# MIRC/CHAMP Status and Updates

John Monnier, Fabien Baron, Xiao Che, Stefan Kraus (UM),
Rafael Millan-Gabet, Ming Zhao, Ettore Pedretti

# MIRC: Status

Guiding Principles:

1) Maximum Calibration Precision for Closure Phases
2) Imaging

- ~~Combines 4 telescopes at present~~ partially dismantled
- Works at H (1.65 micron) and K (2.2 micron)
- Demonstrated sensitivity: H~5 (θ Ori C, 2010), K~3.5
- Spectral resolution: R~ 44, 150, or 400
- Calibration: $V^2$ error ~ 3-8%; CP error ~ 2º-5º (for 6min obs.)
- MIRC 6-telescope upgrade in 2011

# MIRC: Year 5 (2010) Summary

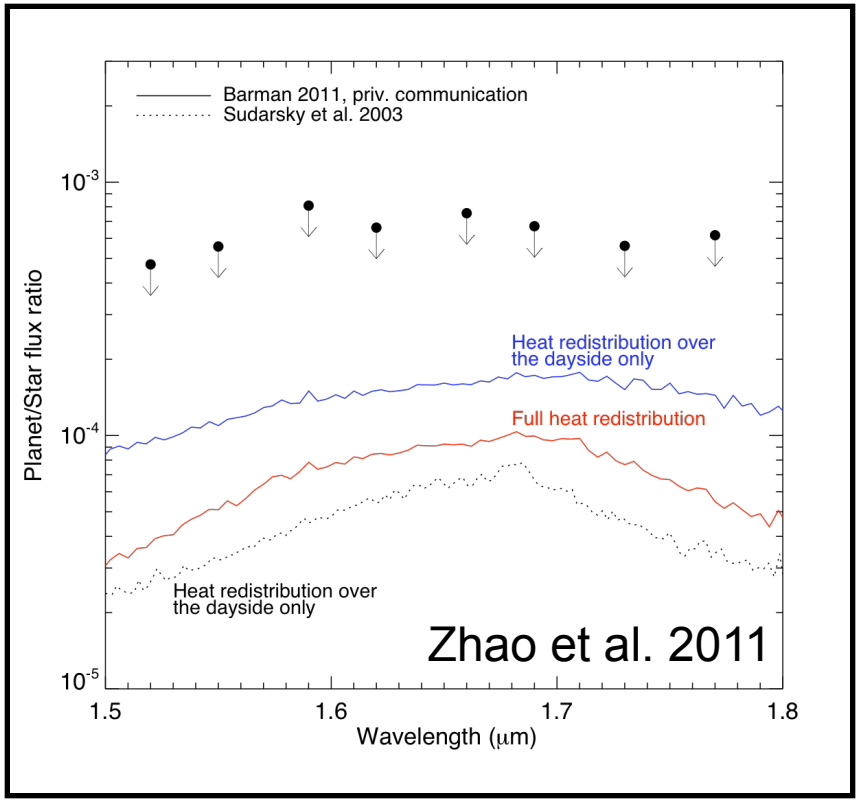
- Observing
  - 2010: 62 nights in total/8 shared with 50 nights of data (81% clear!!)
    - 20/62 nights were “Michigan” time
  - 2009: 51 nights in total with 34 nights of data (66% clear)
    - 17/51 nights were “Michigan” time, the rest from other CHARA collaborations
  - 2008: 42 nights in total with 30 nights of data (66% clear)
  - 2007: 57 nights in total with 24 nights of data (42% clear)

# MIRC: Year 5 (2010) Summary

## Projects in 2010:

- Hot Jupiters: Zhao
- Rapid rotators: Monnier, Che, Maestro, Mourard
- Be stars: Monnier, Mourard, Gies, Schaefer, Che
- Multiples: Zhao, Baron, Stencel, Gies, Schaefer, Kraus
- Debris Disks: Absil
- Spotty stars: Parks

*New NSF proposal submitted for MIRC6 Spots (PI:Monnier)*

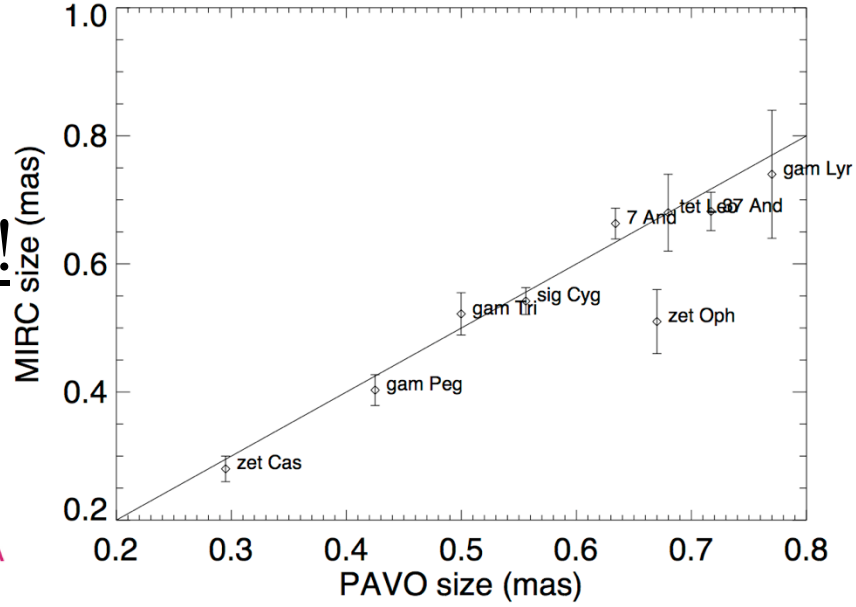


# 2010: Year of Joint Observing (12 nights)

- PAVO
  - We observed MIRC calibrators (2 nights)
  - MIRC tracker used for PAVO (alp cep, alp leo)
  - Mysterious unmodelled drifts between MIRC and PAVO (pain!)
    - It would be good if PAVO coherence length was slightly longer!
- VEGA
  - MIRC tracker for VEGA line work

Multi-λ is the future of CHARA !

  - *See talk by Xiao Che*



# MIRC: Year 5 (2010) Summary

- Publications:
  1. Kloppenborg et al. 2010, Nature, Eps Auriage
  2. Schaefer et al. 2010, ApJ, Zet Tau
  3. Millan-Gabet et al. 2010, ApJ, Delta Sco
  4. Che et al., 2011, ApJ, Beta Cas and Regulus
  5. Zhao et al. 2011, PASP (submitted), Hot Jupiter Ups And

Expecting in 2011:

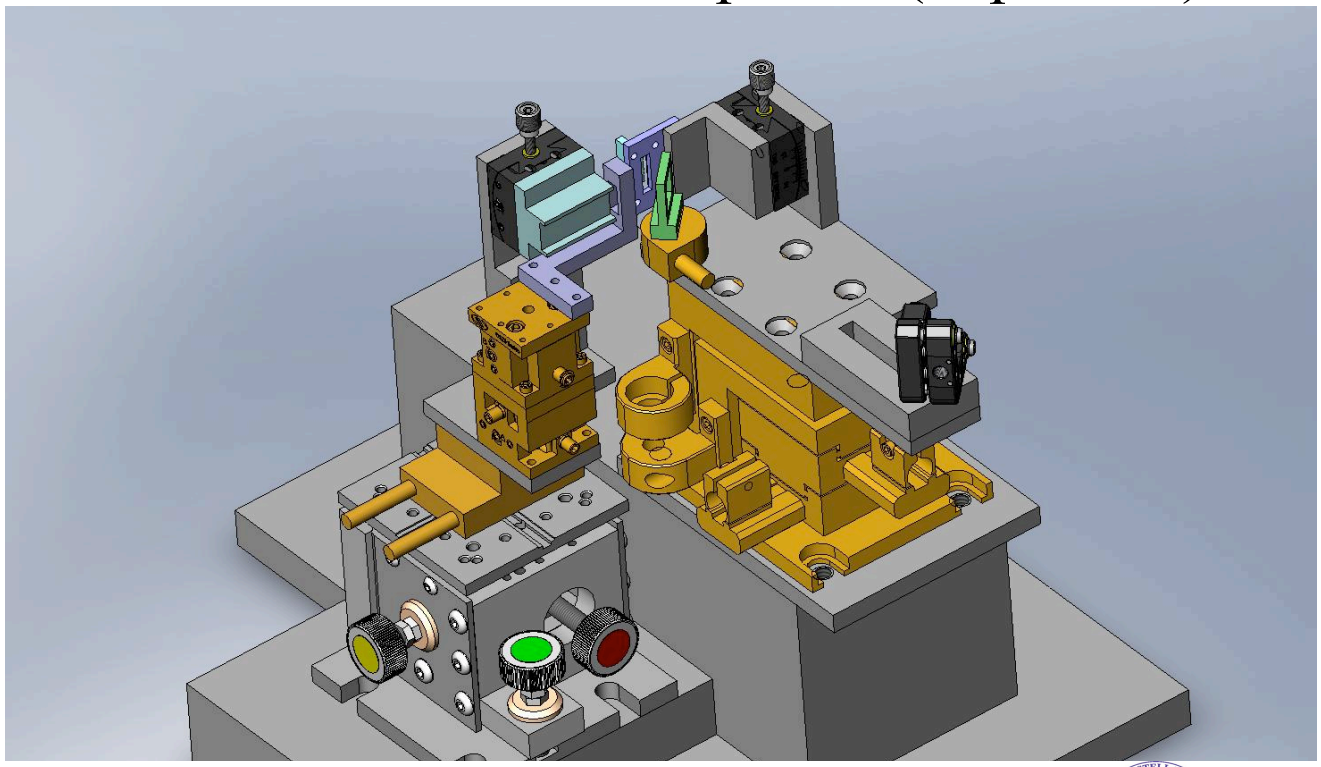
1. Aufdenberg et al. 2011, "Spica"
2. Pedretti et al. 2011, "Zet And"
3. Monnier et al. 2011, "Deneb"
4. Baron et al. 2011, "Algol"
5. Baron et al. 2011, "Hotspots on Red Supergiants"
6. Che et al. 2011, "61 Cyg AB"
7. Che et al. 2011, Joint MIRC/PAVO/VEGA on Regulus

# MIRC Improvements in 2010

- New interface computer *wolverine* [moved *lothlorien* to lab]
- New MIRC button to save fringe offsets for CHARA delay model!!
- New MIRC-only shutters using arduino (by Xiao)
- Photometric channels control software improvements
  - Speed up fiber explorer by x4
- Pedretti ported MIRC code from RTAI to new Xenomai OS
  - Tested and working in lab in 2010 August

# MIRC Improvements in 2011

- Xiao Che will upgrade MIRC from 4 to 6 Telescopes
  - Thesis project
- New Gui for realtime V2/Closure phases (in process)

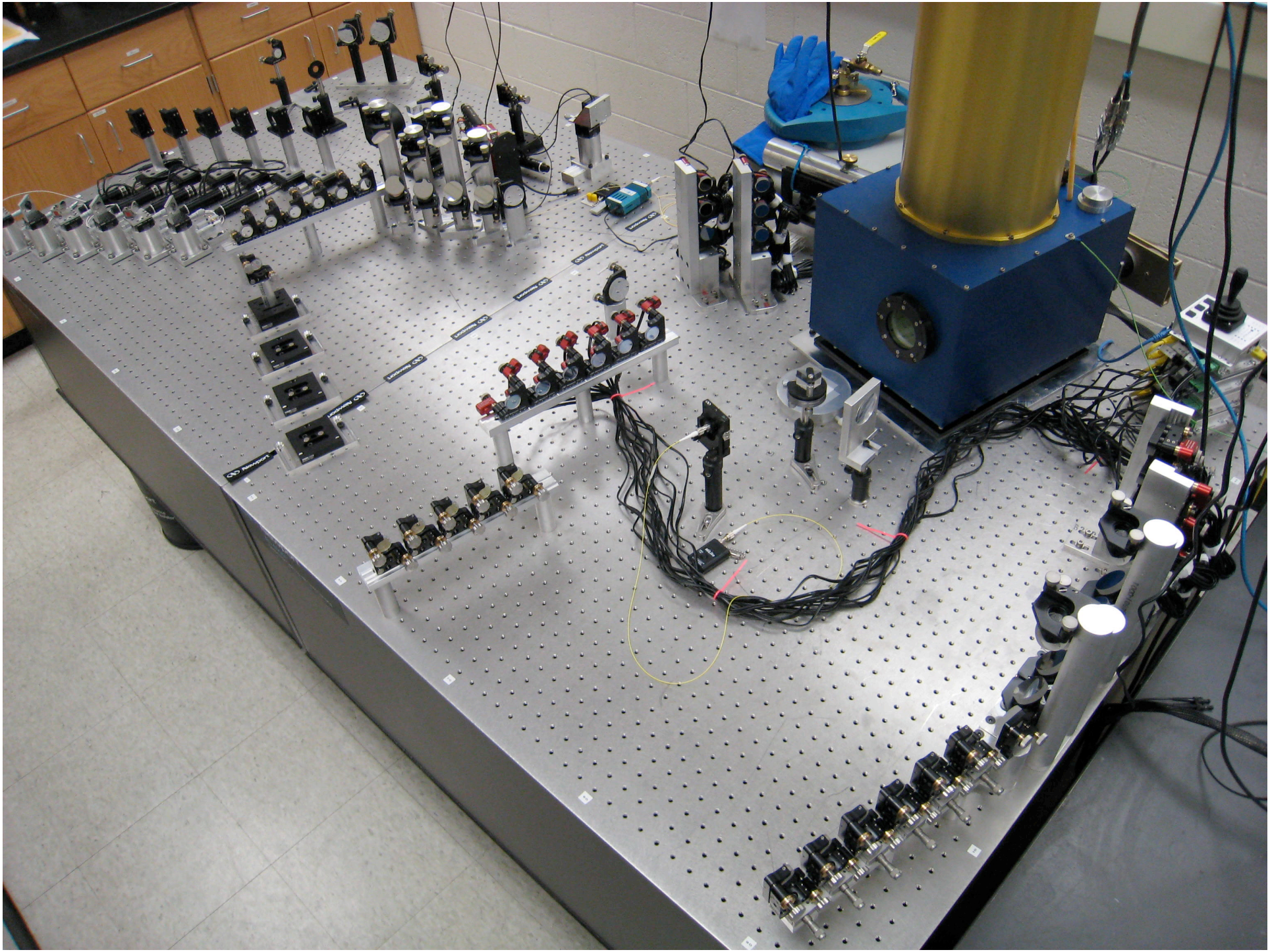


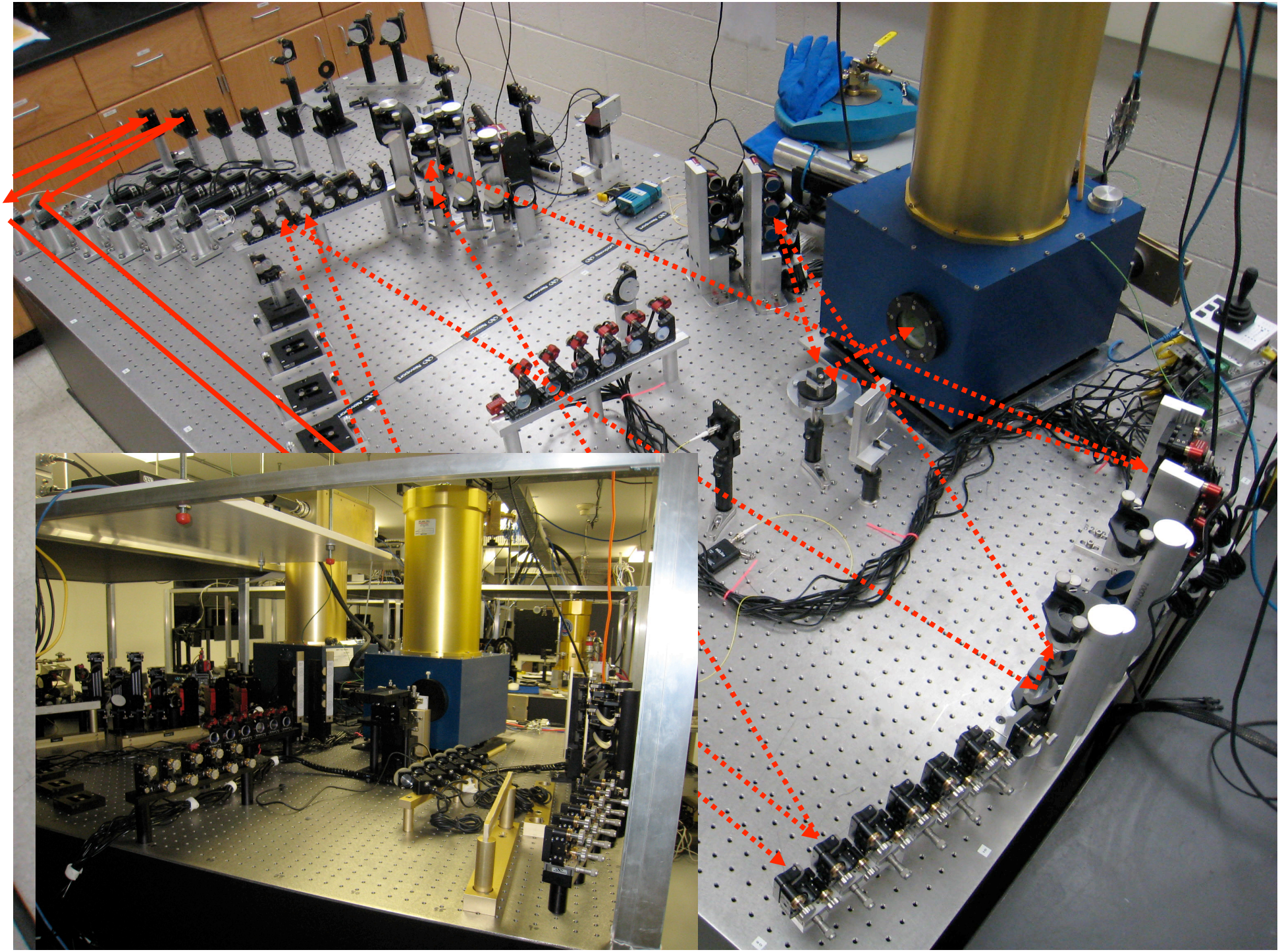
# MIRC Problems

- Hard drives continue to cause problems
  - Bad hot-swap backplane? Out-of-date operating system?
- MIRC realtime system has conflict that requires ople reboot sometime
  - Not sure why this started to be problem – will be resolved with OS upgrade this year
- Delay line performance for W1(?) bad most of the year
  - Turning off is not a pain-free solution – introduces lots of extra lab seeing
- Did not see any improvement in telescope image quality
  - Laszlo's talk this morning blew my mind
- We continue to see 2-5 degs closure phase variations with telescope pointing
  - Good to get rid of the silver coatings in the coude train
  - CHARA beams are HIGHLY polarized (20-30%) at Hband
    - Detected using photometric channel beamsplitters which are birefringent
    - This seems higher than expected if the Aluminum coatings are as thick as they should be
    - JDM plan to measure witness pieces at UM for IR polarization properties of MWO coatings
  - Closure phase drifts could be due to dispersion and non-ideal spectrograph alignment (Zhao et al. 2011)

# CHARA-Michigan Phasetracker (CHAMP)

- Will detect and correct pathlength fluctuations
  - "adaptive optics" for an interferometer
  - "Freezes" the fringes to allow long integrations (max freq_fringe = 500 Hz)
  - Operates in J,H,K bands
- Facility instrument to be used with all combiners
  - IR sensitivity plan for H=7-8 (improve MIRC by x10, esp. for YSOs)
  - Enable imaging at visible wavelengths
- Commissioned 2 telescopes in August 2009





# 2010 August: Four-Telescope Tracking with CHAMP

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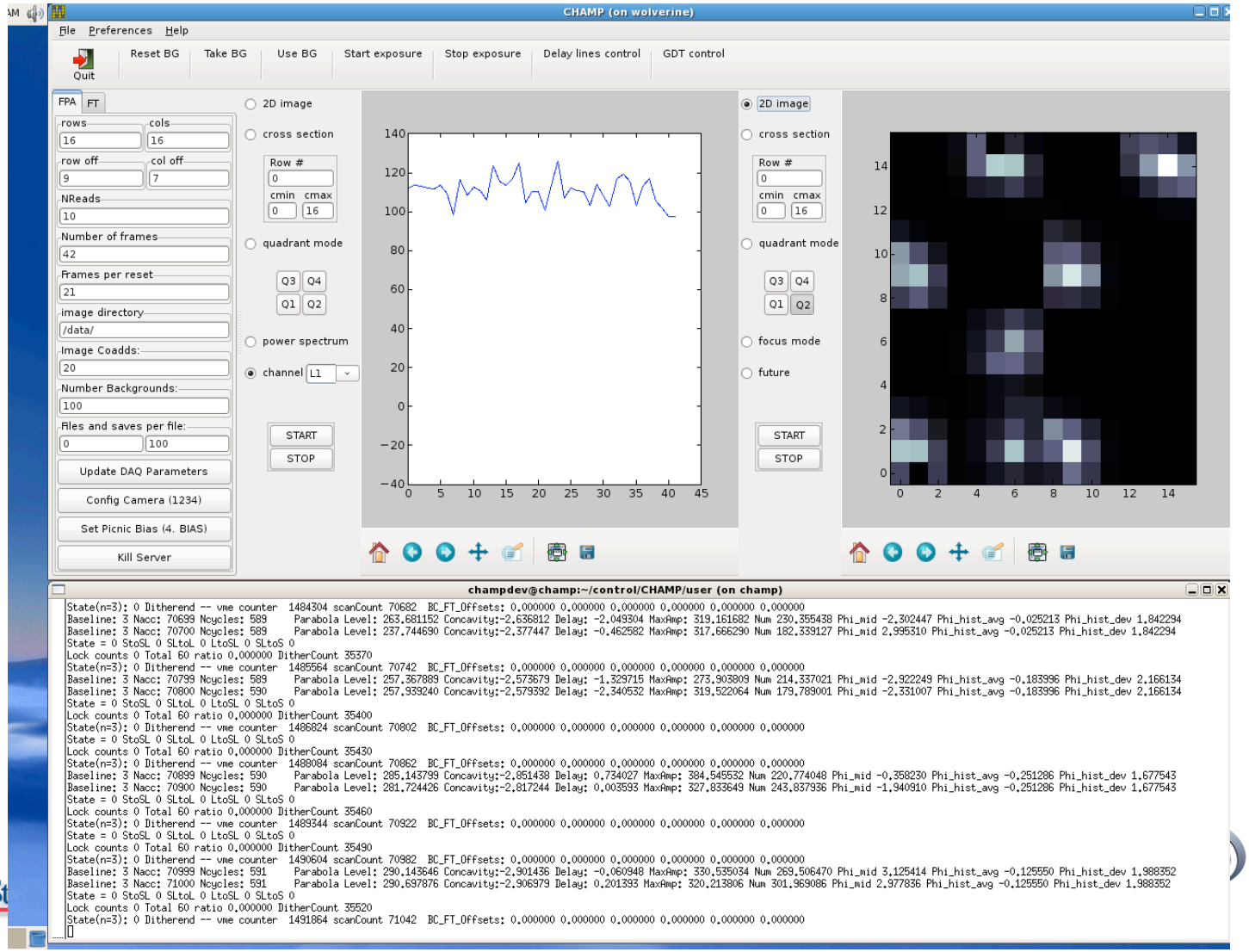

# CHAMP Milestones in 2010/2011

- August 2010
  - Polished and sky-tested interface GUIs
  - Documented alignment procedures
  - First 4 telescope CHAMP fringe tracking with simultaneous MIRC data (!)
- February 2011
  - Installed new retro mounts for delay lines
  - Replaced fried PZT cable
  - Found internal fringes for all 6 beams (for mirc6 regime)
  - Started specialized alignment gui (RMG)
  - Real-time data spooler
  - Sophisticated opd map calculator in IDL
  - Coherencing tests – work on wrap-around estimator

# CHAMP Problems and Solutions

- Software Software Software
  - Reliable and user-friendly GUIs are getting there… Fabien Baron is spearheading this and cleaning up previous code
  - Integrate with CHARA better (server communications)
- 2009 Red laser is too weak to align CHAMP
  - 2010 Green Laser is better!
- 2010-2011: Painful to get internal fringes with delay lines
  - UM machine shop made some Laszlo parts for easier retro reflection through delay lines; tested by Baron/Monnier in Feb 2011 (it works!)
  - Still a bit on the faint side using 50mm retros in ~6” beam
- CHAMP has very tight tolerances for vignetting
  - We would like encoders for tip-tilt mirrors (pretty please?)
- K band fringes on YSOs are weak – try J band
  - RMG ordered new CHAMP dicroics (J/H split & H-pass)
  - Metrology contaminates J band: need better baffling and some in-line filters (TBD)

# Champ Goals for 2011

- Demonstrate 6-telescope fringe tracking with MIRC6 in July 2011
- Photometric optimization in May 2011
  - Focus each beam
  - Vignetting study
  - Detailed Alignment camera pupil
- Integrate with CHARA server communication scheme
- Lots of algorithm testing for faint fringe coherencing
- CHAMP is strong foundation for new 4 or 6 telescope combiners
  - PAVO6 ?
  - Nulling with interferometric chopping for exoplanets?

**We would like to encourage CHAMP and MIRC collaborations for Fall 2011, especially true phase-referencing with CHAMP**

*(esp. for VEGA and FLUOR)*

# Other UM work

- IDL pipeline for CLASSIC done (JDM)
- UM group helped with 2010 CLIMB commissioning
  - JDM working with Theo on Closure Phase cross-validations
- YSO Program with CLASSIC/CLIMB (w/ RMG, RW)
  - New sensitivity of CLASSIC/CLIMB makes big difference
    - 2004-2009 => 4 YSOs
    - 2010 => 14 YSOs

    RY Tau, SU Aur, BP Tau, FU Ori, MWC 614, RW Aur, HD 142666, MWC 758, MWC 863, v1685 Cyg, MWC 361, MWC 147, MWC 166, MWC 340, v1972 Cyg
  - Future progress now limited by R-band Tip-tilt !!
    - NSF AO/TT upgrade projects would be great to get!!

# OHANA at Mt. Wilson?

- Some discussions between CHARA, UM, ISI, and OHANA about fiber-linking ISI telescopes to CHARA

# 2011: MIRC6 + CHAMP6