CHARA Futures

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• CHARA and NOAO
• Guidelines for Discussion
• Scientific Goals
• Stellar Samples
• Mt. Wilson Sites for Additional Telescopes
• Limitations: Telescopes, OPLE, BCL
• Organizational Challenges
• “Strawman” Concepts
• Discussion
CHARA and NOAO

• CHARA is providing open access to the Array for 25 nights/semester (50 nights/year) through competitive proposals collected and reviewed by the National Optical Astronomy Observatory (via Steve Ridgway)

• NOAO interested in continuing plan into future

• Invited representatives from CHARA (ten Brummelaar, Gies, Schaefer), NPOI (van Belle), MROI (Creech-Eakman) [+PFI paper by Monnier et al.] to a Decadal Planning workshop in Tucson (Feb. 20, 21)

• Plan to build science cases and develop specific plans for the U.S. Decadal Review for the 2020s

• Now is the time to consider future of CHARA
CHARA Staff Meeting on Futures

• Now in 15\textsuperscript{th} year of regular observing with AO coming
• Develop plans that build on our strengths
• Not building a new array
• Projects that can be completed in 5 – 10 years
• Scientific goals and physical limitations
• Report here on contributions from staff
Scientific Goals

• From stellar properties to stellar processes

• CHARA Array: many and varied baselines make it ideal for *imaging*

• Need to define key science programs to guide designs

Zeta And (Roettenbacher et al. 2016)
Scientific Goals

• *Surfaces of stars*: starspots, NRP, granulation, differential rotation, intensity

• *Exoplanet host stars*: parameters, hot Jupiters, astrometric perturbations

• *Circumstellar disks and outflows*: young, evolved, interacting binaries

• *Massive stars*: parameters, binary evolution to GW source

• *Active Galactic Nuclei*: environment of supermassive black hole

• Need
  - *larger spatial range* (shorter and longer baselines)
  - *increased (u,v) coverage* (more baselines)
  - *better sensitivity* (larger apertures, high efficiency coatings)
Stellar Samples: optical region

JMMC Stellar Diameter Catalog

DEC > -20°
V < 8 mag
θ > 0.1 mas

N_{star} = 20,713
Stellar Samples: near-infrared region

- DEC > -20°
- V < 15 mag
- H < 10 mag
- θ > 0.1 mas

Nstar = 98,872
Mount Wilson sites for Additional Telescopes

- For light pipes, need direct line of sight to OPLE
- More options for fiber optics relay
- Explore limits from local topography
- 500 m NW arm
- 660 m to S1
- 590 m to E1
• 385 m SW arm to upper parking lot
• 590 m to E1
• 550 m to NW
• Requires bridge (tree-top walk)
• OPLE east end
• Shorter baselines with E2, W2, S2
• Behind CRO (FS approved)
• North of Cadman and shops
Limitations:

- Need to reproduce current telescopes and light paths for polarization matching
- Mixed apertures allowed
- Aperture size limited by aluminizing chamber (2.5 m) and transport over roads (1.5 to 2 m)
Limitations: light pipes

- Two pipes from the West (repeat of existing design all along), but why 4 in the West.
- One West + one South (with new type turning box) possible.
- One West + one East (turning box outside!) possible.
- One South (new type turning box) one East (turning box outside!) possible.
Limitations: OPLE, BCL

• OPLE building has space for two additional variable delay rails and carts; adding more than two more beams would require independent OPLE

• Additional fixed delay possible below new tracks

• Long baseline work will require fast moving carts and hence shorter times before running out of variable delay; consider extending tracks into storage area at east end of OPLE and/or double pass OPLE carts

• Space is very restricted in OPLE and BCL for new beams; would need to reposition optical benches

• MIRC designed for only 6 beams; use beam combiners with subsets of available telescopes and beams until next generation available
Organizational Challenges

• Staff over-worked currently supporting AO and NOAO access programs
• Long lead time required to coordinate with Mount Wilson Institute, Carnegie Observatories, Carnegie Institute, US Forest Service, LA County
• Will require significant effort to find funding from a variety of sources (US federal, Georgia, private foundations, donors)
Concepts:Need your opinions!

• Here are five strawman concepts for expansion
• Please indicate on the page your level of enthusiasm
• Indicate any major positive features
• Indicate any major negative features
• Your name is optional
(1) Add central telescope behind CRO

- Use extra M1, M2 and build 1 m telescope of same design
- Place near the center of Array
- Increased short baseline coverage for baseline bootstrapping
(2) Add 2 m telescope to the far south

- Connect to S1 by fiber
- Use as pathfinder for PFI technology
(3) Add 2 m telescope close to S1

- Helpful for large objects like supergiants and exozodiacal disks
- Role in baseline bootstrapping
- Might share light pipe with S1 or S2
(4) Add two 2 m telescopes to NW and SW

- Very long baselines for highest resolution
- Requires strong bridge for SW light pipe
- Stepping stone to km baseline arrays
(5) Replace all six telescopes with 2 m scopes

• Increase sensitivity using existing light pipes
• Invest in high reflectivity optics
Combinations of these? Other ideas?

• Example: new telescope near S1 (#3) plus NW, SW pair (#4) to create a large triangle for closure phase measurements

• Fiber optics to remote locations (limited bandwidth in near-IR)

Please join the dialogue about future concepts!