Leadership in O/IR Capabilities for the Next Generation of Scientists

Rebecca Bernstein
Chief Scientist, GMTO

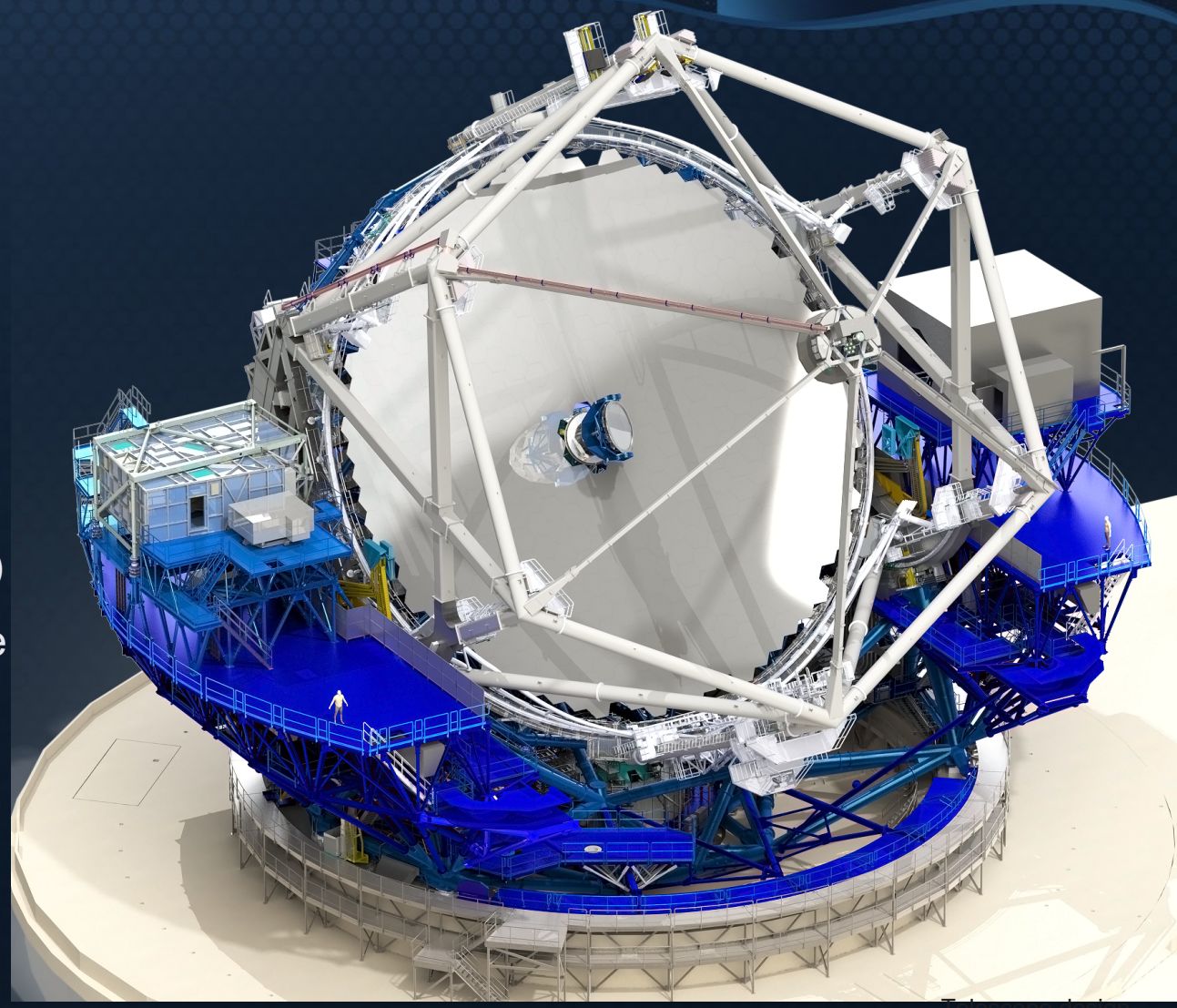
TMT THIRTY METER TELESCOPE

NOIR Lab

GIANT MAGELLAN TELESCOPE

Powerful by design: TMT

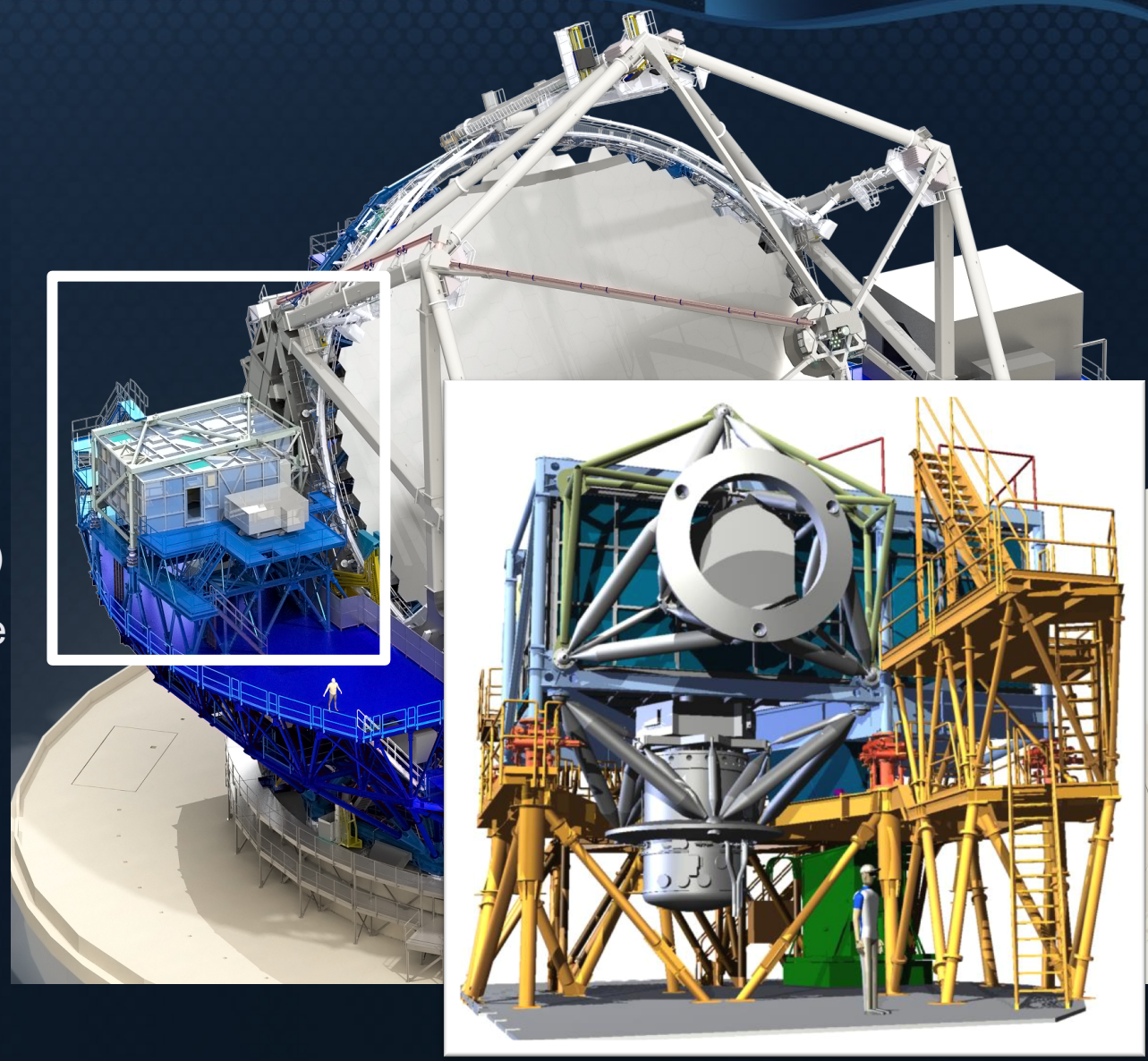
- Optical design:
  - Ritchey-Chrétien, aplanatic, F/15
  - 2.2 mm/arcsec image scale
  - M1: 492 segments, 1.4m diameter
  - M2: 3.1m diameter, monolithic
- AO at first light: NFIRAOS
  - Post-focal system, 2 deformable mirrors (MCAO)
  - 0.6–2.5 μm, low backgrounds, high sky coverage
  - Feeds 3 instrument ports
  - NGAO, 6-Laser LTAO, MCAO
- Heritage from Keck, Gemini, Subaru, VLT



Telescope design by MELCO

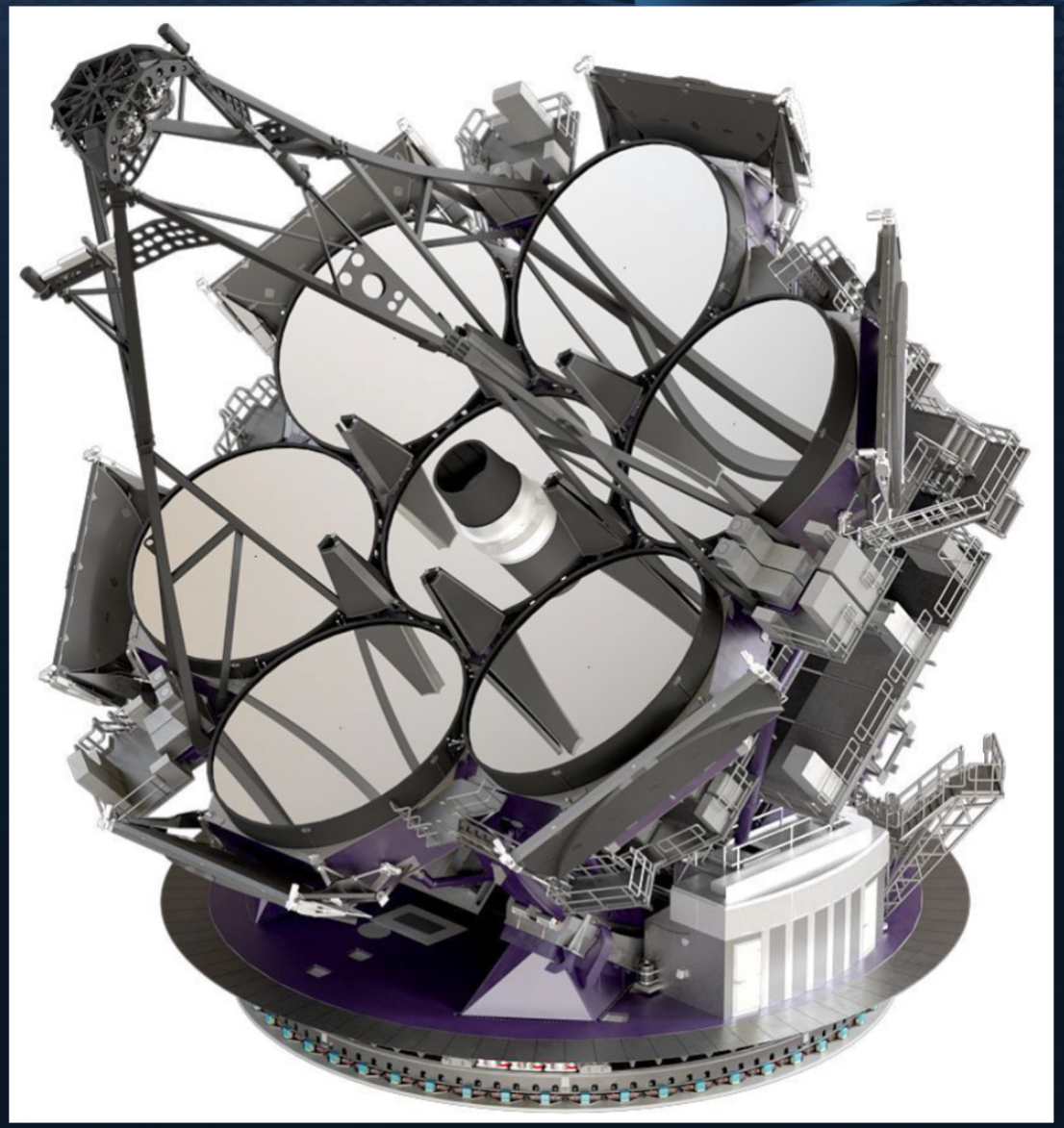
Powerful by design: TMT

- Optical design:
  - Ritchey-Chrétien, aplanatic, F/15
  - 2.2 mm/arcsec image scale
  - M1: 492 segments, 1.4m diameter
  - M2: 3.1m diameter, monolithic
- AO at first light: NFIRAOS
  - Post-focal system, 2 deformable mirrors (MCAO)
  - 0.6–2.5 μm, low backgrounds, high sky coverage
  - Feeds 3 instrument ports
  - NGAO, 6-Laser LTAO, MCAO
- Heritage from Keck, Gemini, Subaru, VLT



Powerful by design: GMT

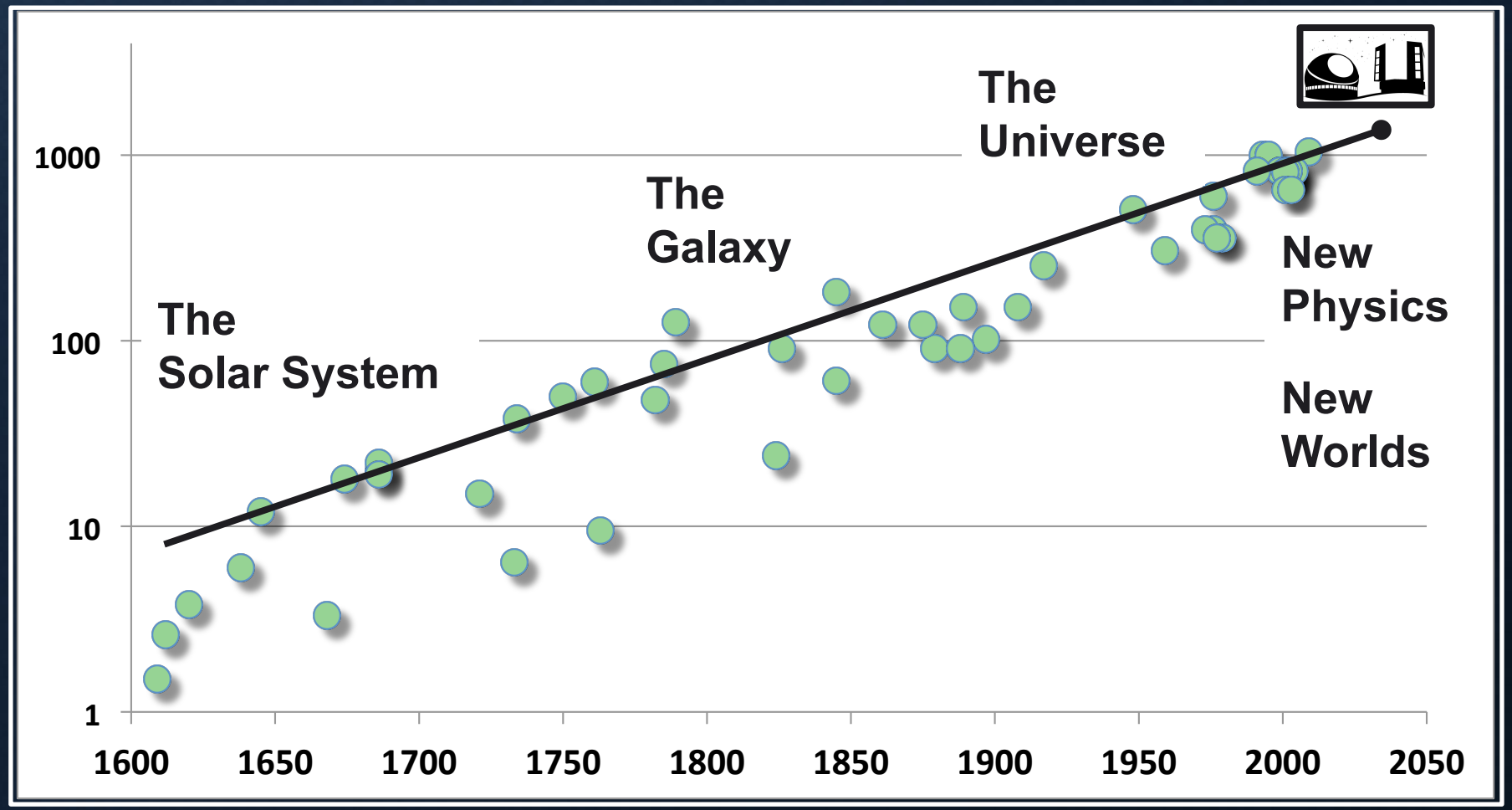
- Optical design:
  - Aplanatic Gregorian, F/8
  - 1.0 mm/arcsec image scale
  - M1: seven 8.4m segments
  - M2: seven 1.1m segments
- AO at first light:
  - Adaptive M2 — paired M1:M2 segments
  - Full time AO, 0.5-25μm, low backgrounds
  - Feeds any instrument (10 mounted)
  - NGAO, 6-Laser LTAO, Ground-layer AO
- Heritage from Magellan, Gemini, VLT, LBT



Powerful by design: GMT

- Optical design:
  - Aplanatic Gregorian, F/8
  - 1.0 mm/arcsec image scale
  - M1: seven 8.4m segments
  - M2: seven 1.1m segments
- AO at first light:
  - Adaptive M2 — paired M1:M2 segments
  - Full time AO, 0.5-25μm, low backgrounds
  - Feeds any instrument (10 mounted)
  - NGAO, 6-Laser LTAO, Ground-layer AO
- Heritage from Magellan, Gemini, VLT, LBT

Greatest leap in discovery potential since Galileo:



Greatest leap in discovery potential since Galileo:

Angular Resolution (~λ/D)

$\theta_J \approx 0.01$ asec

K-band Strehl ~80%

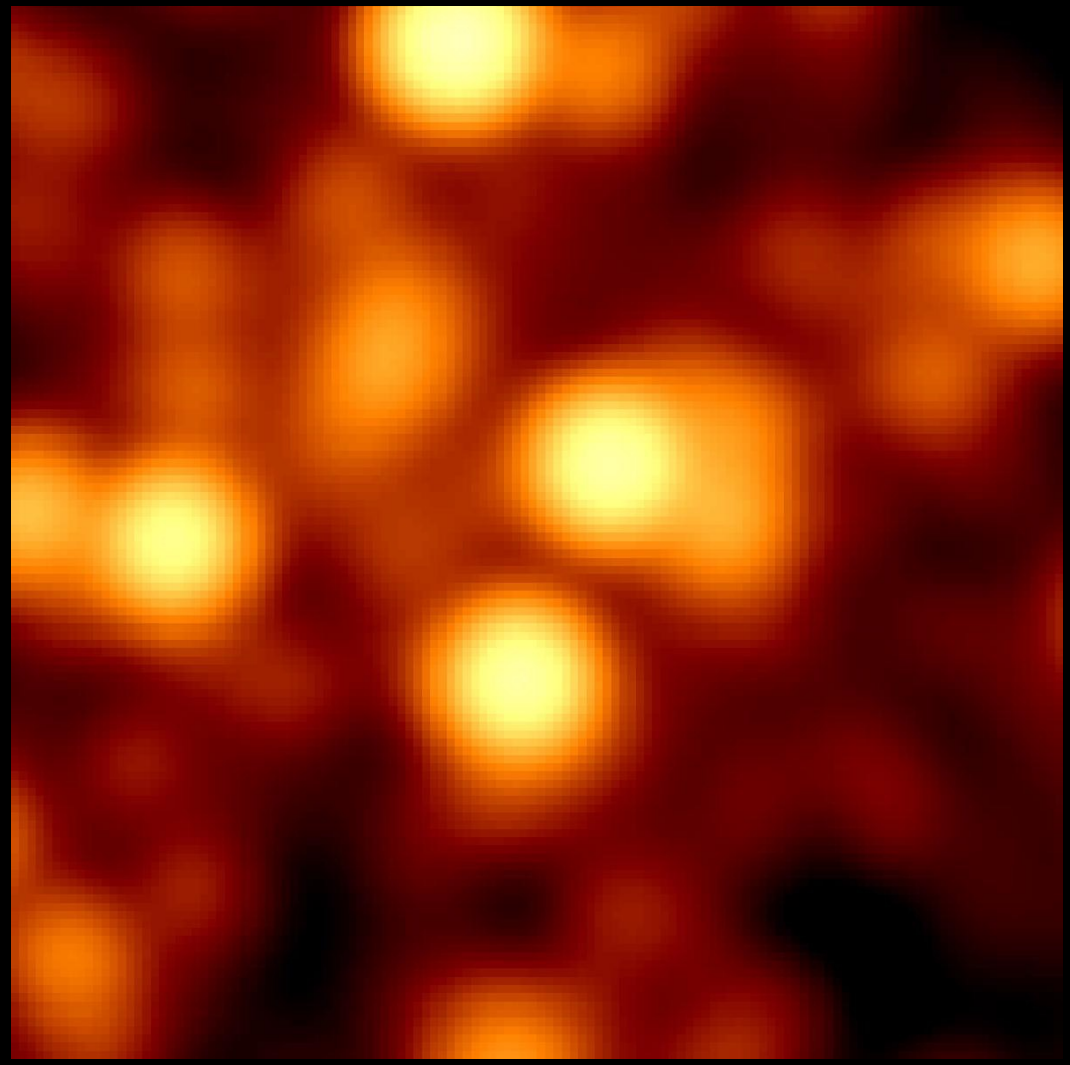
Astrometric stability ~0.01 mas (rms in 1 hr)

10x better than HST

4x better than JWST (1-10μm)

Sensitivity (~D^2/θ^2)

14-200x better than 8m telescopes



Greatest leap in discovery potential since Galileo:

Angular Resolution (~λ/D)

$\theta_J \approx 0.01$ asec

K-band Strehl ~80%

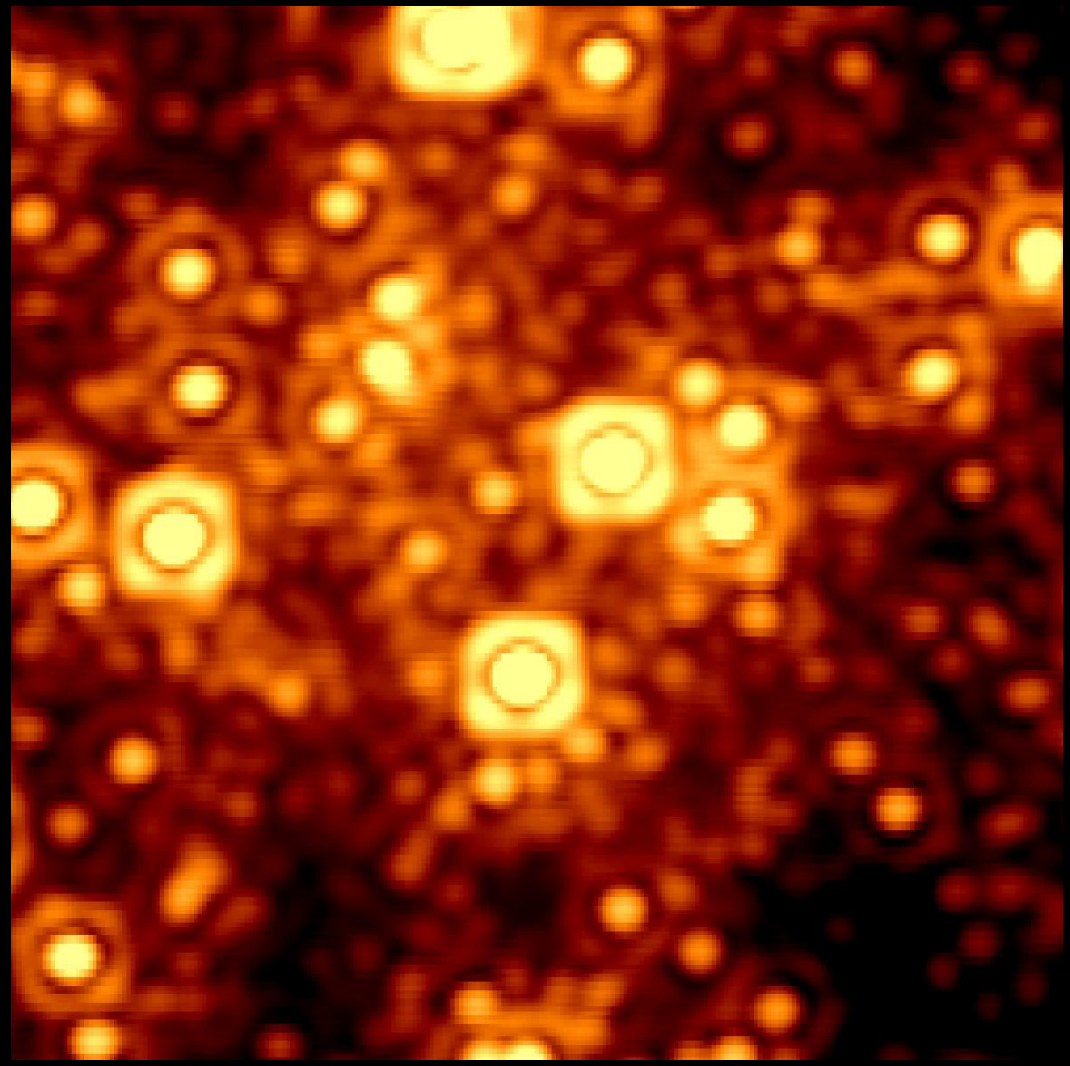
Astrometric stability ~0.01 mas (rms in 1 hr)

10x better than HST

4x better than JWST (1-10μm)

Sensitivity (~D^2/θ^2)

14-200x better than 8m telescopes



Greatest leap in discovery potential since Galileo:

Angular Resolution (~λ/D)

$\theta_J \approx 0.01$ asec

K-band Strehl ~80%

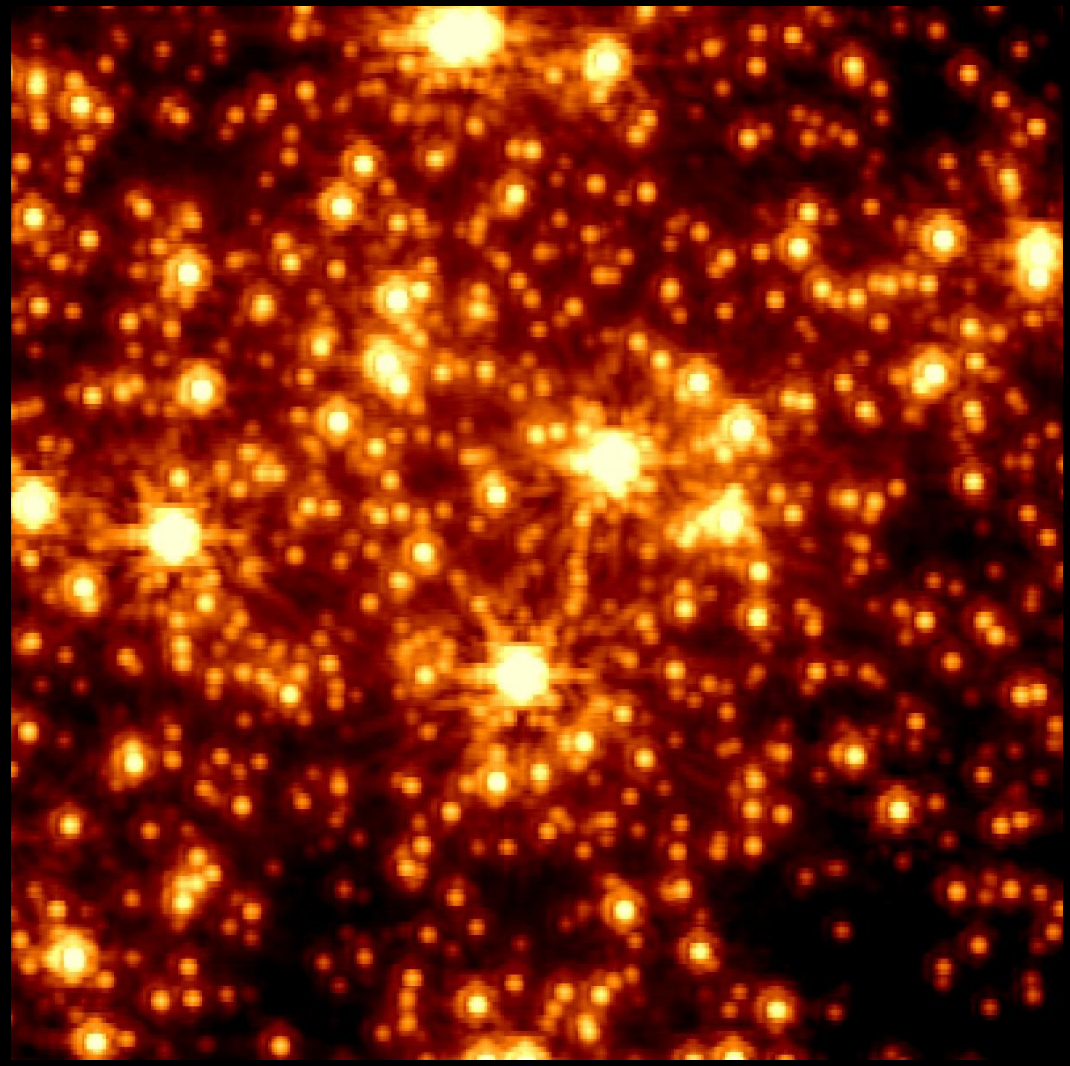
Astrometric stability ~0.01 mas (rms in 1 hr)

10x better than HST

4x better than JWST (1-10μm)

Sensitivity (~D^2/θ^2)

14-200x better than 8m telescopes



Greatest leap in discovery potential since Galileo:

Angular Resolution (~λ/D)

$\theta_J \approx 0.01$ asec

K-band Strehl ~80%

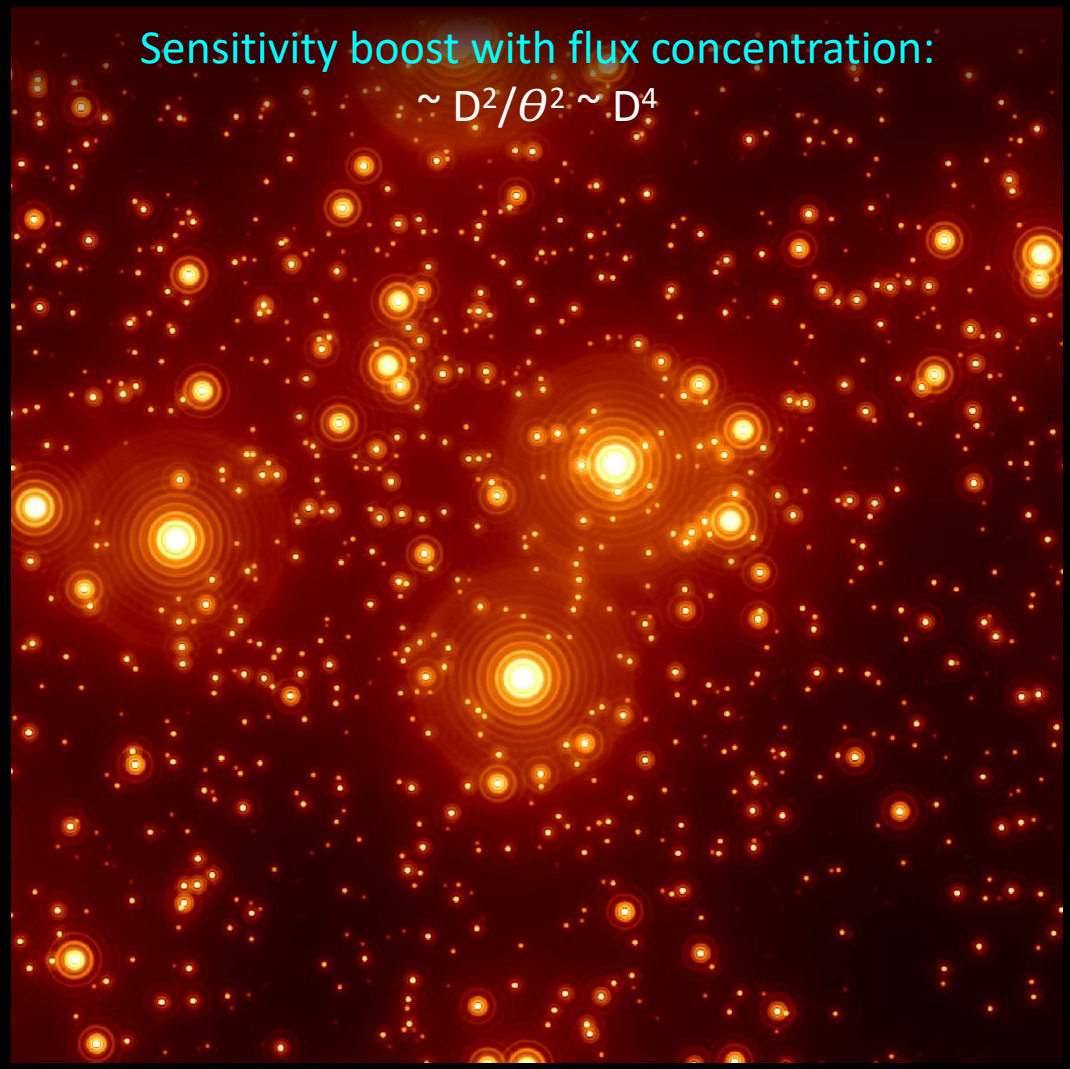
Astrometric stability ~0.01 mas (rms in 1 hr)

10x better than HST

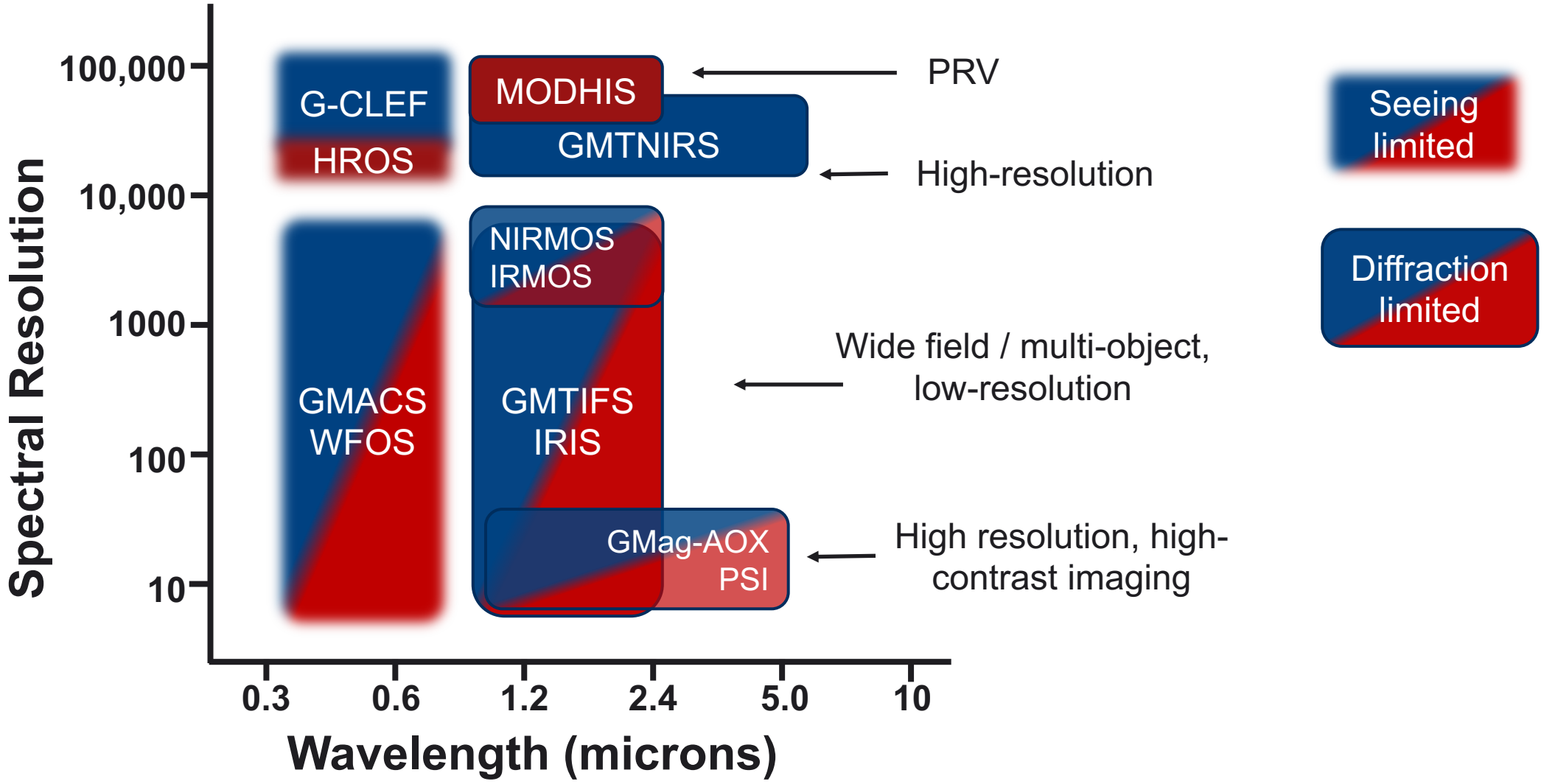
4x better than JWST (1-10μm)

Sensitivity (~D^2/θ^2)

14-200x better than 8m telescopes



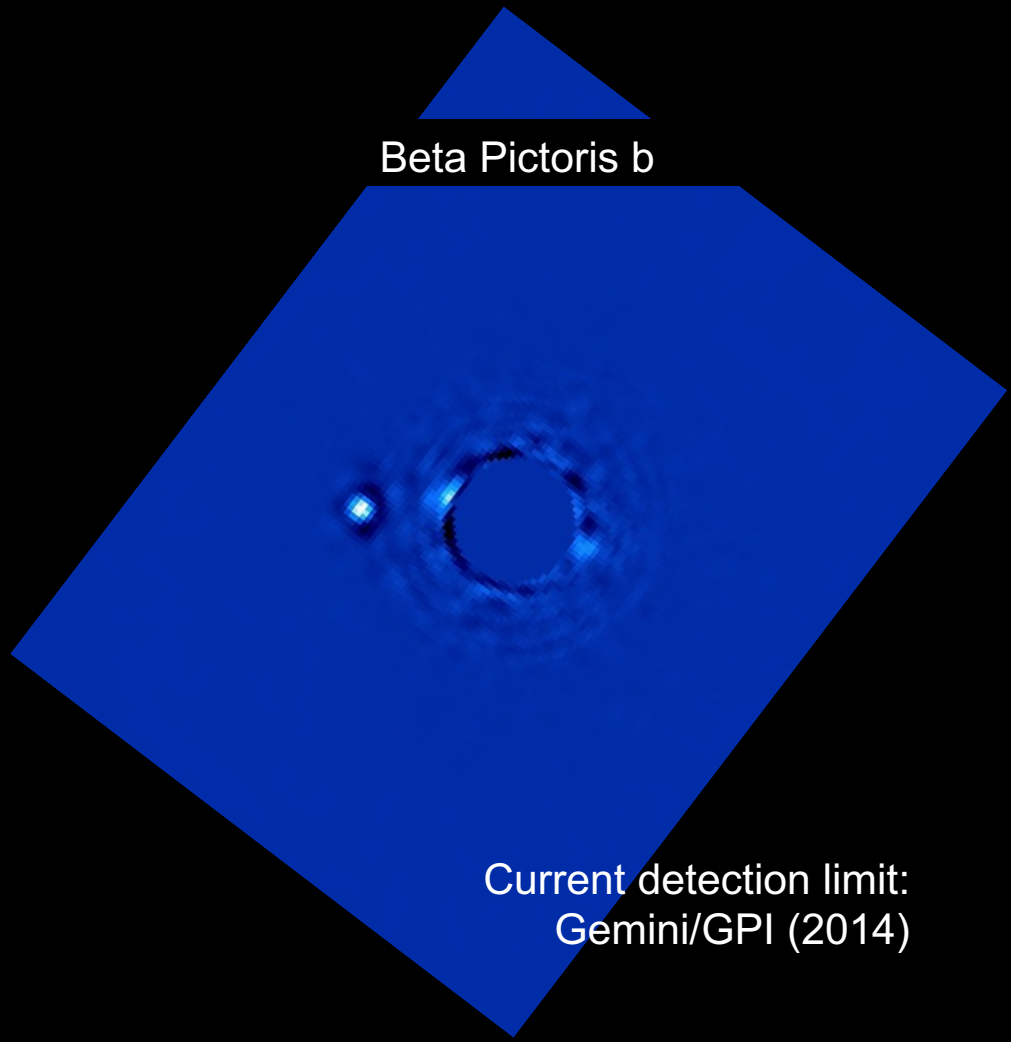
Multiple generations of state-of-the-art instruments and techniques:



Enabling highest priority science:

Solar system: 30 km at Jupiter (5 AU)

Habitable zones: 1 AU at 100 pc

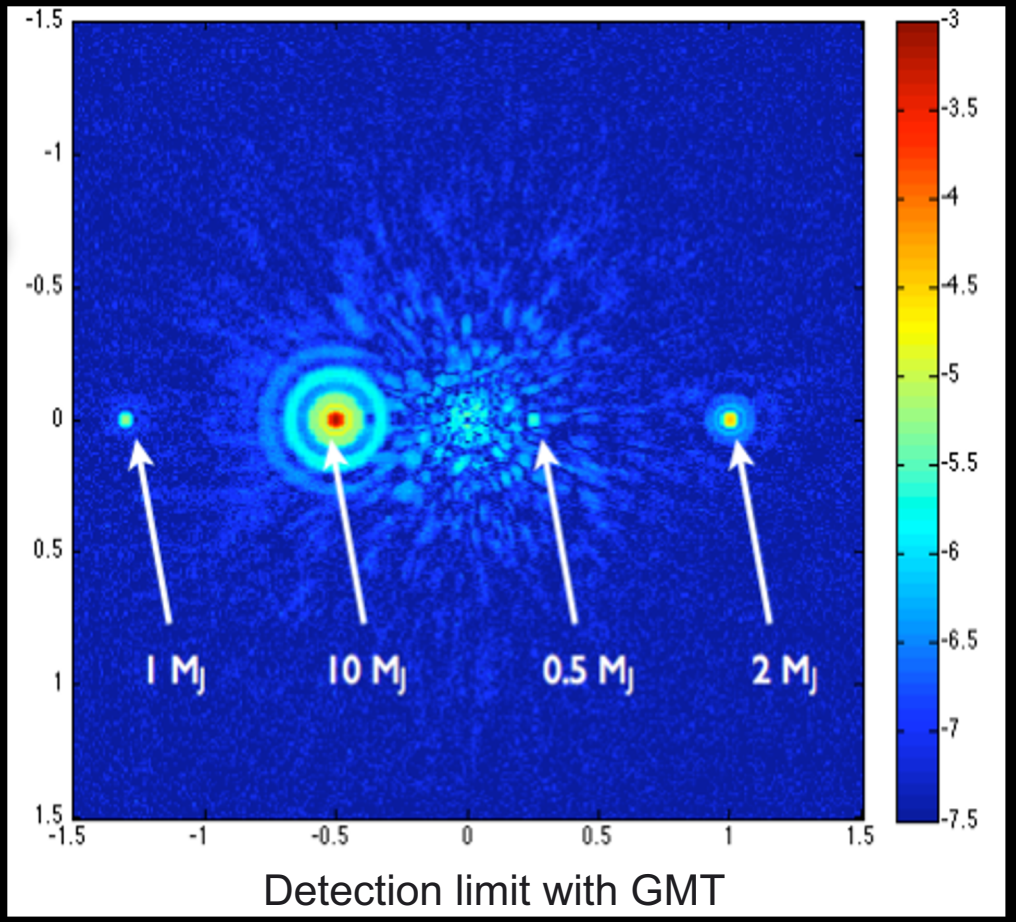


Current detection limit:
Gemini/GPI (2014)

Enabling highest priority science:

Solar system: 30 km at Jupiter (5 AU)

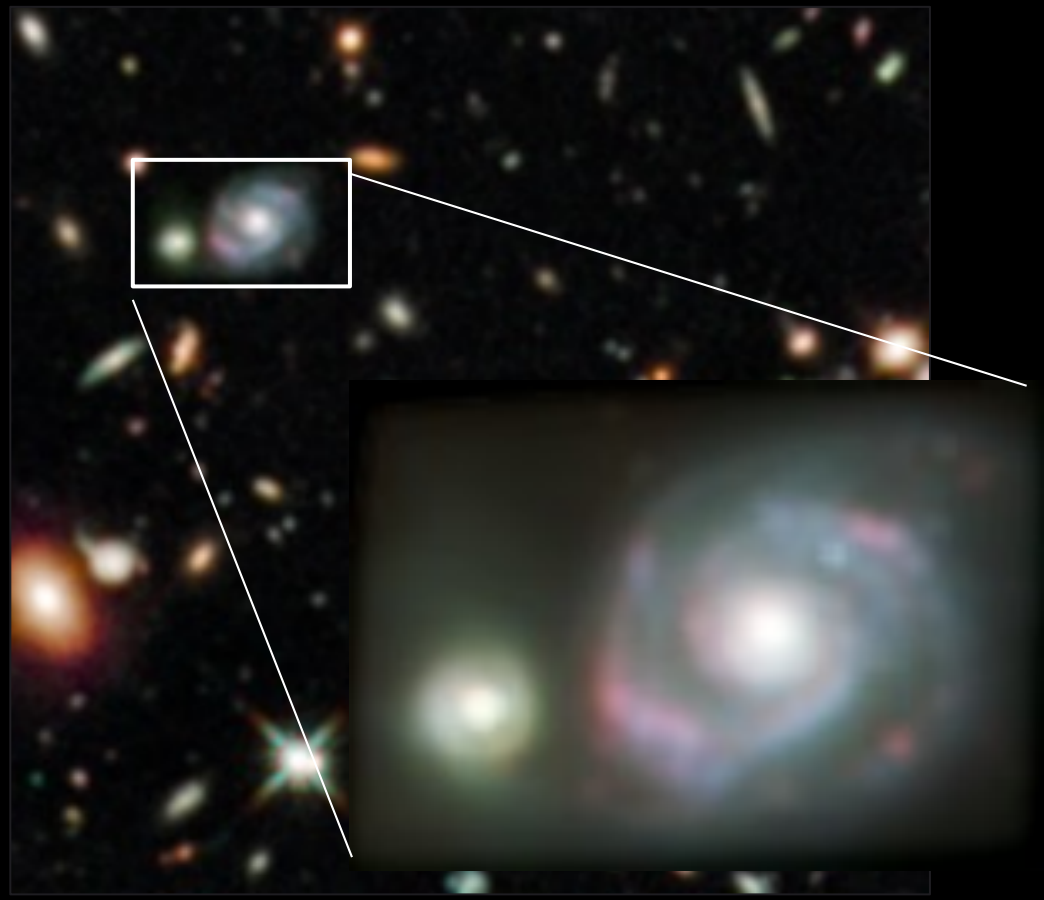
Habitable zones: 1 AU at 100 pc



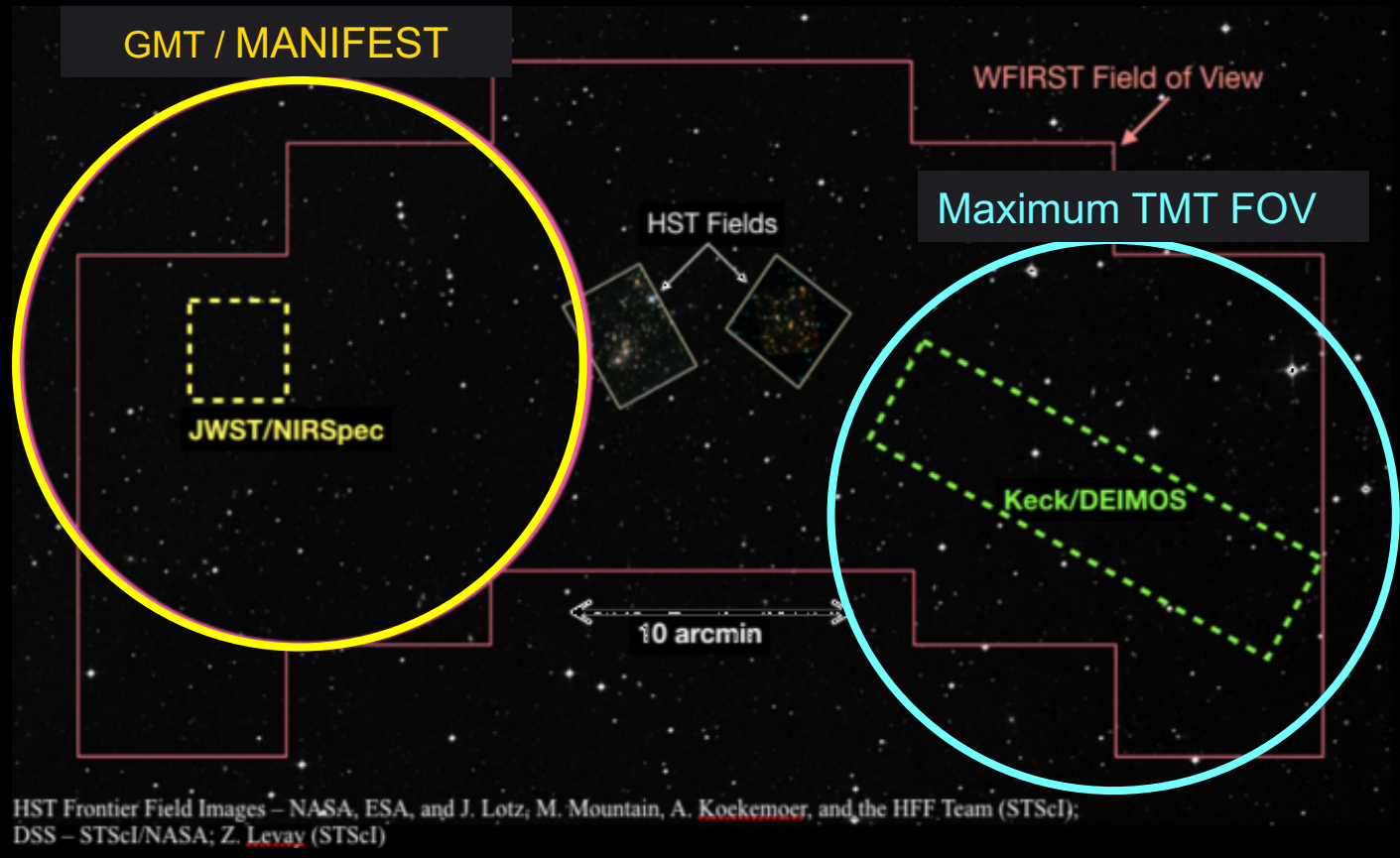
Detection limit with GMT

Enabling highest priority science:

Star forming regions: 60 pc at z=2.5



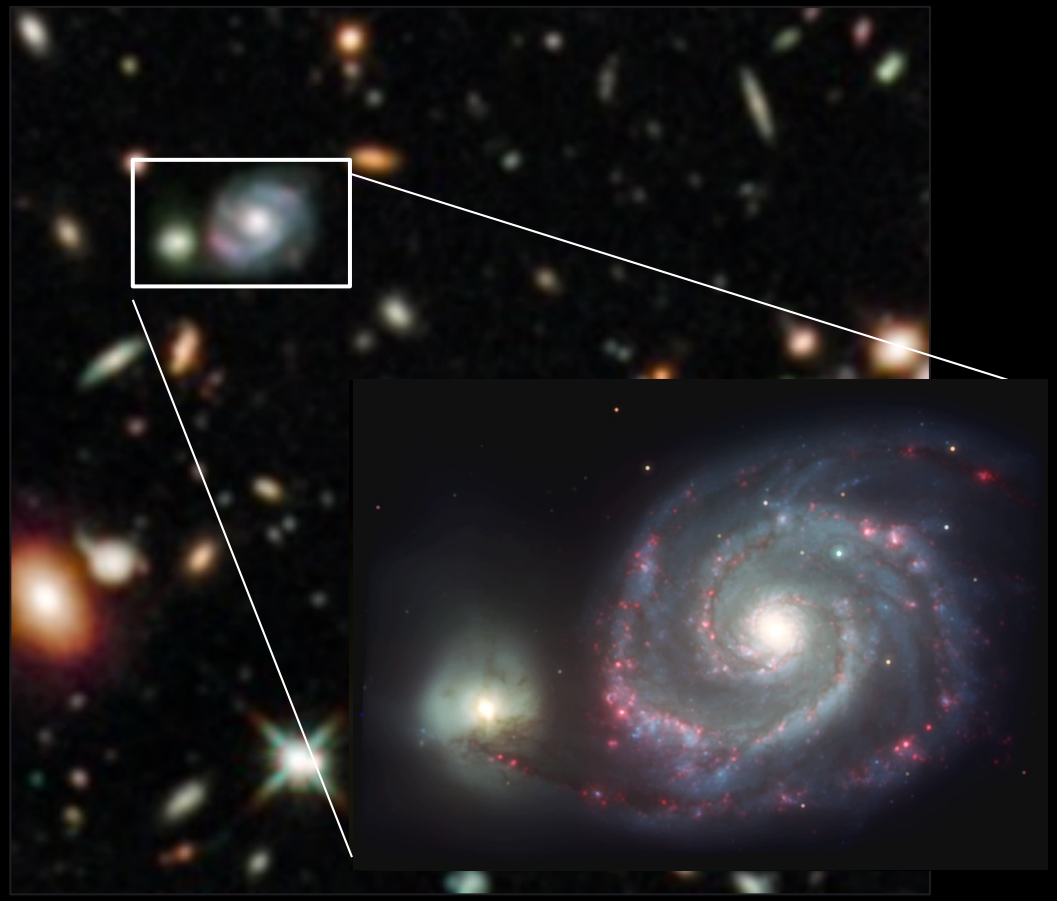
Multiplexing for ~100's of ultrafaint sources



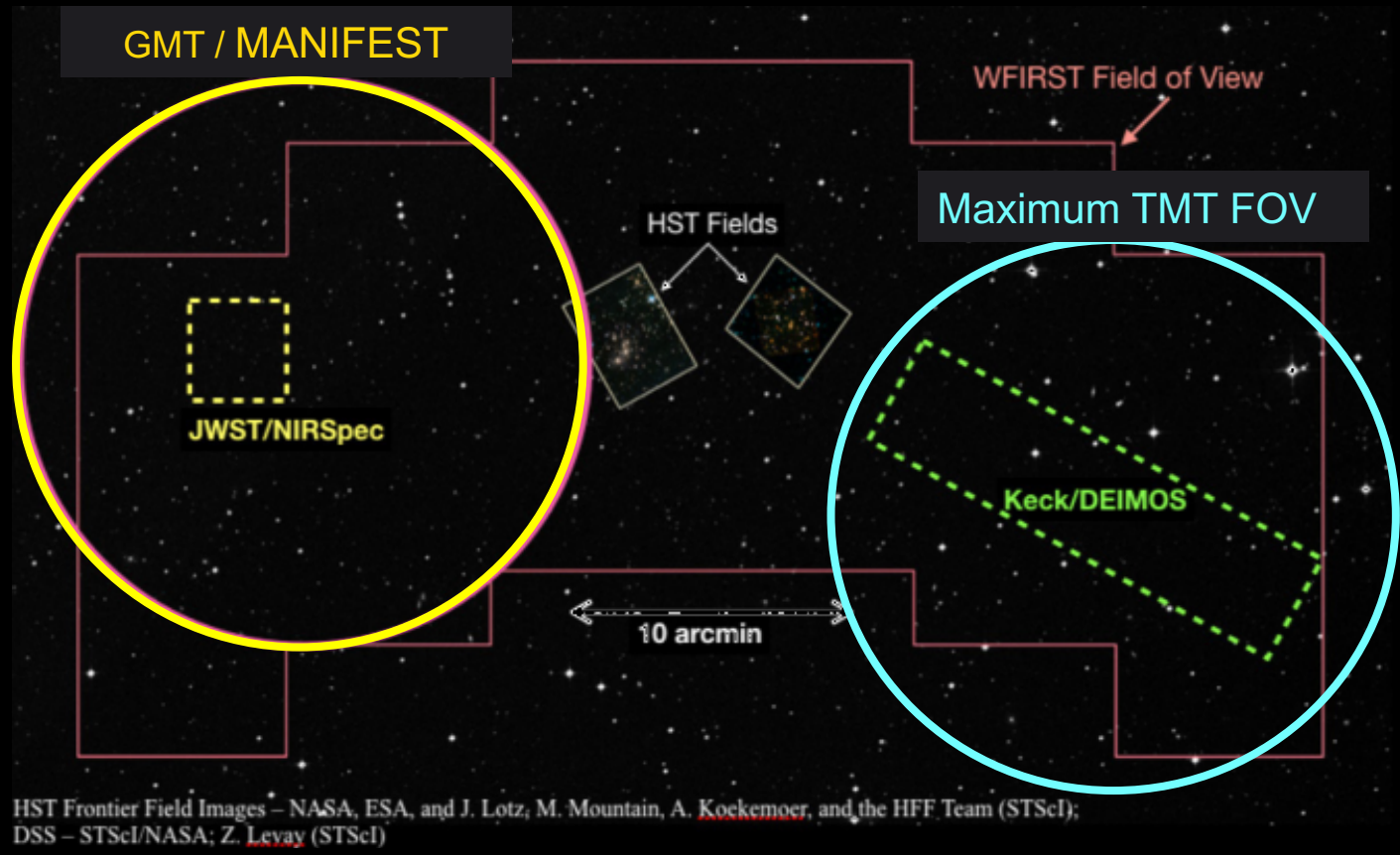
Colless et al. (2018)

Enabling highest priority science:

Star forming regions: 60 pc at z=2.5

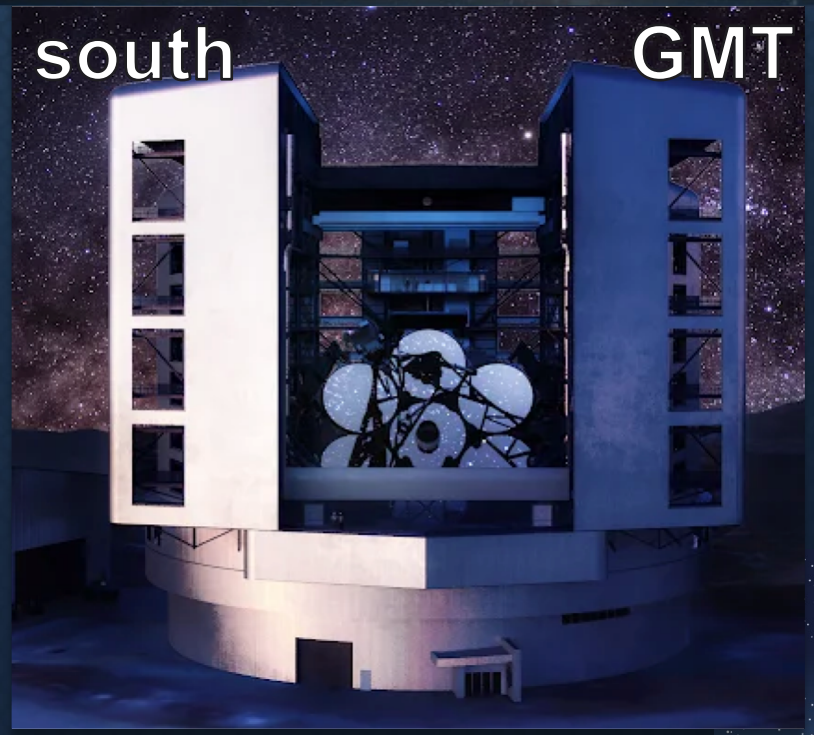


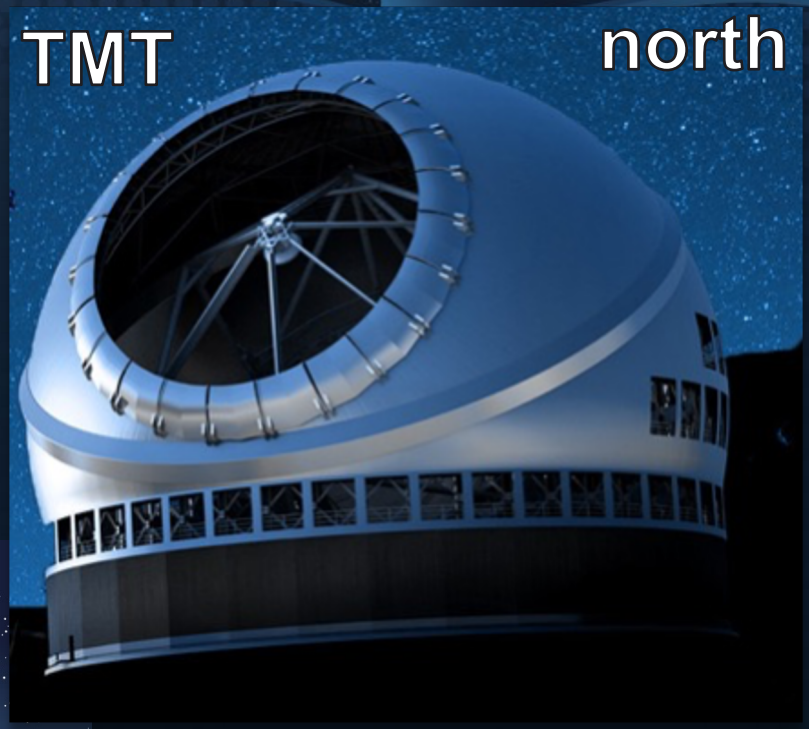
Multiplexing for ~100's of ultrafaint sources

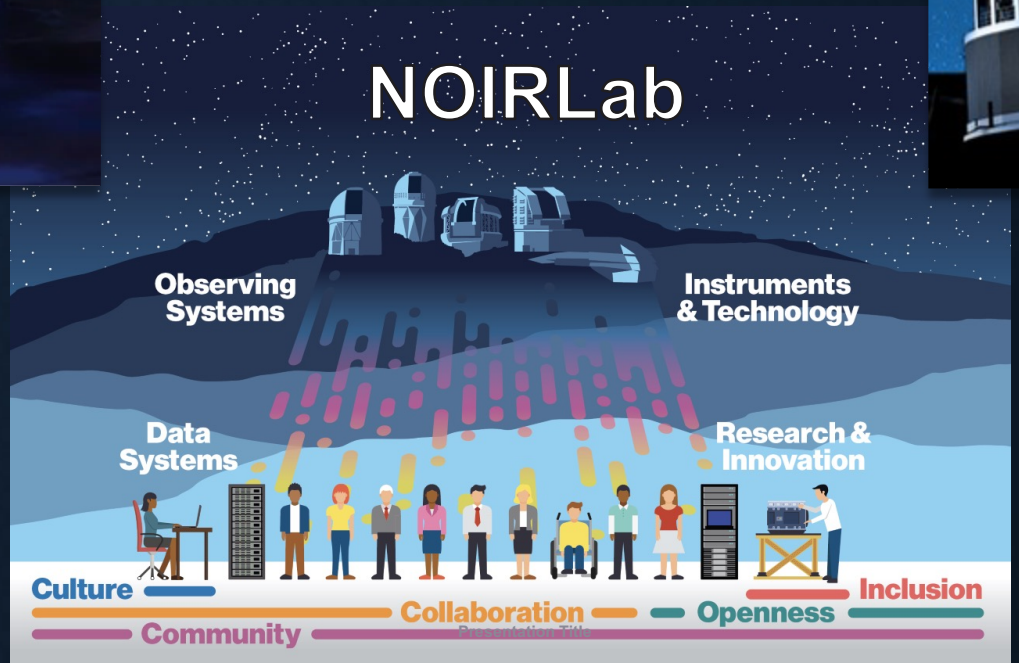


Colless et al. (2018)

A world-leading O/IR system for US astronomers







Revolutionary capabilities:
- Sensitivity
- Resolution
- State-of-the-art instruments

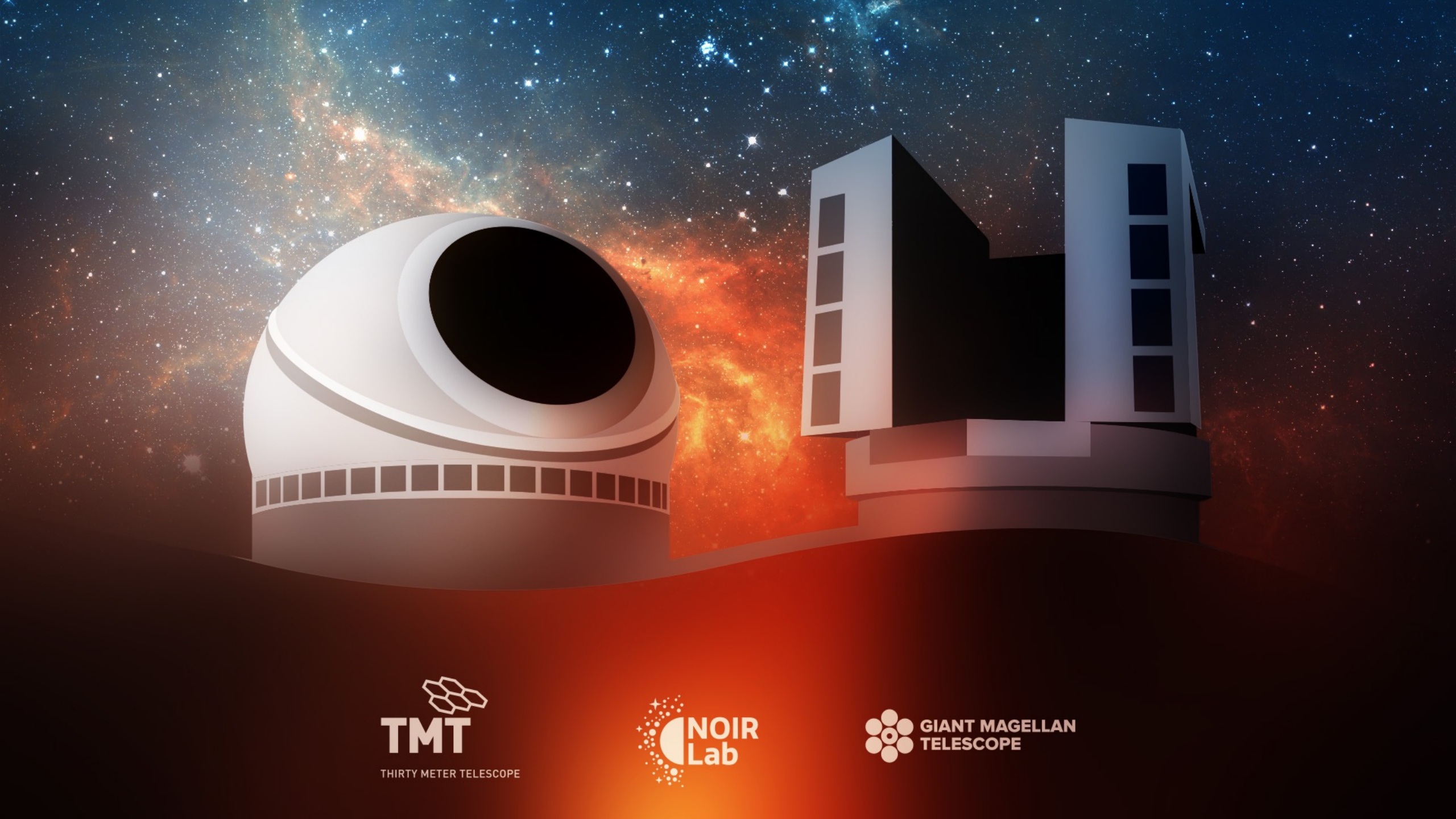
Data archives

Full sky coverage

Community-wide access
- >25% of both facilities
- Key Science Programs
- Individual PI Programs

User support

Data products & platforms


TMT
THIRTY METER TELESCOPE
NOIR Lab
GIANT MAGELLAN TELESCOPE