A Proposed NPOI Facility Upgrade

In Response to the AFRL RFP
Amplitude Interferometer Research for Geosynchronous Earth Orbit (GEO) Space Situational Awareness (SSA)

Dr. Gerard van Belle, Principal Investigator
Lowell Observatory
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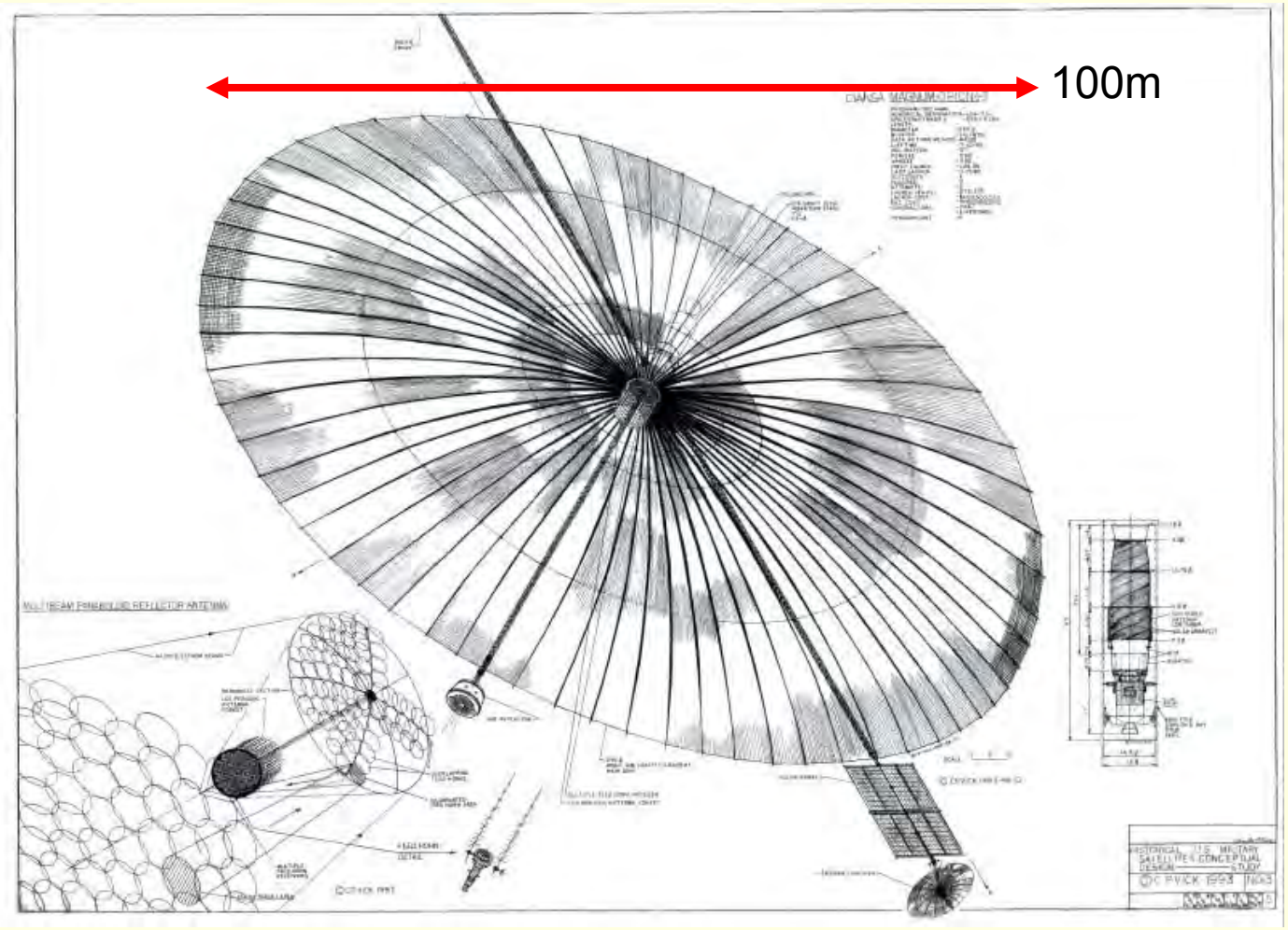
AFRL Call for Proposals

- Followed an AFRL Request for Information (RFI) in May 2014
- Call went out November 2014, due Jan 6, 2015
- Five phases
  - Funding of $5M for each phase
- Astrophysical applications desired
- “Anticipated Award Date: 10 March 2015”
  - No news yet

The Nature of the Imaging Targets

- Small angular scale
  - 130ft @ 22,000 miles
  - But not *that* small: up to 100mas
- Faint
  - 10-15th at V
- Desired resolution
  - AFRL: 25cm → 1.4mas pixels
  - DARPA: 10cm

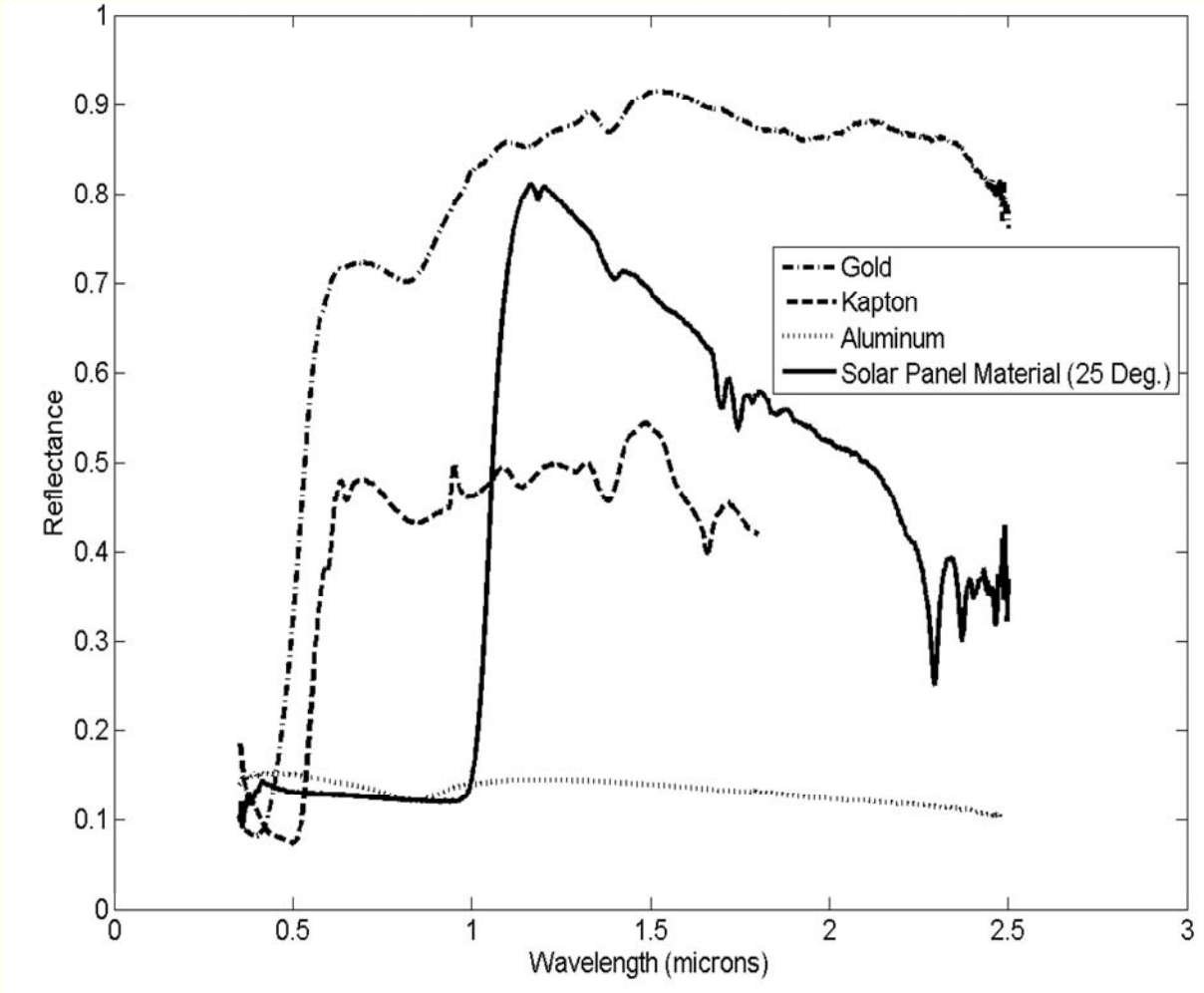
Largest Geosats



Reflectance versus Wavelength

- Bus: gold
  - 1.5×1.5m
- Panels
  - 16×2m
  - Each
- Areal Ratio
  - 28:1

- 150× near-IR flux, versus V

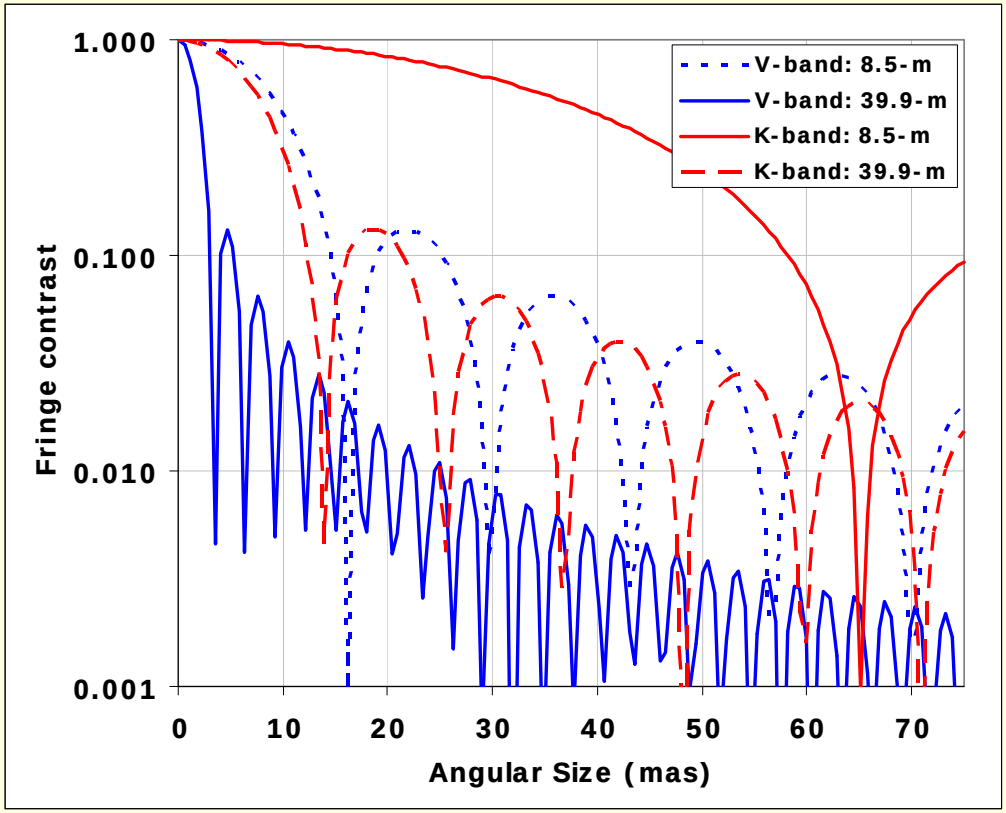


Technical Approach

- Single-aperture non-redundant masked imaging (NRM)
  - 4.3-m DCT
  - Constrains low-spatial-frequency imaging
- Add large apertures to NPOI
  - Increases sensitivity
  - Prescribes a need for AO
- New back-end instrumentation for NPOI
  - Fringe track in near-IR
    - Significantly increased flux
    - Reduced resolution → higher contrast fringes
  - New[?] visible imager to take advantage of cophased signal

Wavelength-Baseline Bootstrapping

- Real NPOI configuration
  - Longest ‘short’ baseline is 8.5m
  - Longest baseline is 39.9m
- Challenge: tracking well enough in near-IR

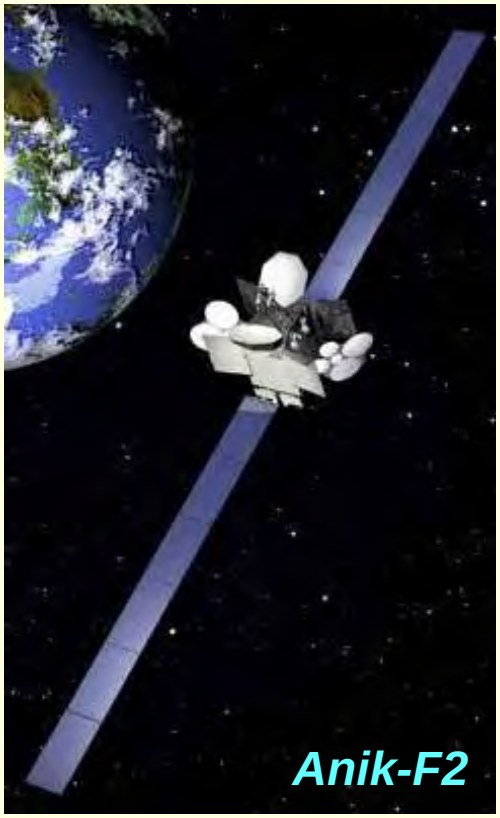


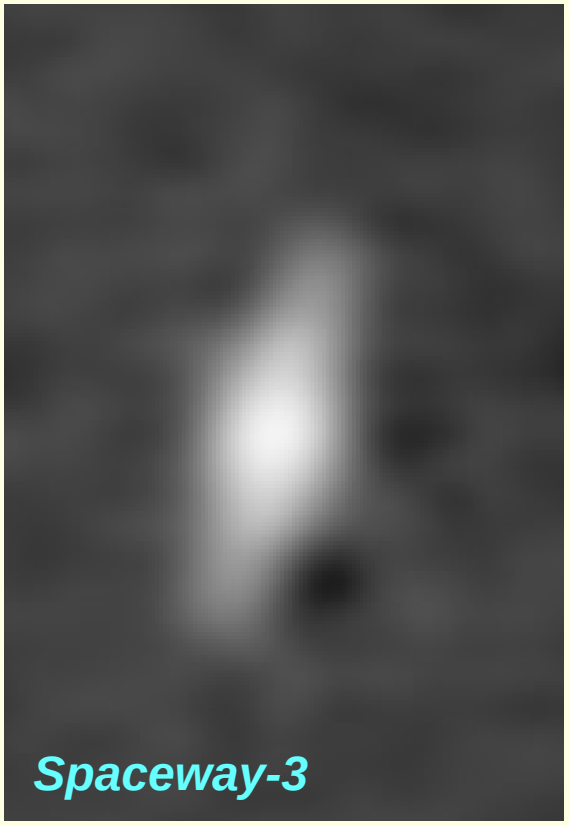
Technical Challenges

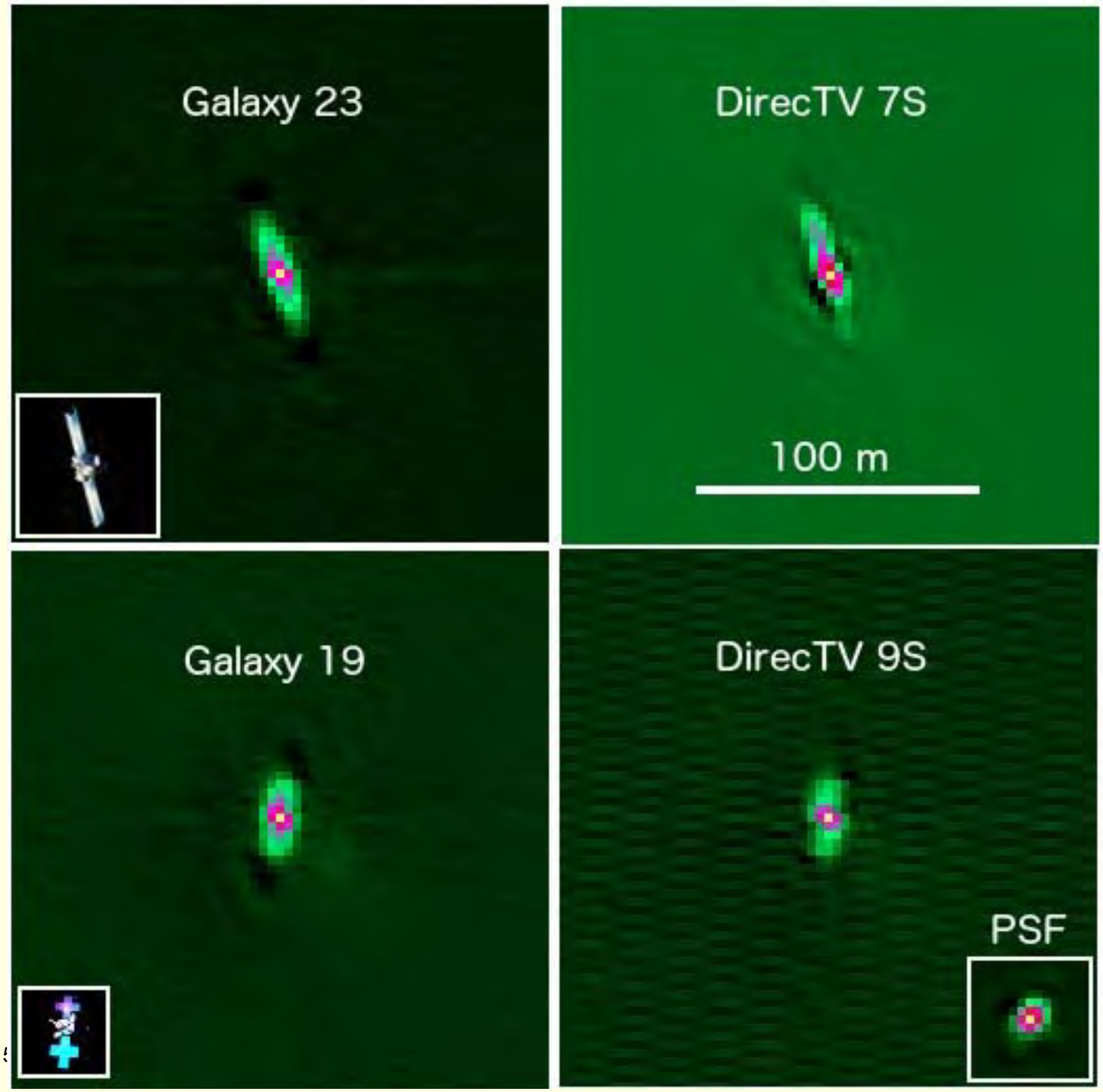
- System engineering
  - Multiple baselines
  - Multiple AO systems
  - Many large relocatable apertures
- Near-IR detection
  - New SELEX detectors[?]
- Near-IR FTK for V-band coherencing
  - Propogation of errors?

Technical Demonstrations (I)

- DSSI speckle imaging at 4.3-m DCT
  - 692nm → roughly 6m pixels

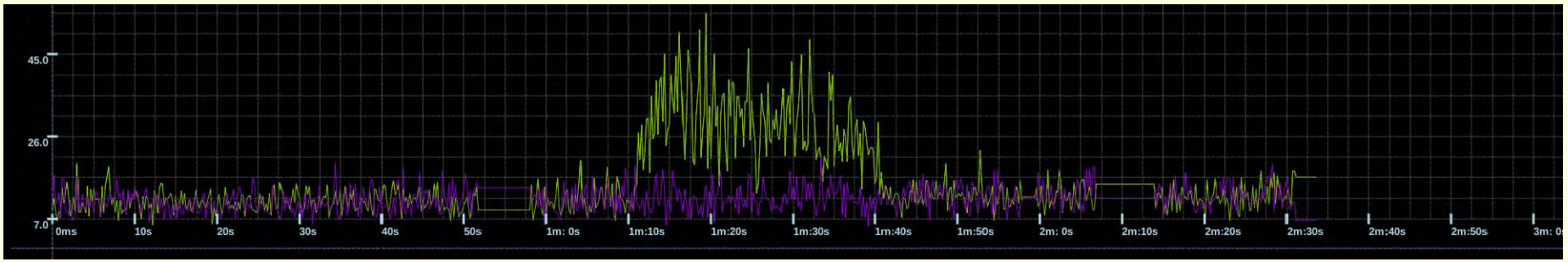





Galaxy 23
DirecTV 7S
100 m
Galaxy 19
DirecTV 9S
PSF

Technical Demonstrations (II)

- NPOI ‘glint’ observations of geosats
- Demonstrates operational ability to acquire, integrate upon geosats

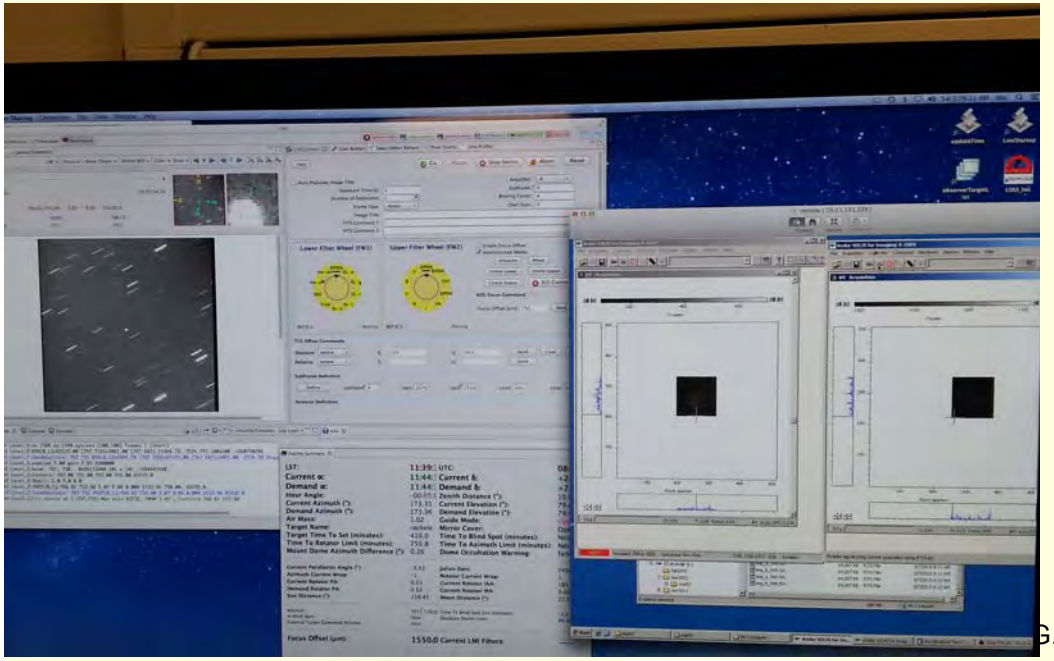


Key Points

- Use of existing NPOI infrastructure
- Emphasis on use of advanced yet proven subsystems
- Immediate on-sky results guiding development
  - Phase 1 has a significant observational component
  - Target sensitivity: H≈>10, V≈>12.5
    - V-H of targets is ≈2.5

DCT NRM

- Already
  - Geosat imaging
  - Other high-alt imaging
- Phase 1
  - DSSI speckle imaging
  - Build NRM
- Phase 2
  - NRM use
- Later Phases
  - AO-assisted NRM



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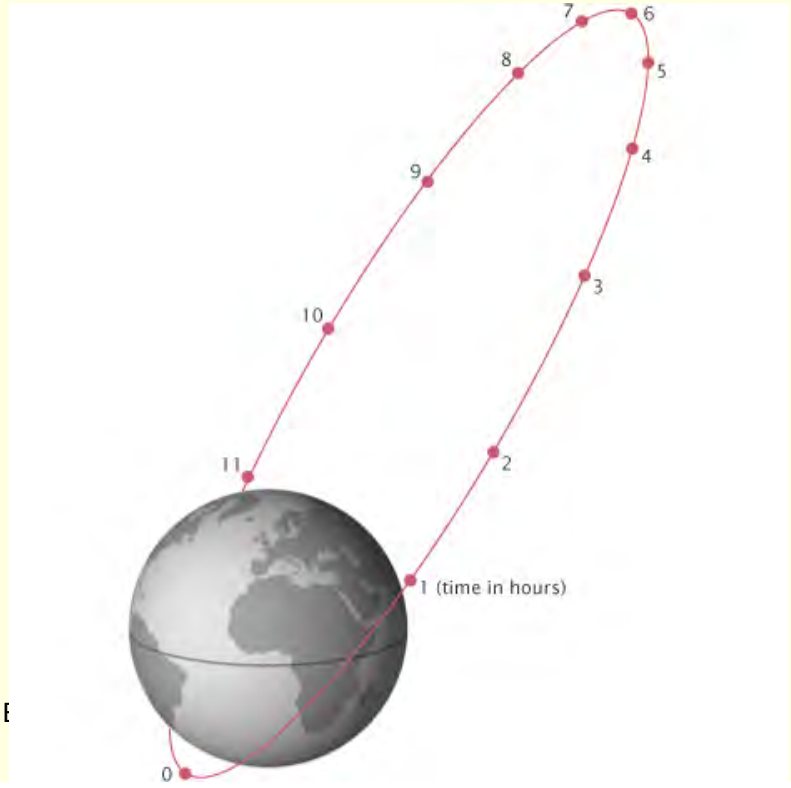
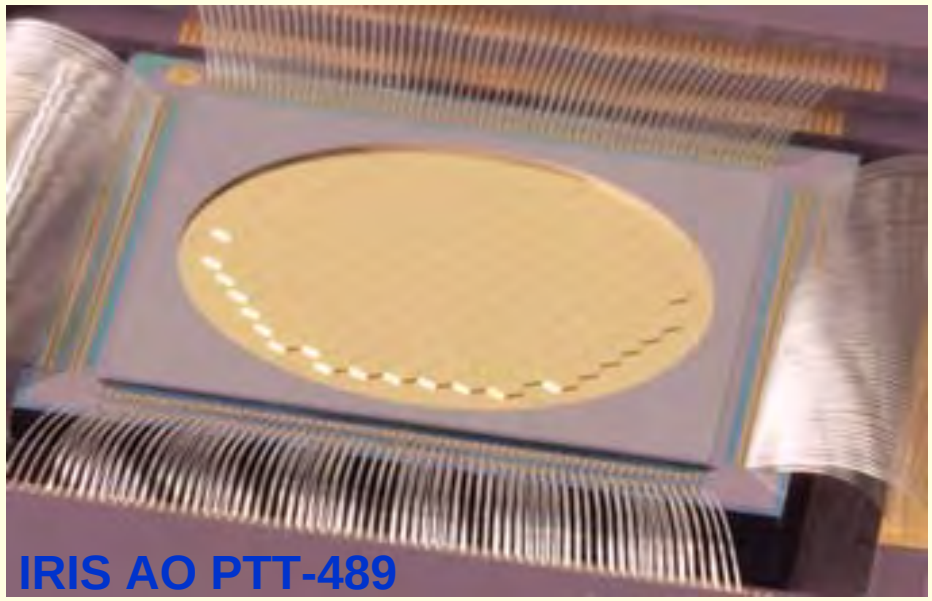


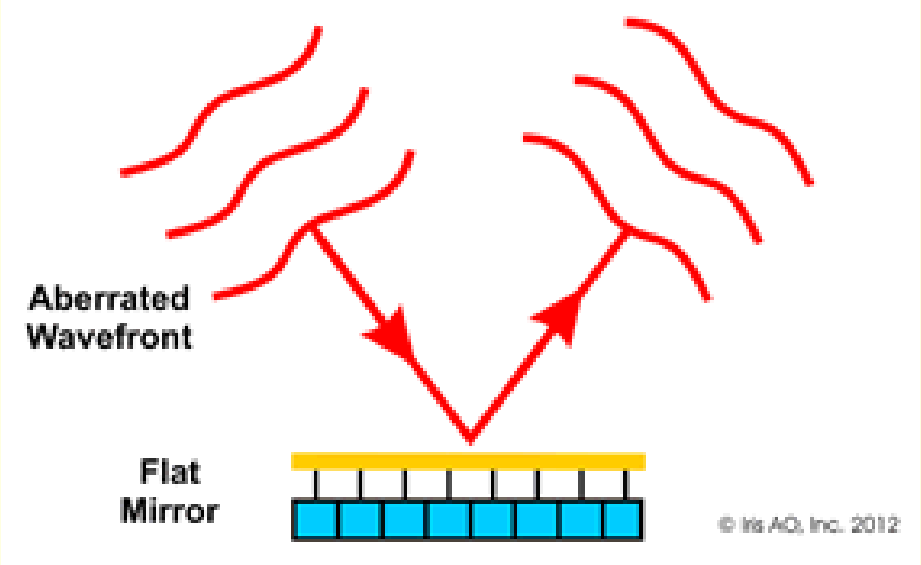
Large Apertures

- 1.0m PlaneWave
  - Demonstrated operations
- 1.4m CMA CFRP
  - ~100kg
- Goal of rapid relocation
  - 1 day station-to-station time

Adaptive Optics

- ‘Turn-key’ AO systems
  - Eg. Iris-AO
- LGS vs. NGS?
  - NGS baselined for now
  - Key challenge: photons for the AO

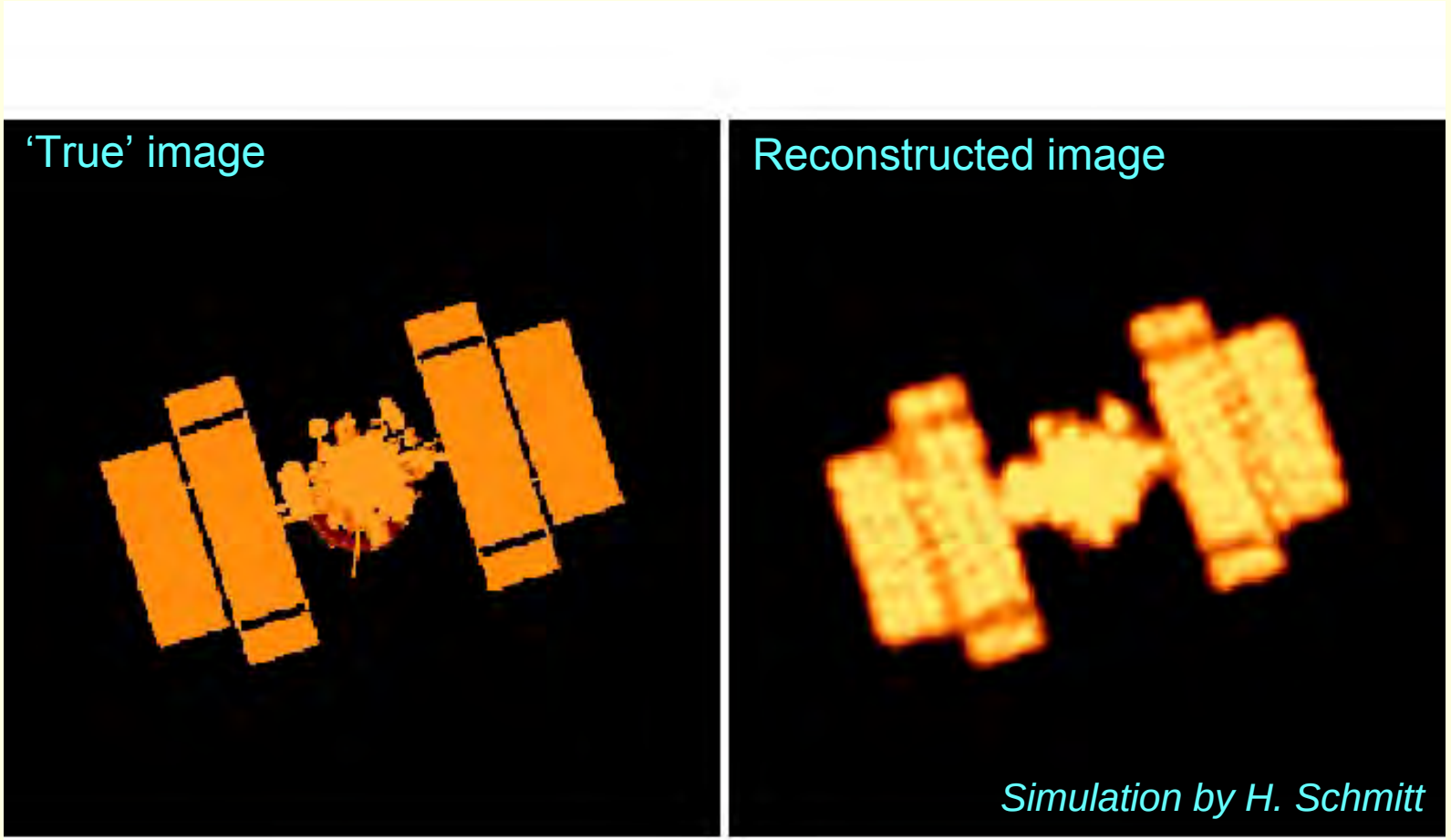




Advanced near-IR FTK

- SELEX detectors
  - Low read-noise near-IR
- ESO development
  - Being commercialized by First Light Imaging
- Fringe tracking improvement of ~1.5-2.0mag over earlier generation of detector

Expected Results



- 25cm resolution on a Russian Gorzint satellite
- Simulated using multiple DCT baselines and real NPOI stations

Coming Soon:
Navy Precision Optical Interferometer-Plus?

Any day now …

we'll keep you posted!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Navy Precision Optical Interferometer-Plus?
Anderson Mesa
Any day now …
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