



Michigan Group Updates:

What's happening with MIRC-X, MYSTIC, and the Pipeline(s)

John Monnier, Mayra Gutierrez, Noura Ibrahim, Linling Shuai,
Stefan Kraus + Exeter, Narsi Anugu, and more

Michigan folks

- Recent People Changes at Michigan
 - Ben Setterholm now in Heidelberg working on ELT-METIS
 - Tyler Gardner still at Exeter with Stefan's group
 - Rachael Roettenbacher returned to Michigan as a Research Scientist
 - Noura Ibrahim is finishing her 4th year in graduate school, working on MIRC-X and MYSTIC Imaging of Young Stellar Objects
 - Linling Shuai is a new graduate student, working on modelling CHARA polarization
 - Mayra Gutierrez, who has been single-handedly keeping the MIRC-X upgrades going the past year, attending graduate school next year
 - Where?

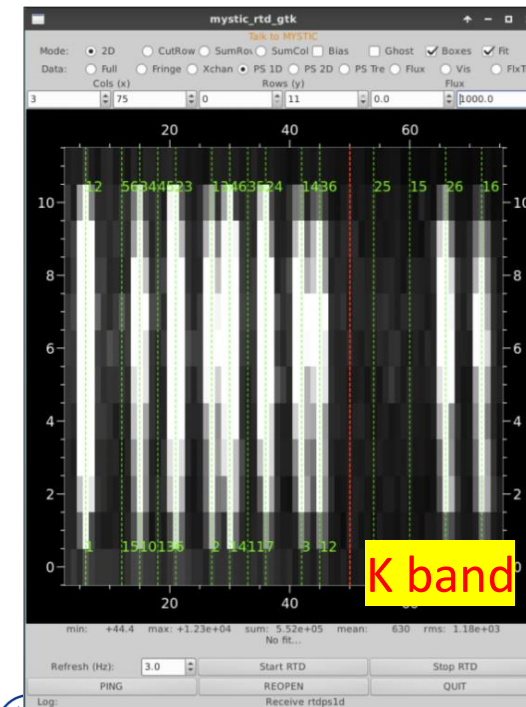
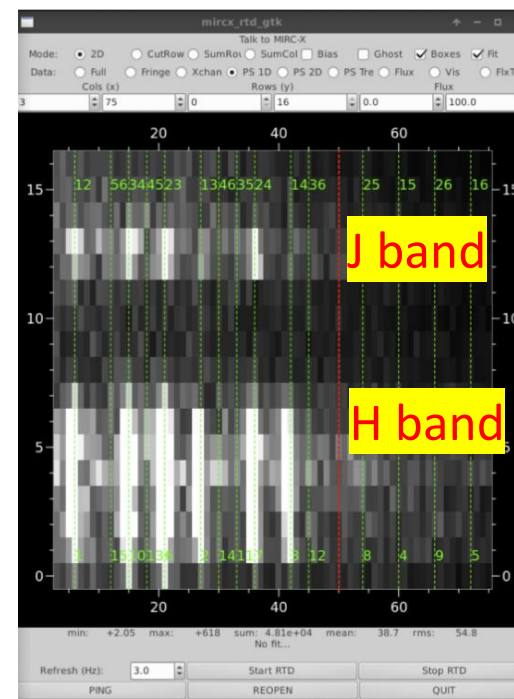
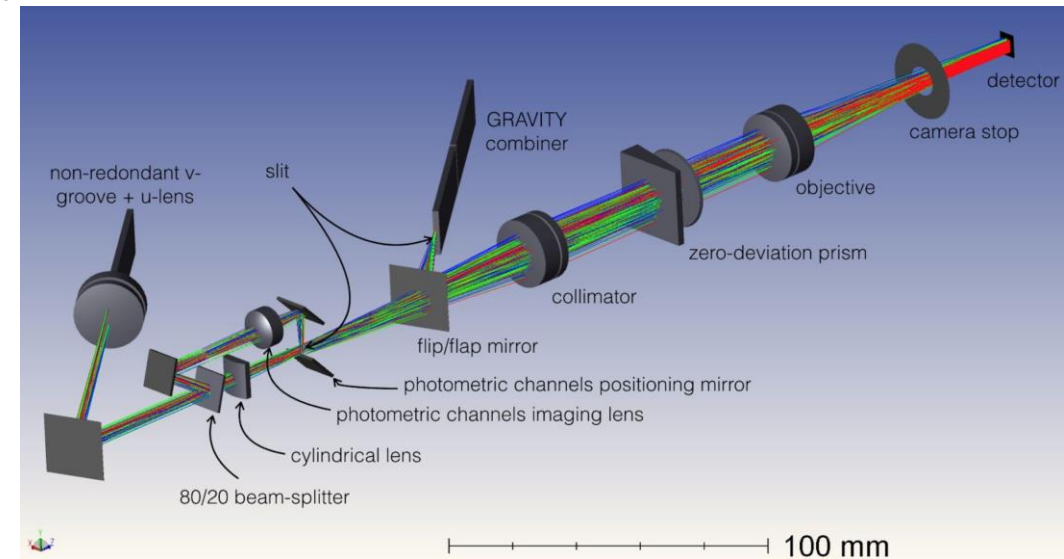




MIRC-X / MYSTIC

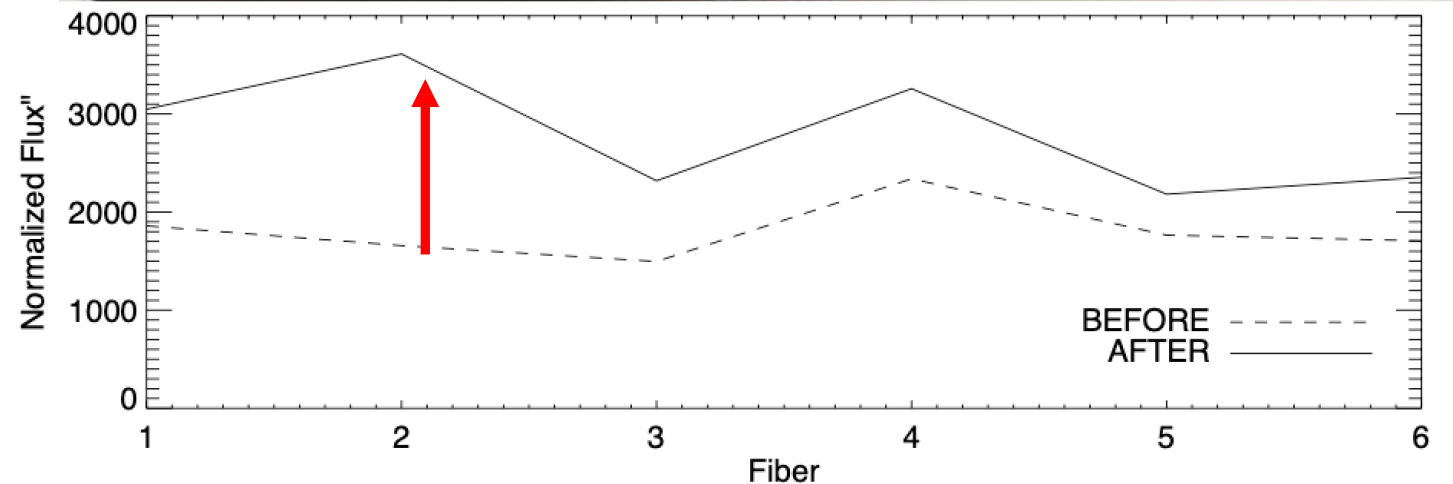
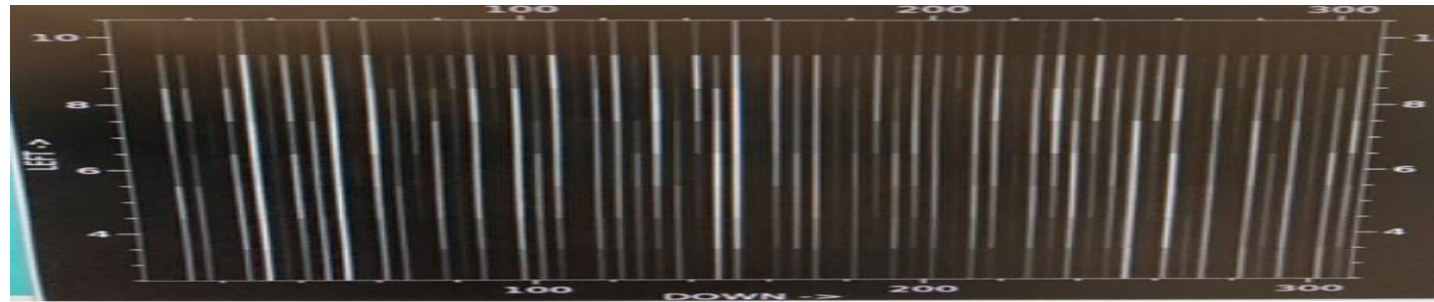
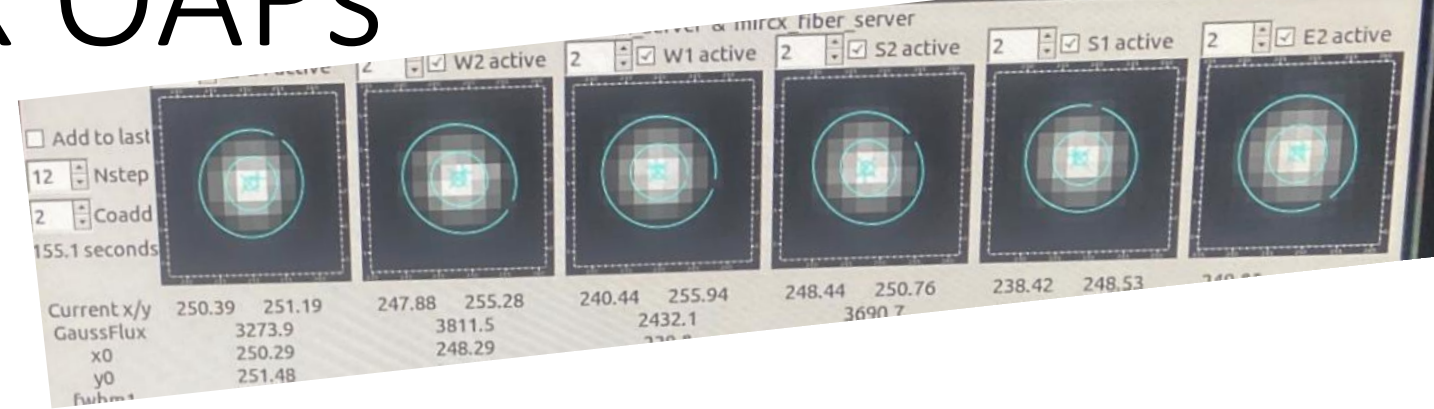
- MIRC-X (Michigan and Exeter Collaboration)
 - H-band (1.5-1.72 microns) 6-beam combination
 - Limiting mag 7.5
 - Many spectral modes from R50 to R>1000
 - Wollaston prism available
 - J-band (1.05-1.35 microns) mode available: 4T only
 - New Integrated Optics Mode
- MYSTIC (Michigan and Grenoble Collaboration)
 - K band (1.95-1.38microns)
 - 6-beam all-in-one mode and 4T GRAVITY chip
 - Limiting mag 7.5
 - Many spectral modes R20 to R>1000

MIRC-X and MYSTIC work together at the same time, accounting for ~80% of the nights at CHARA



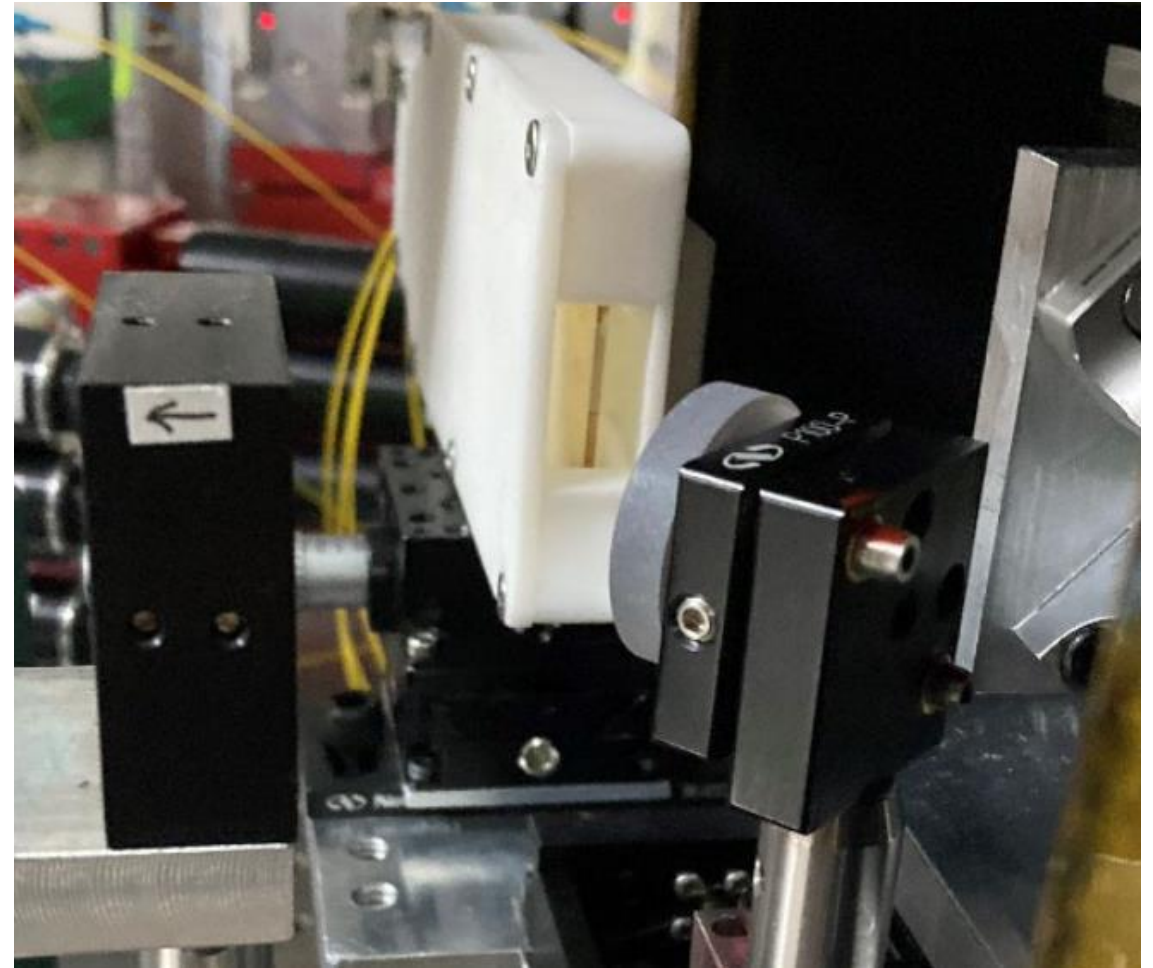
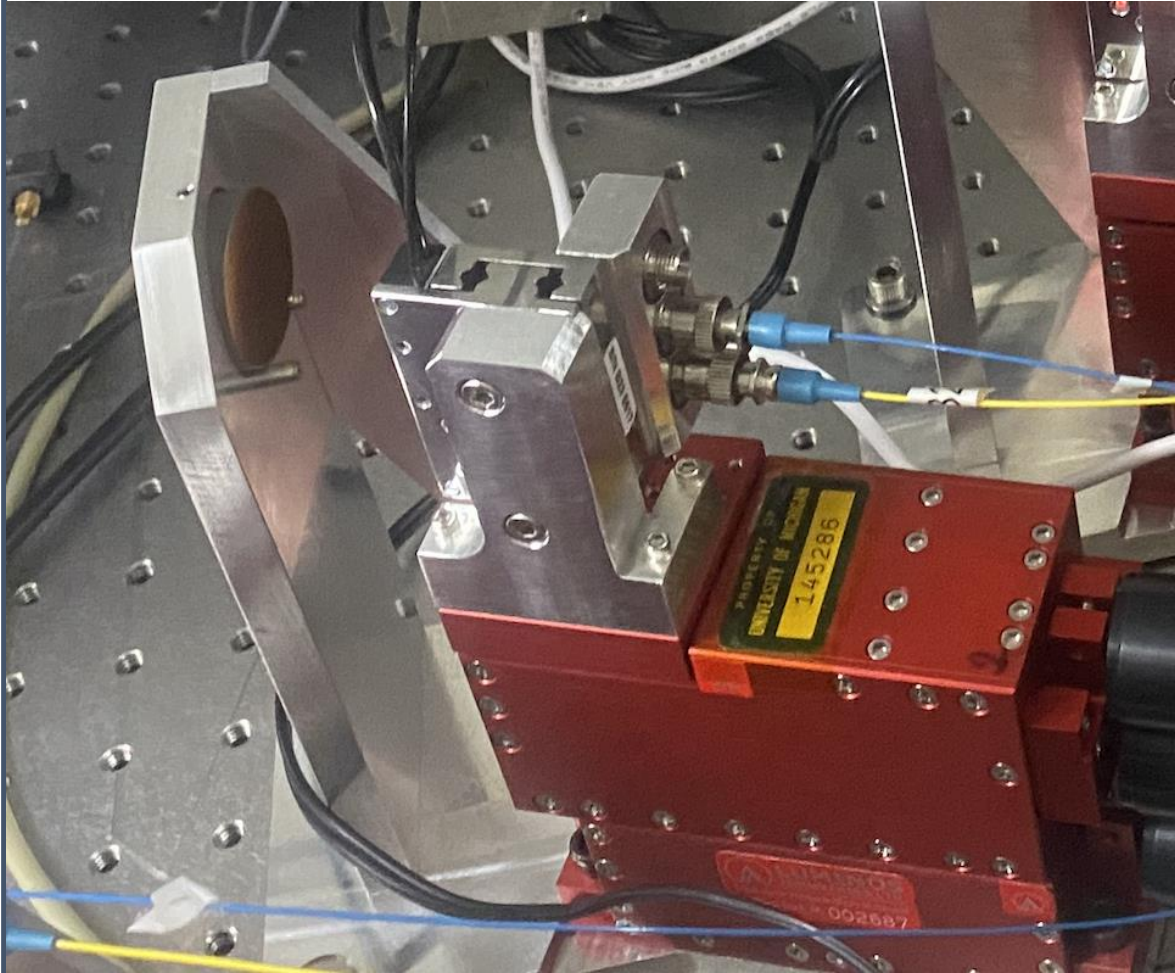
New MIRC-X OAPs

- New OAPs for MIRC-X $f=75\text{mm}$
 - 55% more STS light than before.
 - Discovered some defocus/astigmatism caused MIRC-X pickoff mirrors
- 3-Fiber switchyard
 - SPICA-FT or MIRC-X fibers
 - Open port for backward illumination
- Moving mirror for combiner selection
- SPICA-FT chip can now be used, though pipeline work is under development





New MIRC-X Fibers and Mirrors



Your Talk Title Here



Observatoire de la CÔTE d'AZUR



THE UNIVERSITY OF SYDNEY



Australian National University



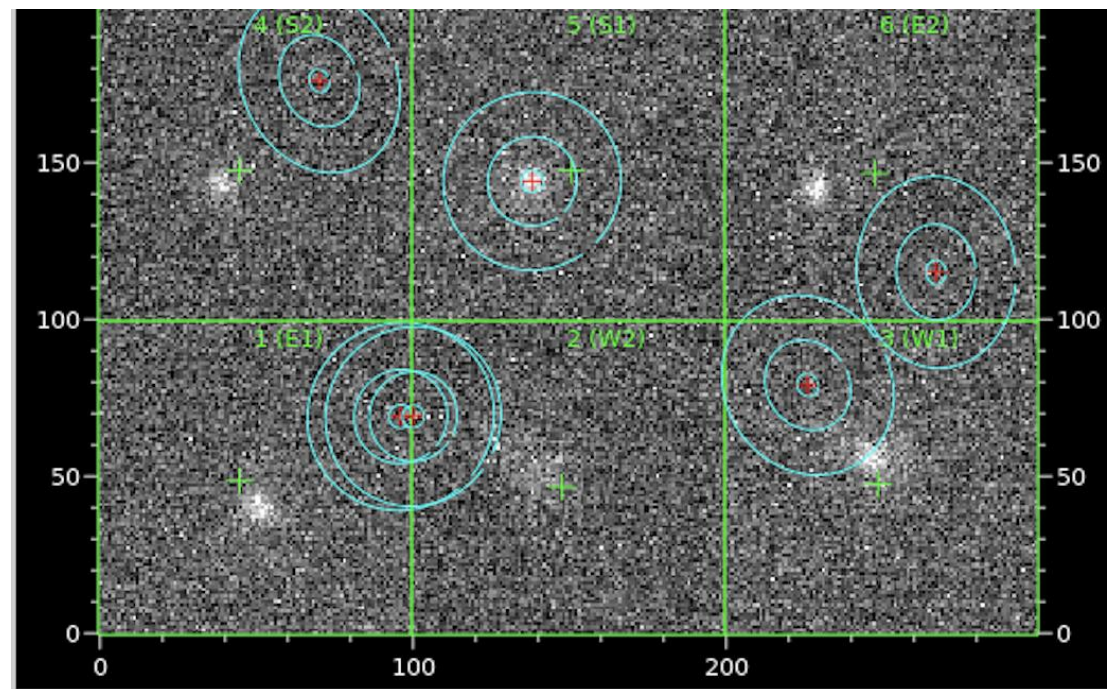
KYOTO SANGYO UNIVERSITY



STST long exposures

Six Telescope Star Tracker can check pupils and keep light centered on fibers tips, using CRED-2

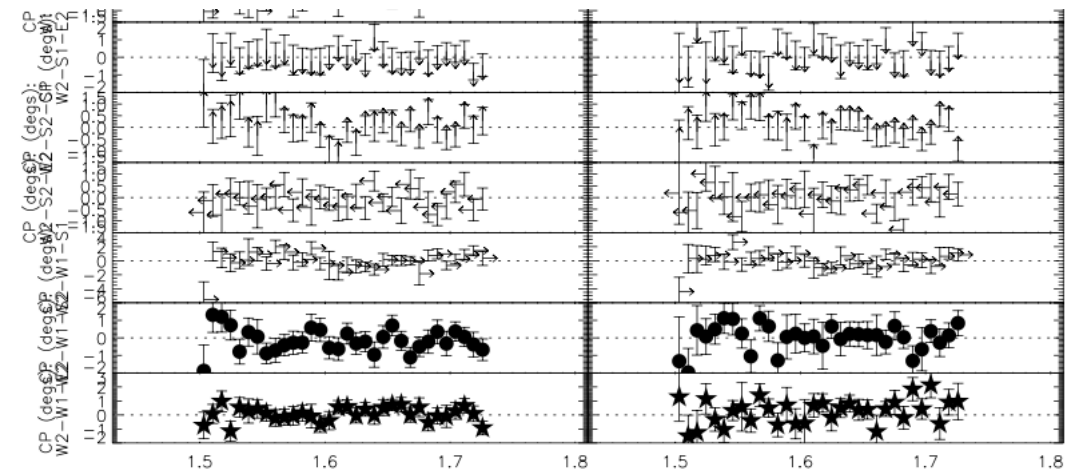
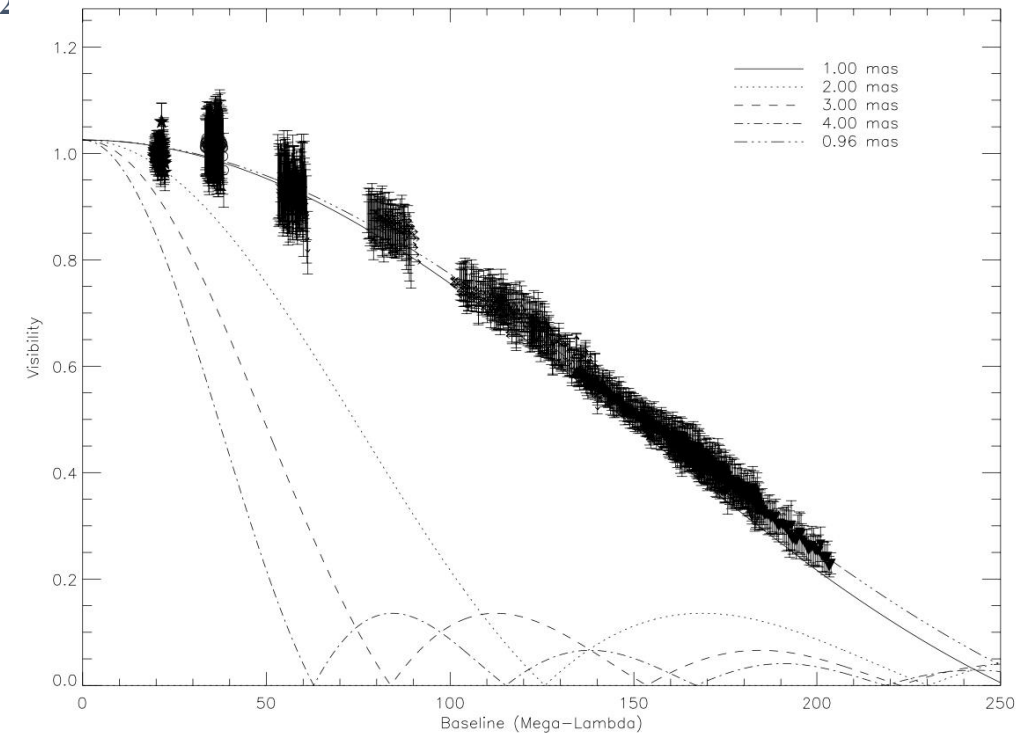
- Laser background well managed
 - Thanks to Rob and Narsi
- Demonstrated $J \sim 6.8$ (goal $J \sim 8$ or better)
 - 10x1sec
- JDM showed good performance for 6x10sec
 - About 1 mag better ($J \sim 7.8$) should be achievable
- ***Need reliable actuators at telescopes to make use of low frame rates on fainter objects***



**Would be best to use lower readnoise/
background camera: e.g., NIRO/FLUOR camera**

Software Progress

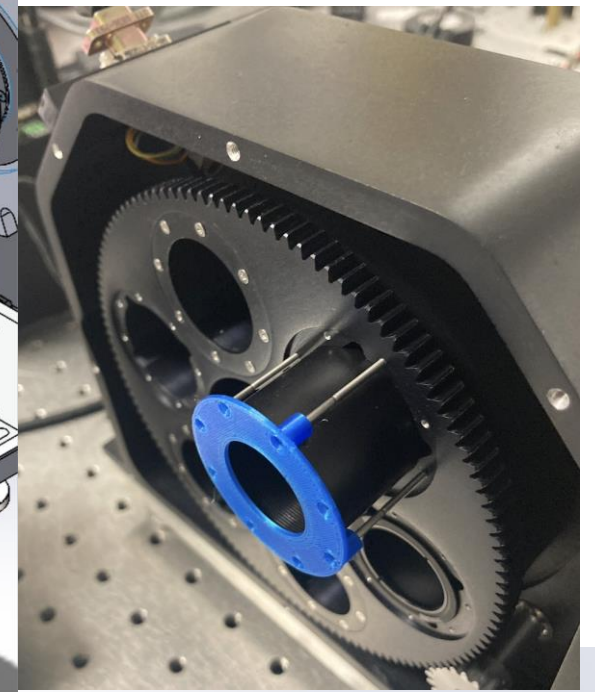
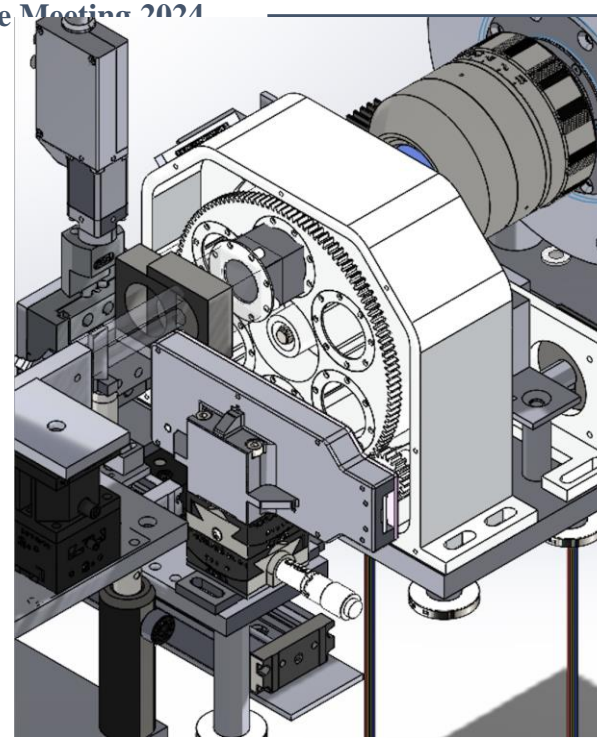
- `mircx_jdm_develop` (python)
 - More robust when things go wrong in observing
- `Mircx_cal` (IDL) works well
 - Can autofilter outliers (“deep clean”)
 - Produces nice standard output pdfs
- Other tools
 - Macim, sparco, surfing can now compile on Apple Silicon
 - Rachael has python tools for surfing
 - Please reach out if you want to use these imaging codes
- Working through MIRC ARCHIVE
 - Let me know if you ever need any old MIRC data OIFITS



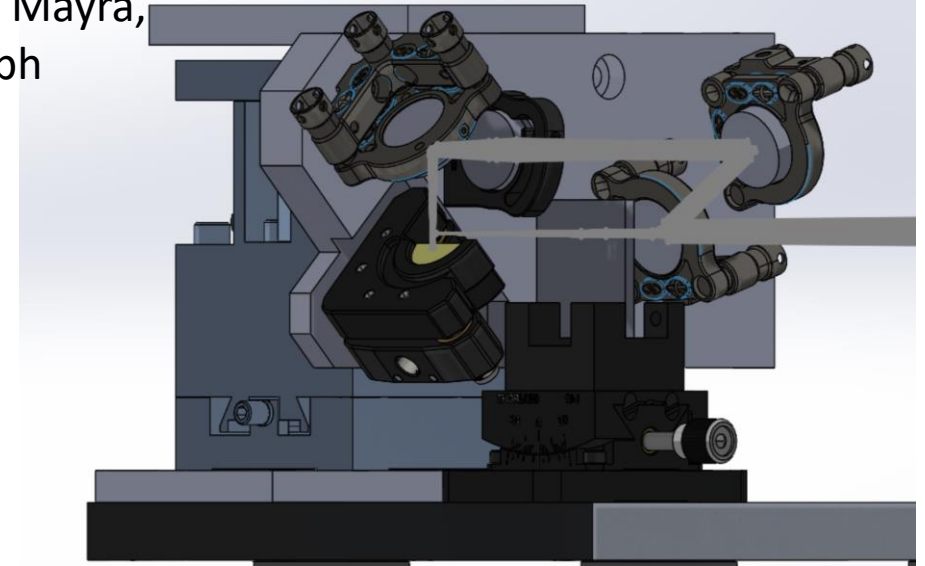


Upgrades coming

- Automated filterwheels on MIRC-X
- New spectral modes:
 - VPH R6000 at 1.08microns
 - More.. intermediate resolutions
- New combiner w/ new mounting plate
 - Better J+H simultaneous combination
- 75mm zoom lens for 6T J+H data
- Science commissioning of MIRCX-POL
- Continuing work on new MIRCX/MYSTIC Pipeline v2.0
 - To support IO combiners, polarization, and fringe tracking
- New heavy duty vacuum pump for MYSTIC



Thanks esp. to Mayra,
Dan, and Sorabh





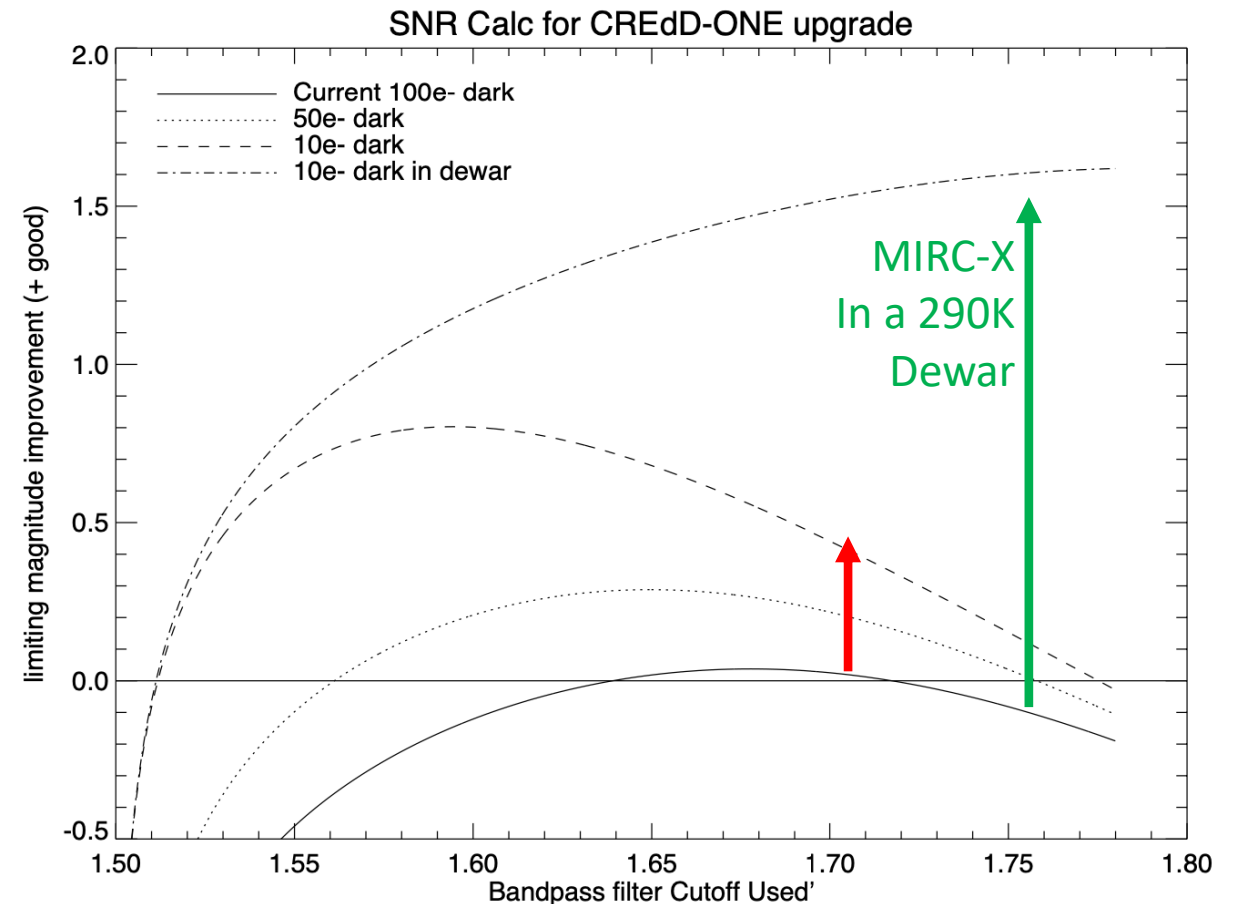
CRED-ONE upgrade for MIRC-X

Stefan Kraus funded a new upgrade for MIRC-X

Improvements include:

- 10x lower dark current (!!)
- Optimized baffle
- Better long-wave suppression
- Less focal plane vibration
- Removal of the cryocooler sine wave on signal

Install planned for early 2025 during winter shutdown

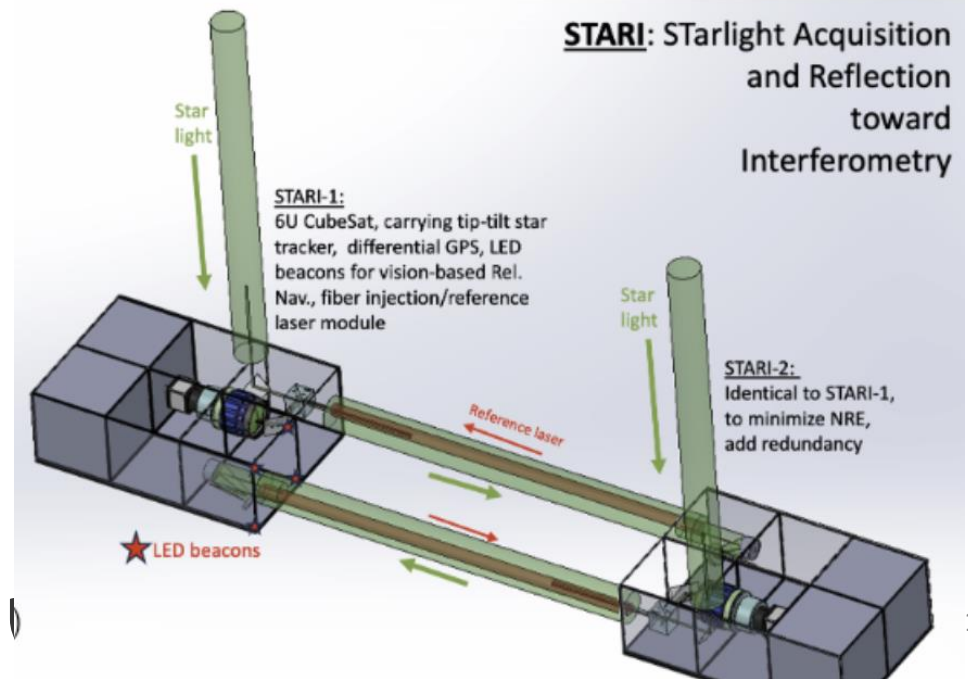
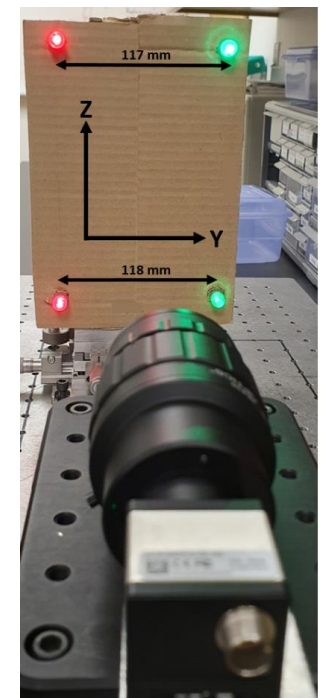




Other UM Work

In addition to CHARA work,

- Drone platform for testing cubesats and explore long-baseline interferometry potential
- Cubesat proposal to demonstrate formation flying and relay starlight from one cubesat to a fiber in another
- Quantum interferometry initiative with Oregon/Illinois, including on-sky tests with Sun
- New highly-multiplexed heterodyne lab experiment with Cundiff, Burghoff, Diddams, Eickenberry
- ELT-METIS aperture masking mode being worked on
- Nulling interferometry testbed at UM, under study





Authorship Guidelines

Approximately 33 refereed MIRC-X (2018-) and MYSTIC (2021-) papers so far

- Currently 17 instrument co-authors on MIRC-X / MYSTIC invited on new papers

Last year, John and Stefan polled the MIRC-X and MYSTIC instrument team on thoughts about authorship policies

General agreement that authorship should be related to the intensity and length of time worked on project (hardware and software), and whether ongoing support.

New policy should be based on the following principles:

- Co-authorship should be based on the year the data was taken.
- If you were working on project during the time data was taken, you will invited as a co-author (OPT-IN); similar to policy for observers.
- If you left the project, there will be a certain # of years that you will continue to be included as co-authors (OPT-IN), typically varying from 1 to 5 years depending on contributions
- Terms based on mutual agreement as much as possible, consistent with equity and fairness



MIRC-X/MYSTIC Code of Conduct

- Principles

- Members are expected to treat each other with equity and respect.
- No tolerance for discrimination, harassment, bullying or persistent unwelcome behavior.
- IAU Code of Conduct Reference. ann16007
- Professional Conduct under AAS Article VI of AAS bylaws.

“provide an environment that encourages the free expression of scientific ideas”

Discourse “conducted in a professional atmosphere in which all participants are treated with courtesy and respect”

- Invitation to collaboration meetings, telecons, and co-authorship on papers may be revoked if violating Code of Conduct
- Reporting violations or concerns to senior leadership (John or Stefan) or can talk with CHARA Directors
 - Concerns will be treated confidentially unless person raising them agrees to communicating them further (subject to HR rules)
 - We recommend CHARA PI meeting to discuss climate on an annual basis, informed by a user survey



Final Thoughts

- Support for STST Guiding Mode – deterministic actuators at telescopes and better camera
- Look into the W2 polarization problem we recently found
- Delay line fixes to the serious clock jitter problem and 120Hz oscillations
- Continue to work towards replacing dichroics with smaller wedge (to keep vis-NIR aligned in lab)
- Add White light fiber at telescope beacon focus for checking alignments on instruments
- AO improvements; work toward new visible AO system based on MEMs mirrors
- Support for simple delay line extension to allow more 6T sky coverage in north and south
- Re-aluminize telescope mirrors on a regular basis
- Focus more on adding large central telescope for better sensitivity and uv coverage rather than fiber-linked small mobile telescope
- More Array oversight of "visitor" projects. Sky time is not being used efficiently IMO
- Serious thoughts about 2030 Decadal Survey – New US Facility or stick with current infrastructure?
- Offer NOIRLAB a simple way to request binary star observations w/o full proposal process
- CHARA Array Code of Conduct should be developed
- Creation of formal Instrument PI advisory board to advise GSU CHARA leadership

Quarterly Meetings to discuss: Science, Strategy, New Funding Opportunities, Management, Climate