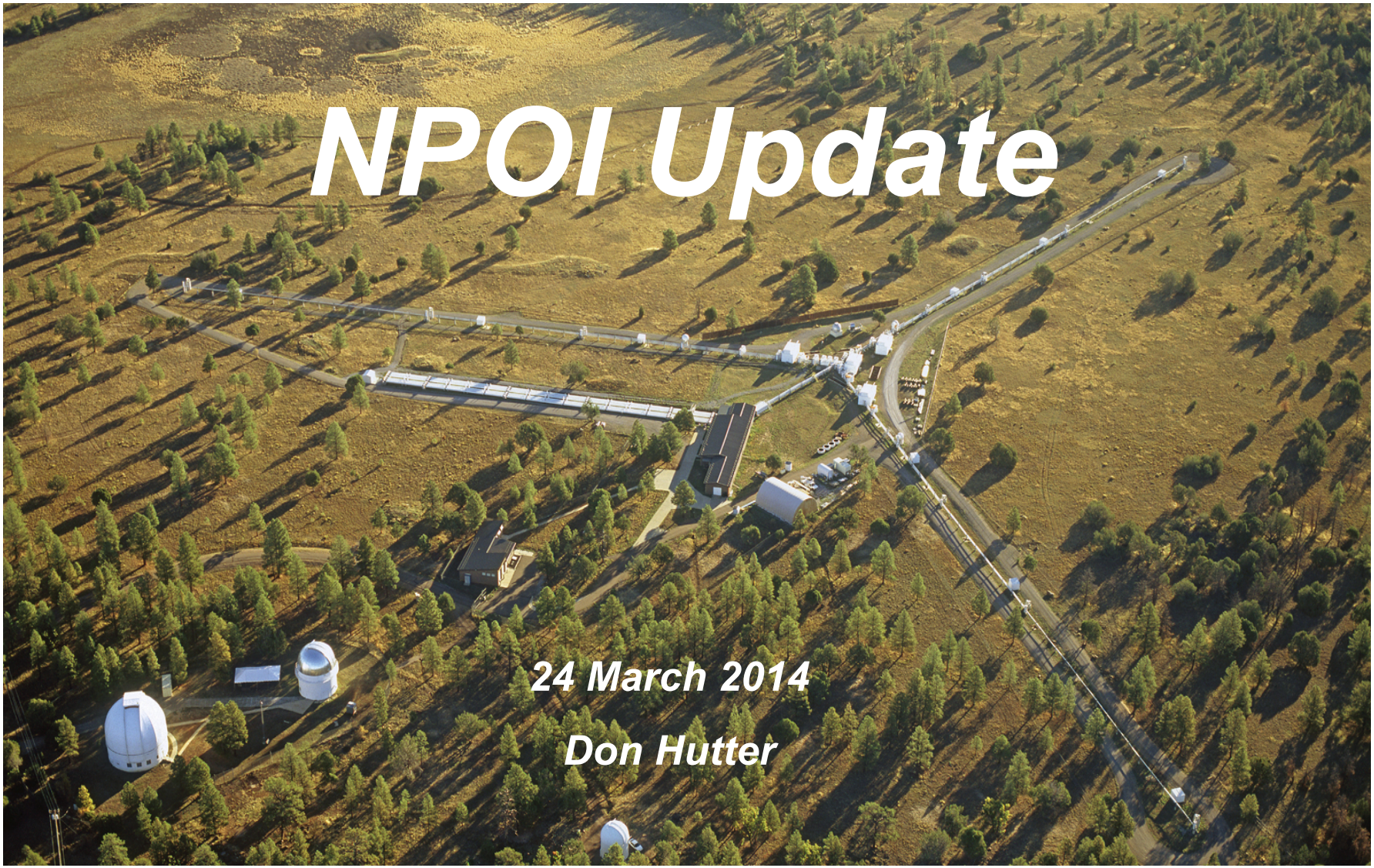


# NPOI Update

24 March 2014

Don Hutter

# NPOI Update

## The "BASICS"

- NPOI = Navy Precision Optical Interferometer
- Major funding by Oceanographer of the Navy and Office of Naval Research
- NPOI is collaboration b/w USNO, NRL & Lowell Observatory




- Lowell is science partner & contractor to USNO (infrastructure & ops)
- Several external collaborators, some with independent funding (NMT, TSU)

# NPOI Update

## The NPOI Team:

USNO:

Paul Shankland
Don Hutter
Jim Benson
Mike DiVittorio
Bob Zavala

AES:

Tim Buschmann
David Allen

NRL:

Richard Bevilacqua
Sergio Restaino
Tom Armstrong
Jonathan Andrews
Ellyn Baines
Jim Clark
Henrique Schmitt

TSU:

Matt Muterspaugh

ONR:

8 Navy Reservists

Lowell:

Jeff Hall
Gerard van Belle
Bill DeGroff
Lisa Foley
Victor Garcia
Jim Gorney
Jason Sanborn
Susan Strosahl
Steve Winchester
Ron Winner

NMT:

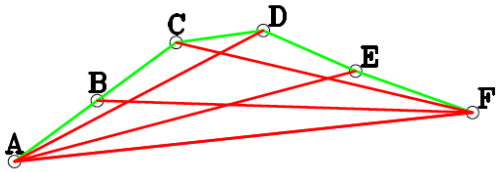
Anders Jorgensen
Matt Landavaso

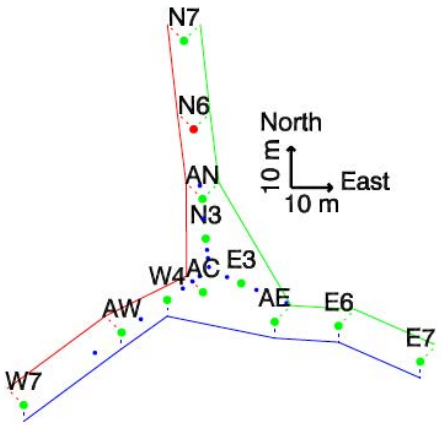
# NPOI Update

## Expansion of Imaging Array:

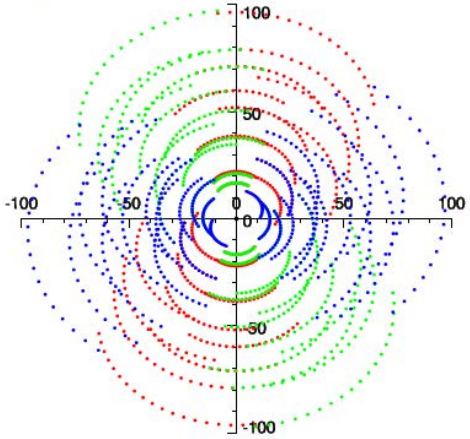
### Goal: Infrastructure @ 10 stations for 6 portable siderostats

- Demonstrate multi-baseline bootstrapping (5+ array elements)



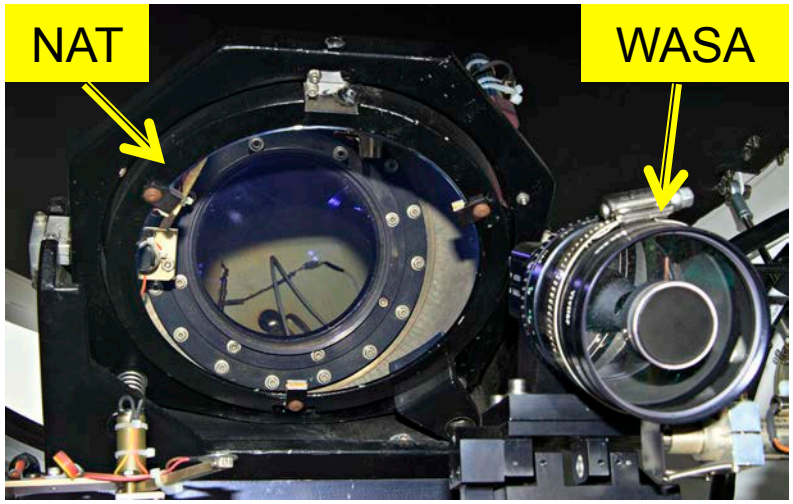




- Geosatellite imaging techniques
  - Observe stars and satellites on short bootstrapped baselines




- High precision imaging
  - Observe O stars, solar analogs with 432 m baseline

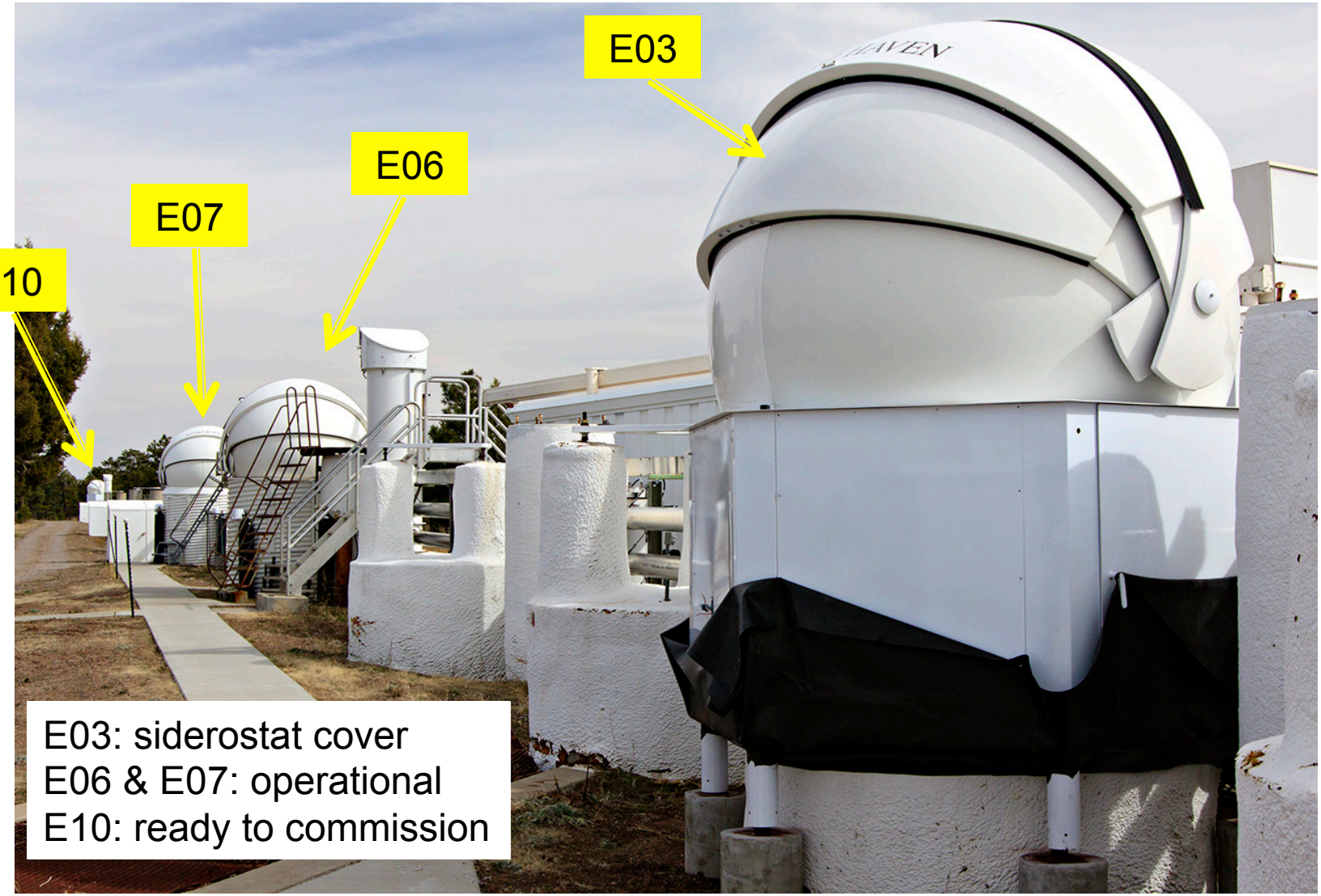
# NPOI Update



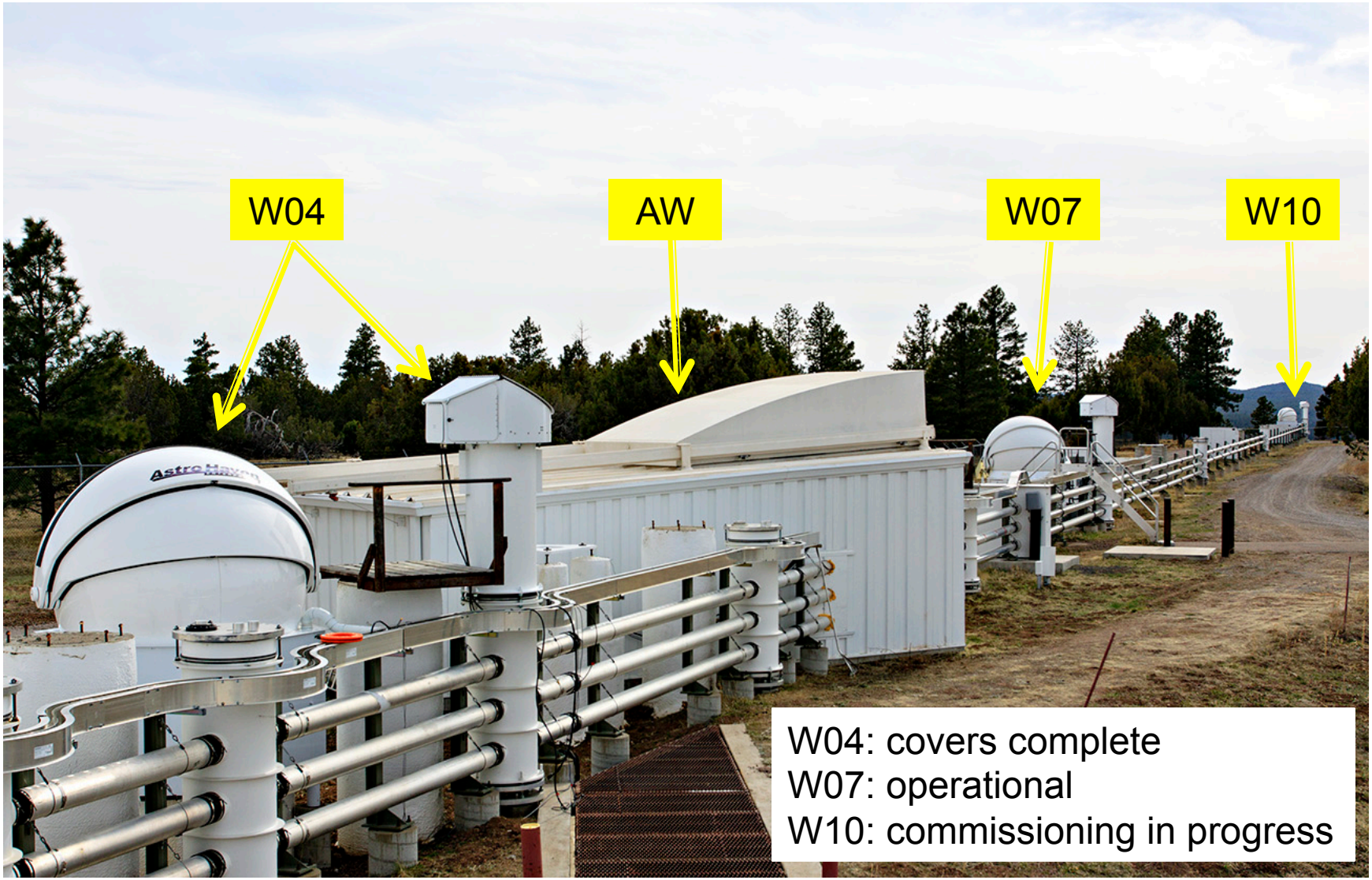


Siderostat

# NPOI Update

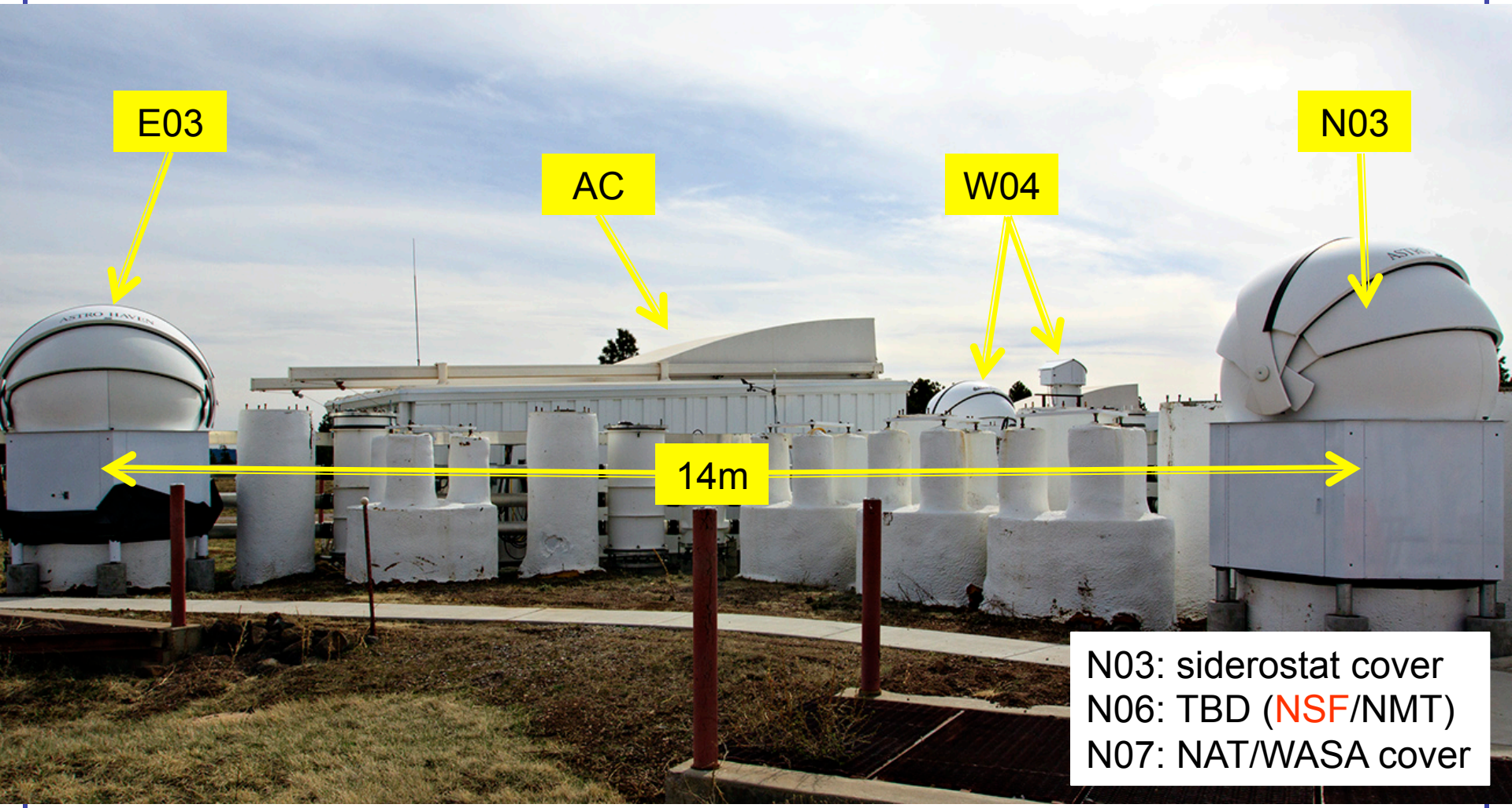

E03
E06
E07
E10
E03: siderostat cover
E06 & E07: operational
E10: ready to commission

# NPOI Update




W04: covers complete
W07: operational
W10: commissioning in progress

# NPOI Update

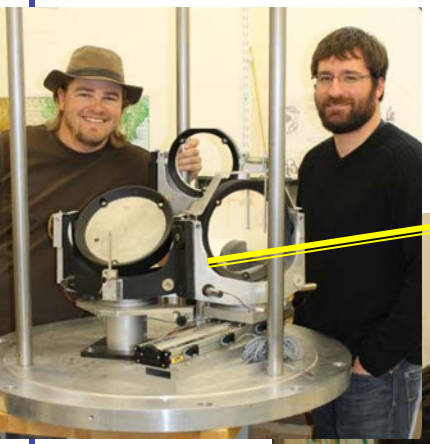

E03
AC
W04
N03
14m
N03: siderostat cover
N06: TBD (NSF/NMT)
N07: NAT/WASA cover

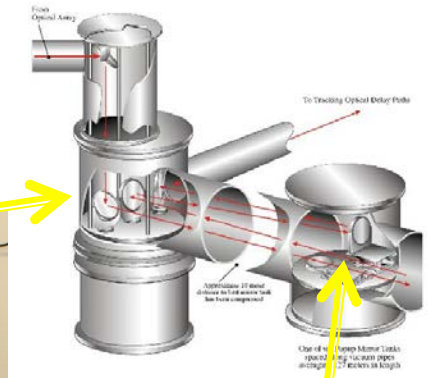
# NPOI Update

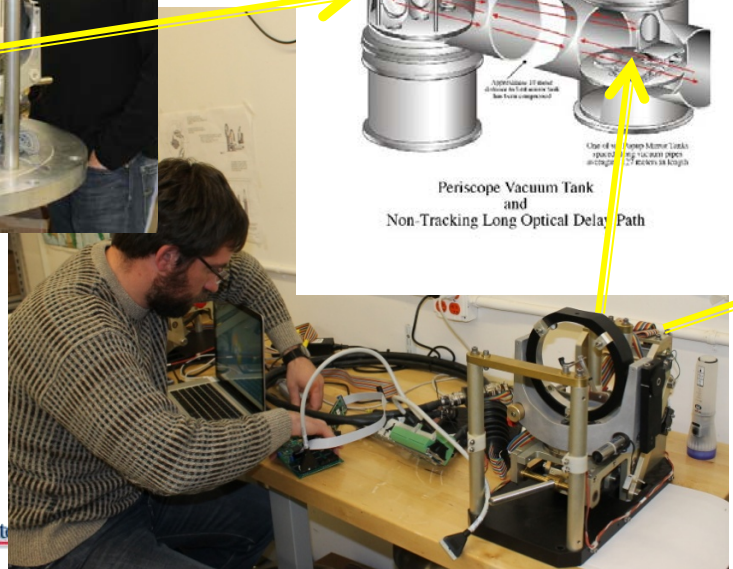
## Integration of Long Delay Lines (LDLs):

- Controllers for (72) “Popup” Mirrors constructed, programmed & installed (50% wired in, 25% field tested). Completed this summer.

- Periscope controller design, fabrication of remaining mechanical components, TBD.





# NPOI Update

## Control Systems Upgrades (1):

- PC-based siderostat controllers (SIDcons) for astrometric & imaging stations (AES) (10 constructed; 1 to finish, 8 installed)

# NPOI Update

## Control Systems Upgrades (2):

- PC-based Fast Delay Line (FDL) control system (AES):

- 6 channel FDL control system
- PC architecture with specialized low-latency Linux Kernel
- Tracking with typical 2-7nm jitter
- In system programmability of all custom-built hardware
- Metrology achieves 1.24nm resolution (sampling at 64kHz)
- Stroke generator:
  - Upload of data per high speed USB2.0
  - 1 mbps samples with 16bit resolution output
- In-system diagnostics of all subsystems and sensors
- In-system tuning of all servos and pre-amps
- Remote control via GUIs and programming APIs
  - Stroke API and FDL Api in Python and C++

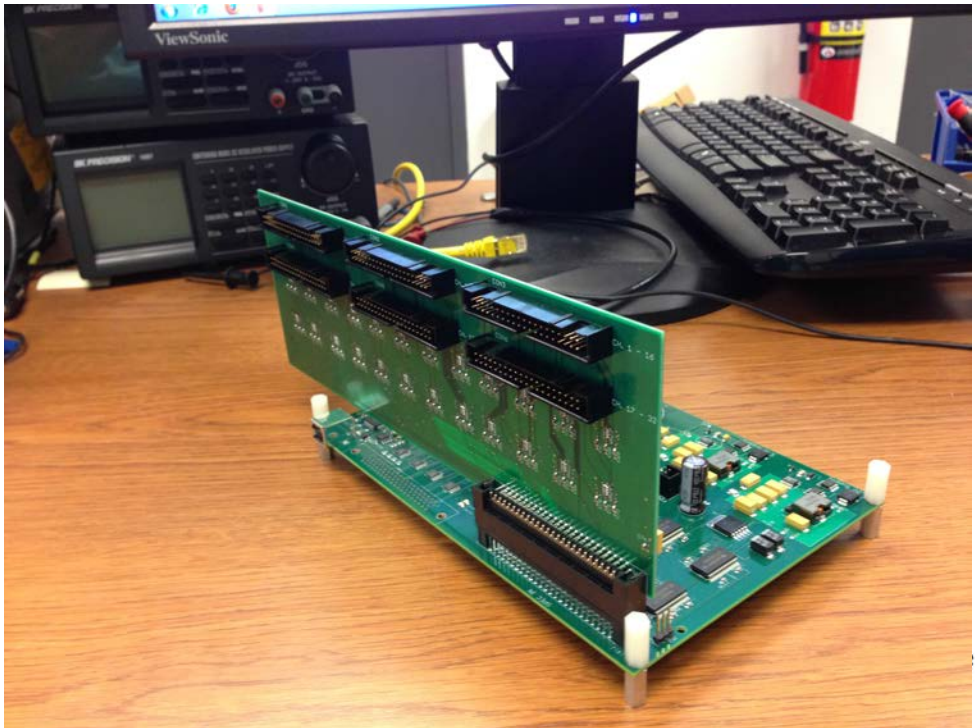
# NPOI Update

## Control Systems Upgrades (3):

- New Fringe Engine for NPOI "classic" beam combiner

  - Hardware finished (AES)

  - Firmware & software (NMT) undergoing on site tests.



# NPOI Update

## VISION beam combiner:

- See Victor Garcia's presentation Tuesday.
- NSF funded (TSU)
- 6-beam, visible-light analog of MIRC
  - 11 Oct 2012: First stellar fringes (single Baseline)
  - 15 Jan 2013: First 4 station (6 Baseline) stellar fringes
  - 16 Dec 2013: First bootstrapped fringe tracking (5 stations).
  - Currently fringe tracking to 4th magnitude

# NPOI Update

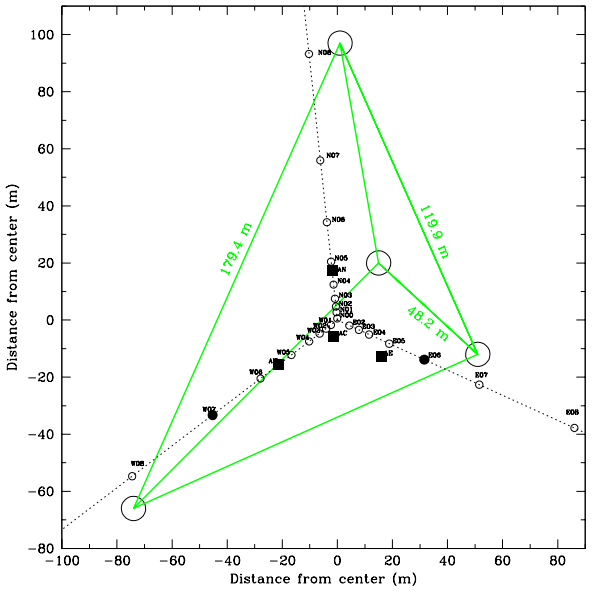
## 1.8m telescope installation (1):

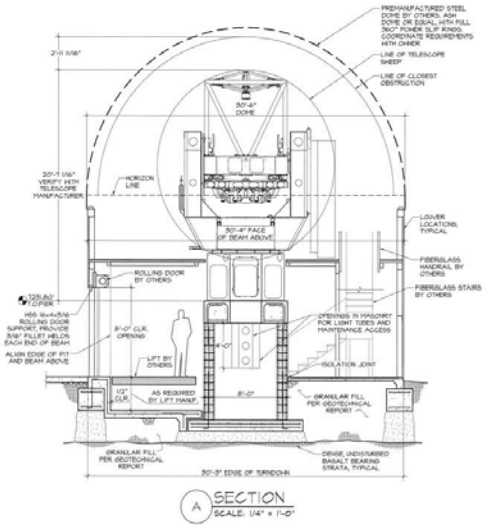
- **Goal:** large aperture array for wide-angle astrometry & visible/near-IR imaging

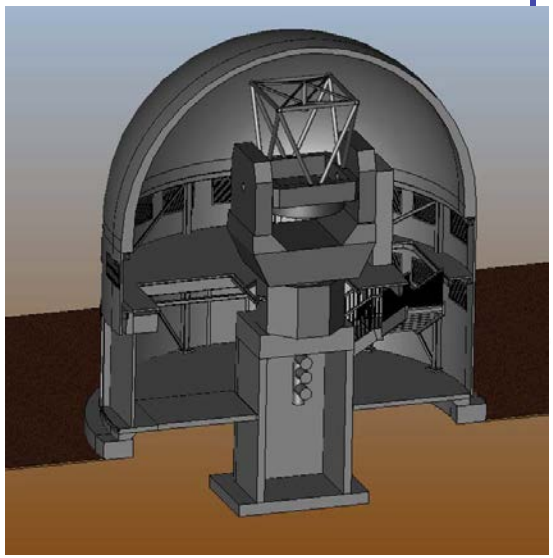
- **History:**
  - Nov 2010: gifted to Navy (USNO Flagstaff) by CARA
  - May 2012: Infrastructure (construction ready) plans finished
  - July 2012: Special Use Permit from US Forest Service

- **Currently:**
  - Updating construction cost estimates & contract preparations towards construction start in Fall 2014.

  - *Probably* sufficient funds for infra-structure & install (assembly) of 2 telescopes in FY15.



# NPOI Update

## 1.8m telescope installation (2):

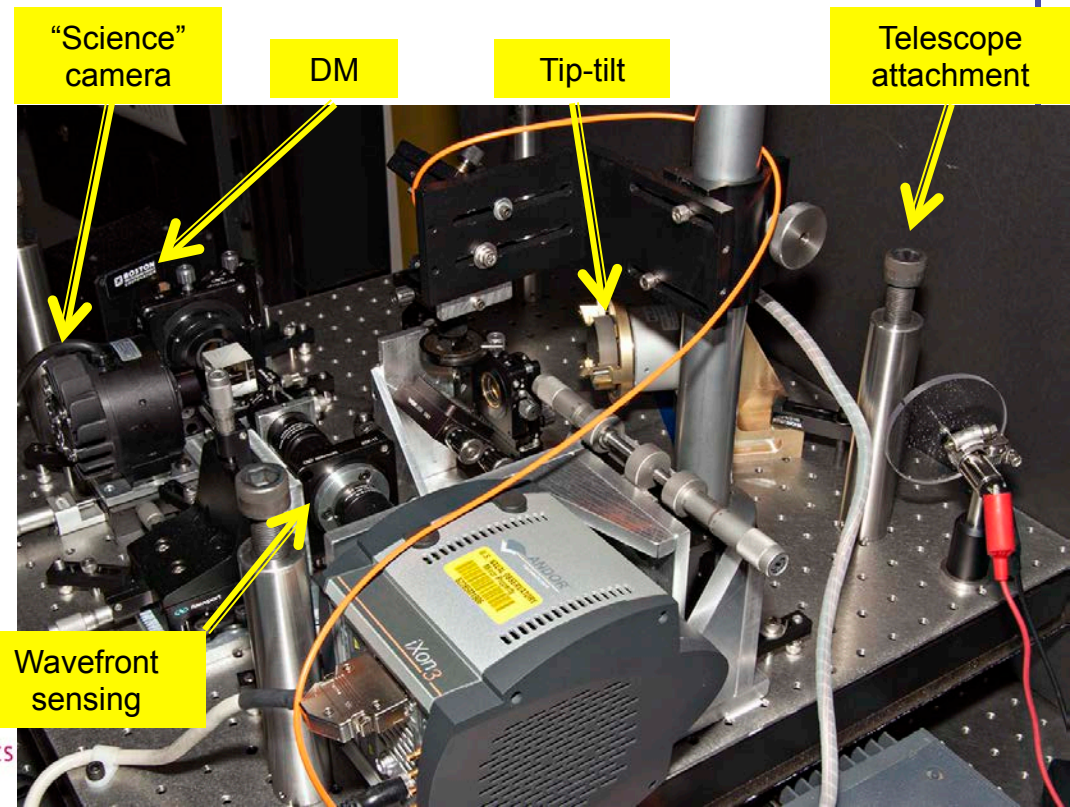
- **Future (FY16-17):**

  - Replace VME-based control system with modified NPOI siderostat controller using existing telescope motors and encoders (AES)

  - Complete LDLs (periscope control)

  - Vacuum Feed connection to array: (Windows, mirrors, vacuum cans, vacuum pipe & supports from "M7" to existing array)

  - Continue AO test bed development (NOFS, w/USNA/Lockheed; to test on NOFS 1.0m &1.55m)



# NPOI Update

## Research / Publications (1):

USNO – NPOI Astrometric Catalog (UNAC):

- Goal: Catalog of ~ 1000 stars with positions accurate to < 16 mas (tied to ICRF).

- 31 Dec 2013: internal USNO release of UNAC 1.0
  - 50 stars (19 nights data), 3 mas formal accuracy (but some bad data)

- April 2014: UNAC 1.1 expected
  - ~100 stars (~80 nights data)
  - Improved error distribution calc., only data from “locked” baselines

# NPOI Update

## Research / Publications (2):

Refereed papers from *previous 12 months*:

- NPOI Update – Armstrong et al., 2013, J. Astrom. Instrum., 2, 1340002
- κ CrB – Baines et al., 2013, ApJ, 771, L17
- 89 Her – Hillen et al., 2013, A&A, 559, A111
- ζ Ori A - Hummel et al., 2013, A&A, 554, A52
- 10 Stellar Oscillators – Baines et al., 2014, ApJ, 781, 90

See also: presentations here by Tom Armstrong, Ellyn Baines, Victor Garcia & Chris Tycner