Open Access and Engineering at the CHARA Array

Gail Schaefer

CHARA Array of
Georgia State University

Observing Opportunities at CHARA

- Internal Time
  - Researchers at institutions that are part of the CHARA Collaboration

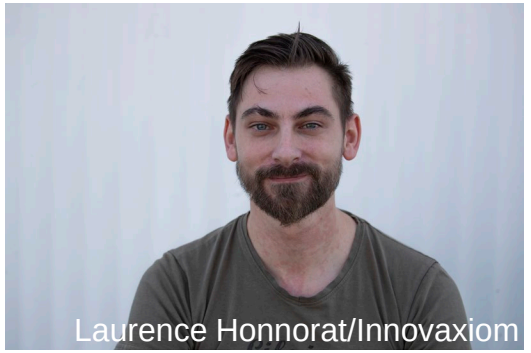
Observing Opportunities at CHARA

- Open Access Time
  - Supported by National Science Foundation: Mid-Scale Innovations Program
  - Open to the broader astronomical community
  - UPDATE: Non-GSU members of the CHARA collaboration can apply, but we ask that you do not submit the same proposal to both TACs
- Currently offer 45 nights per semester to the community
  - Expand up to 50 night
- Open Access Time offered through NOIRLab
  - Semester A (Feb – Jul): due end of September
  - Semester B (Aug – Dec): due end of March

Support for Open Access Time

- CHARA staff can assist new users:
  - Developing science programs
  - Planning observations
- Open access observations conducted by CHARA staff
  - Investigators encouraged to participate in-person or remotely
  - Travel funds available
  - Users with prior experience can take observations
- CHARA provides calibrated OIFITS files
  - Reduction pipeline available on remote data reduction machine

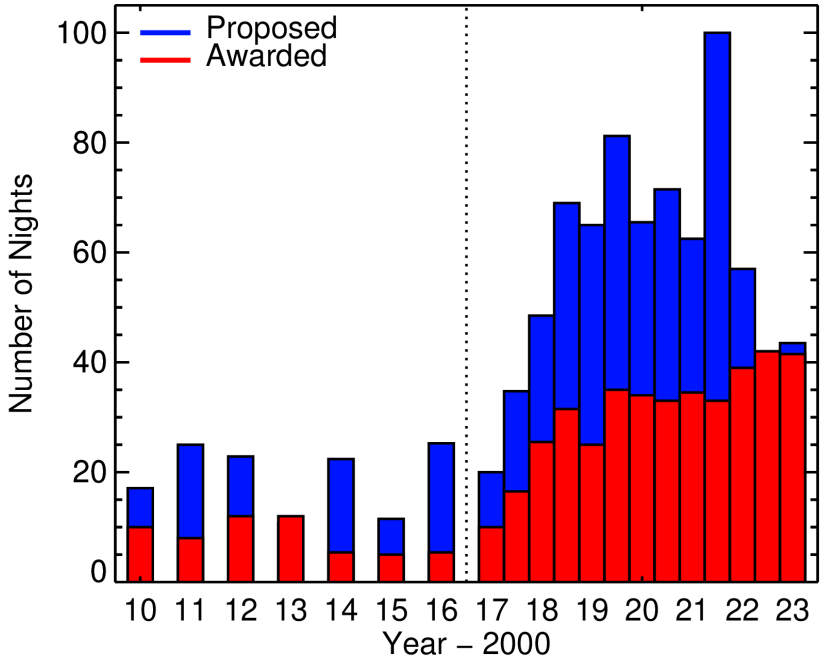
Visitor Support Scientist:
Cyprien Lanthermann

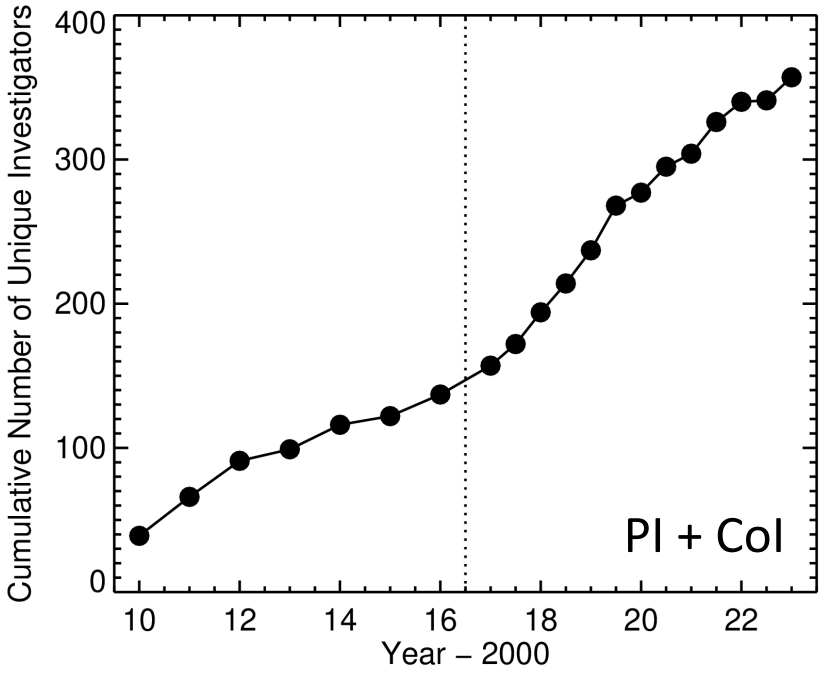


Data Scientist:
Jeremy Jones

Open Access Statistics

- Average over-subscription rate ~ 2
- Over 350 astronomers applied for open access time

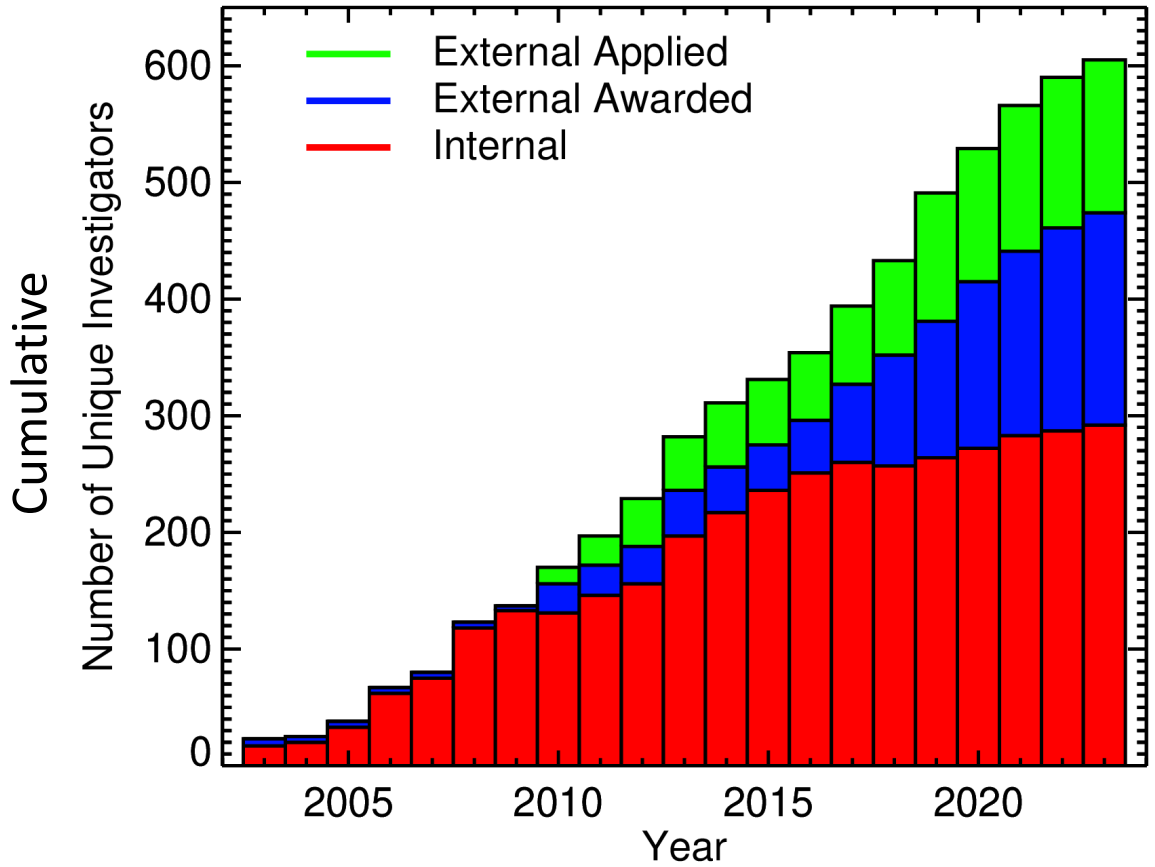




Open Access Observers Presentations at 2023 CHARA Meeting

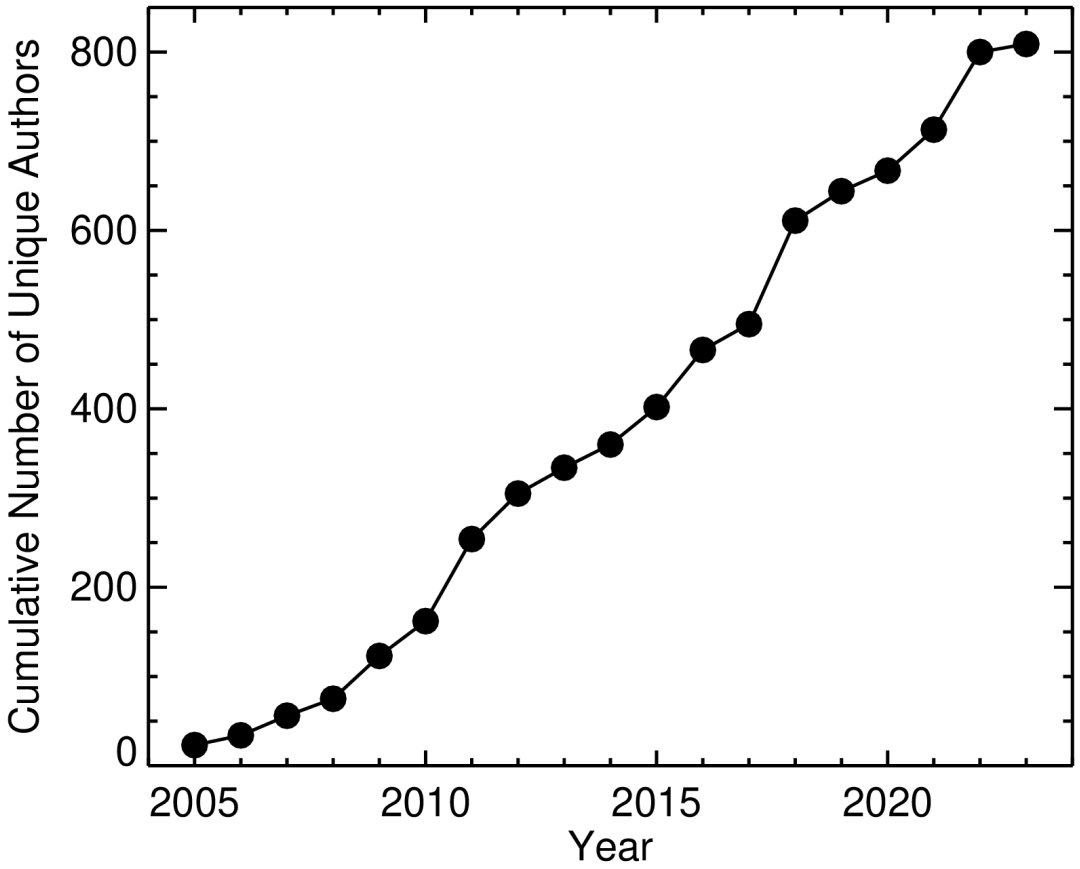
- Matthew DeFurio – A-Star Multiplicity
- Ashley Elliot – Exoplanet Host Stars
- Muhammed Zain Mobeen – Stellar Merger Remnant
- Ryan Norris – Evolved Stars
- Rachael Roettenbacher – Spotted Stars
- Eric Sandquist – Age Calibration in Nearby Clusters
- Willie Torres – Orbits and Masses in Castor System

Comparison of Internal and External CHARA Observers



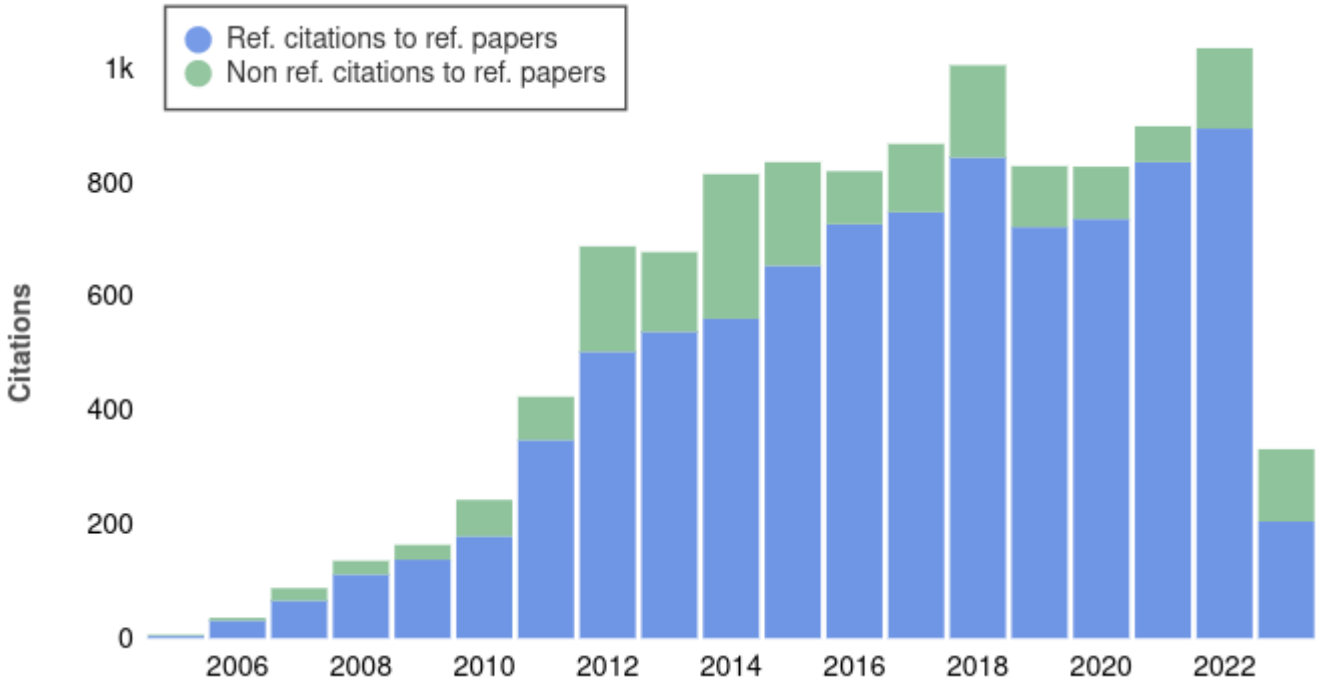
CHARA Publications

- 238 refereed publications based on CHARA data
- Over 800 unique coauthors!



CHARA Publications

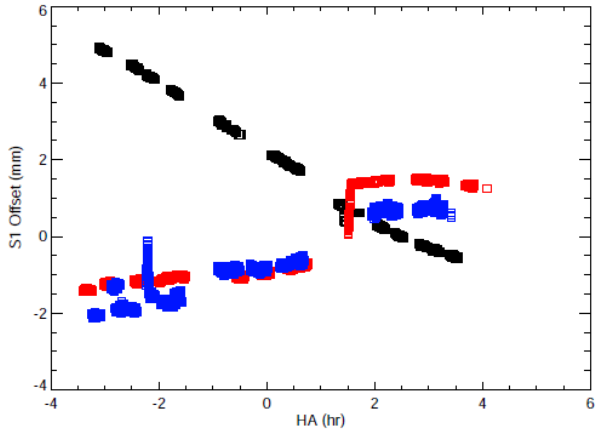
- 238 refereed publications based on CHARA data
- Over 800 unique coauthors!
- 5900 citations in refereed papers

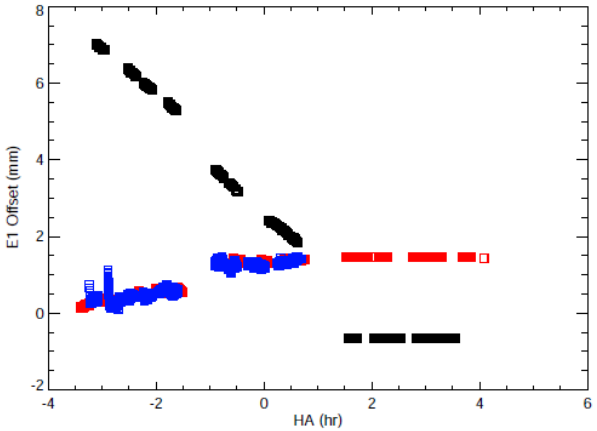


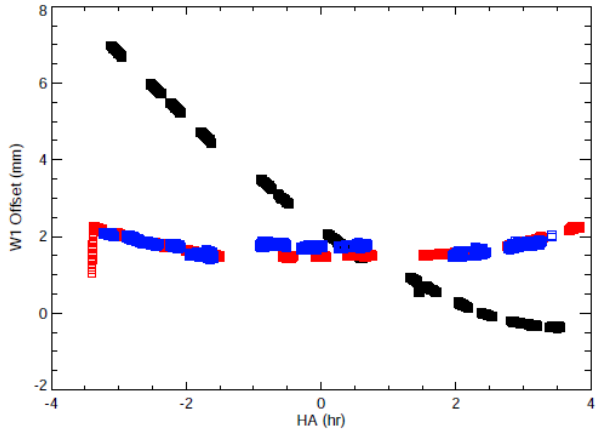
Engineering Time at the CHARA Array

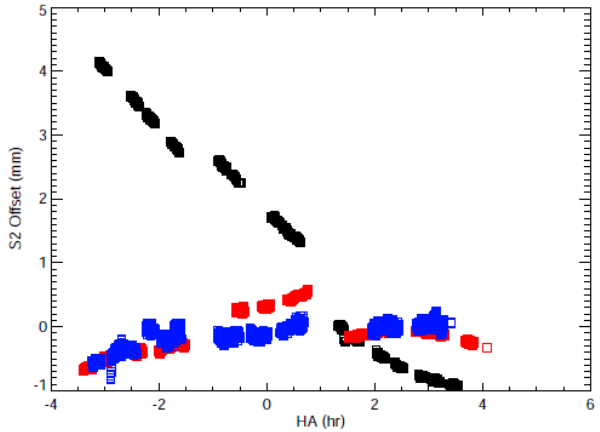
- First half of Wednesday nights
- Test new software developments
- Investigate problems reported by observers

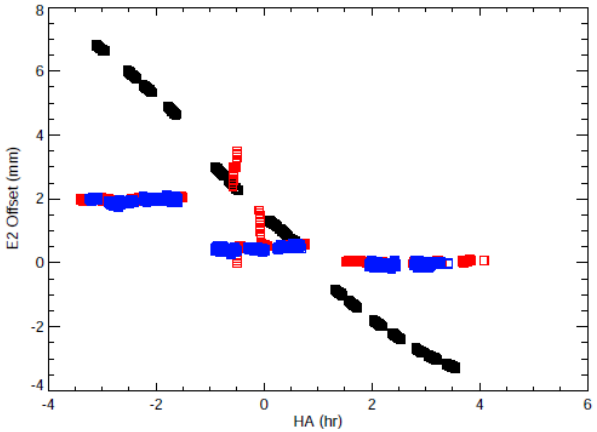
Seasonal Baseline Solutions

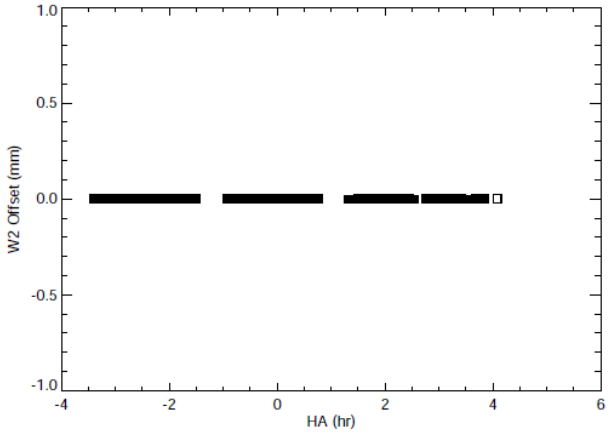












Old solution – **UT2022Apr02**

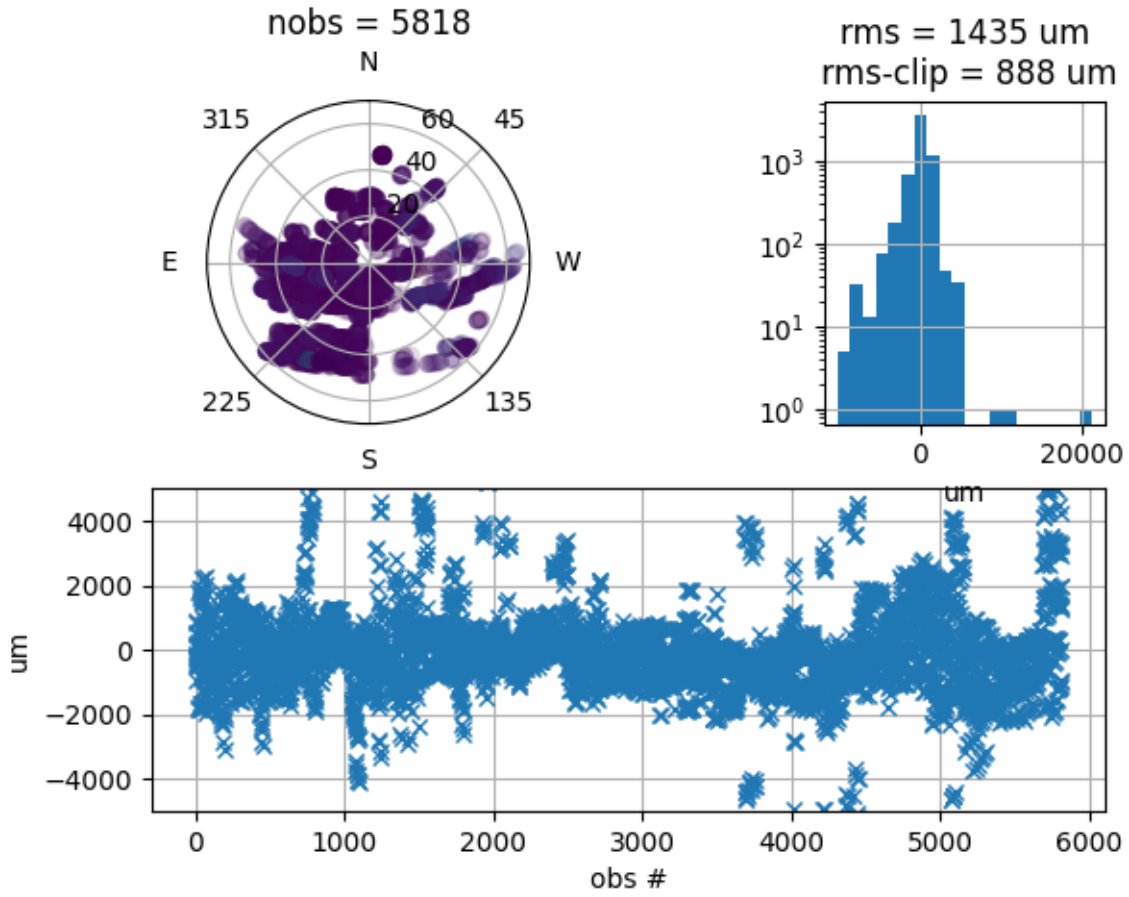
New solution – **UT2022Apr03** **UT2022Apr04**

MIRC-X offsets relative to W2

Seasonal Baseline Solutions

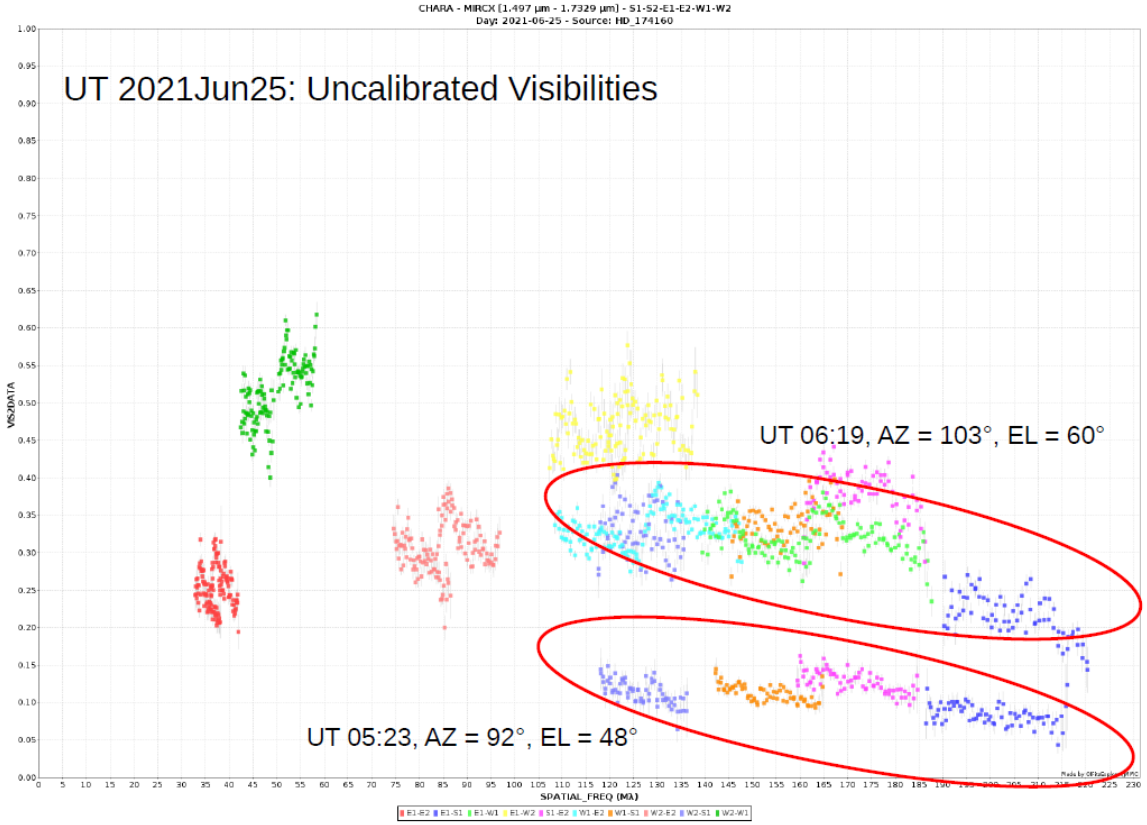
- Update the baseline solution every few months using last 2-3 months of baseline solution data
  - Minimize drifts in offsets over time
- Transition to using Aaron Labdon's python baseline solution tool:
  - https://gitlab.com/alabdon/baseline-solution-tool/-/tree/main
  - Fix beam positions. Fit telescope XYZ, LIGHT path, POPs.
- New solution created 2023Feb20 based on Dec-Nov data
  - Updated solution will be needed as temperatures warm up

Seasonal Baseline Solutions



S1 – Bad Visibility Calibration Zone

- S1 baselines show V2 miscalibration at low elevations in the east
  - Elev < 55, AZ ~ 100
- Possible link to cart vibrations – S1 moves slowly in this region of sky
  - Goes away when S1 is ref cart
- Temporary fix:
  - Use S1 as ref when observing in this part of sky
- Next step: Reproduce in lab

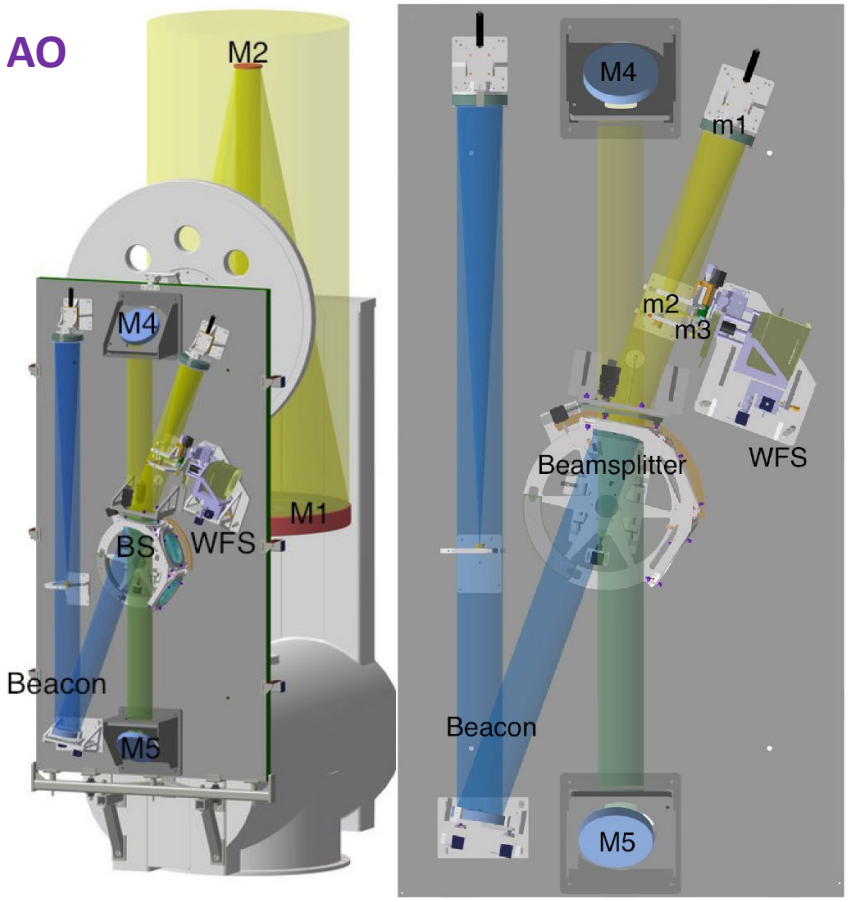


Low Flux Problems

- Low flux on S1-POP5 when pointing low in south
  - E2 and other telescopes also show intermittent low flux
- Use the Six Telescope Star Tracker to help diagnose problem
  - See John Monnier's talk

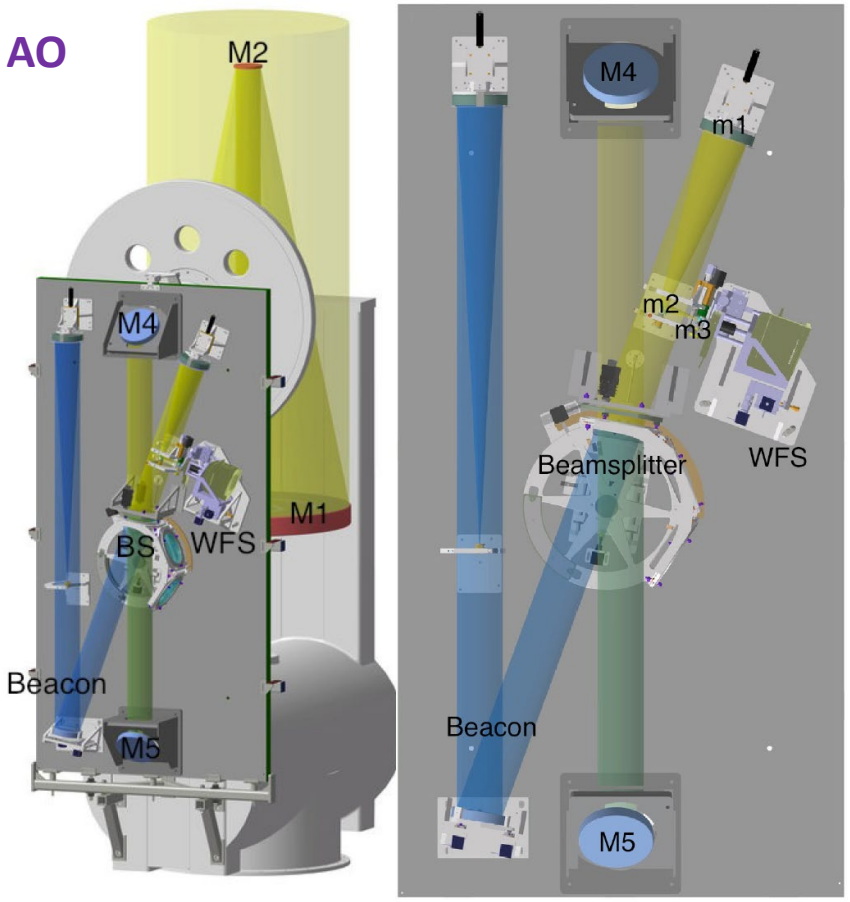
Low Flux Problems –
Standard Alignment Sequence

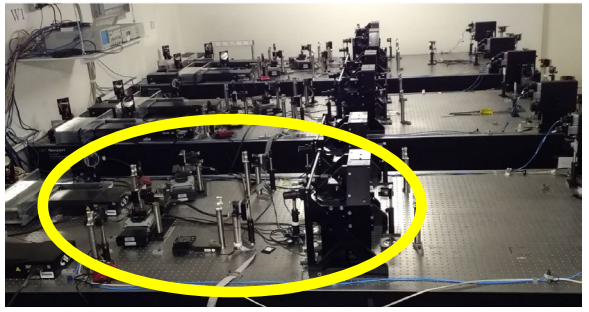
Telescope AO



Low Flux Problems –
Standard Alignment Sequence

Telescope AO

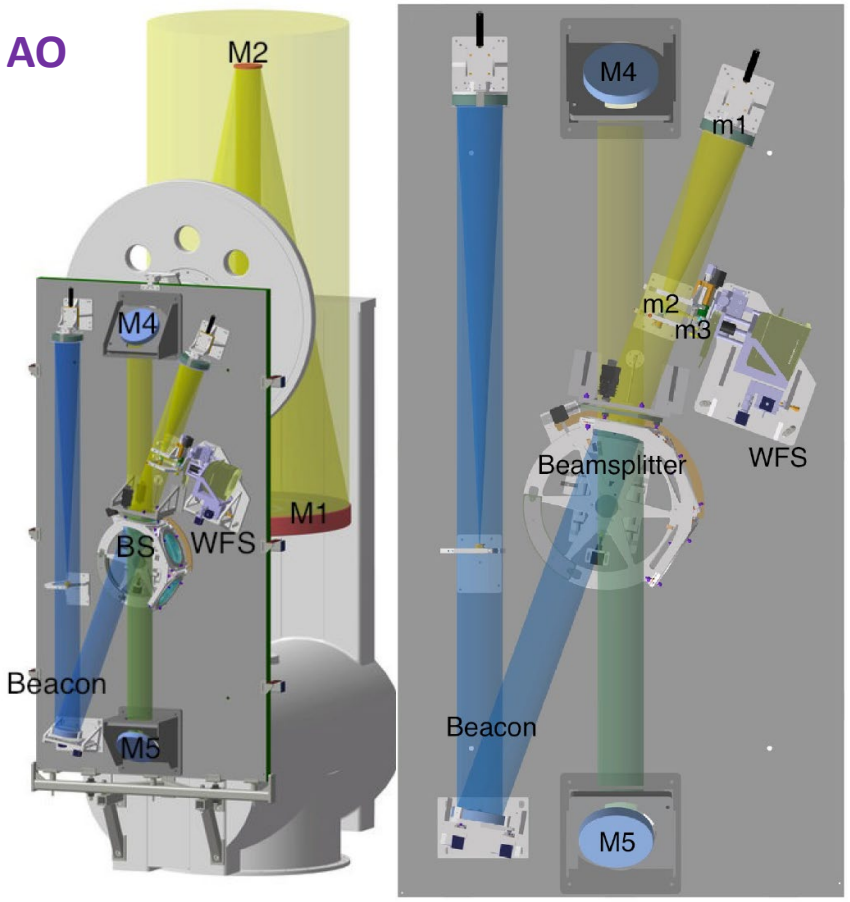




Lab AO

Low Flux Problems –
Standard Alignment Sequence

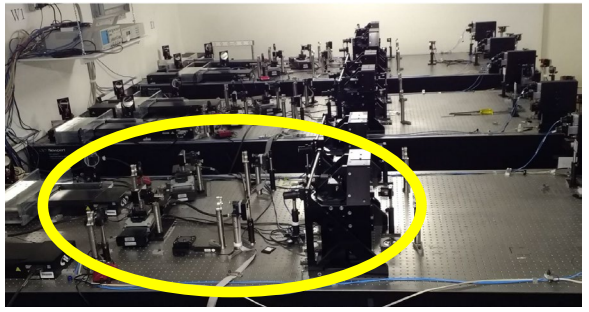
Telescope AO



Standard Alignment

Red Beacon:
Align beacon flat mirror to telescope WFS

Blue Beacon:
Align dichroic to labAO WFS

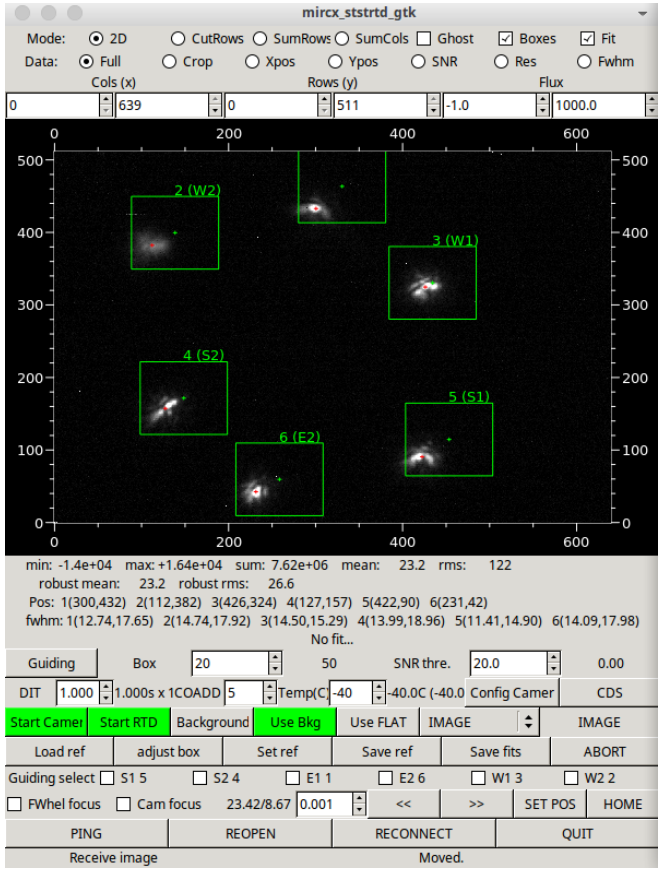


Lab AO

Low Flux Problems -
IR Light Offset in lab Compared with Visible

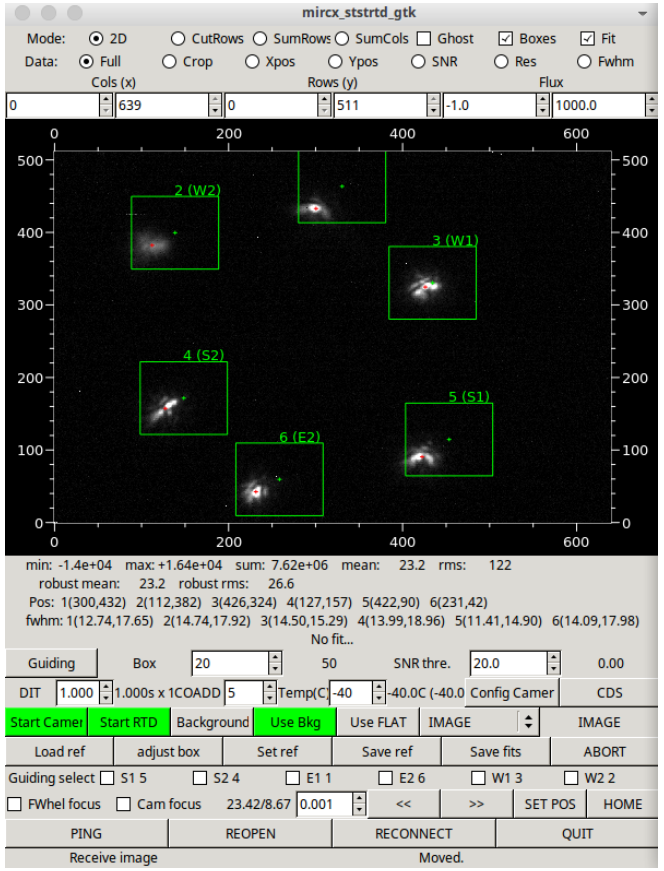
- In December, Norm and Narsi found that aligning the IR starlight to the Star Tracker reference positions improved mircx/mystic flux

Standard Alignment

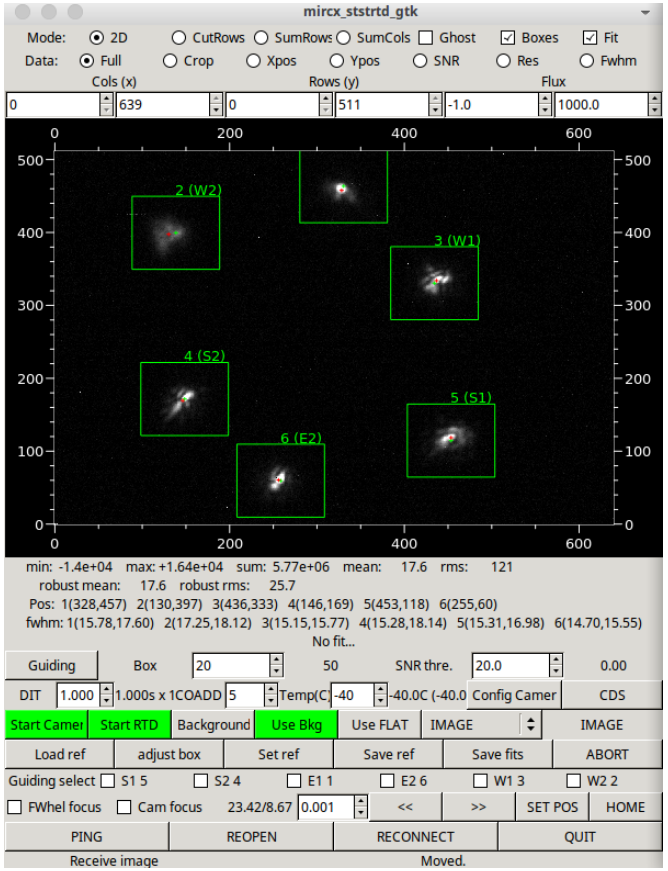


Low Flux Problems -
IR Light Offset in lab Compared with Visible

Standard Alignment



Beacon Flat Alignment



- Move beacon flat to align IR light to the IR Star Tracker
- This misaligns the red beacon and starlight but improves throughput to IR science combiner

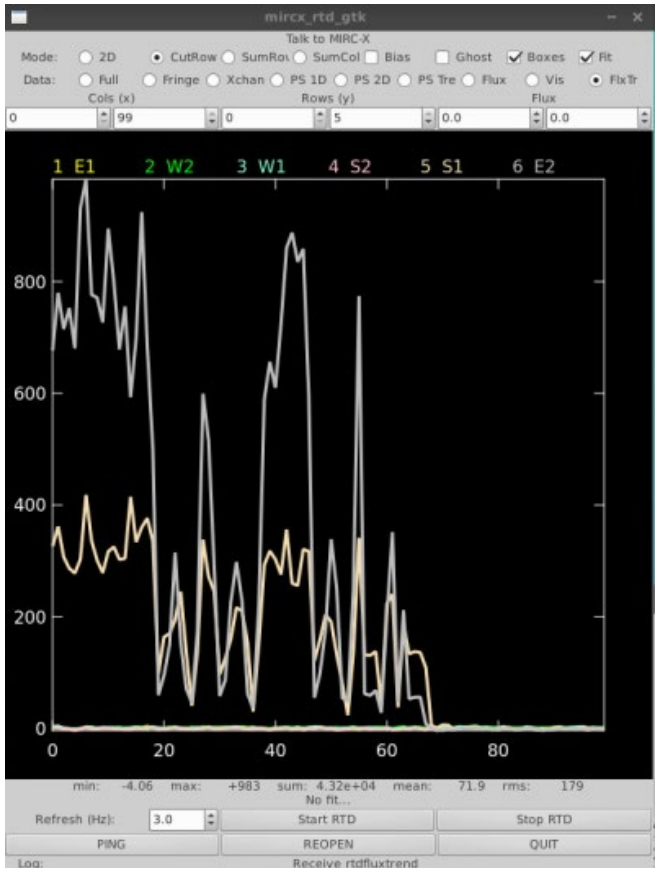
New Alignment Sequence

MIRC-X Fluxes

Standard Alignment

E2 Flux →

S1 Flux →



New Alignment Sequence

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Standard Alignment

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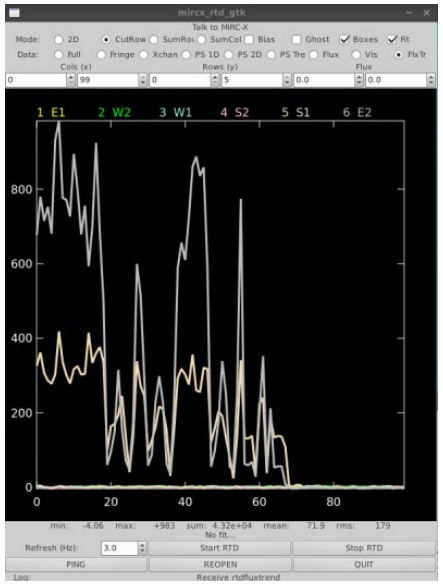


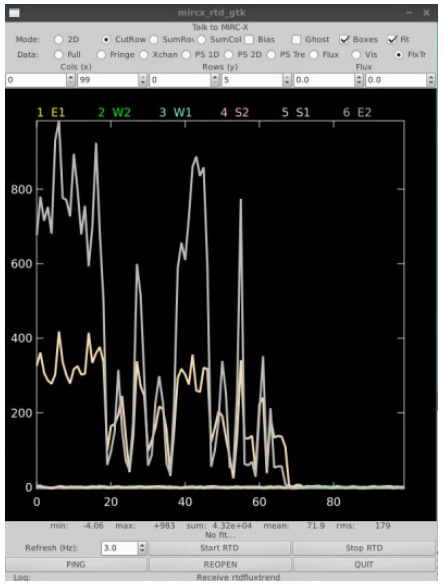
New Alignment Sequence

MIRC-X Fluxes

Standard Alignment

E2 Flux

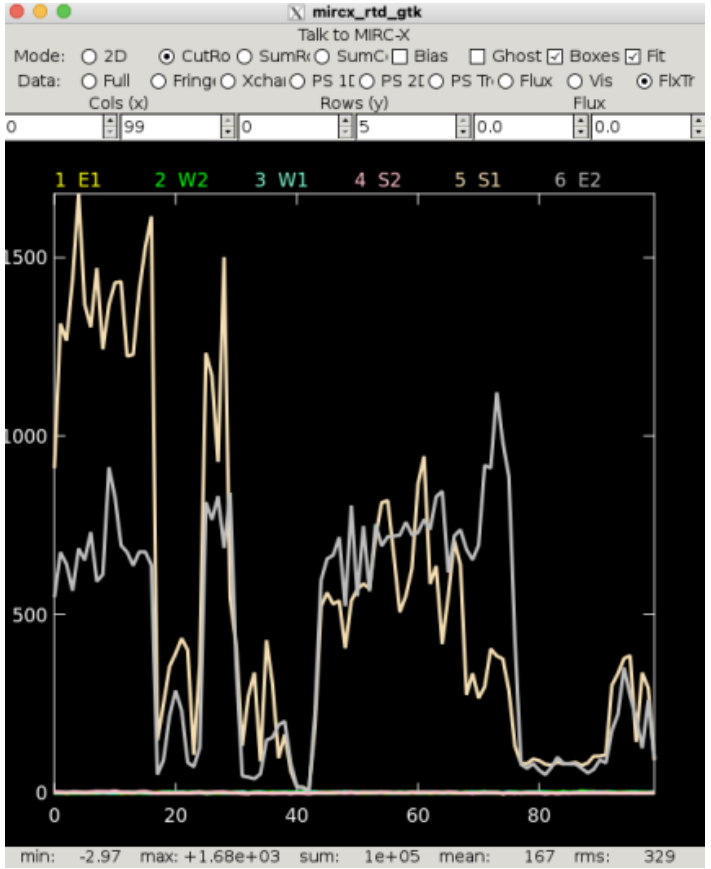
S1 Flux



Beacon Flat Alignment

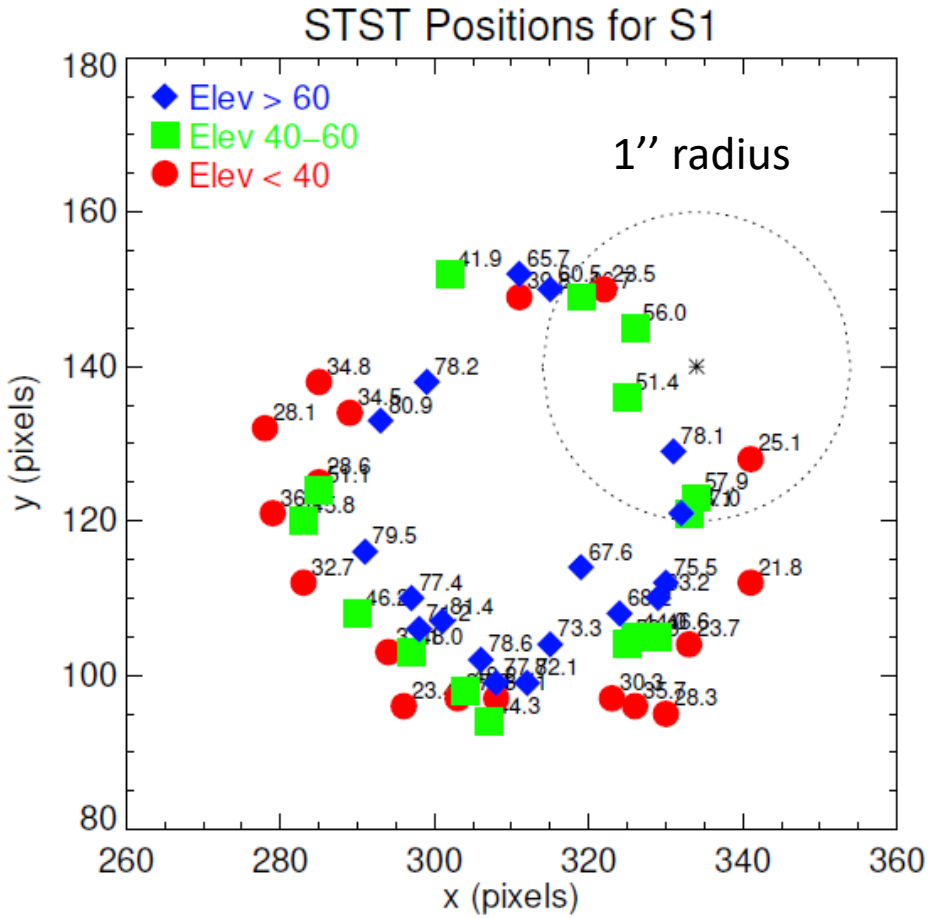
S1 Flux

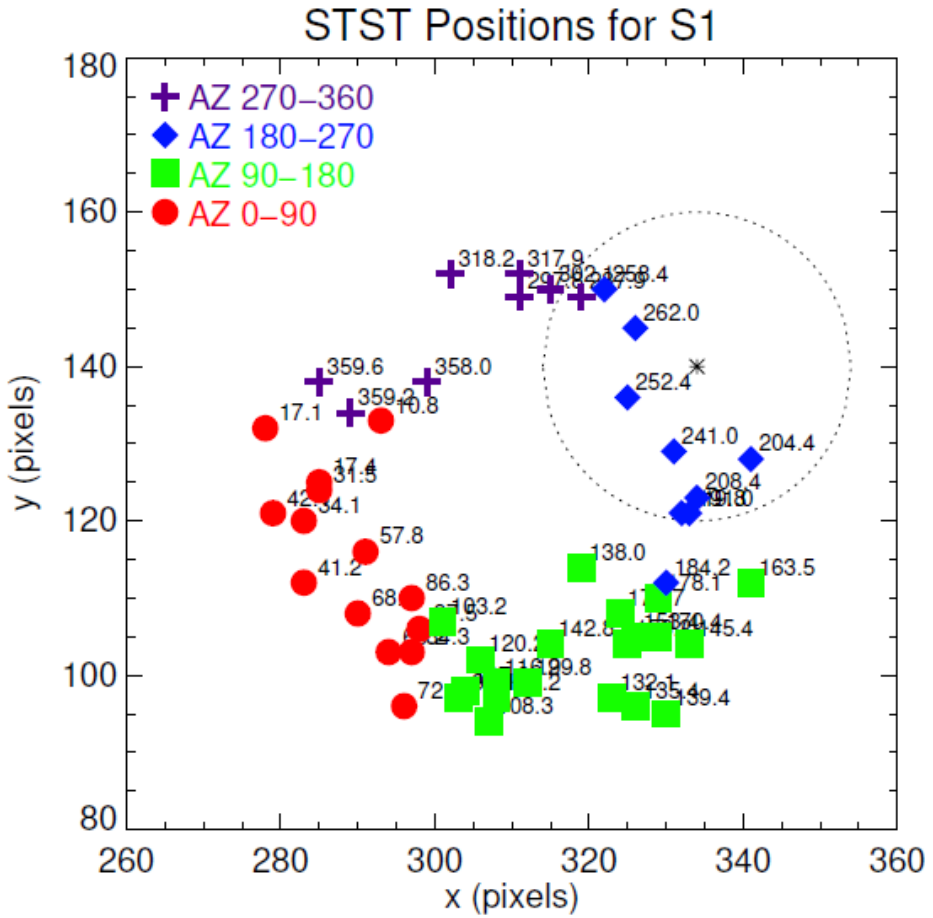
E2 Flux



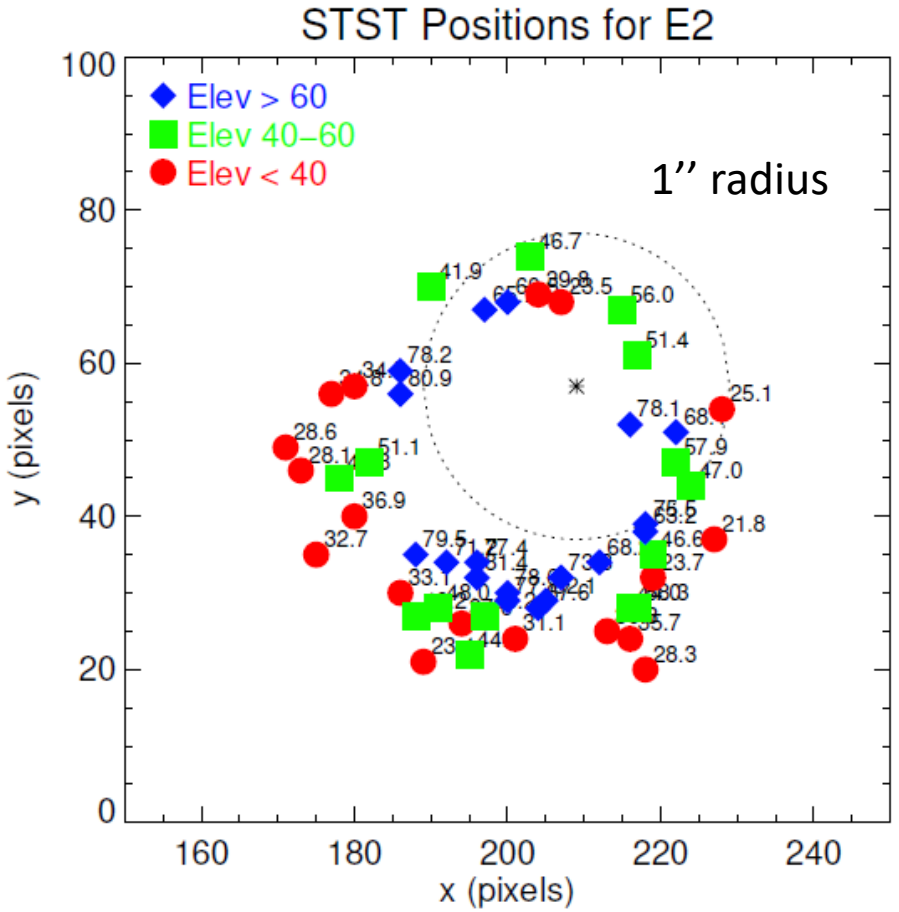
3x S1 Flux

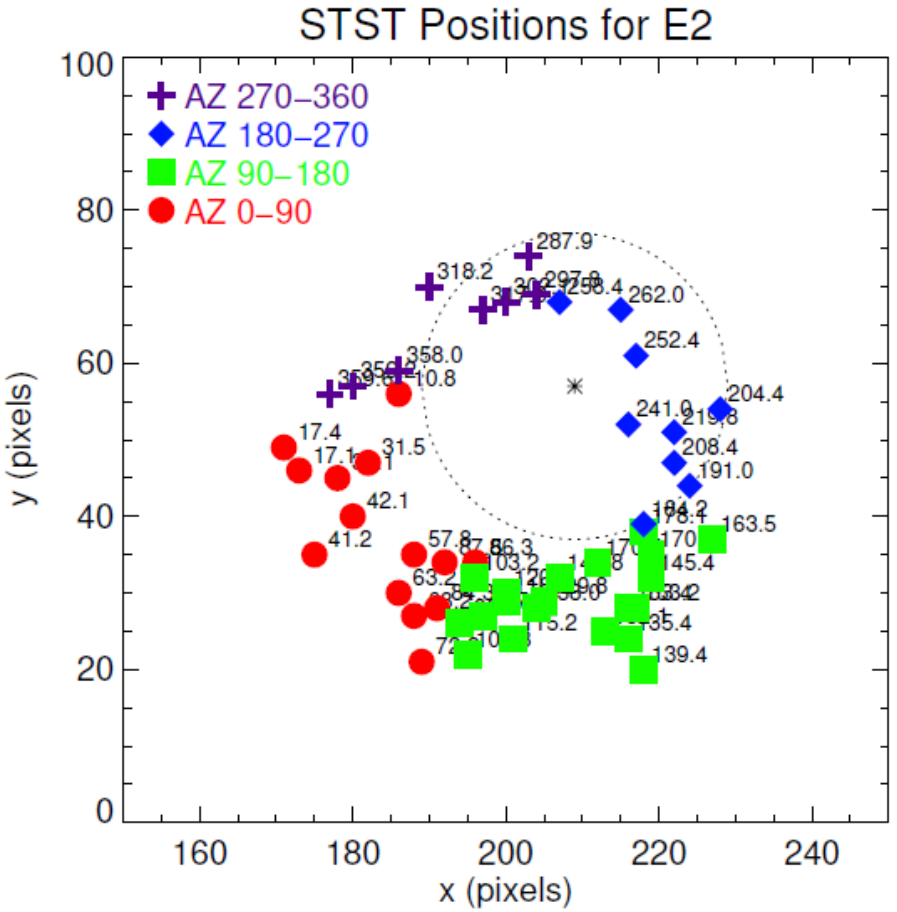
IR Position Offsets – S1



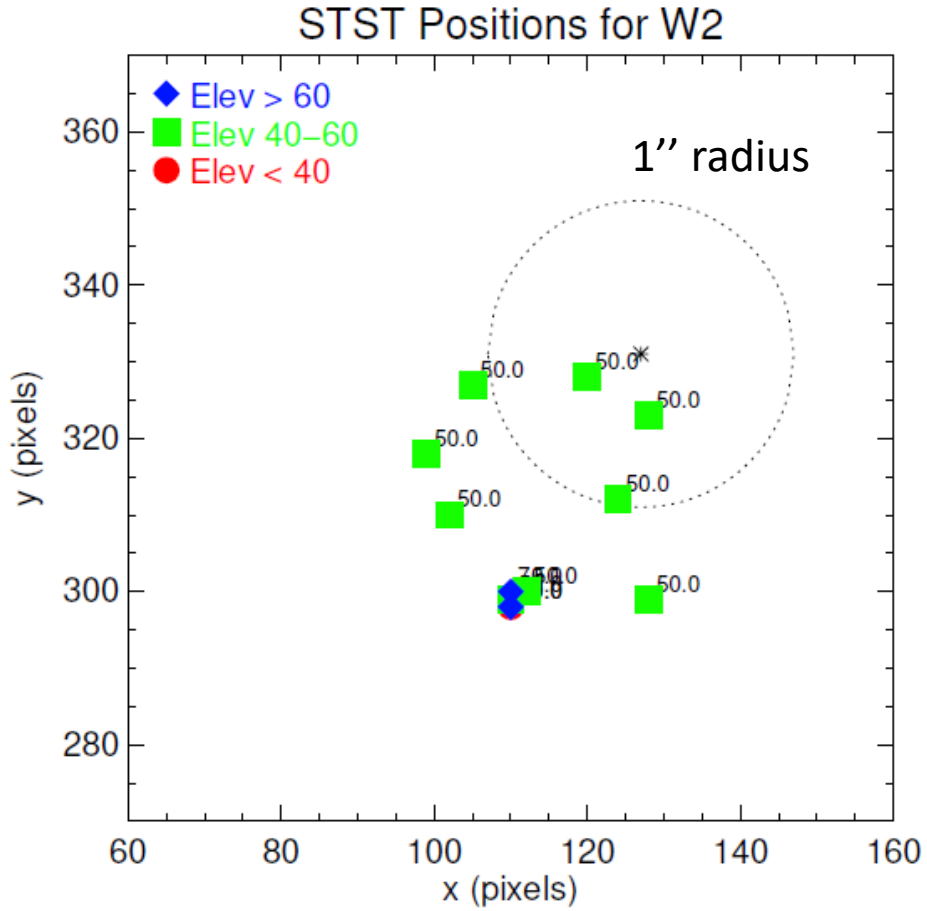


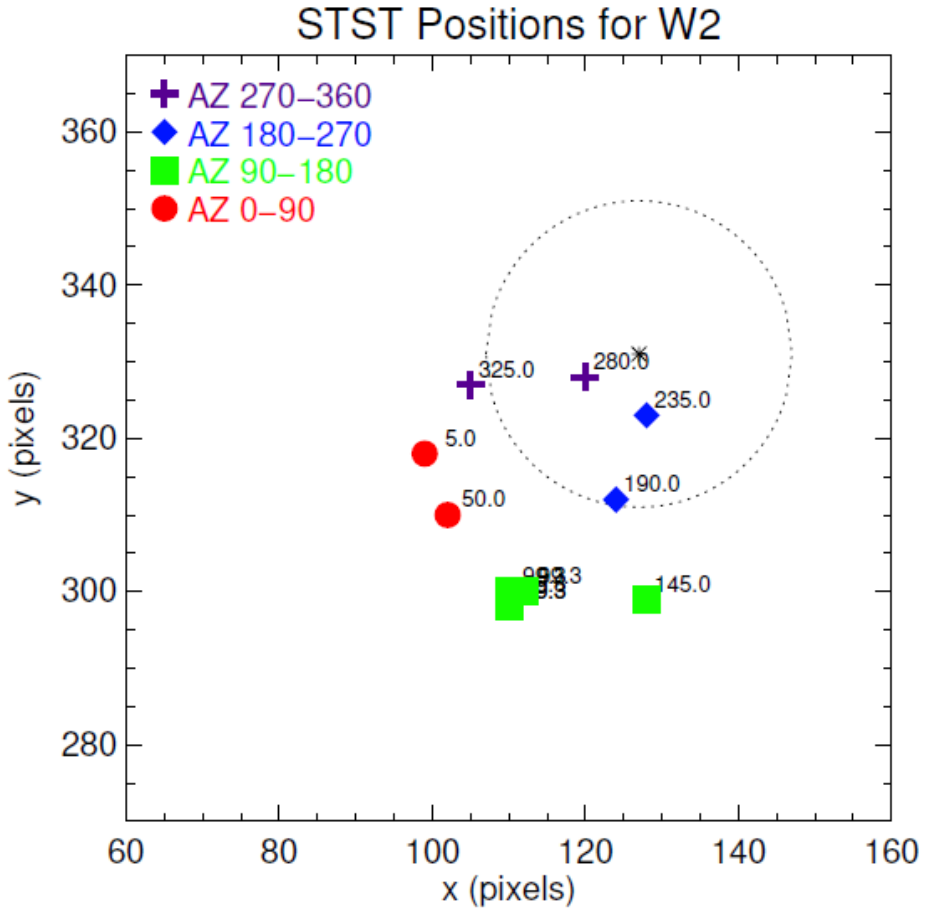
IR Position Offsets – E2





IR Position Offsets – CalSource

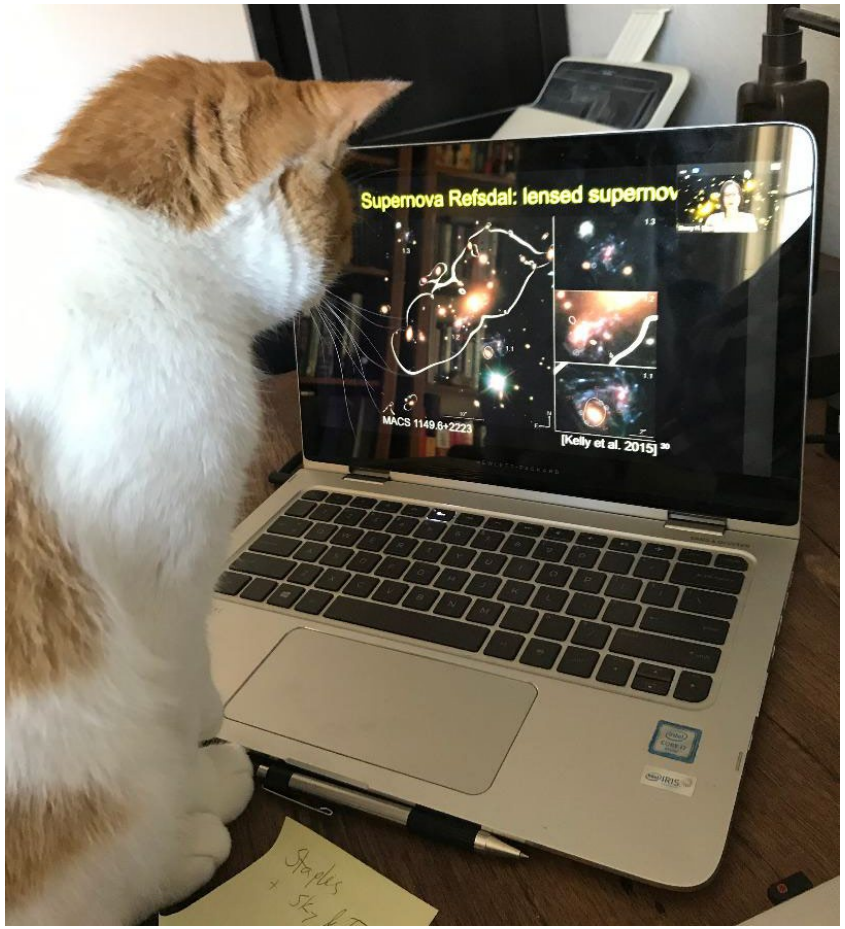




Misalignment between IR vs. VIS Light

- Offset between IR and visible light rotates with azimuth (1’’)
  - Dispersion from dichroic on telescope AO bench
- Larger offsets for lower elevation stars
  - Atmospheric refraction
- Static offset
  - Vacuum windows?
  - Other yet to be identified source?
- New alignment sequence
  - Move beacon flat to center IR light in lab using the 6T Star Tracker

Summary



- Expanding participation in the community through the CHARA open access program
- Continued engineering time to test new software and observing techniques to improve performance of the array.