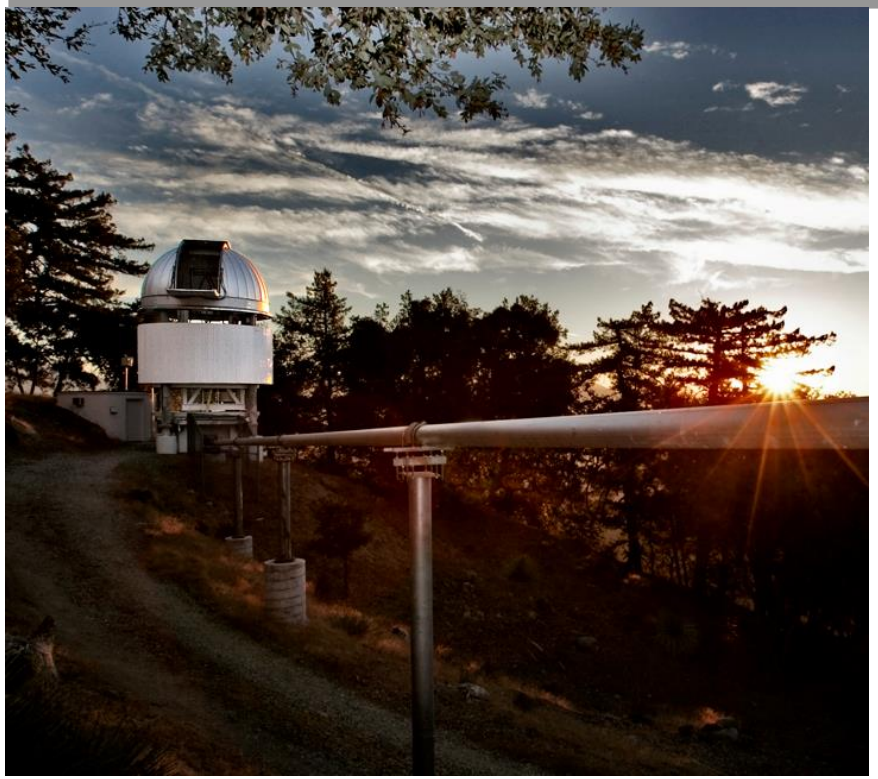
Open Access, Engineering, and Future Plans



Gail Schaefer

Director of the CHARA Array
Georgia State University

Open Access at the CHARA Array

- Open Access Time Available through NOIRLab
  - Trial program started in 2010
  - Supported by National Science Foundation since 2017 – Mid-Scale Innovations Program (MSIP)
  - Open to broader astronomical community and non-GSU collaboration members
- Offering 50 nights per semester to the community in 2024B
- Next Call for Proposals
  - Semester 2024B (Aug – Dec): due April 1st
  - Semester 2025A (Feb – Jul): due end of September

Support for Open Access Time

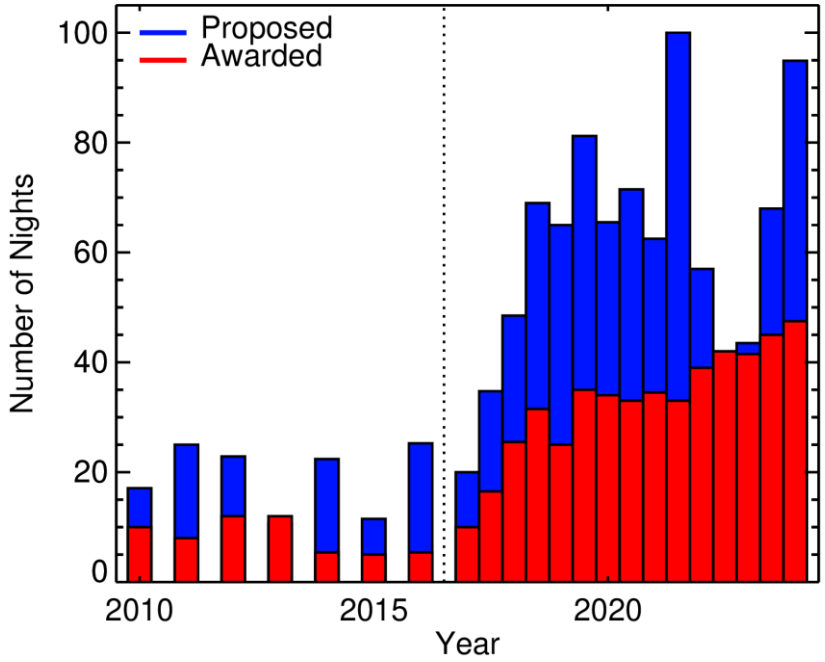
- CHARA staff can assist new users:
  - Developing science programs
  - Planning observations
- Open access observations conducted by CHARA staff
  - Investigators encouraged to participate in-person or remotely
  - Users with prior experience can take observations
- CHARA provides calibrated OIFITS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

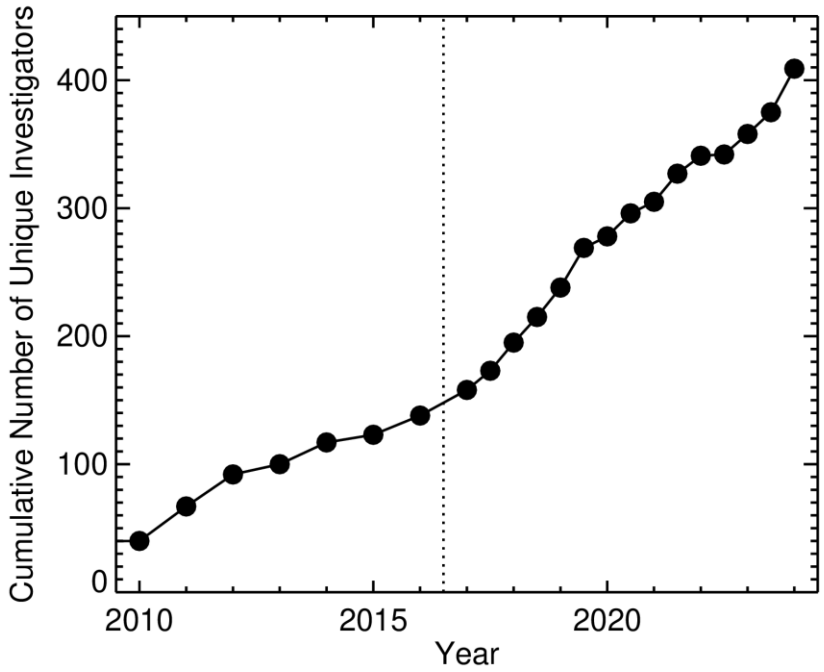
Visitor Support Scientist:
Cyprien Lanthermann

Data Scientist:
Jeremy Jones

Open Access Statistics

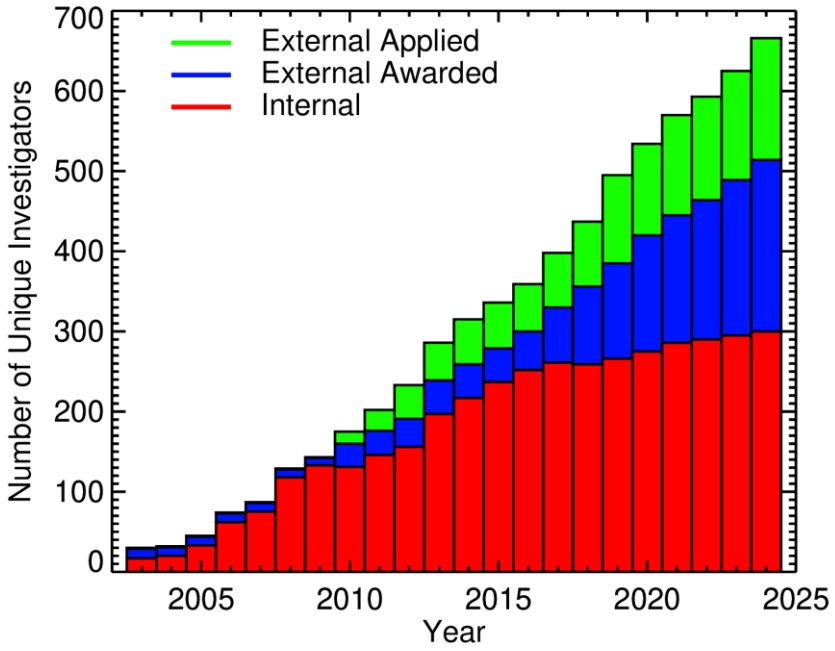
- Average over-subscription rate ~ 2
- Over 400 astronomers applied for open access time (PI+CoI)



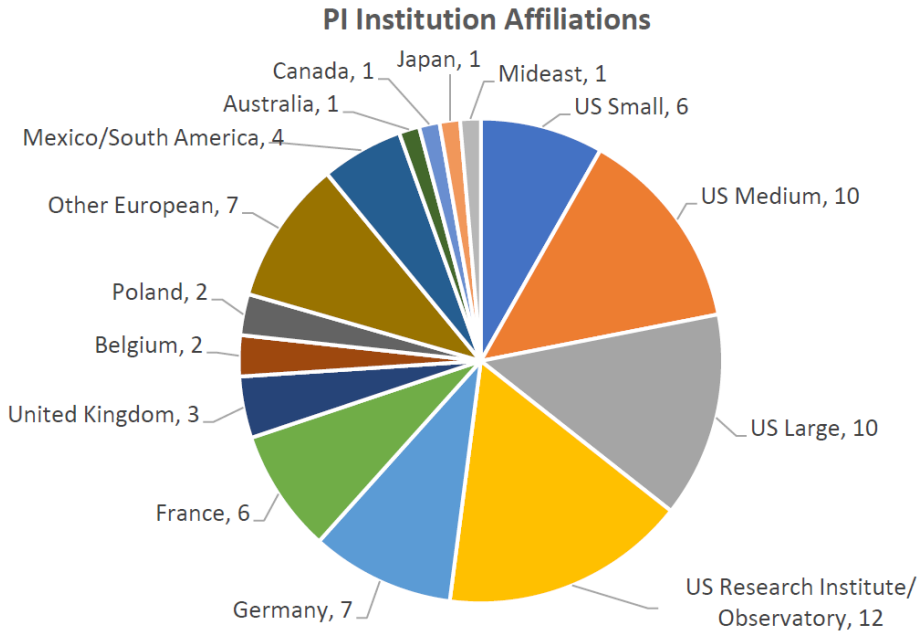


Community Statistics

PI + CoI



Open Access PI



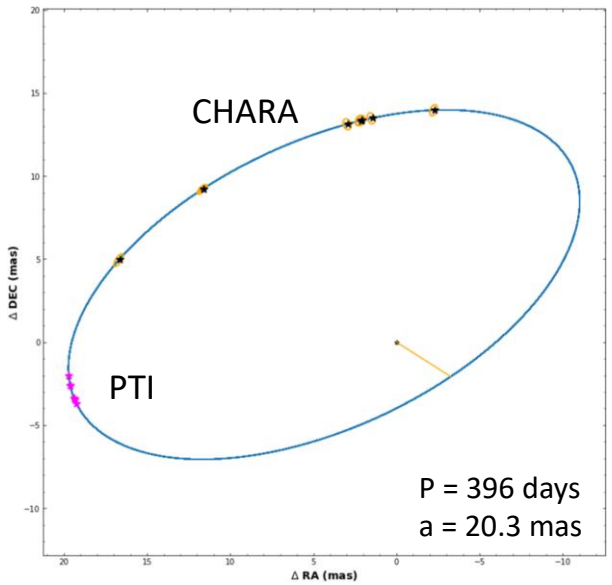
- 352 open access proposals submitted since 2010
- 101 unique open access PIs from 73 distinct institutions
- US small < 5,000 students
- US medium 5,000-15,000
- US large > 15,000 students

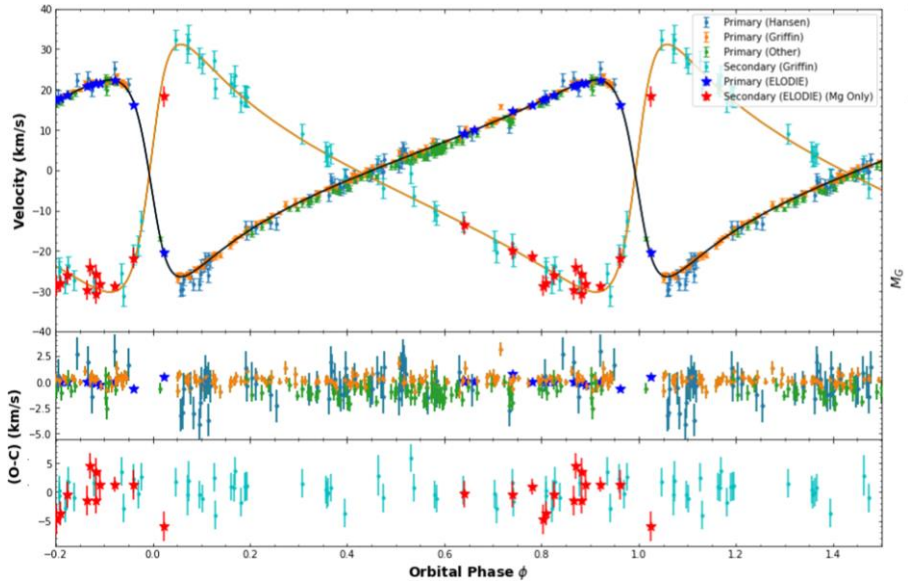
The Astronomical Journal, 166:29 (18pp), 2023 July
https://doi.org/10.3847/1538-3881/accddb

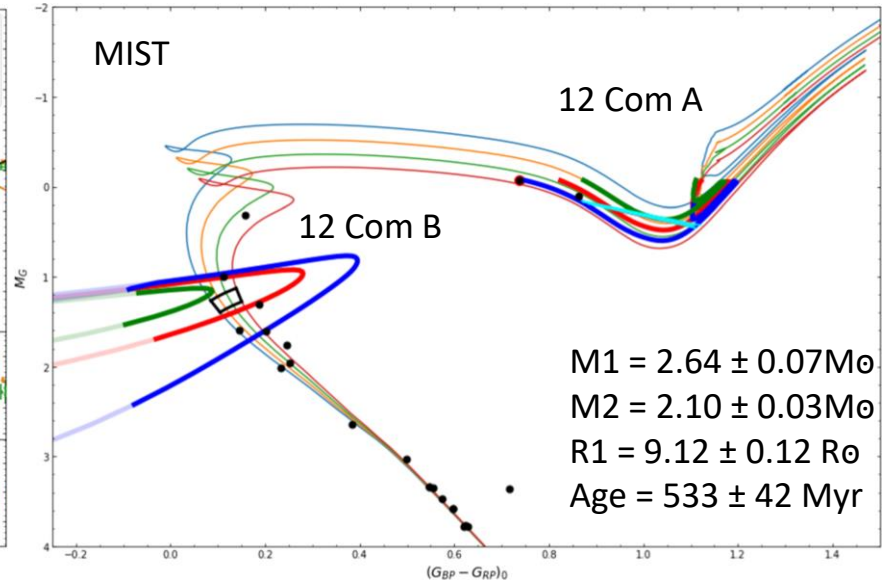
Precise Age for the Binary Star System 12 Com in the Coma Berenices Cluster

Rex Lam[1], Eric L. Sandquist[1], Gail H. Schaefer[2], Christopher D. Farrington[2], John D. Monnier[2], Narsireddy Anugu[2], Cyprien Lanthermann[2], Robert Klement[2], Jacob Ennis[3], Benjamin R. Setterholm[4], Tyler Gardner[3,4], Stefan Kraus[5], Claire L. Davies[5], and Jerome A. Orosz[1]

[1] San Diego State University, Department of Astronomy, San Diego, CA 92182 USA
[2] The CHARA Array of Georgia State University, Mount Wilson Observatory, Mount Wilson, CA 13 91023, USA
[3] University of Michigan, Deparment of Astronomy, Ann Arbor, MI 48109, USA
[4] Astronomy Department, University of Michigan, Ann Arbor, MI 48109, USA
[5] Astrophysics Group, Department of Physics & Astronomy, University of Exeter, Stocker Road, Exeter, EX4 4QL, UK
Received 2022 December 8; revised 2023 April 8; accepted 2023 April 10; published 2023 June 26



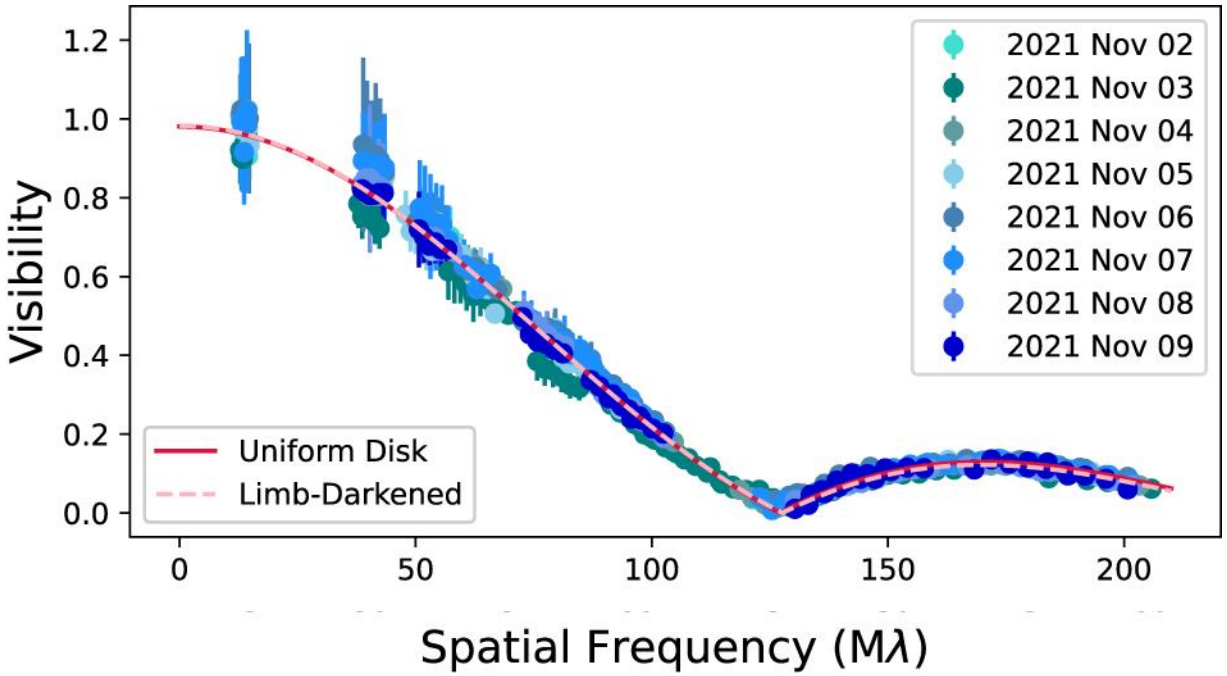




The Astronomical Journal, 166:123 (9pp), 2023 September
https://doi.org/10.3847/1538-3881/ace906

Refining the Stellar Parameters of τ Ceti: a Pole-on Solar Analog

Maria Korolik[1], Rachael M. Roettenbacher[1,2], Debra A. Fischer[1], Stephen R. Kane[3], Jean M. Perkins[4], John D. Monnier[2], Claire L. Davies[5], Stefan Kraus[5], Jean-Baptiste Le Bouquin[6], Narsireddy Anugu[7], Tyler Gardner[2,5], Cyprien Lanthermann[7], Gail H. Schaefer[7], Benjamin Setterholm[2,8], John M. Brewer[9], Joe Llama[10], Lily L. Zhao[11], Andrew E. Szymkowiak[1], and Gregory W. Henry[12]
[1] Department of Astronomy, Yale University, 52 Hillhouse Avenue, New Haven, CT 06511, USA; rmroett@umich.edu
[2] Department of Astronomy, University of Michigan, Ann Arbor, MI 48109, USA



- Limb-darkened angular diameter: 2.019 ± 0.012 mas
- Rotation period: 46 ± 4 days (gyrochronology)
- Stellar inclination of 7° ± 7° (vsini, R, P)
- Nearly pole-on orientation brings into question long-term stability of reported exoplanets.
- Misalignment with debris disk rotation axis
  idisk = 35° ± 10°

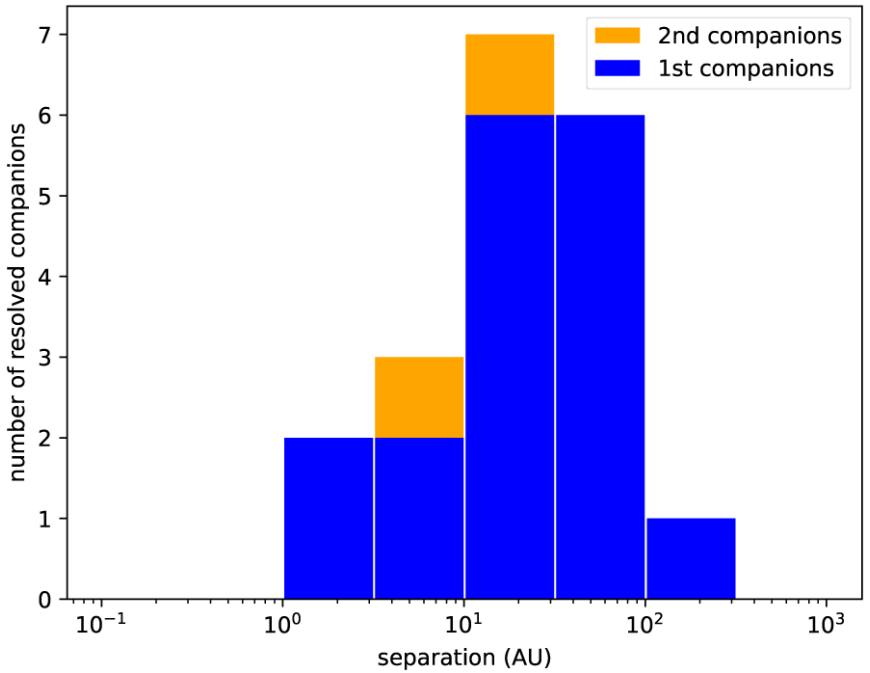
A&A 672, A6 (2023)
https://doi.org/10.1051/0004-6361/202245364

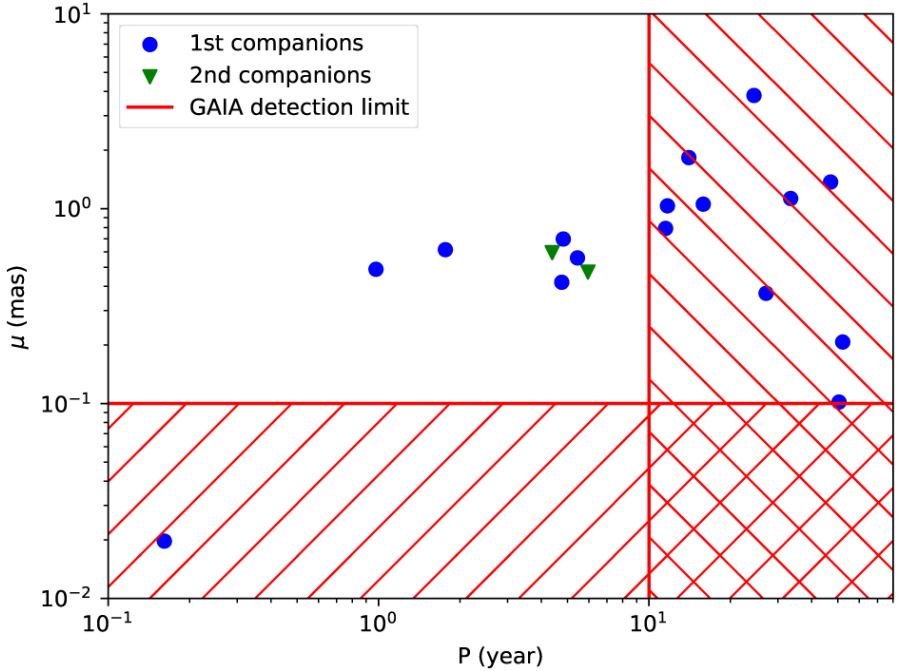
Astronomy & Astrophysics

Multiplicity of northern bright O-type stars with optical long baseline interferometry

Results of the pilot survey

C. Lanthermann[1,2,3], J.-B. Le Bouquin[3], H. Sana[2], A. Mérand[4], J. D. Monnier[5], K. Perraut[3], A. J. Frost[2], L. Mahy[6], E. Gosset[7], M. De Becker[7], S. Kraus[8], N. Anugu[1], C. L. Davies[8], J. Ennis[5], T. Gardner[5], A. Labdon[9], B. Setterholm[5], T. ten Brummelaar[1], and G. H. Schaefer[1]





- Survey 29 massive stars.
- Resolved 19 companions in 17 different systems.
- Separations: 0.5-50 mas
- Multiplicity fraction: $f_m = 0.59 \pm 0.09$
- Average number of companions
- $f_c = 0.66 \pm 0.13$

The Astrophysical Journal, 950:149 (11pp), 2023 June 20 https://doi.org/10.3847/1538-4357/acd1e6

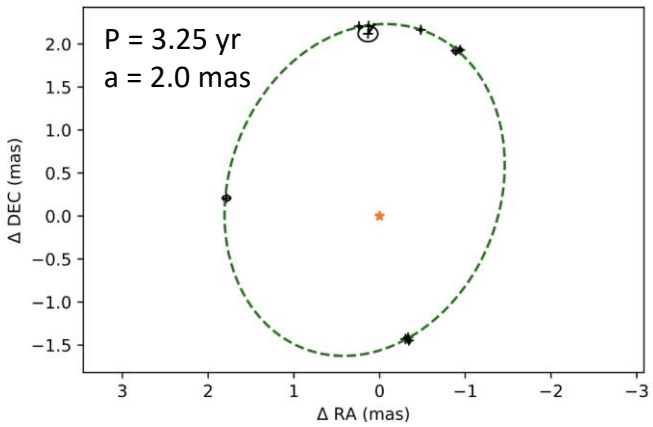
Three-dimensional Orbit of AC Her Determined: Binary-induced Truncation Cannot Explain the Large Cavity in This Post-AGB Transition Disk

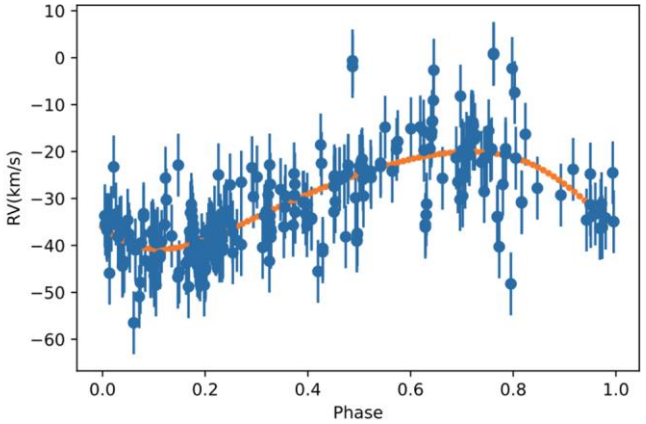
Narsireddy Anugu[1,2], Jacques Kluska[3], Tyler Gardner[4], John D. Monnier[5], Hans Van Winckel[3], Gail H. Schaefer[6], Stefan Kraus[4], Jean-Baptiste Le Bouquin[7], Steve Ertel[2,8], Antoine Mérand[9], Robert Klement[6], Claire L Davies[4], Jacob Ennis[5], Aaron Labdon[10], Cyprien Lanthermann[6], Benjamin R. Setterholm[5], Theo ten Brummelaar[6], Akke Corporaal[3], Laurence Sabin[11], and Jayadev Rajagopal[12]

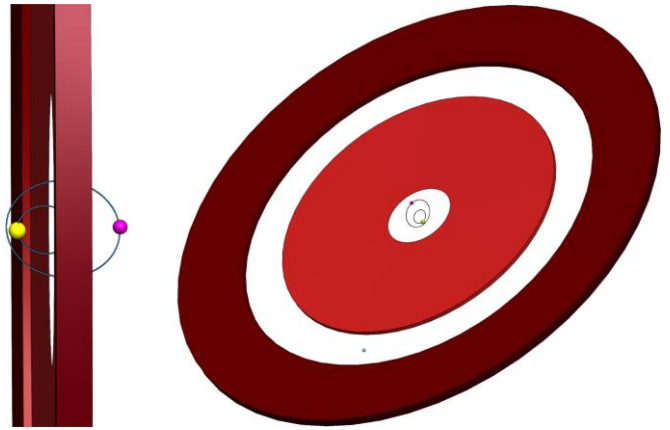
The Astrophysical Journal Letters, 957:L28 (6pp), 2023 November 10 https://doi.org/10.3847/2041-8213/ad0730

AC Her: Evidence of the First Polar Circumbinary Planet

Rebecca G. Martin[1,2], Stephen H. Lubow[3], David Vallet[1,2], Narsireddy Anugu[4], and Douglas R. Gies[5]







Open Access Results
Presented at 2024 CHARA Science Meeting

Talks:

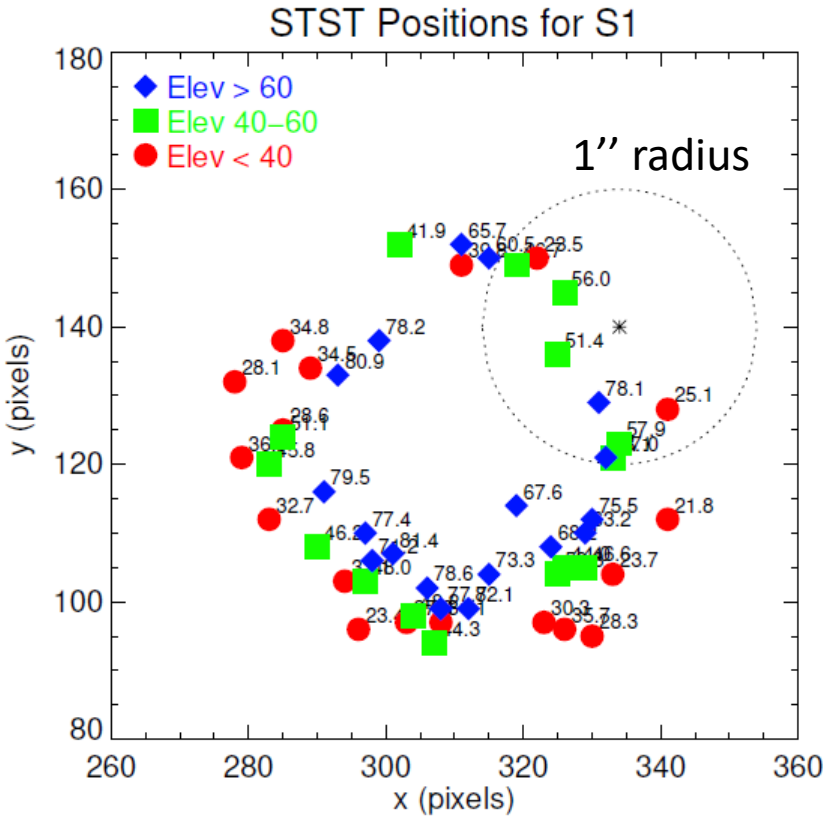
- Nancy Evans: “The Orbit and Mass of Polaris”
- Noel Richardson: “Visual Orbits of Wolf Rayet Stars”
- Ashley Elliott: “Stellar and Planetary Parameters of the 51 Eridani System”
- Shashank Dholakia: “Analytic Interferometry of Stellar Surfaces with Spherical Harmonics”

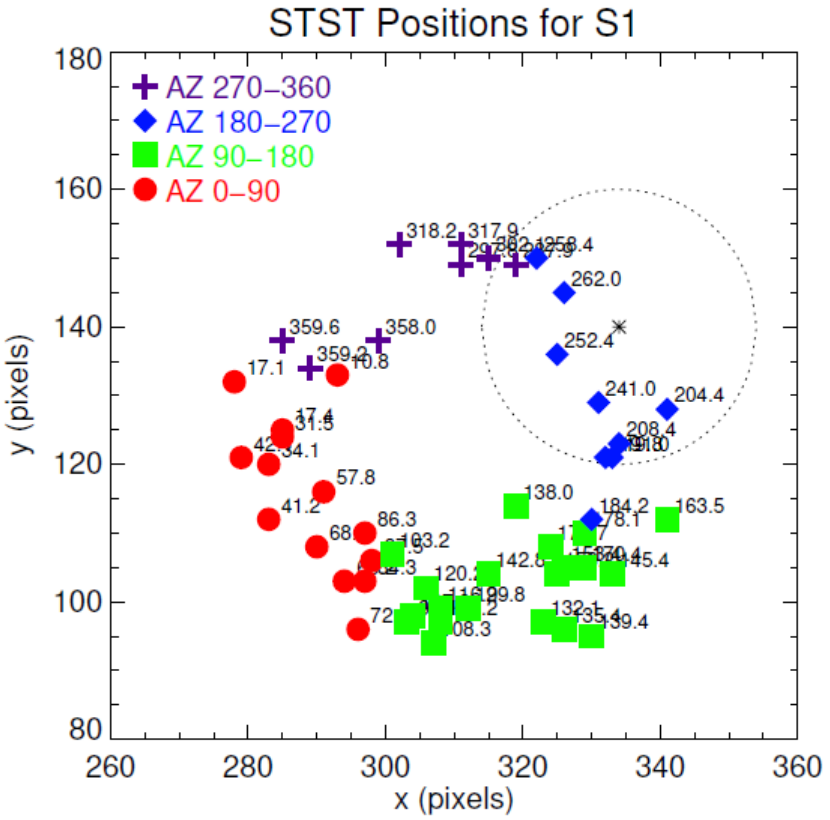
Posters:

- David Frothingham: “MIRCX and MYSTIC Observations of High Mass Loss Red Supergiants”
- Ryan Norris: “Interferometric Imaging of CH Cyg”
- Muhammad Zain Mobeen: “RADMC3D Models of V838 Mon in the HK bands”

Engineering Update on Alignment Sequences

Update on Alignment Sequences
Offset in IR Star Position in Lab





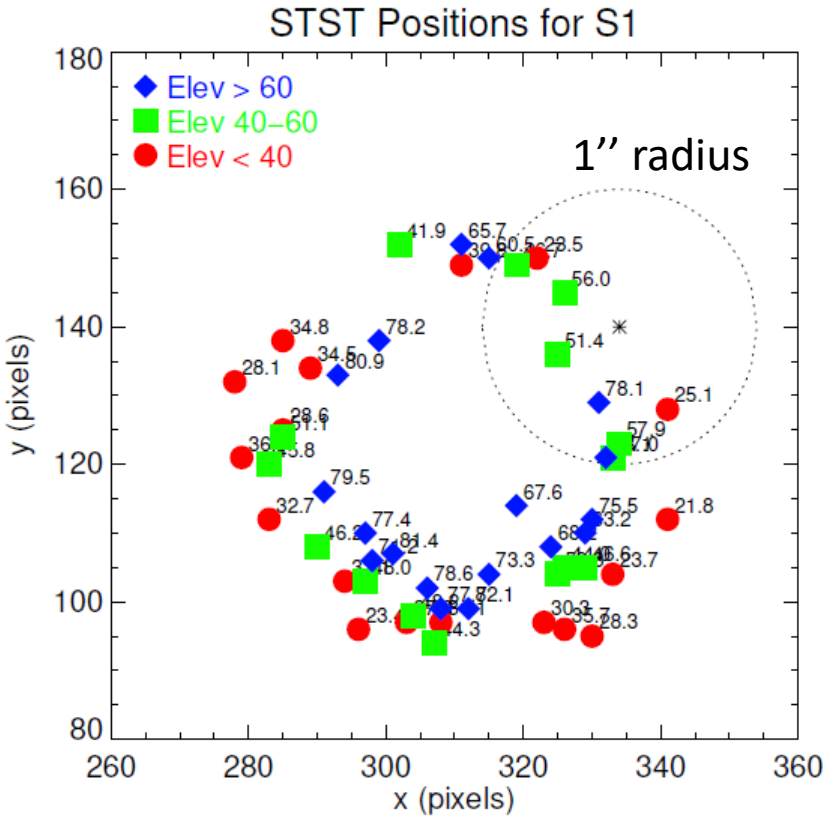
Elevation

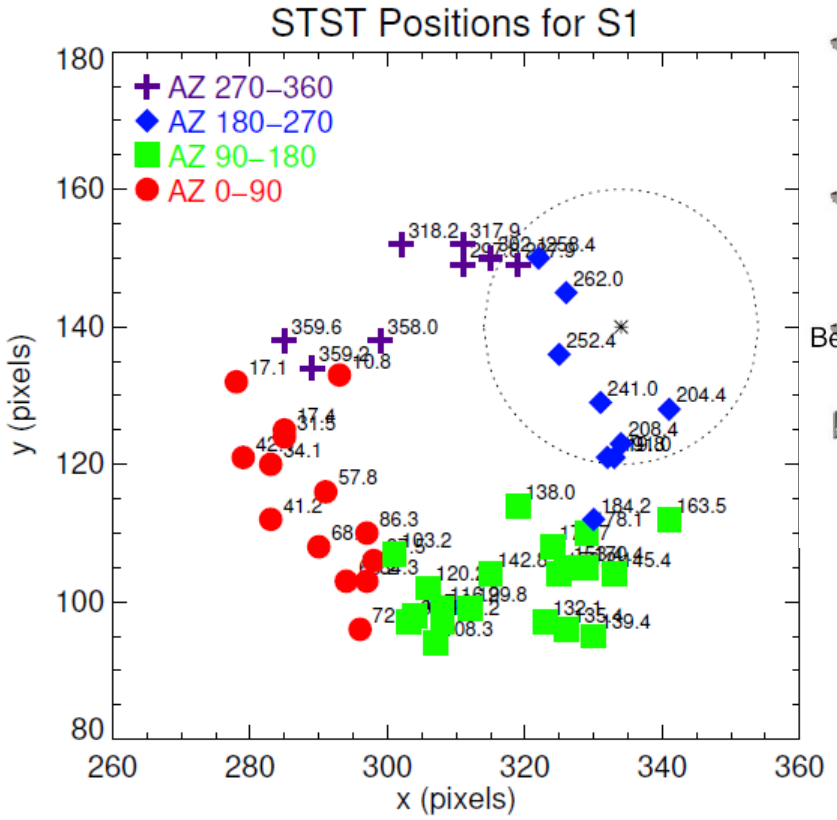
Atmospheric differential refraction

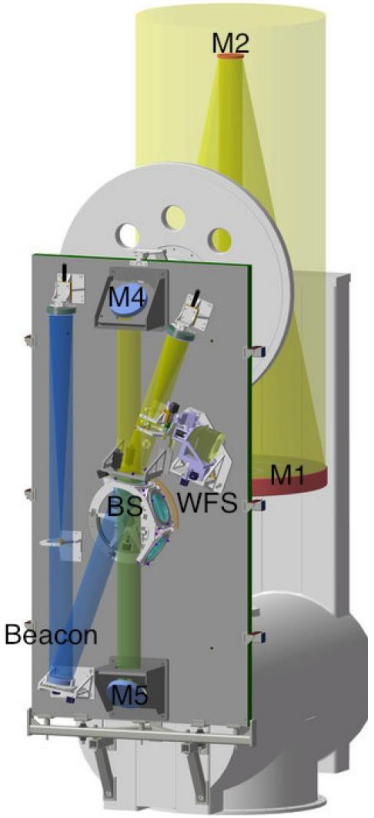
Azimuth

Telescope AO Dichroic

Update on Alignment Sequences
Offset in IR Star Position in Lab







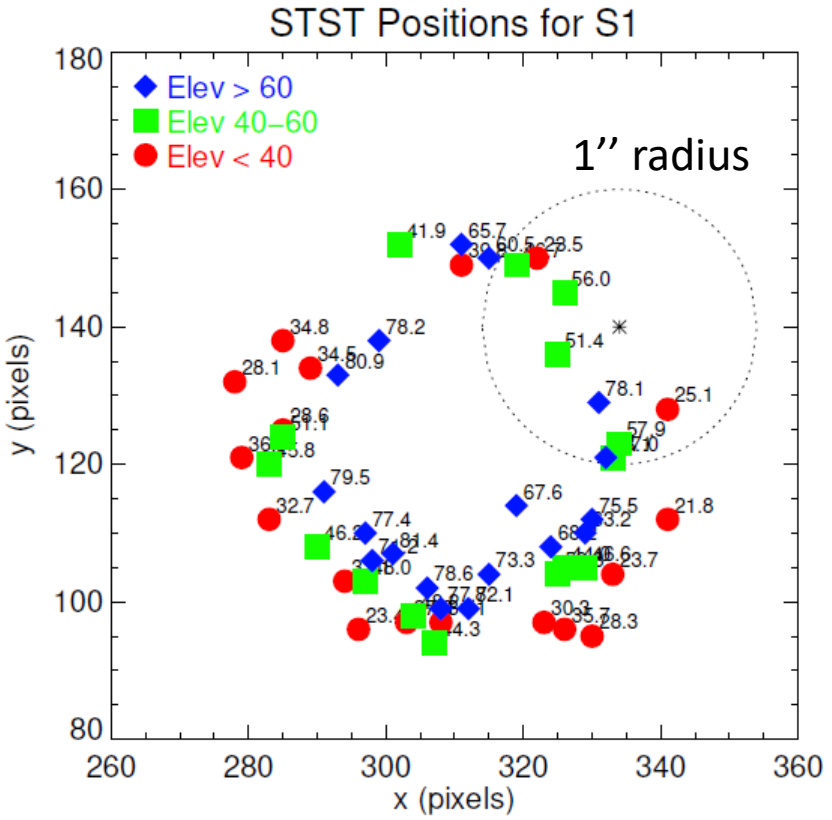
Elevation

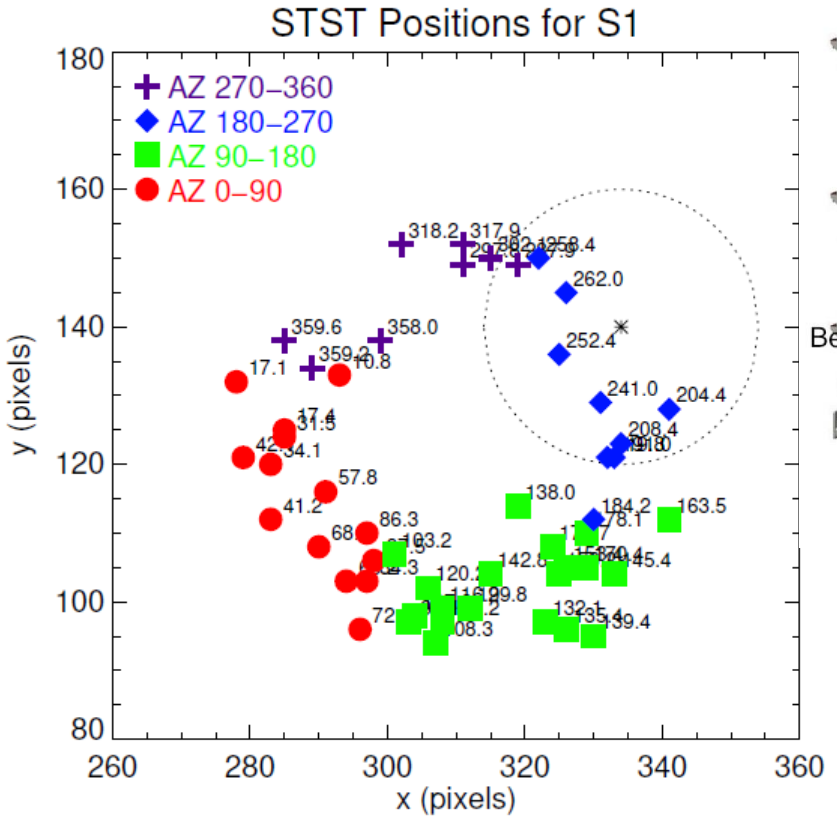
Atmospheric differential refraction

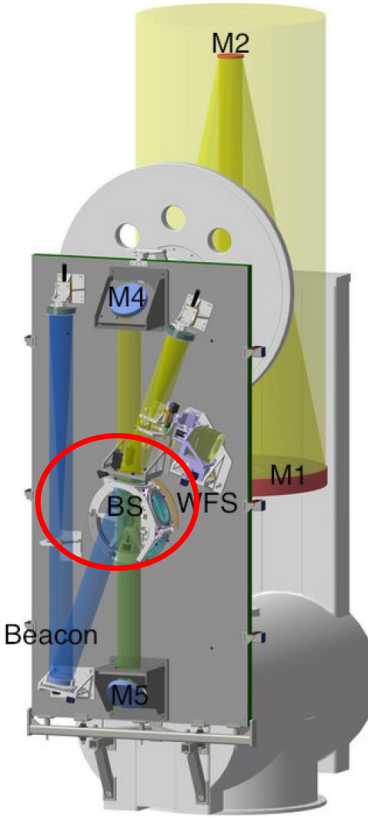
Azimuth

Telescope AO Dichroic

Update on Alignment Sequences
Offset in IR Star Position in Lab



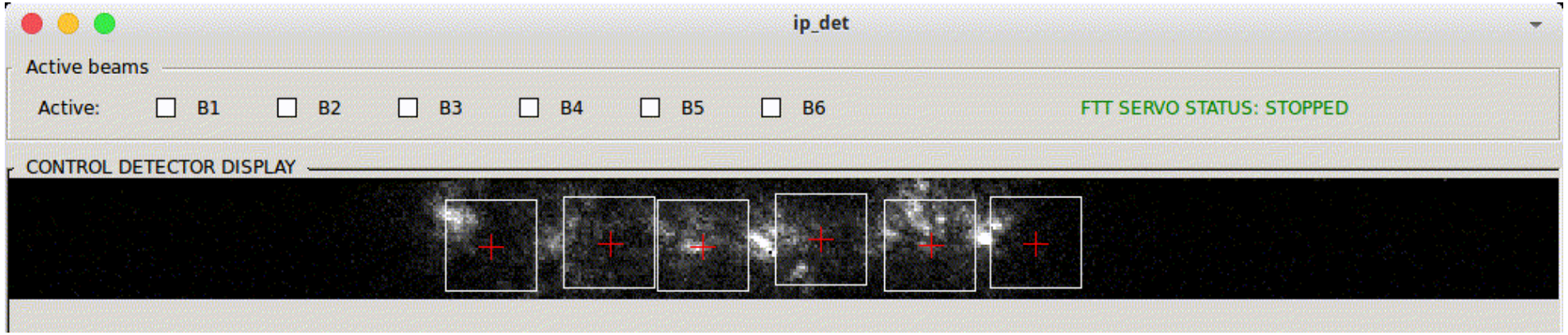




Elevation — Atmospheric differential refraction

Azimuth — Telescope AO Dichroic

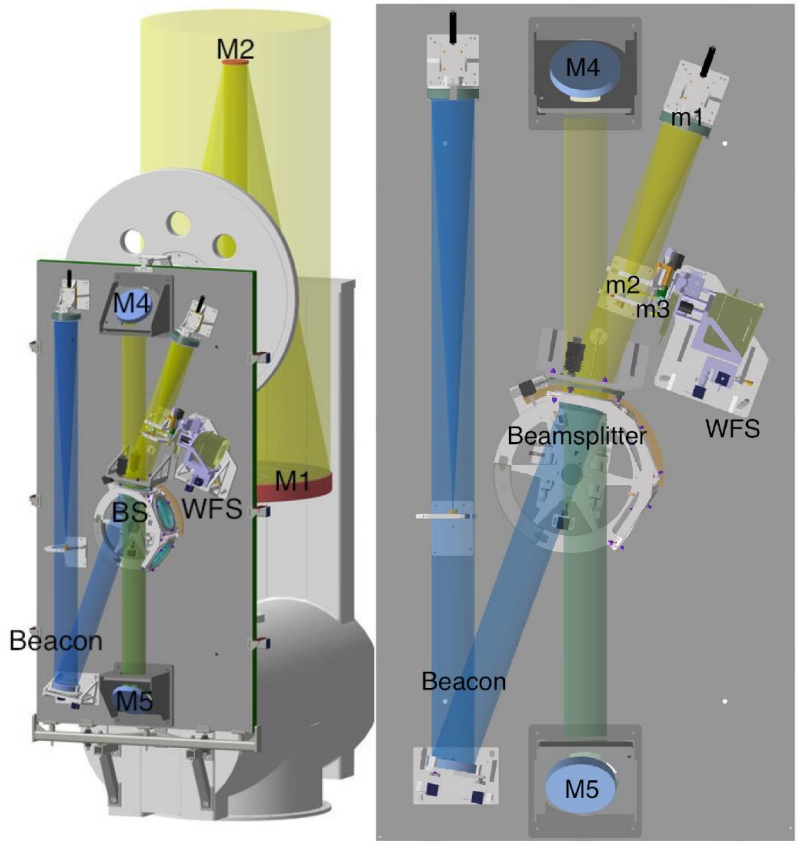
Update on Alignment Sequences
Offset in Visible Light Positions



Stars at similar elevations, but different azimuths

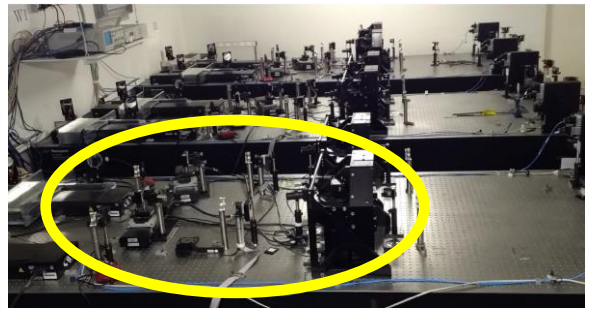
Alignment of the AO Systems

- Telescope AO locks on starlight.
- Lab AO Locks on blue beacon.
- Telescope dichroic causes dispersion between different wavelengths going into the lab.



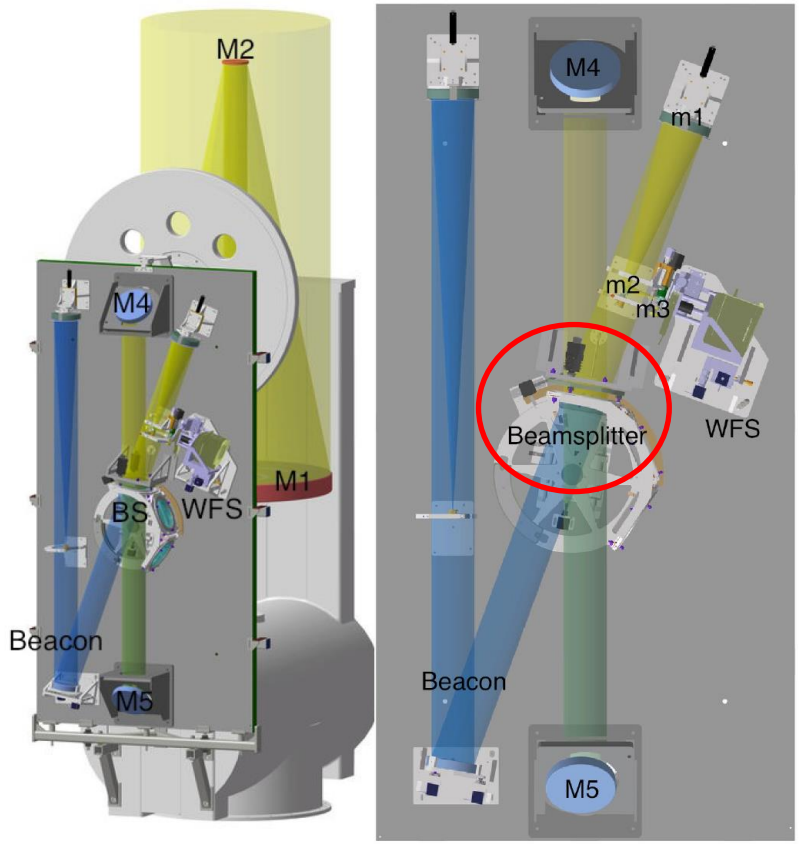
Telescope AO

Lab AO



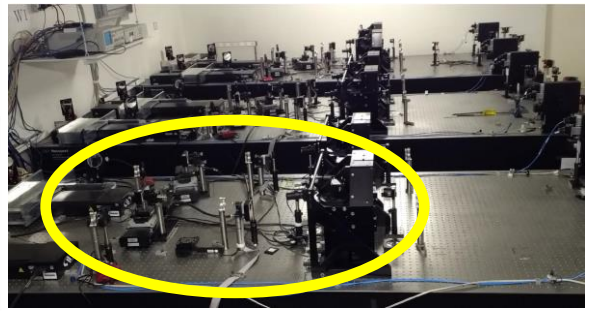
Alignment of the AO Systems

- Telescope AO locks on starlight.
- Lab AO Locks on blue beacon.
- Telescope dichroic causes dispersion between different wavelengths going into the lab.

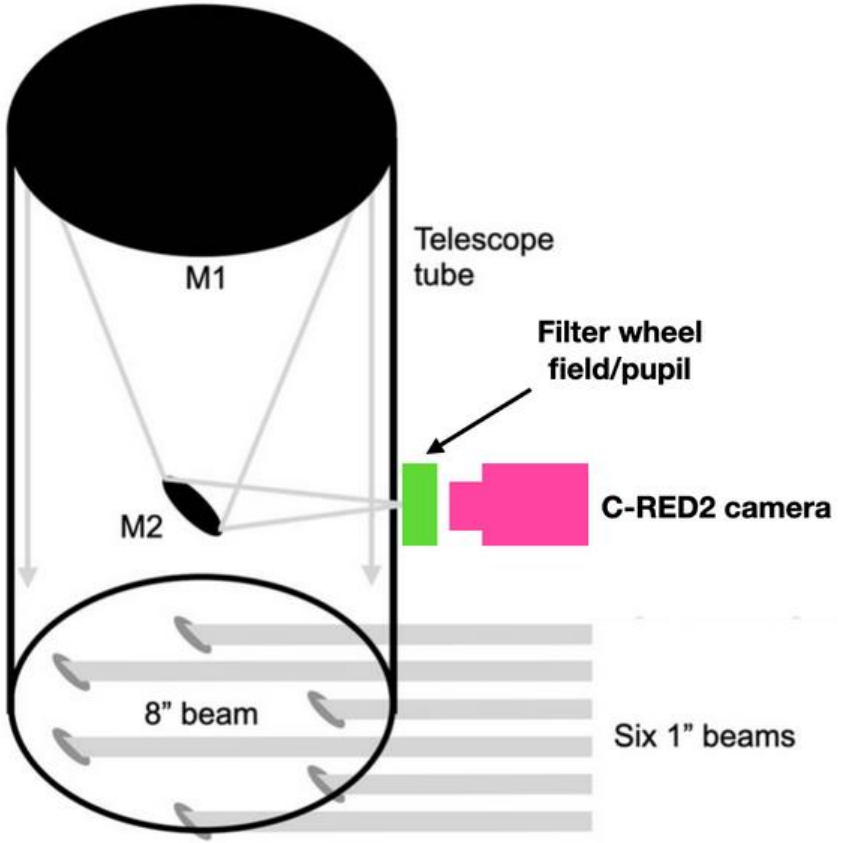


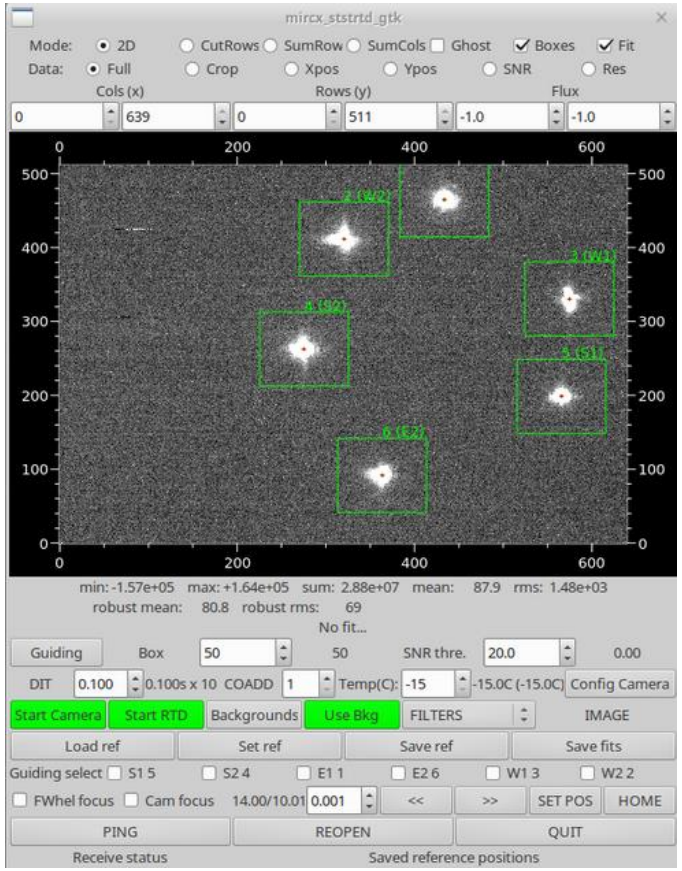
Telescope AO

Lab AO



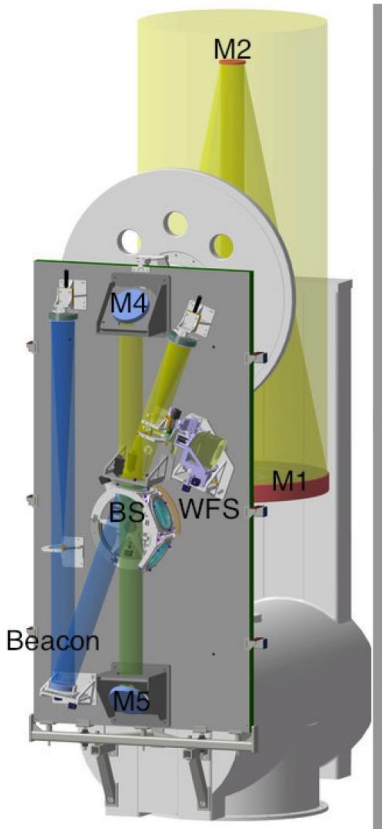
Six Telescope Star Tracker (STST)

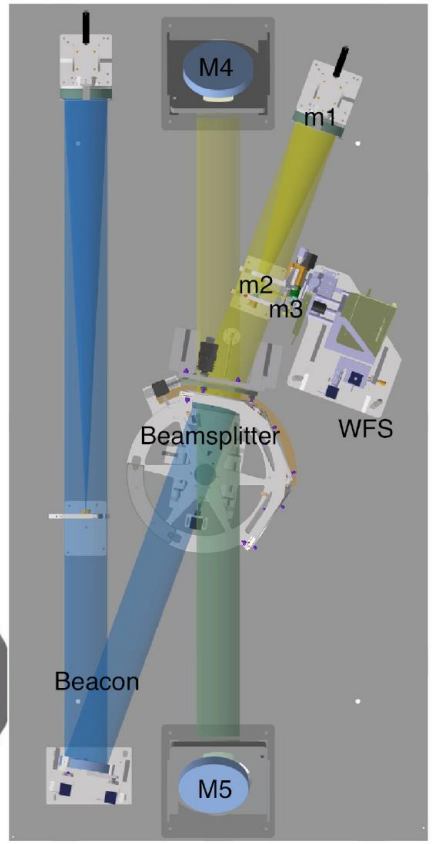




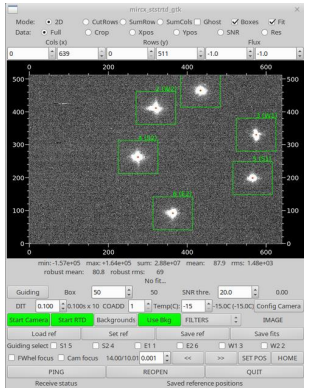
New On Sky Alignment Sequence in 2023

- Move beacon flat mirror and M7 to keep starlight centered on STST and blue beacon aligned to Lab AO
- Next steps: Implement STST Guiding
- Need to improve STST sensitivity for fainter stars (J ~ 6 mag)
- Use SPICA Control camera in place of STST for aligning visible starlight



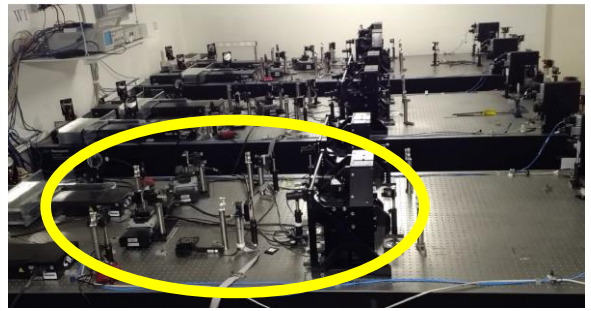


Telescope AO



STST

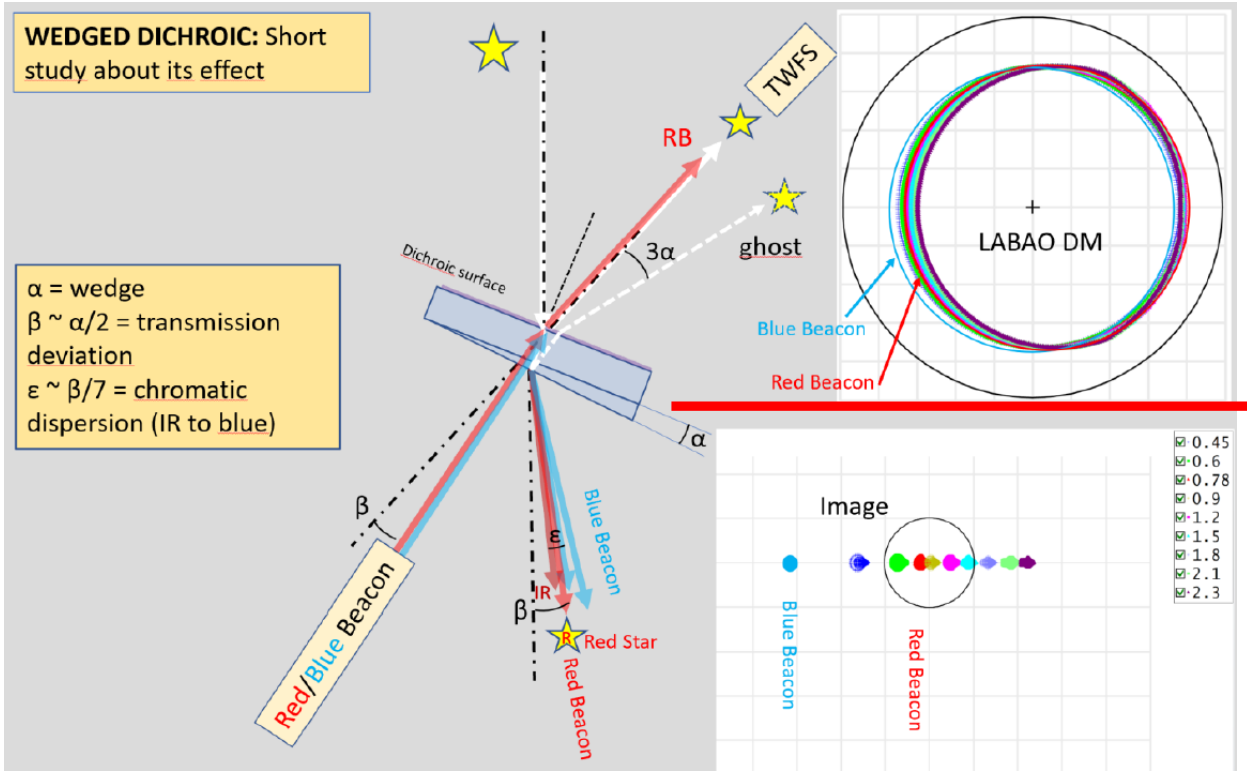
Lab AO

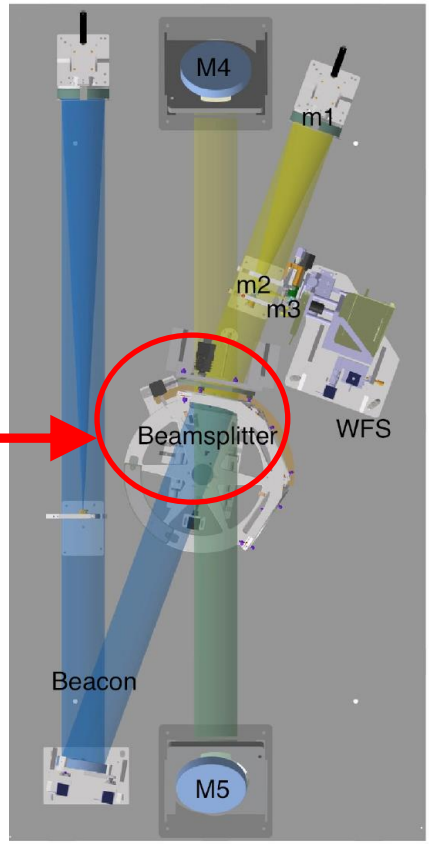


AO Dichroic Causes a Misalignment Between Visible and IR Light in the Lab

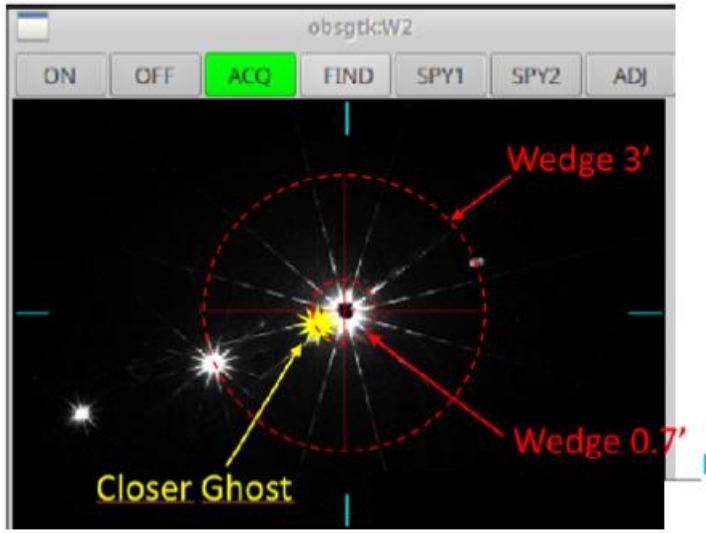
Compromise in alignment for simultaneous multi-wavelength observations across V+H+K with SPICA + MIRC-X + MYSTIC

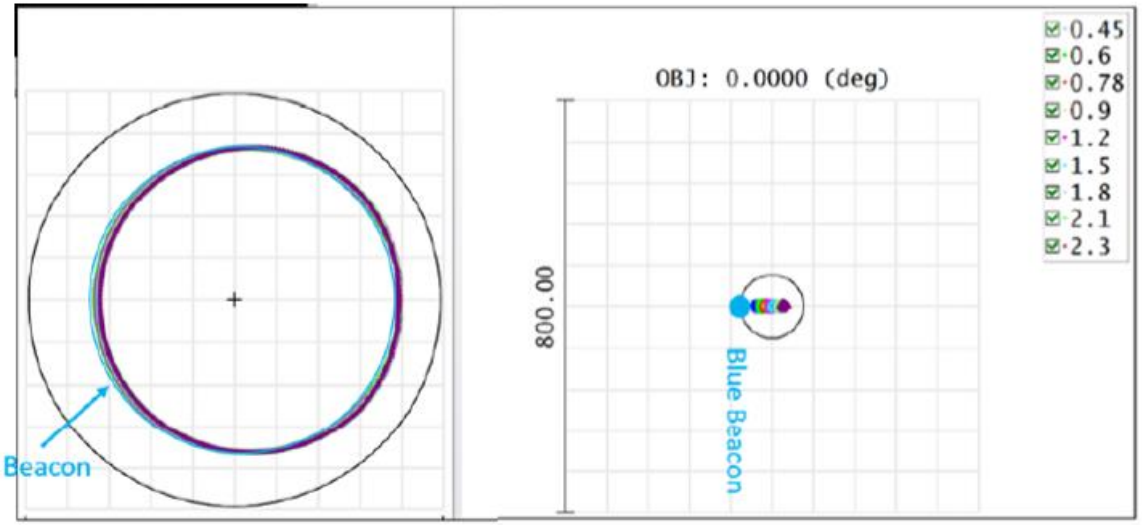
Modeling by Julien Dejonghe

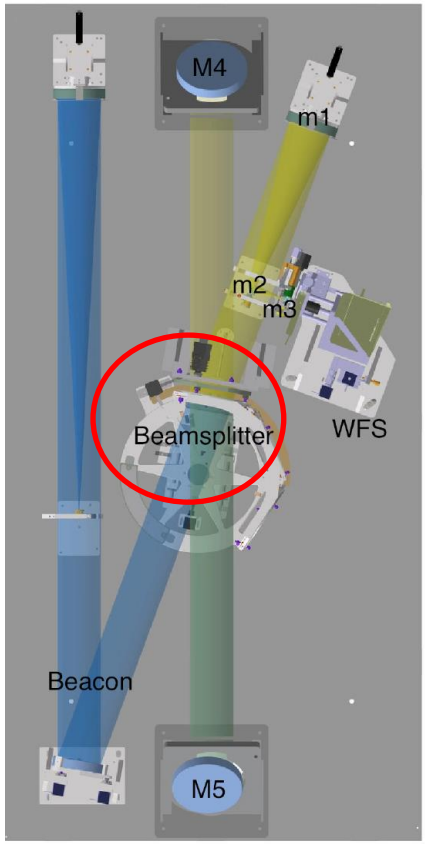




Possible Solution: Reduce Wedge Angle of Dichroic to Minimize Dispersion between Visible/IR







Modeling by Julien Dejonghe

Collect multi-wavelength data simultaneously with good alignment to SPICA + MIRC-X + MYSTIC!

NSF ATI Proposal Pending:
AO Upgrades and Sensitivity Enhancements

- Next Generation Adaptive Optics
  - Maximize performance for recording fringes simultaneously at visible and IR wavelengths
  - New telescope dichroics – minimize dispersion
  - New lab AO deformable mirrors – flat shape / increase stroke
- Enhance Sensitivity for Faint Targets
  - See talk by Cyprien Lanthermann

Long Term Future Directions

- Next big initiatives
  - Central 2m telescope – sensitivity, imaging (prelude to an array of 2m scopes)
  - Longer baselines – development of 1 km CMAP site
  - Expanding delay lines – (double pass?)
  - Testbed for new instrumentation – integrated optics, nulling, quantum techniques
- Join us for the community discussion on Thursday!