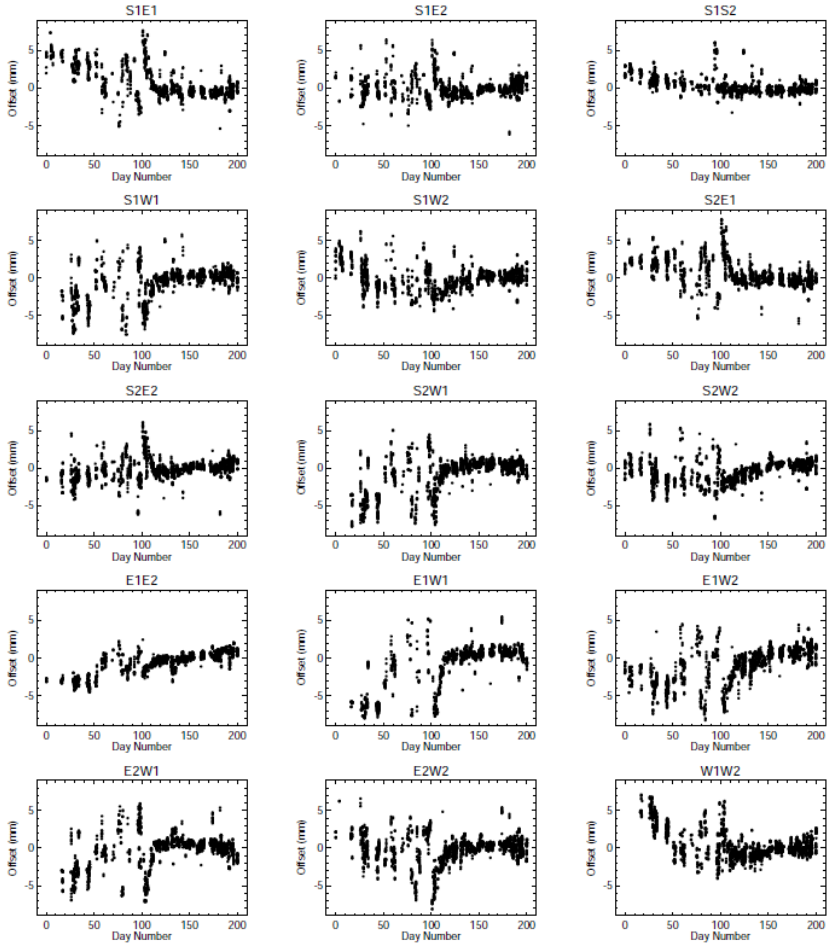




Residuals:




UT 2025 Feb 21 – Sep 9

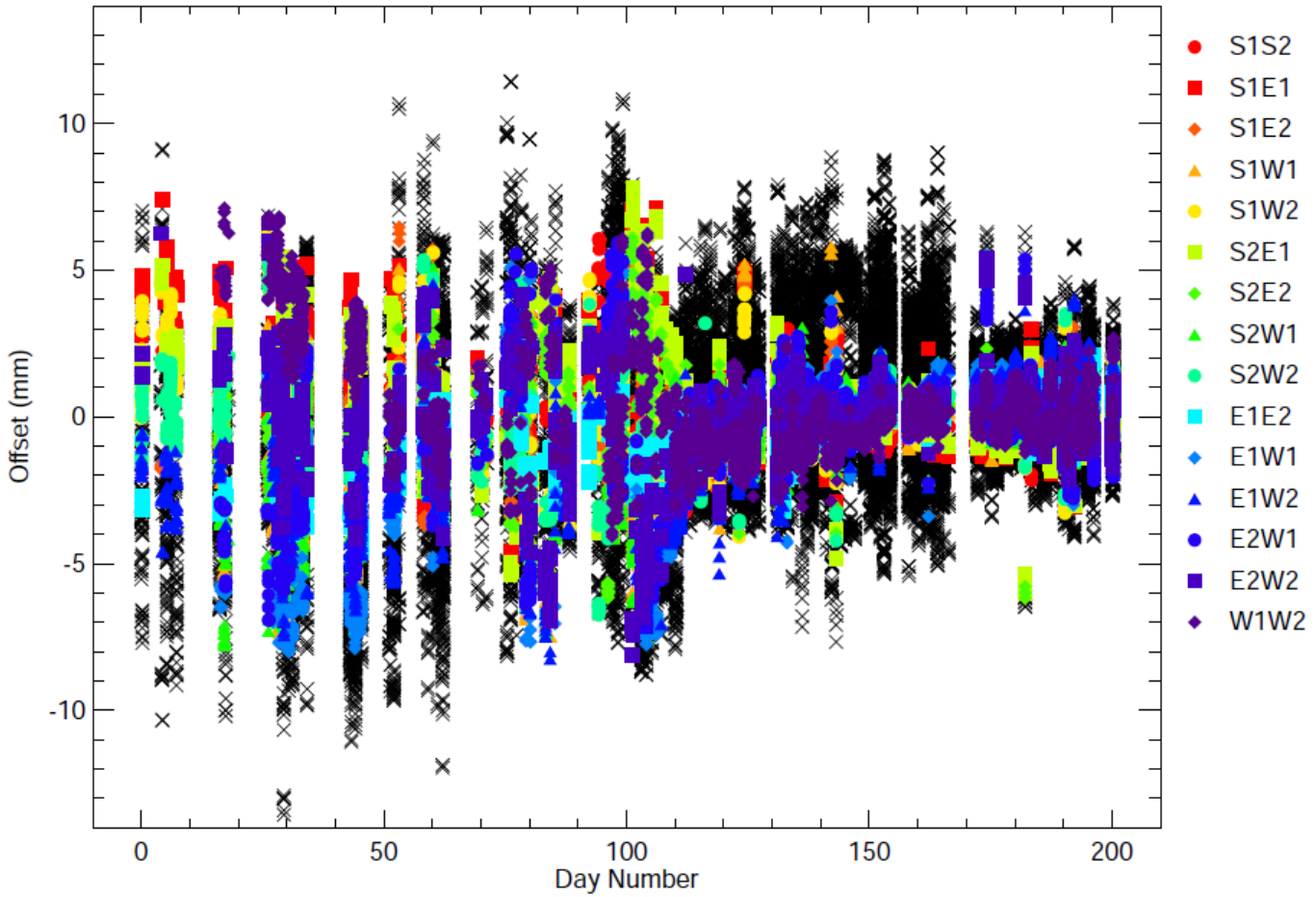
# New Baseline Solution Code




Residual offsets for each baseline can be plotted against:

- Time
- Elevation
- Azimuth

# New Baseline Solution Code

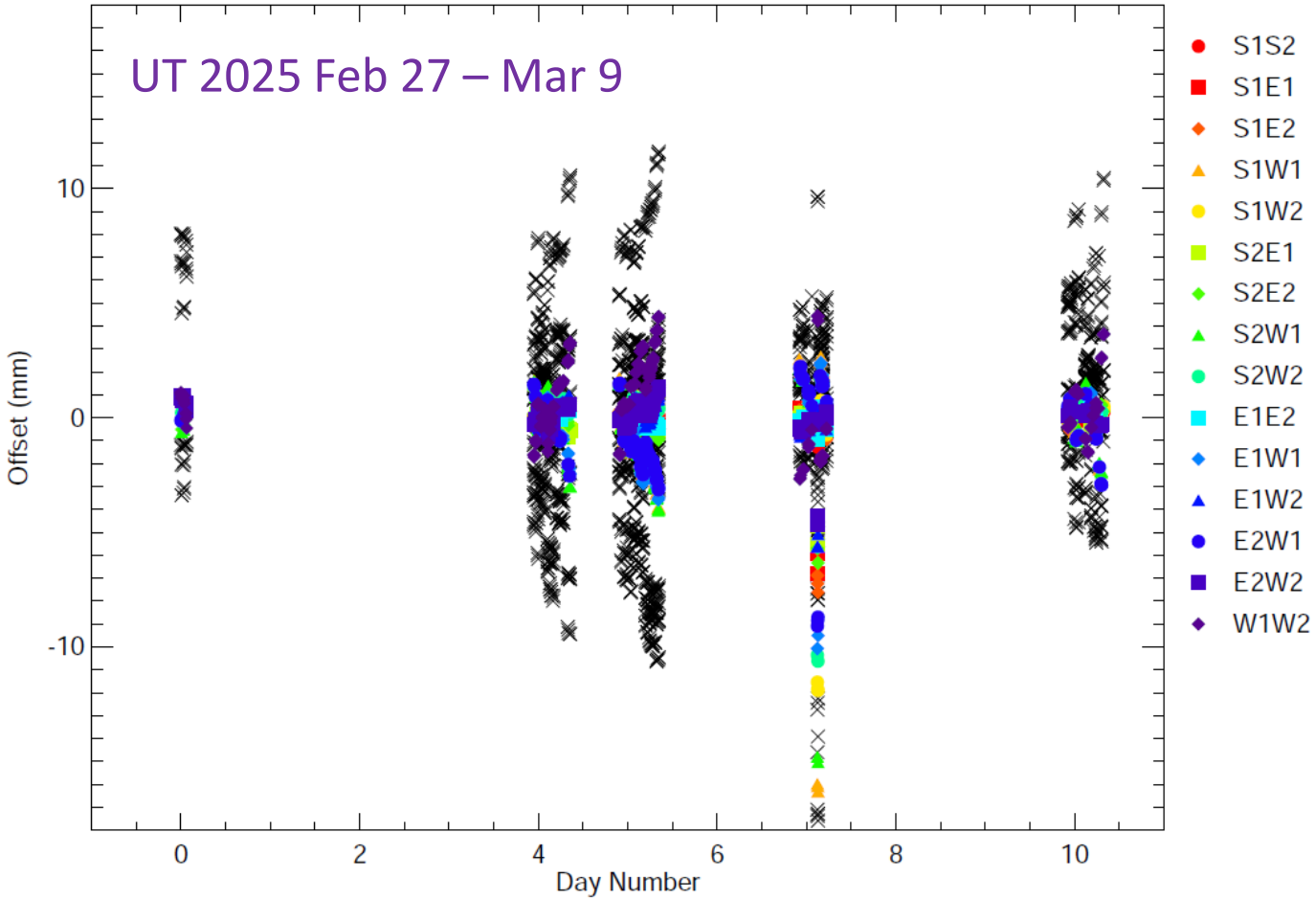



## UT 2025 Feb 21 – Sep 9

Residual from the fit to the baseline solution.

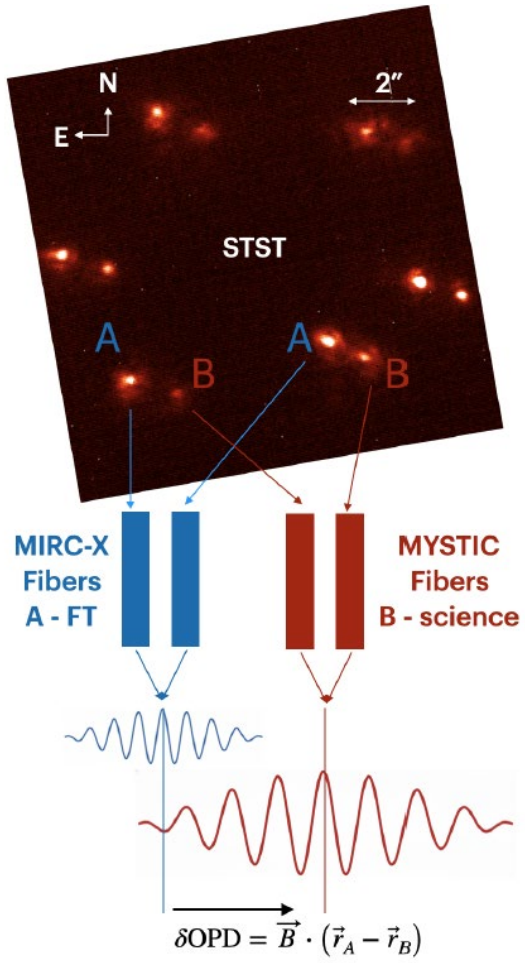
Black crosses indicate the offset measured on sky using the baseline solution in use at that time.

# Baseline Solution This Year

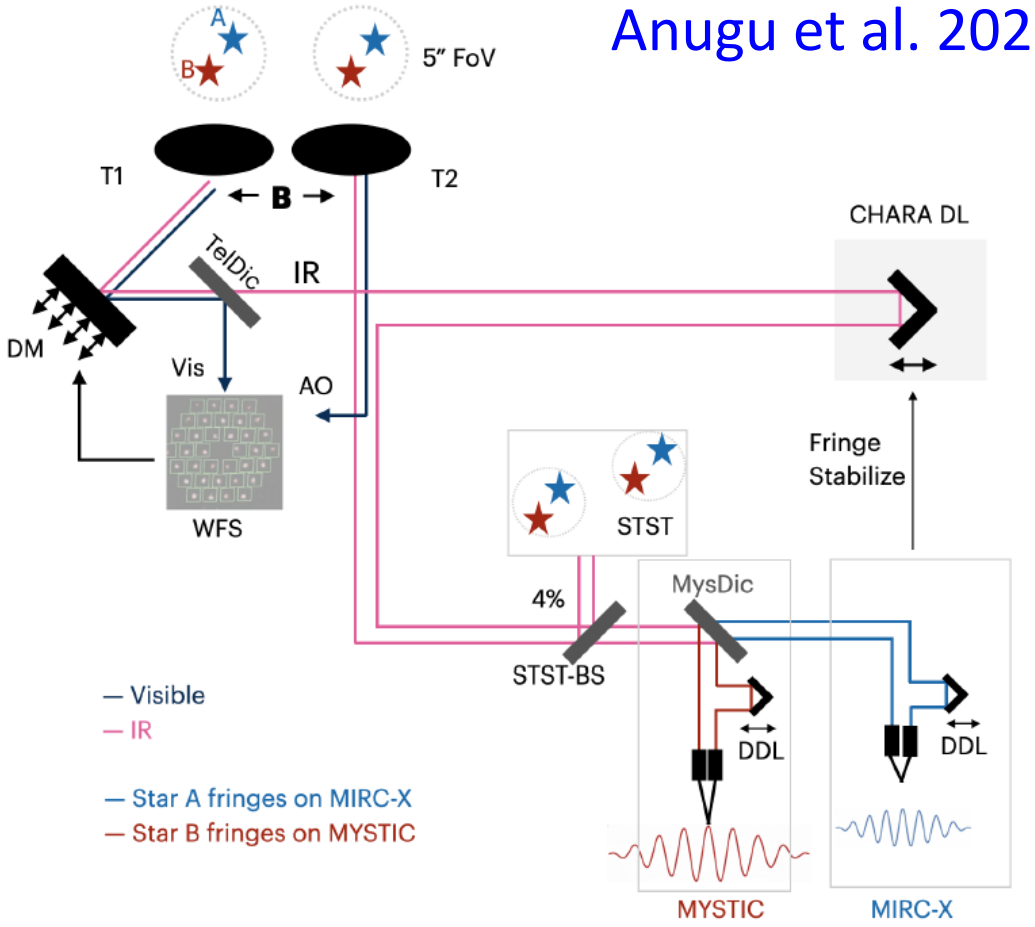



- Start of year usually plagued with large offsets that trend quickly with hour angle until enough data is collected.
- New code
  - High weight for recent data with sparse coverage
  - Progressively lower weights for data from last year to improve sky and POP coverage
- Offsets already within ± 1.5 mm

# New Dual Field Mode Commissioned



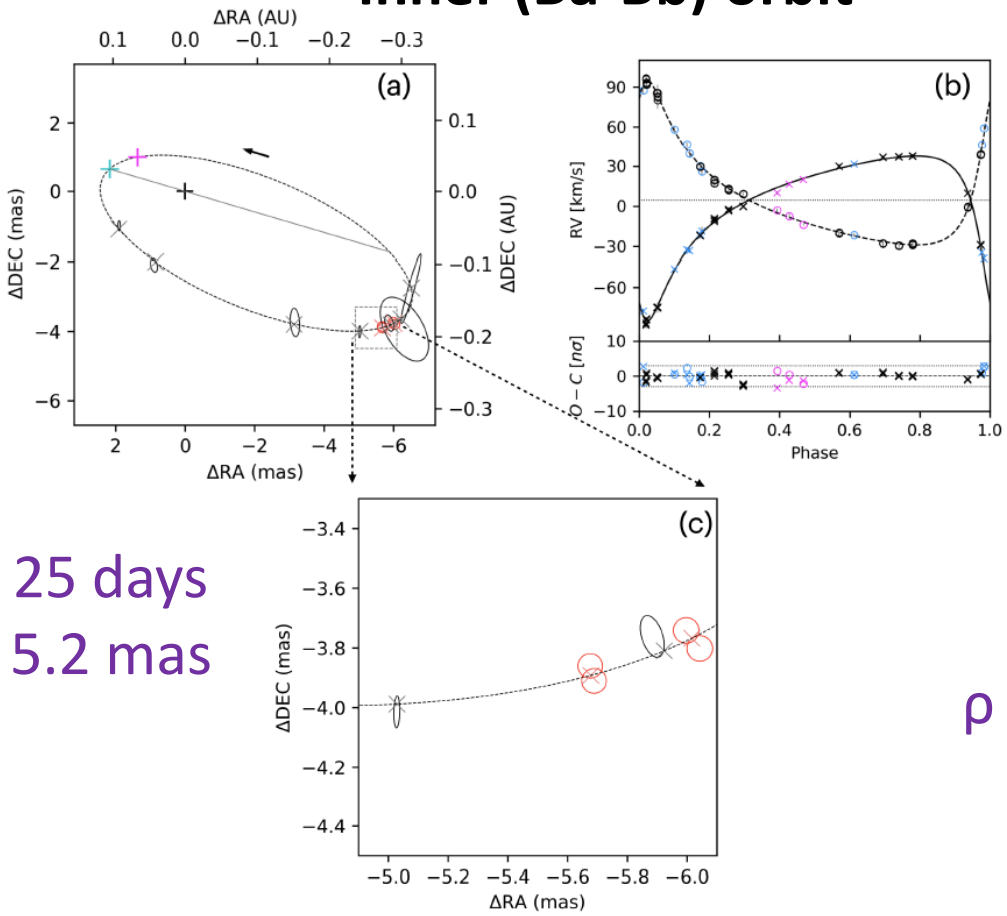

Anugu et al. 2026, AJ



# New Dual Field Mode Commissioned

## First Demonstration: Hierarchical Triple α Piscium

### Inner (Ba-Bb) orbit

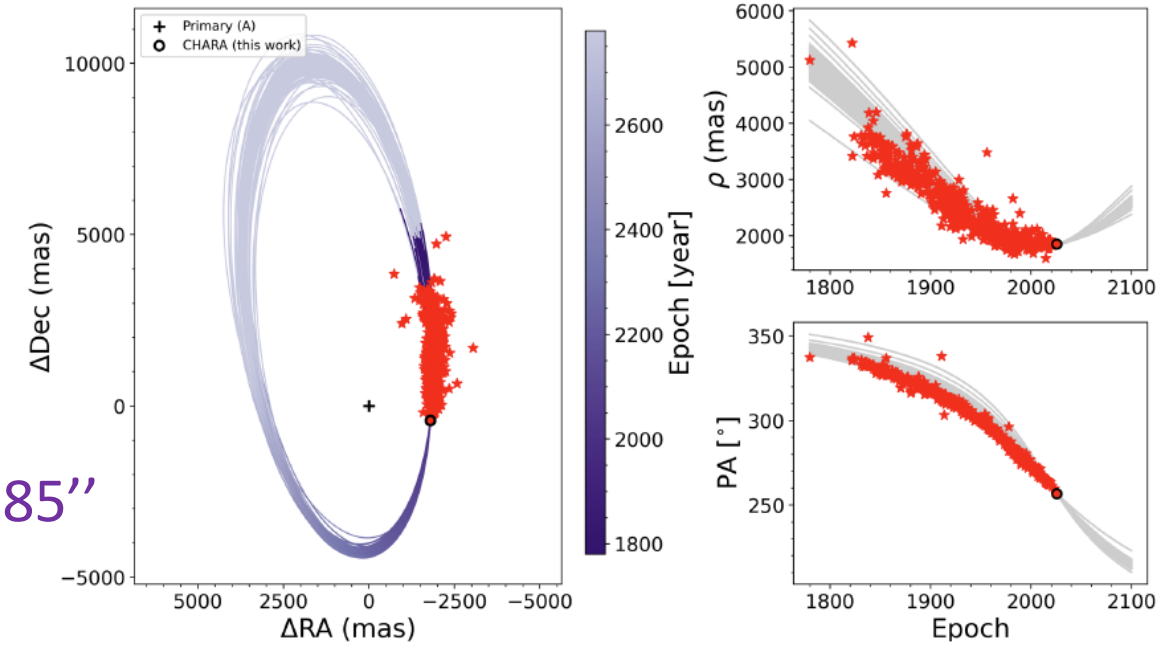



P = 25 days

a = 5.2 mas

Anugu et al. 2026, AJ

### Outer (A-B) orbit



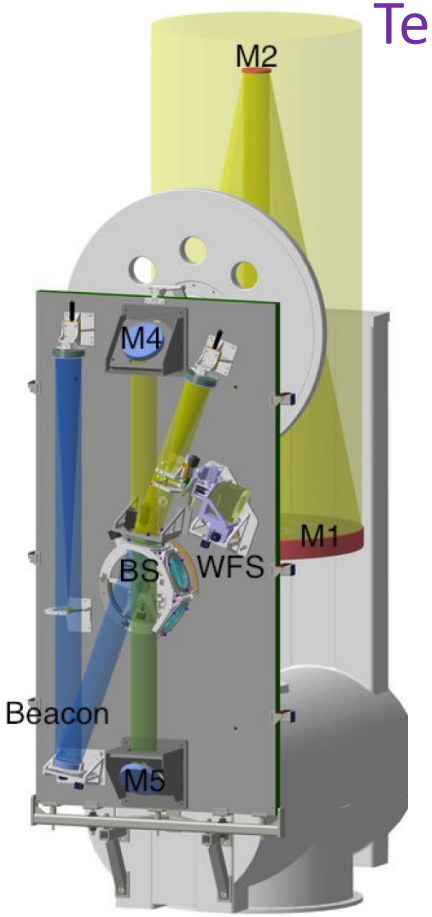

ρ = 1.85”

# Multi-Spectral Band Advances

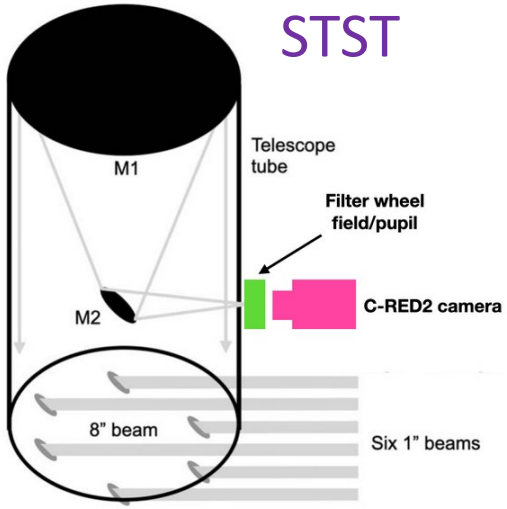
## NSF Major Research Instrumentation Track 1 ($1.4M)

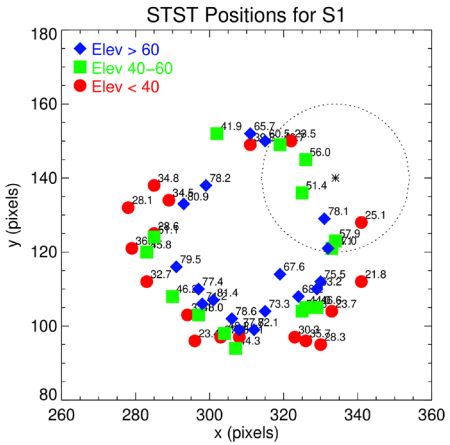
- Upgrade the dichroic beam splitters in AO systems at telescopes
  - Minimize dispersion between visible and IR light transported to lab
  - Simultaneous recording in R, H, K with SPICA, MIRC-X, and MYSTIC
  - Expect to install Jan-Feb 2027
- Upgrade detector in the Six Telescope Star Tracker (C-RED One)
  - Extend recent improvements in alignment and guiding stability to fainter targets
  - Currently working on design of reimaging optics and filter bandwidth for Star Tracker
  - Expect to install Jan-Feb 2028

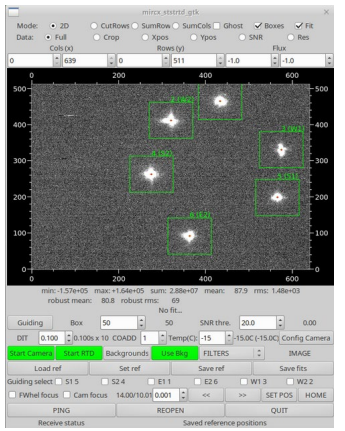
TelAO




STST



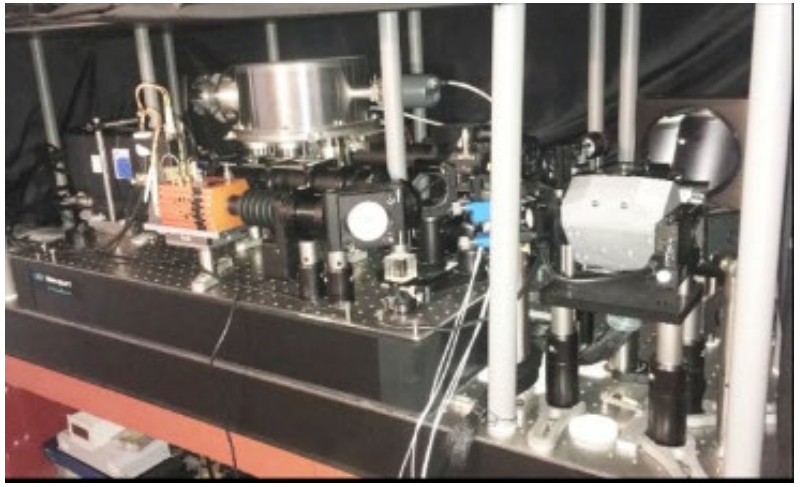



# Future Priority: Next Generation AO

## Optimized AO Performance at Visible Wavelengths

- Identified as highest priority during future planning meeting organized by Nic Scott – July 8, 2025
- Goal: Achieve Strehl ratio of 50% at 600 nm in median seeing conditions ($r_0$ ~ 7 cm)
- Funding opportunity:
  NSF Mid-Scale Research Infrastructure-1
  - Preliminary proposals due Sept 1, 2026
- SPICA team computing simulations based on AO system for 1-meter C2PU telescope at Calern

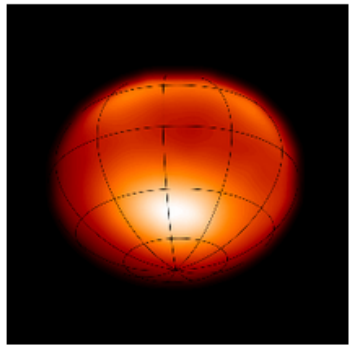
AOC Bench at Calern



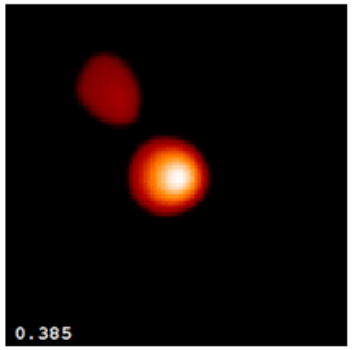
# CHARA Image Gallery

**https://chara.gsu.edu/photos-videos/image-gallery**

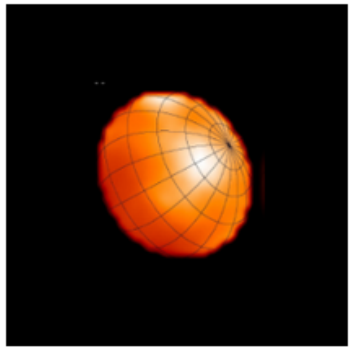
Alderamin



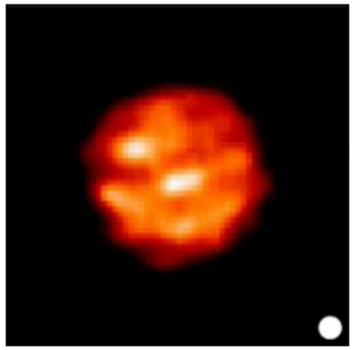
Algol



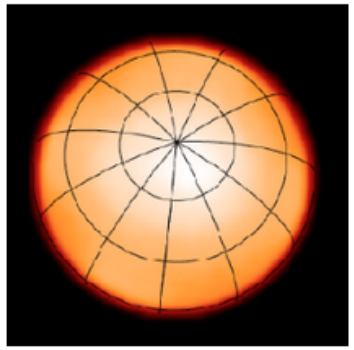

Altair



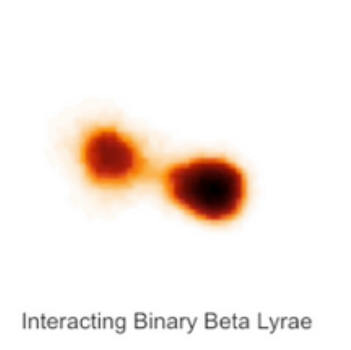
AZ Cyg



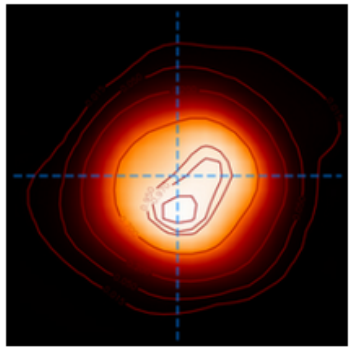
Beta Cas



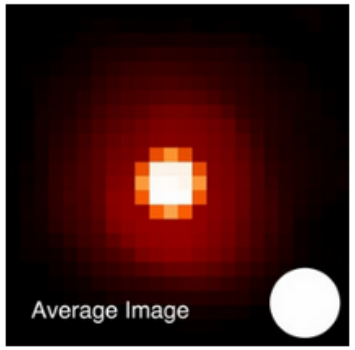
Beta Lyrae




CL Lac



Delta Sco




- 28 images
- Links with details
- Contact Gail or Jeremy to contribute images or text