Subaru GLAO:
Comparisons with Space Missions

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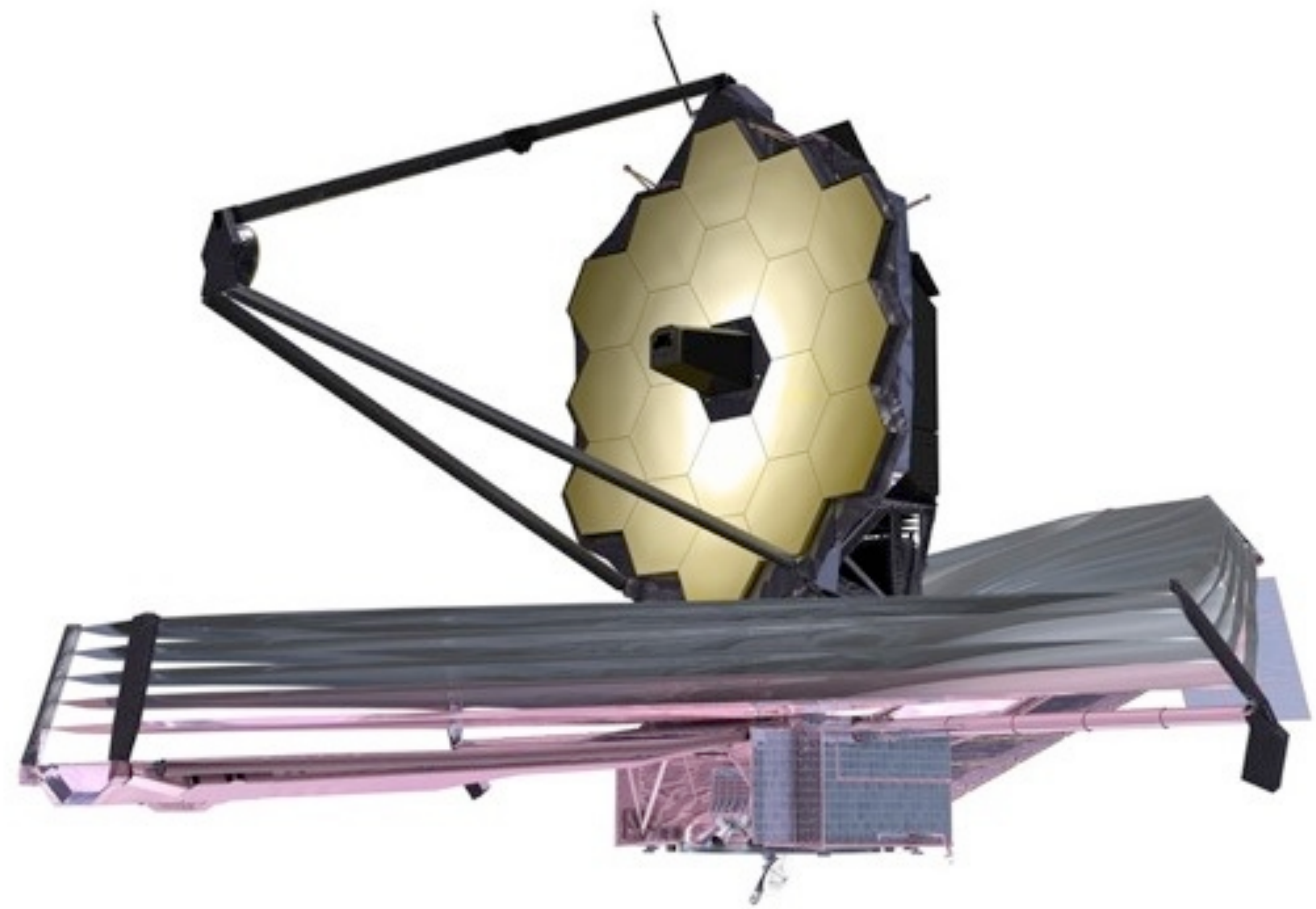
2011/08/25
2013/05/28 small revisions
2013/06/04 include JWST/NIRISS

Space Missions in Near-Future

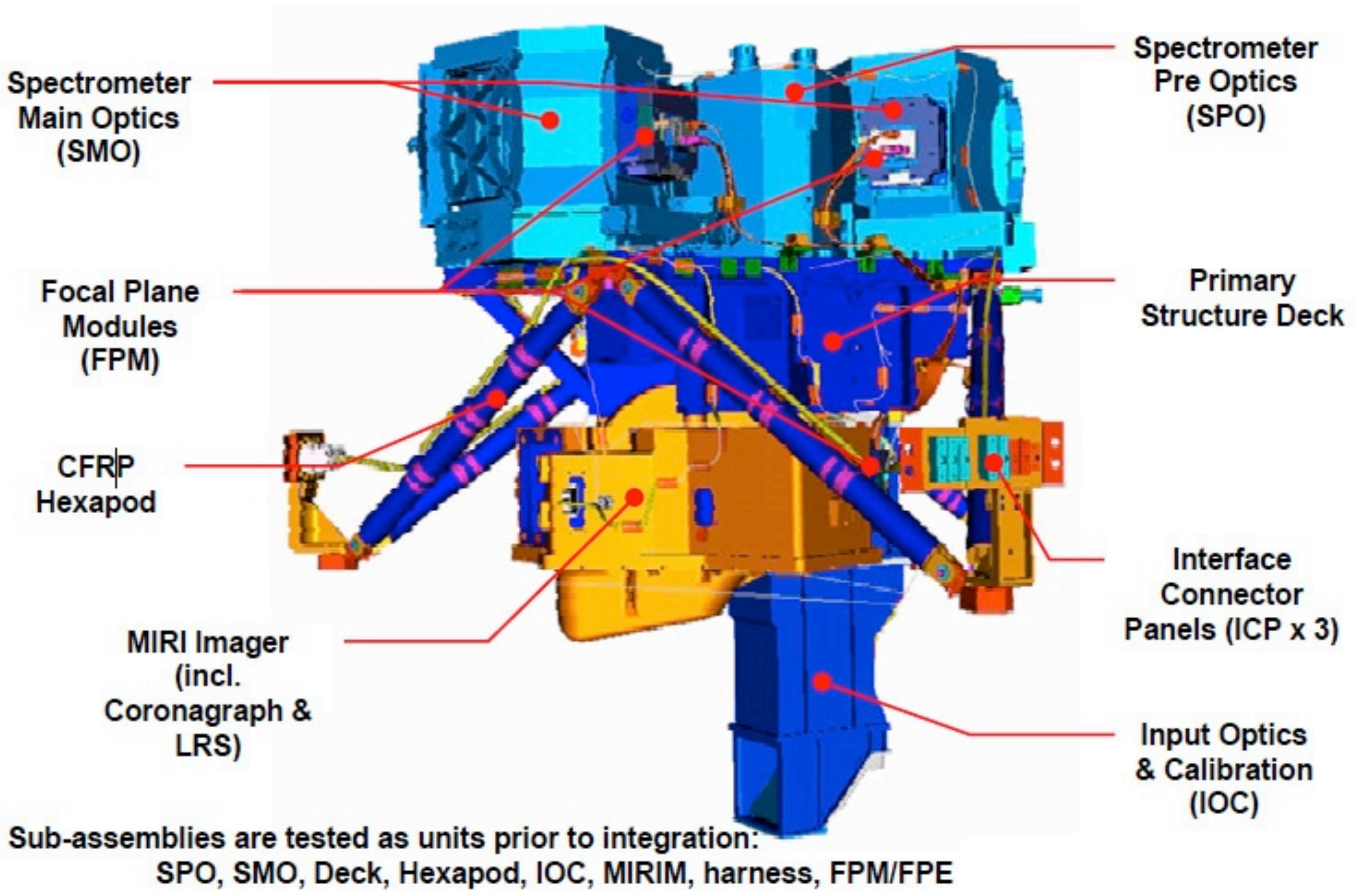
JWST

- 6.5m Deployable Mirror, Passive Cooling at S-E L2
- Four Science Instruments:
  - MIRI: Mid-IR (5 - 28µm)
  - NIRSpec
  - NIRCam
  - NIRISS



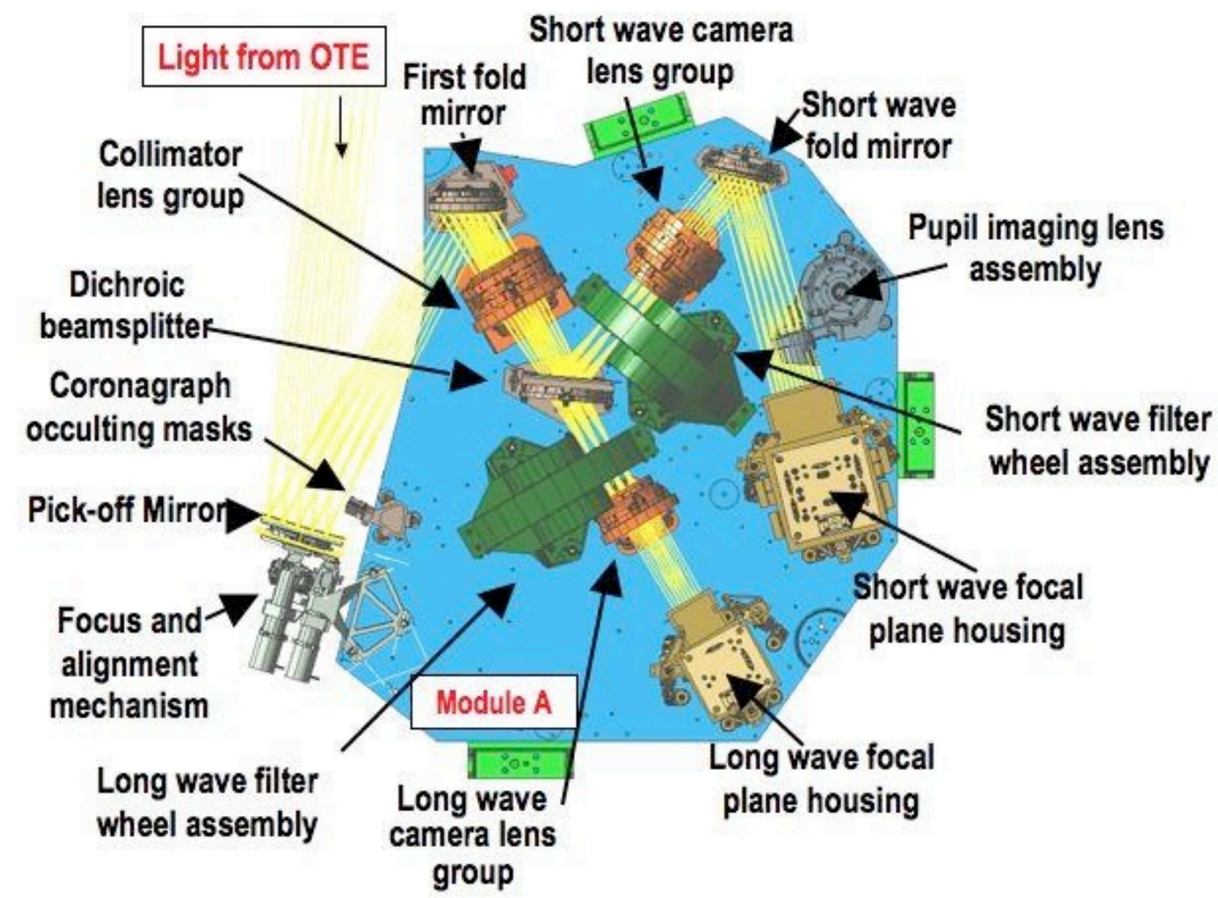
JWST MIRI

- Imaging 5 - 28.3μm, FoV 1.25' x 1.88'
- Coronagraph
- R=1,000 - 3,000 Spectrc

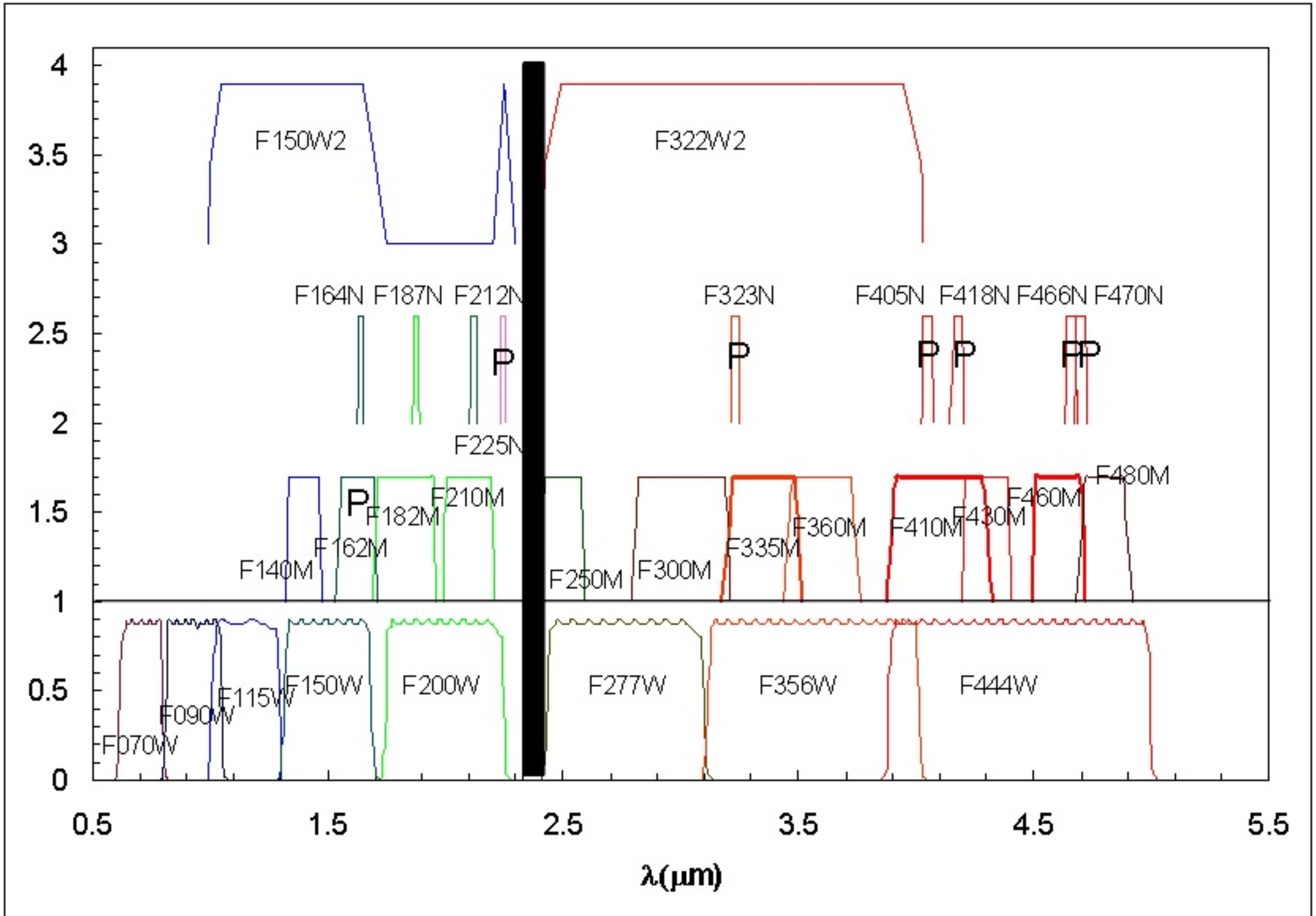


JWST NIRCam

- Two Channels, both 2.2' x 4.4'
  - Short: 0.5 - 2.3 µm, 32 mas (8 H2RGs)
  - Long: 2.5 - 5.0 µm, 64 mas (2 H2RGs)
- Coronagraphic High Contrast Imaging
- Slitless Grism Spectroscopy R~1800

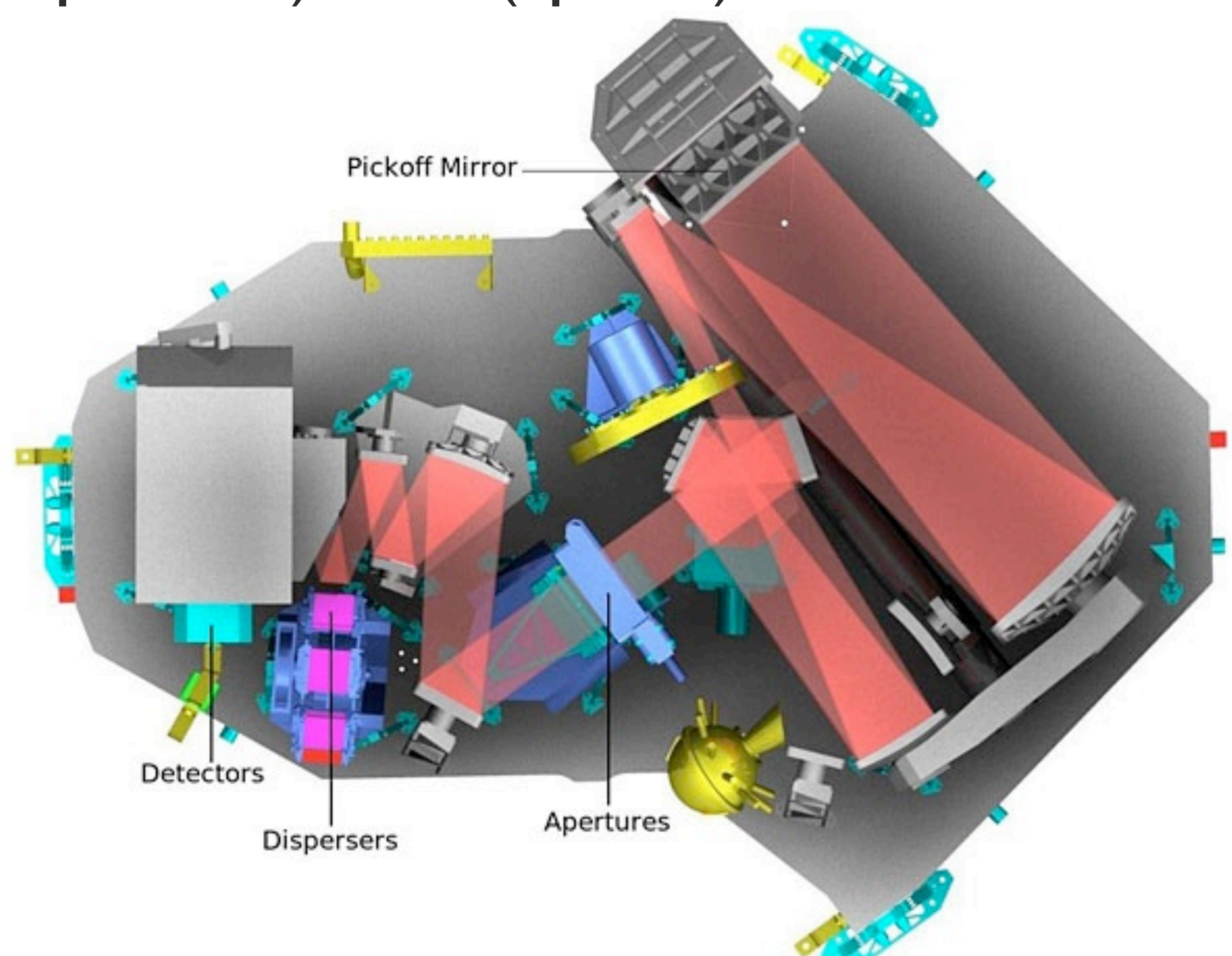


NIRCam Filters



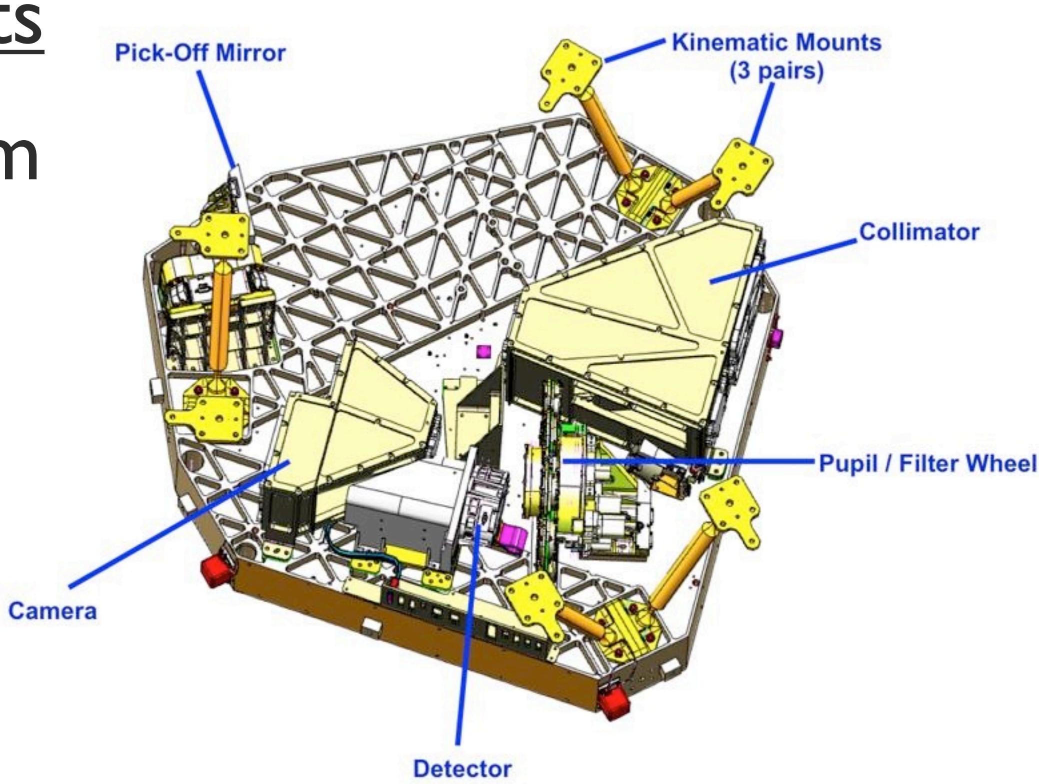
JWST NIRSpec

- 3.6' x 3.4' FOV
- Micro-Shutter Assembly: 0.2" x 0.46" Micro-Shutters
- Fixed Slits: 0.4"x3.8", 0.2"x3.3", 1.6"x1.6"
- IFU: 3"x3" FOV, 30 Slices, 0.1"(dispersion) x 3" (spatial)
- R = 100, 1000, 2700
- 2 x H2RG



JWST NIRISS (Near-IR Imager and Slitless Spectrograph)

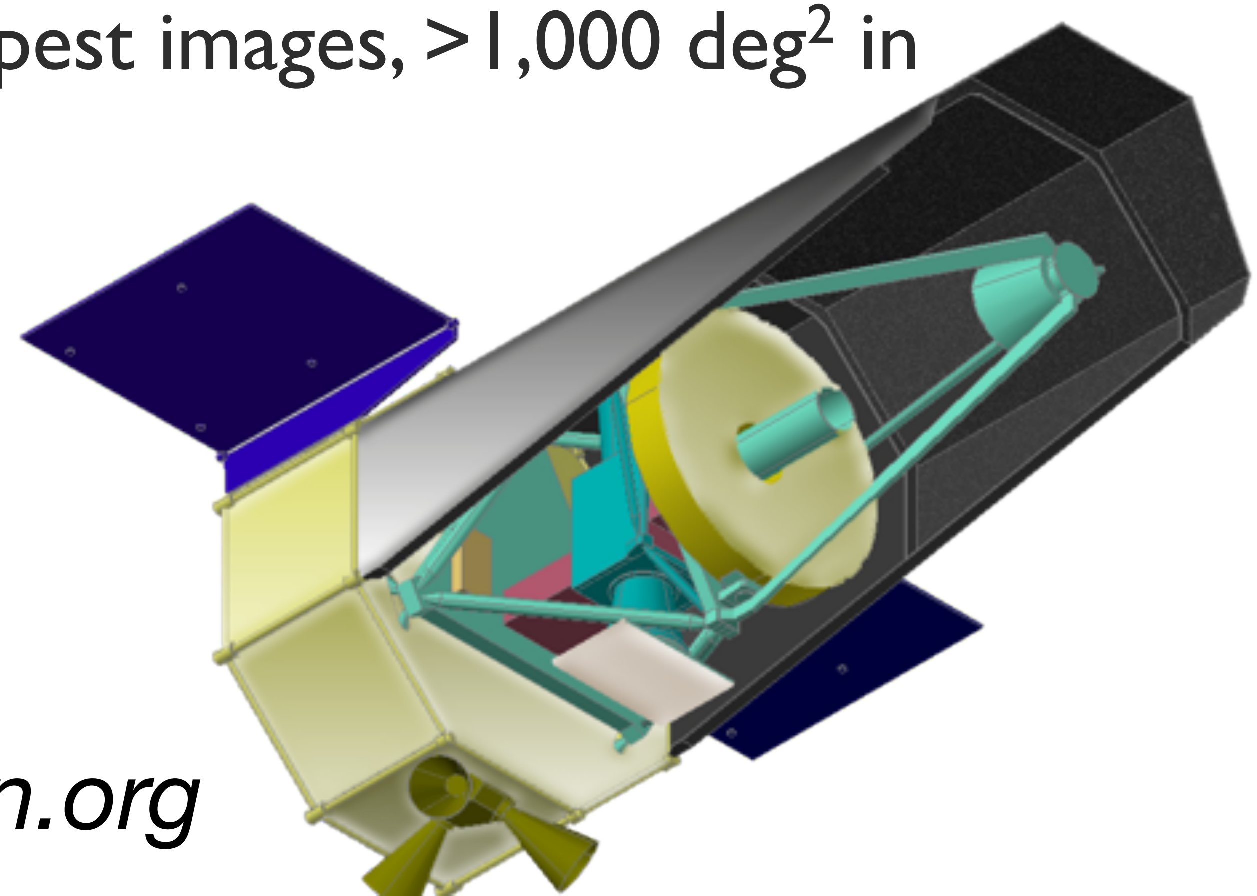
- http://www.stsci.edu/jwst/instruments/niriss
- 1x H2RG 5.3μm cutoff, 0.065”/pix, 2.2’ x 2.2’ FoV
- Wide-Field Slitless Spectroscopy: 1.0-2.5μm, R~150 optimized for z>10 LAEs
- Single-Object Slitless Spectroscopy: R~700 (0.6-2.5μm) using cross-disperser optimized for transiting exoplanets
- Aperture Masking Interferometry: 3.8-4.8μm
- Imaging: 0.9-5.0μm



WISH: Wide-field Imaging Surveyor for High-redshift

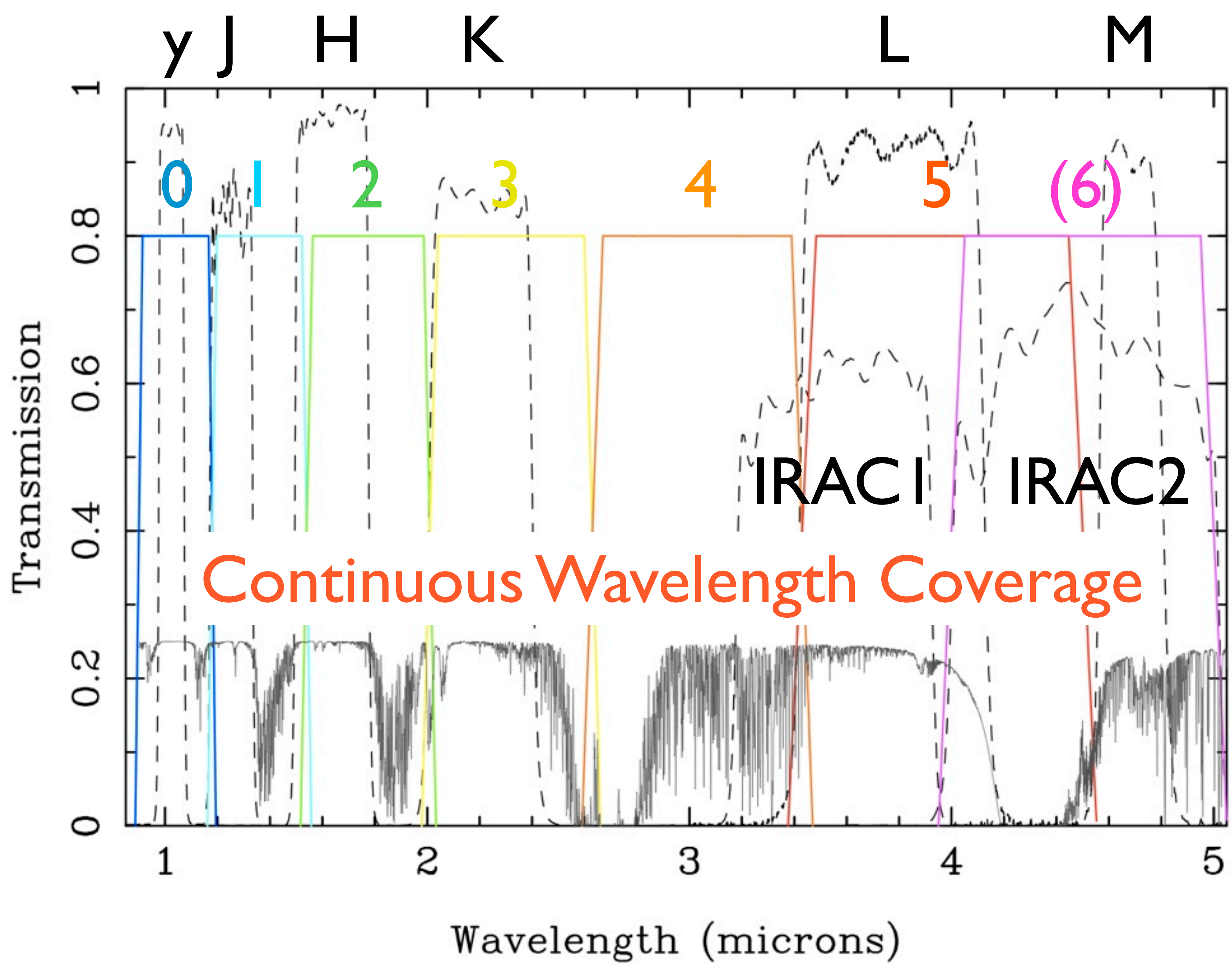
- Space Telescope Mission with 1.5m Diameter Aperture
- Wide-Field Near-Infrared Camera (0.9 - 5 μm)
- (Passively) Cooled Mission with Sun - Earth L2 Orbit

- Depth - deeper than images with any ground-based telescopes
- Width - 100 square degrees in deepest images, >1,000 deg^2 in shallower surveys



http://wishmission.org

WISH Broad-band Filter Set

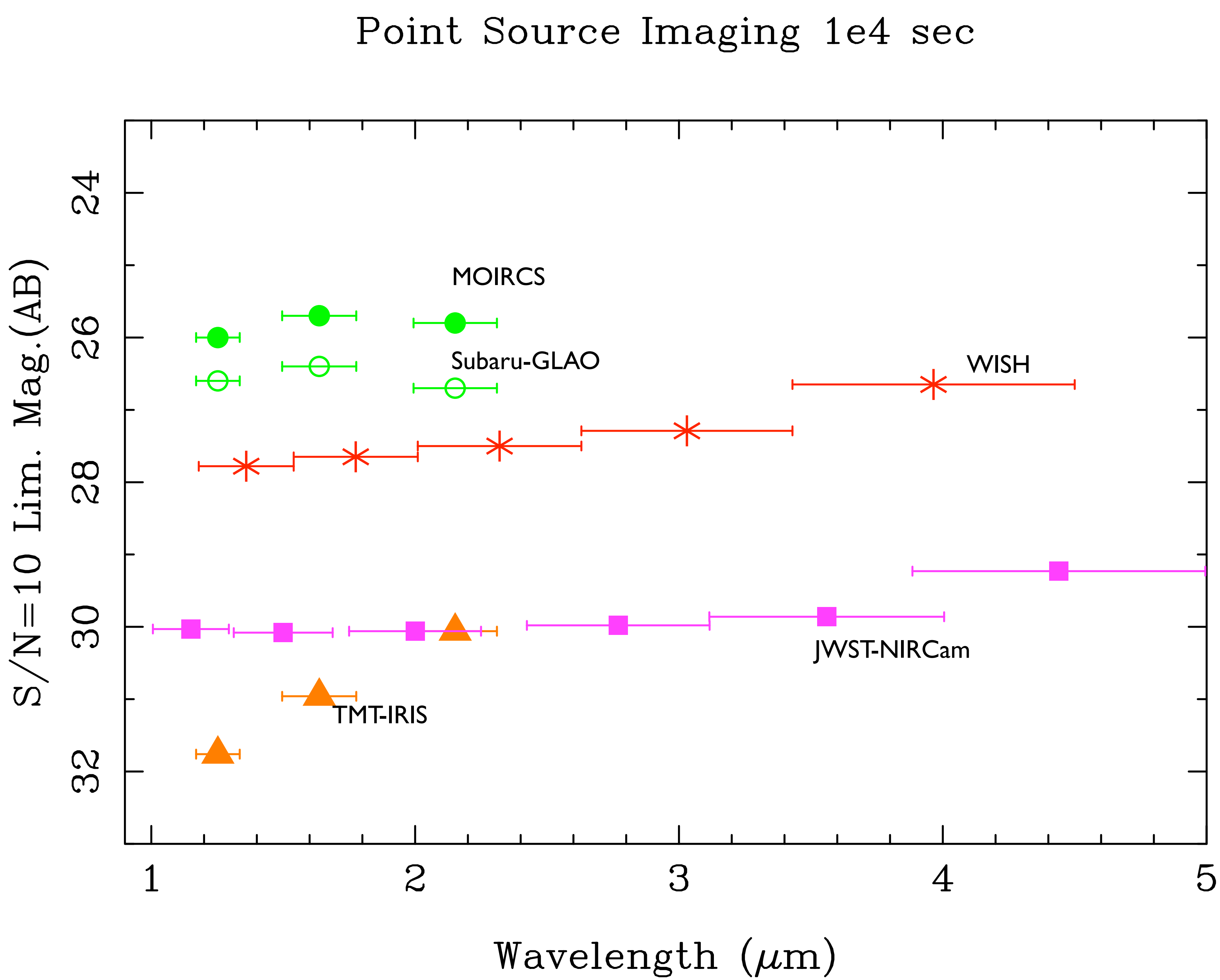


Euclid, WFIRST, and WISH

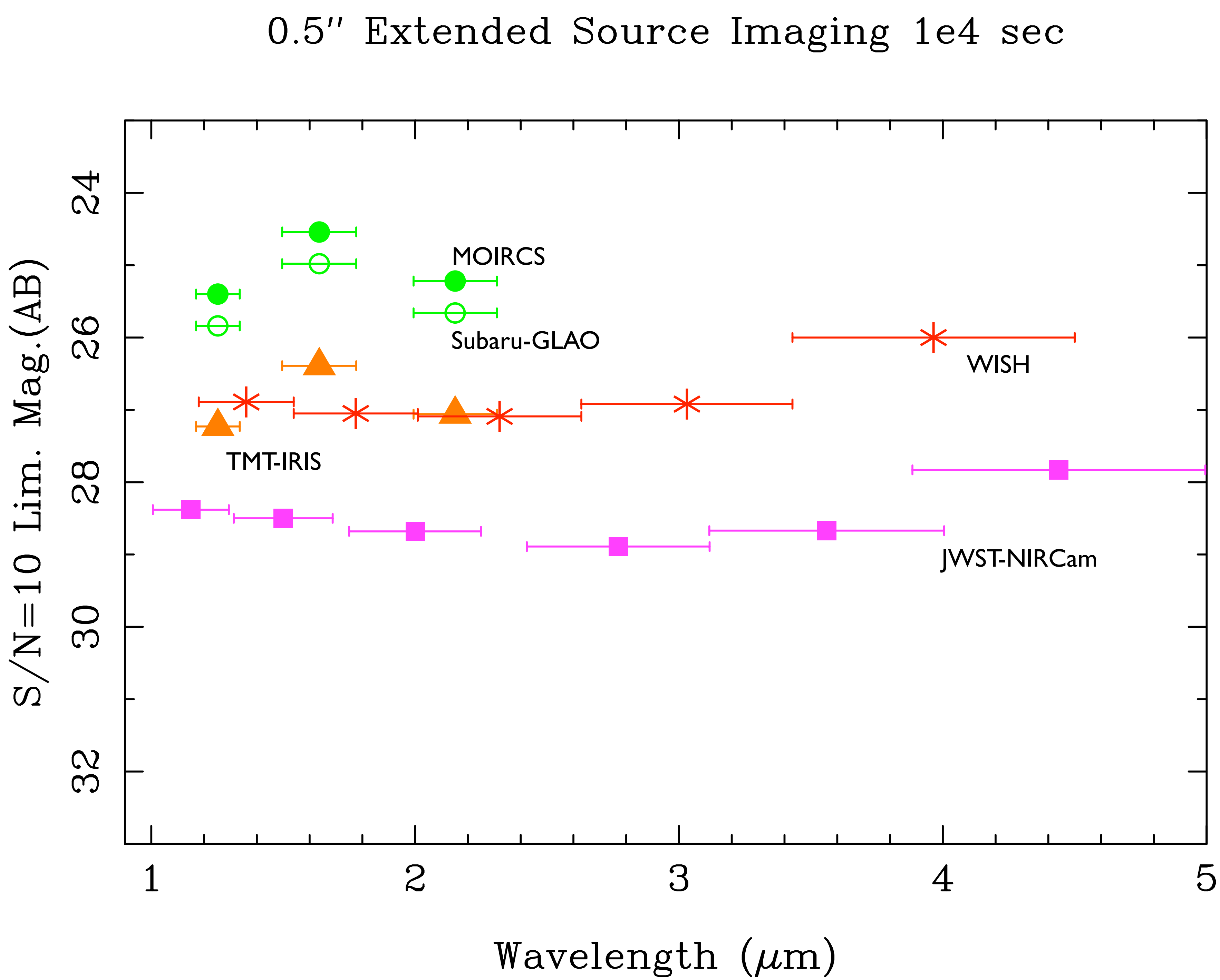
	Euclid	WFIRST	WISH
Mirror	1.2m	1.3m / 2.4m?	1.5m
FoV	0.5 deg^2	0.3deg^2	0.23deg^2
Visual Imager	RIz	↓	--
NIR Imager	YJH	0.6-2.0μm	0.9-5.0μm
Lim. Mag.	24AB	25.9AB /	28AB
Survey Area	20,000 deg^2	>11,000 deg^2	100 deg^2
Primary Science	Dark Energy	DE, Exoplanet, QSO	First Galaxies
Expected Operations	2018- (7 years)	202x? (5 years)	end of 2010s (5 years)

Imaging Sensitivity

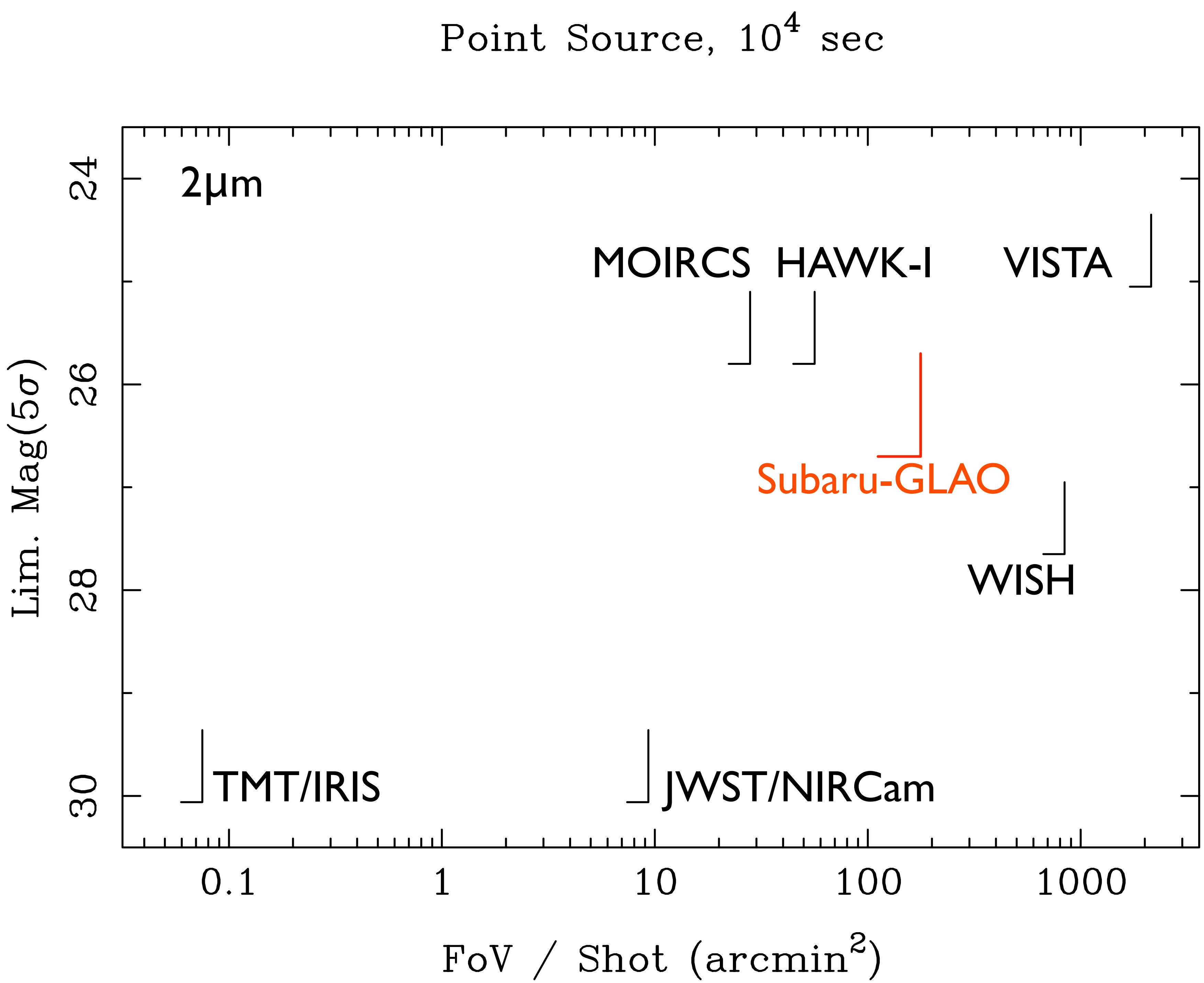
Imaging: Sensitivity for Point Sources



Imaging: Sensitivities for Extended Sources



Imaging: Sensitivity and Field-of-View



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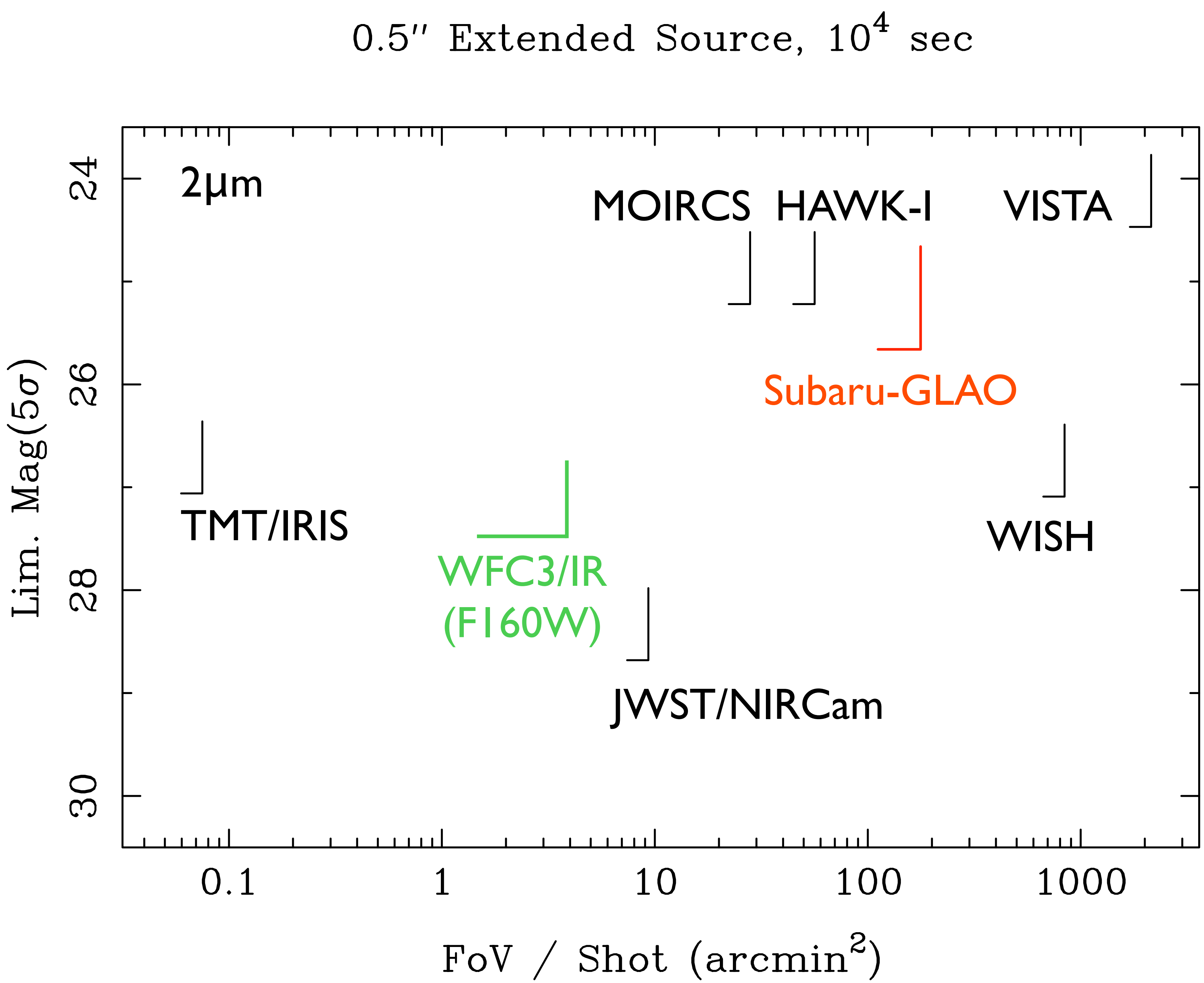
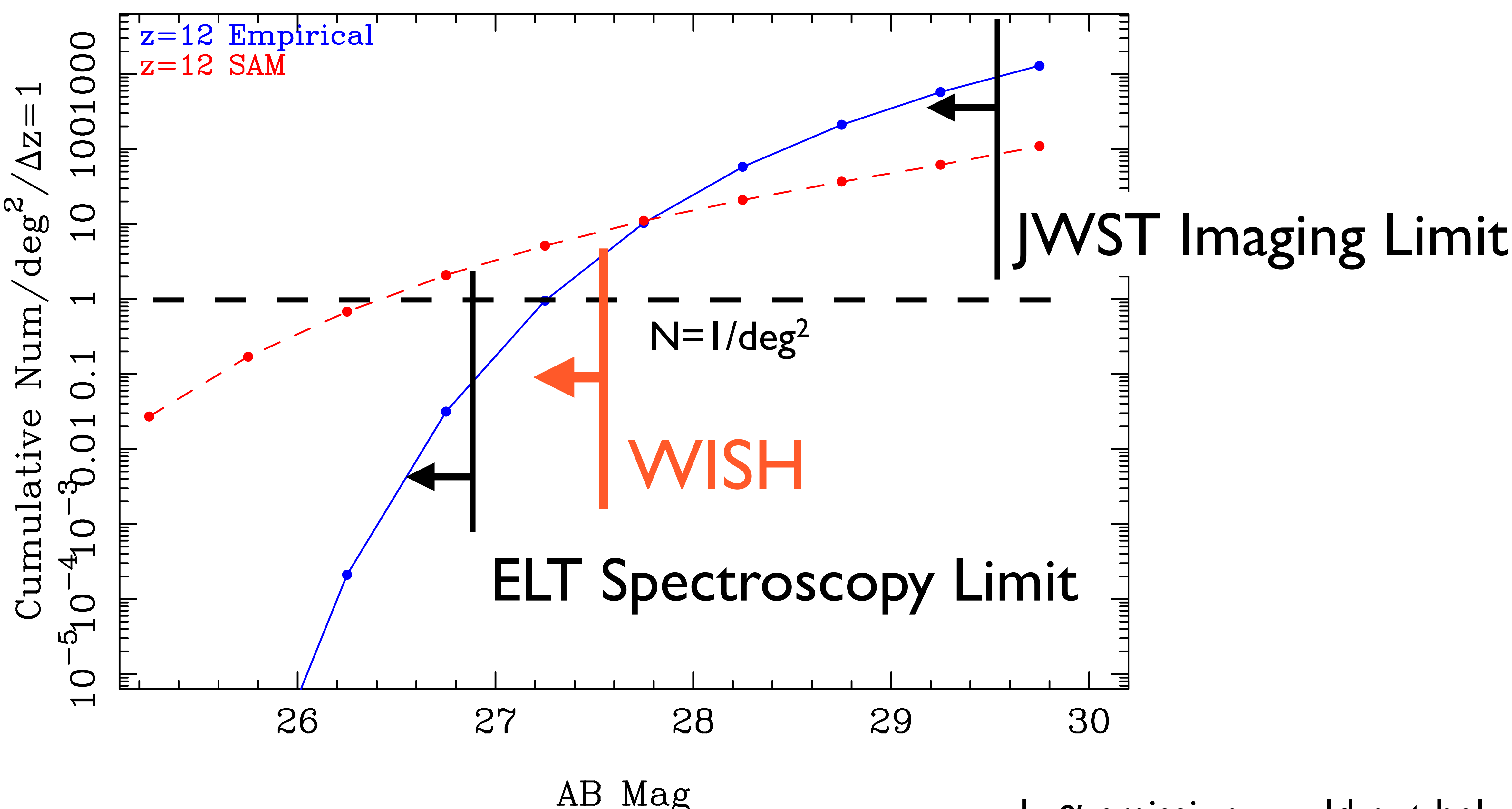


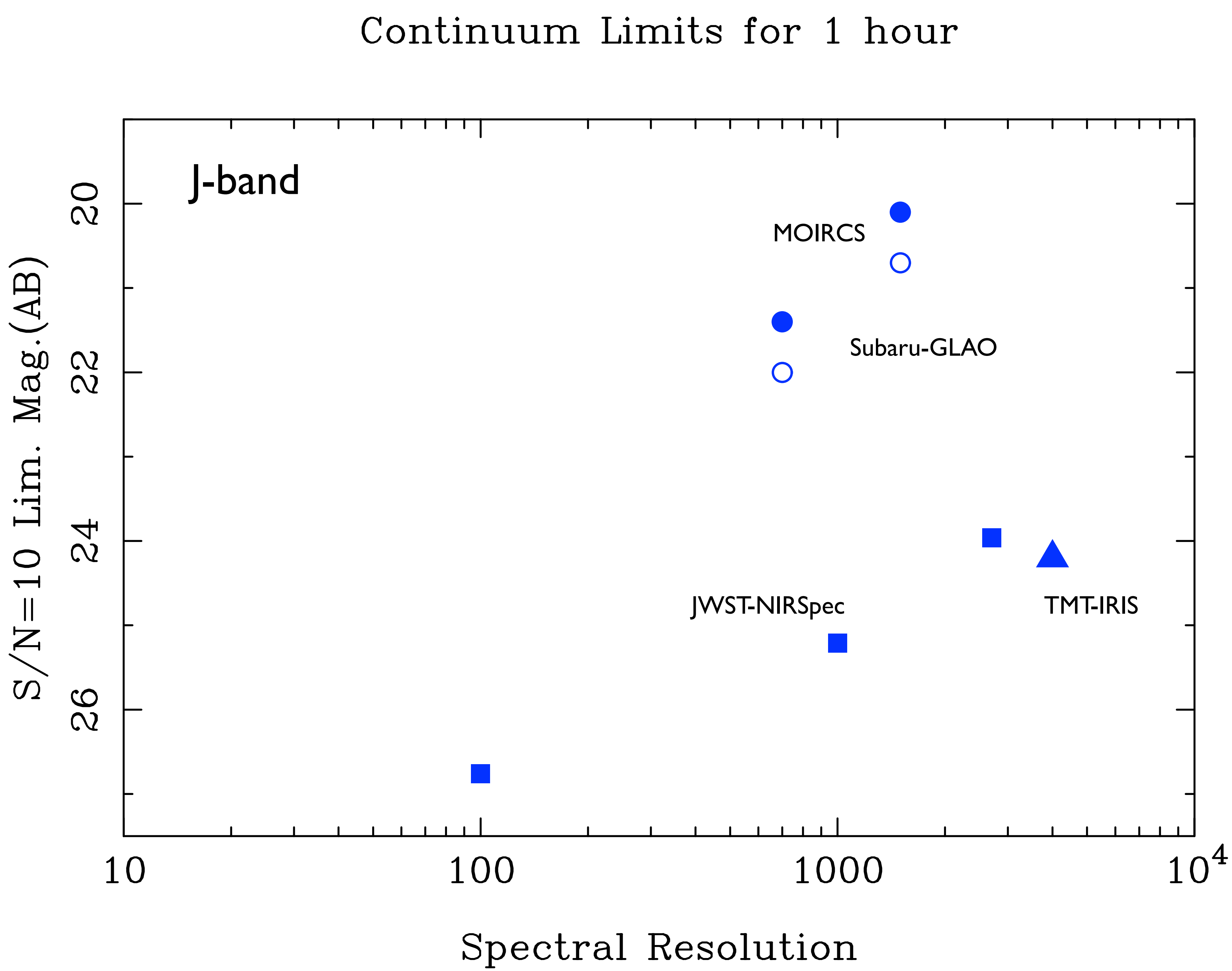
Number Density of z=12 Galaxies



Lyα emission would not help improving the detection limit with ELTs for extended sources

Spectroscopic Sensitivity

Spectroscopy: Continuum Sensitivity (Point Sources)



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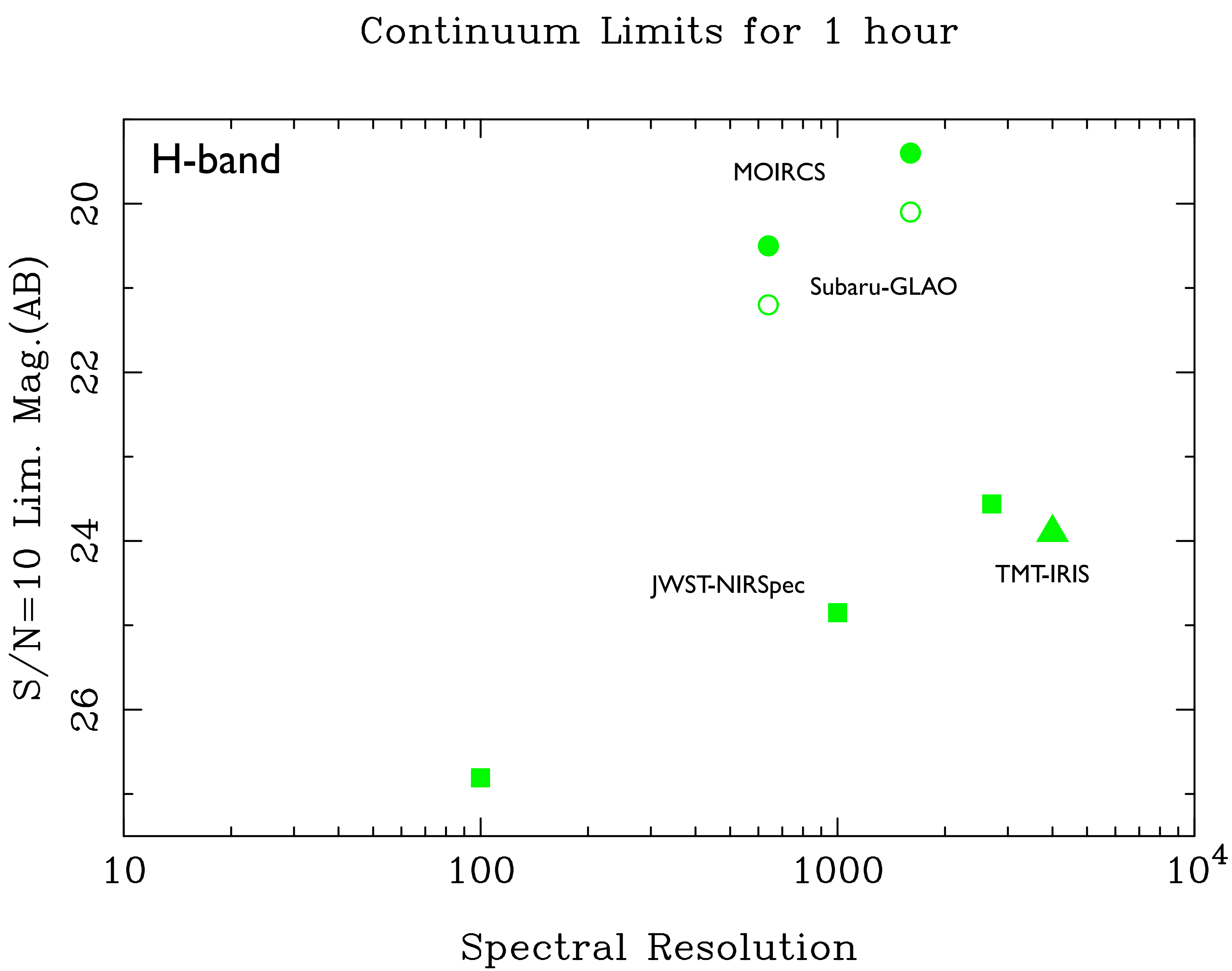

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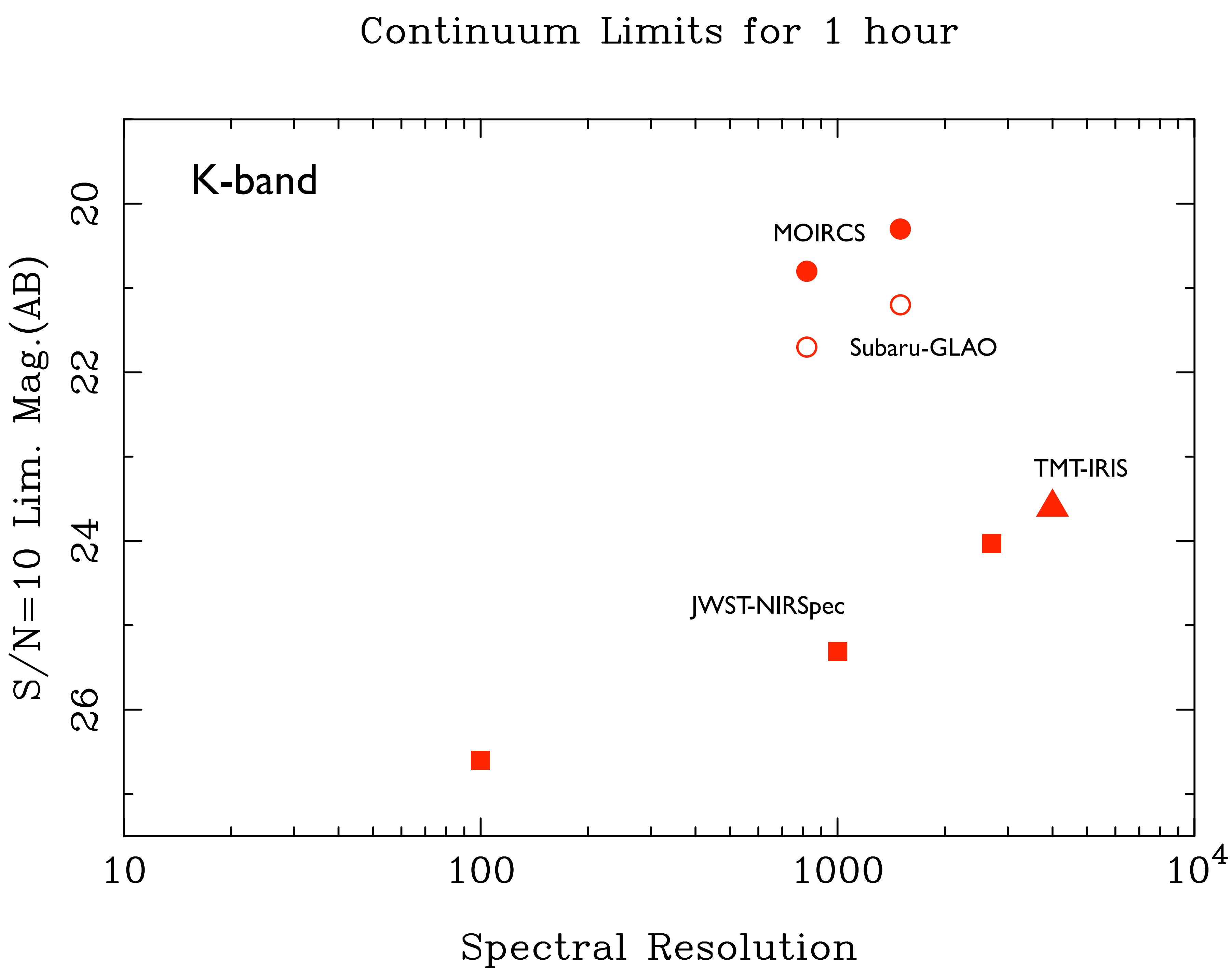
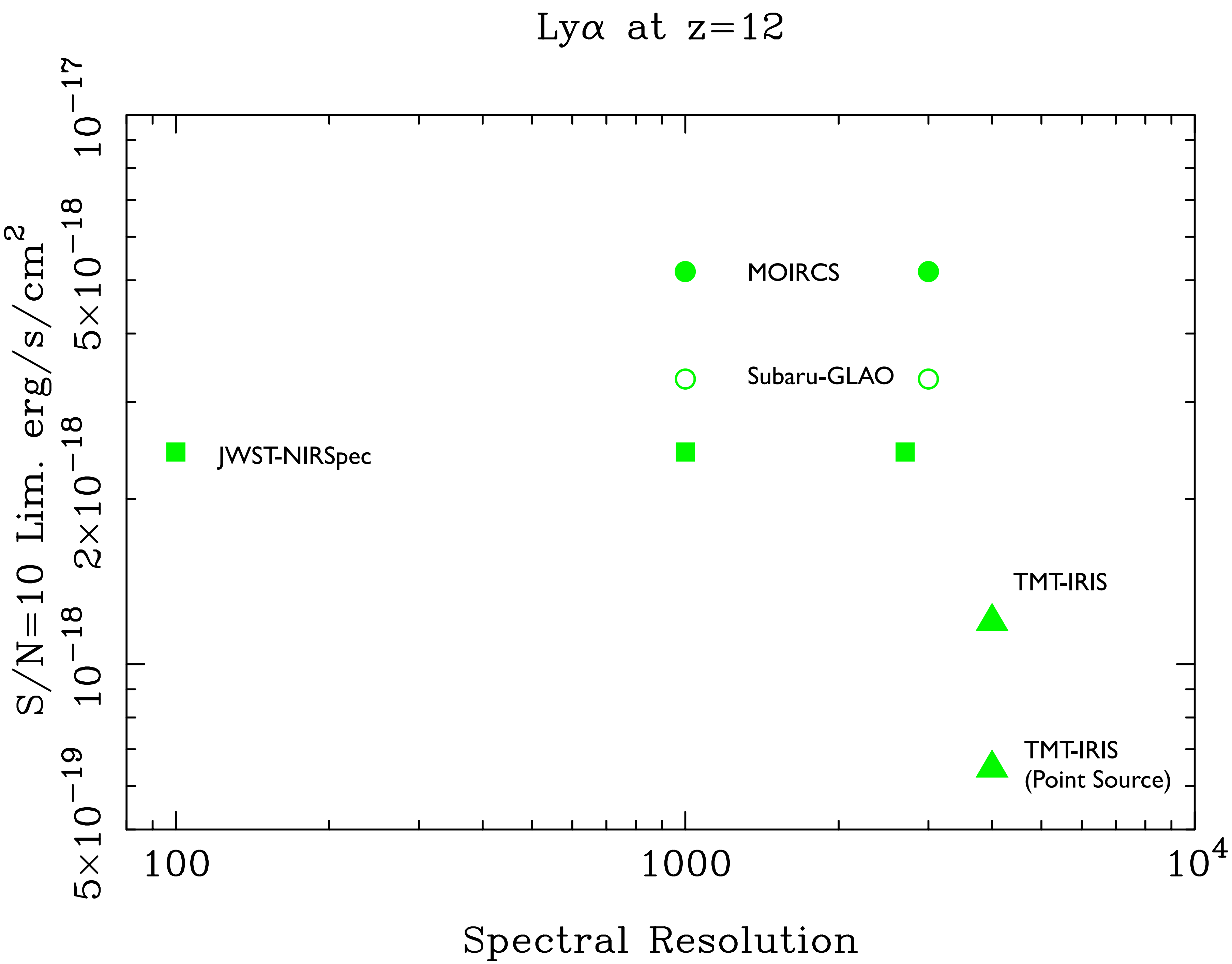


Spectroscopy: Sensitivity for Emission Lines

1 hours, ~0.25” extended source



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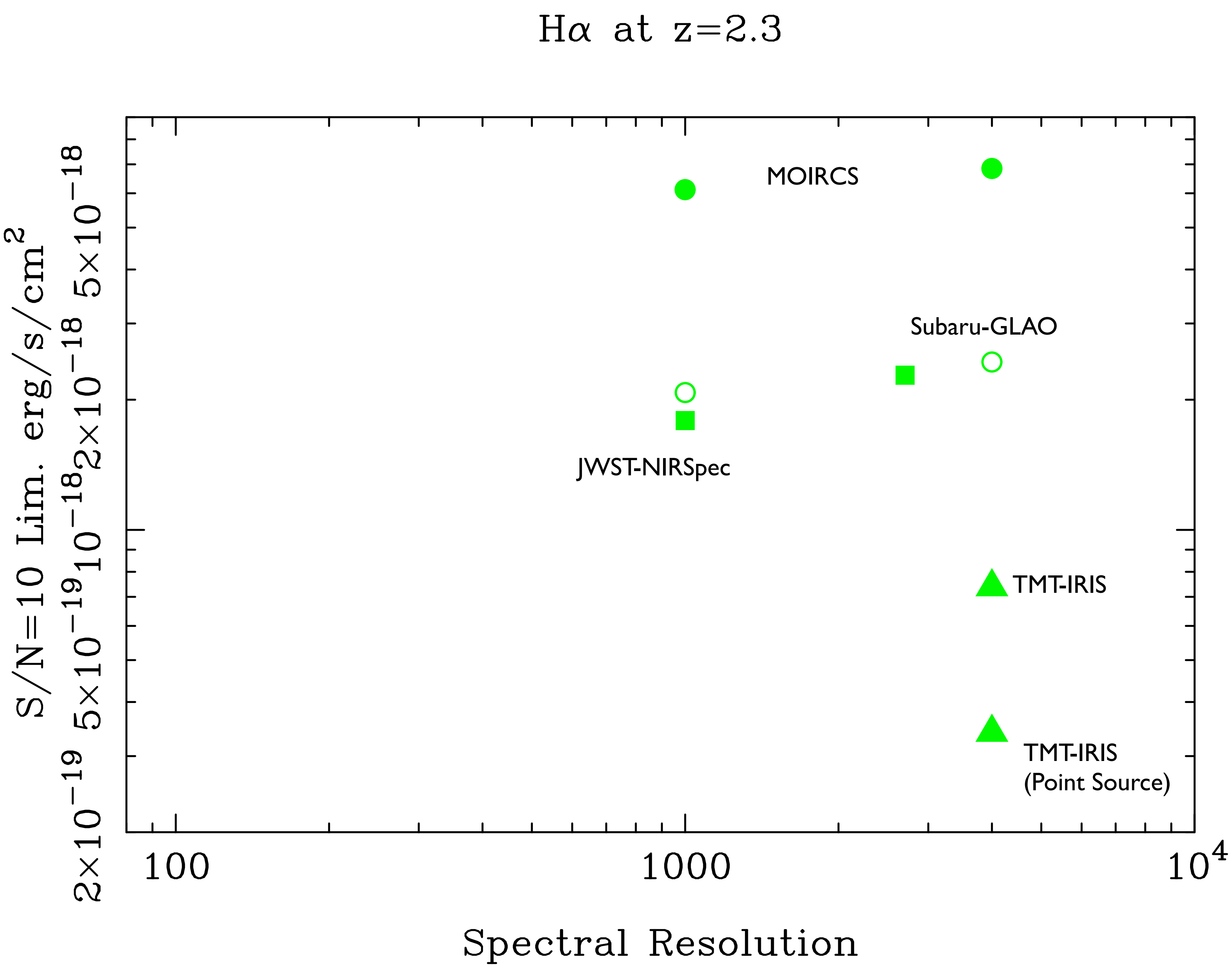

Summary

- Imaging: Space Missions have significant advantages
  - Narrow-band imaging capability is more suited for ground-based telescopes
- Spectroscopy:
  - Sensitivity gain can be as much as ~2x with GLAO
  - For extended sources difference between ground-based and space telescopes becomes smaller.
  - The most sensitive observations will be realized by TMT.
  - Reducing Read-out Noise is important.