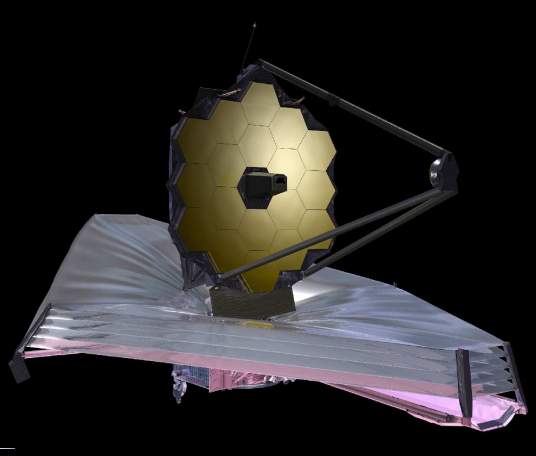
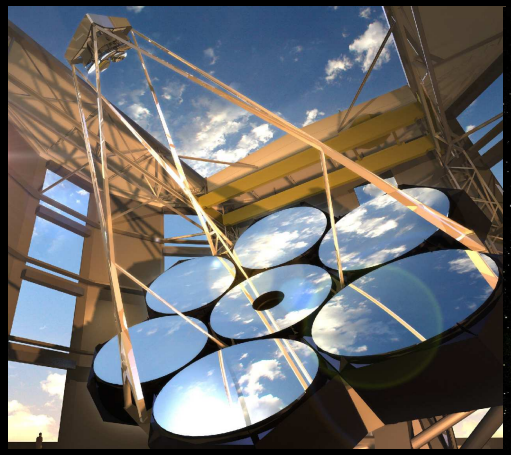
SESE and Big Telescope Projects: Past, Present, & Future

Rogier Windhorst — on behalf of SESE Astronomy & Cosmology faculty

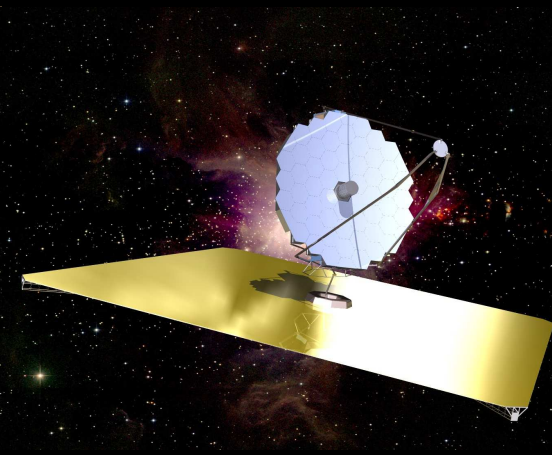
1973∼2018^{+};



1996∼2029;



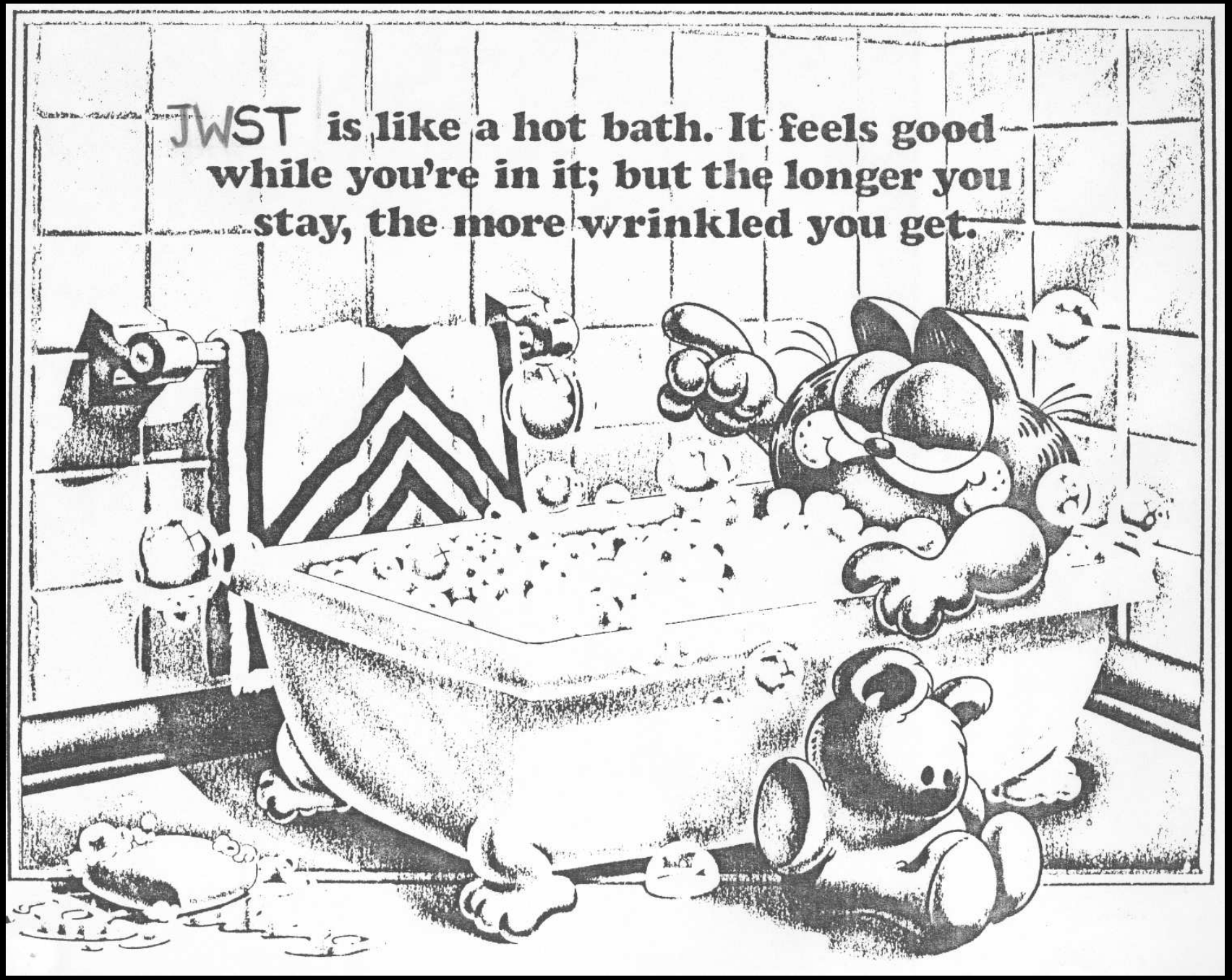
2000∼2050^{+}



2020∼2050^{+}?

SESE Graduate Student Orientation, ASU ISTB4, Tempe, AZ

Wednesday, Aug. 12, 2015. All presented materials are ITAR-cleared.



WARNING: Both Hubble and James Webb are 30–40^{+} year projects:

You will feel wrinkled before you know it ... :)

Outline

- (1) Space Telescopes — Past and Present: Hubble
- (2) Space Telescopes: Near Future: James Webb Space Telescope (JWST)
- (3) Future Ground-based and Space Telescopes: GMT and ATLAST
- (4) Where do our students end-up? Possible NASA Careers

Sponsored by NASA/HST & JWST

ASU Arizona State University

Talk is on: `http://www.asu.edu/clas/hst/www/jwst/jwsttalks/asu_grads15_hstjwst.pdf`

(1) Space Telescopes: Past and Present: Hubble Wide Field Camera 3

10 filters with HST/WFC3 & ACS reaching AB=26.5-27.0 mag (10-σ) over 40 arcmin^2 at 0.07–0.15" FWHM from 0.2–1.7μm (UVUBVizYJH). JWST adds 0.05–0.2" FWHM imaging to AB$\simeq$31.5 mag (1 FF) at 1–5μm, and 0.2–1.2" FWHM at 5–29μm, tracing young+old SEDs & dust.

When was the last time an average hydrogen atom did anything interesting?

Image: NASA, ESA, & A. Field.

From STScI - PR2010-31

- Most ordinary matter is hydrogen between the galaxies.
- The last time that matter did anything interesting was *"reioinization,"* when it was ionized by the earliest starlight.

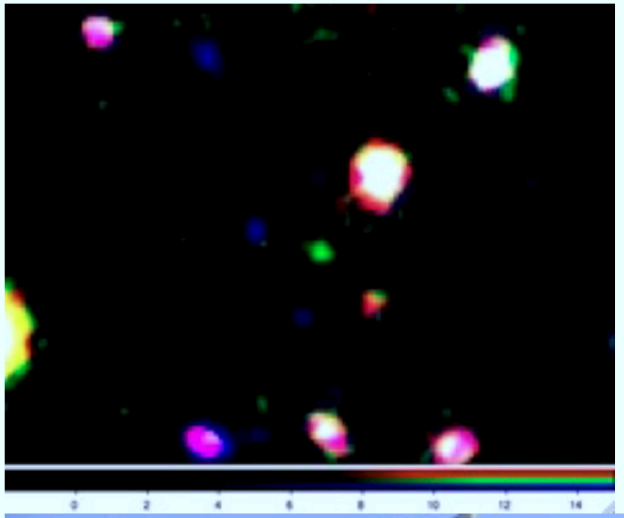
oads: What we're learning
e Faintest, Farthest Galaxies

History of Hydrogen in the Universe: First stars to the first galaxies:

- **Observational:** Prof. Bowman, Malhotra, Rhoads, Windhorst
- **Instrumental:** Prof. Butler, Groppi, Mauskopf, & Scowen
- **Theoretical:** Prof. Scannapieco, Starrfield, Timmes, & Young

Cosmic Dawn

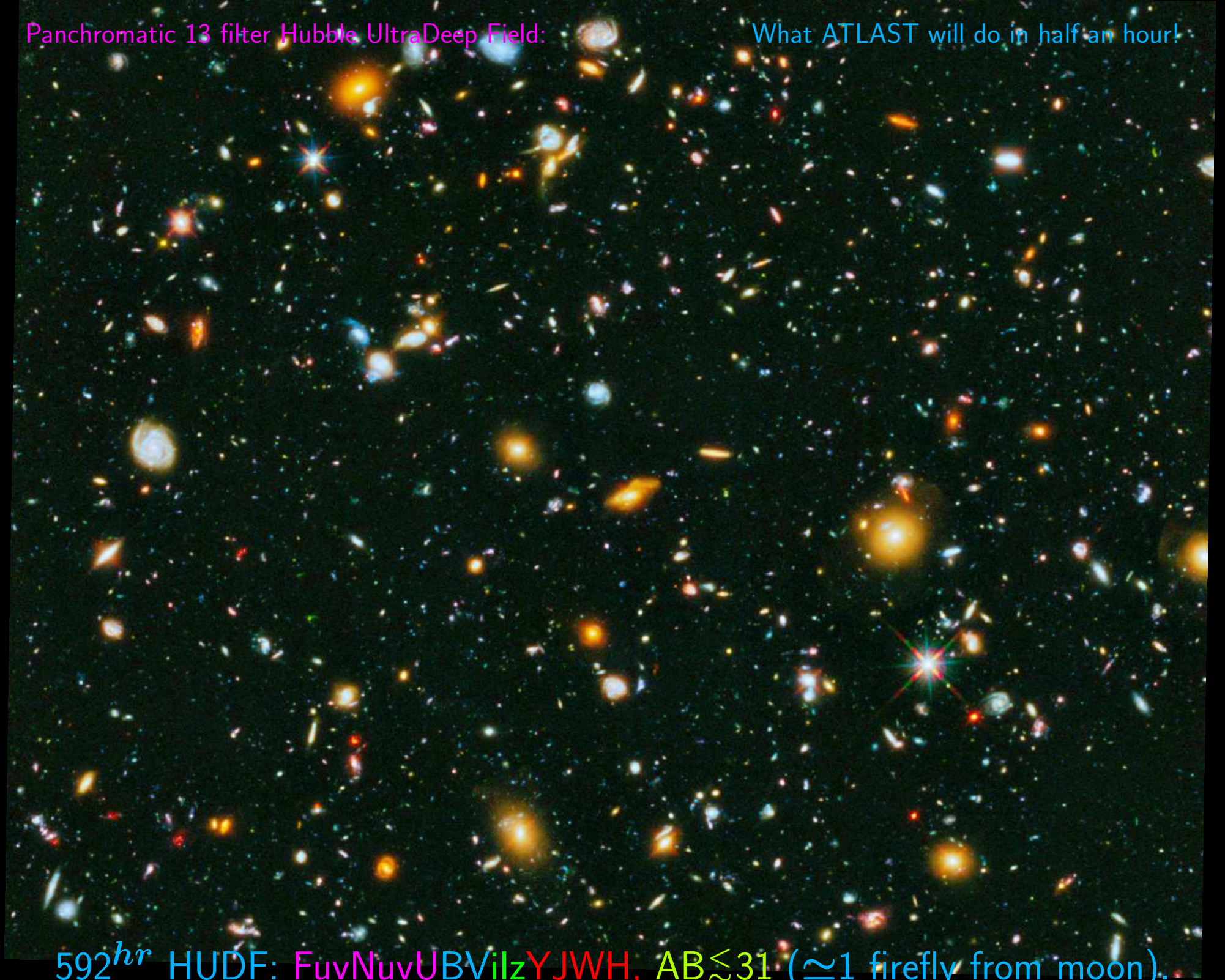
The first billion years – earliest, farthest (faintest) galaxies.

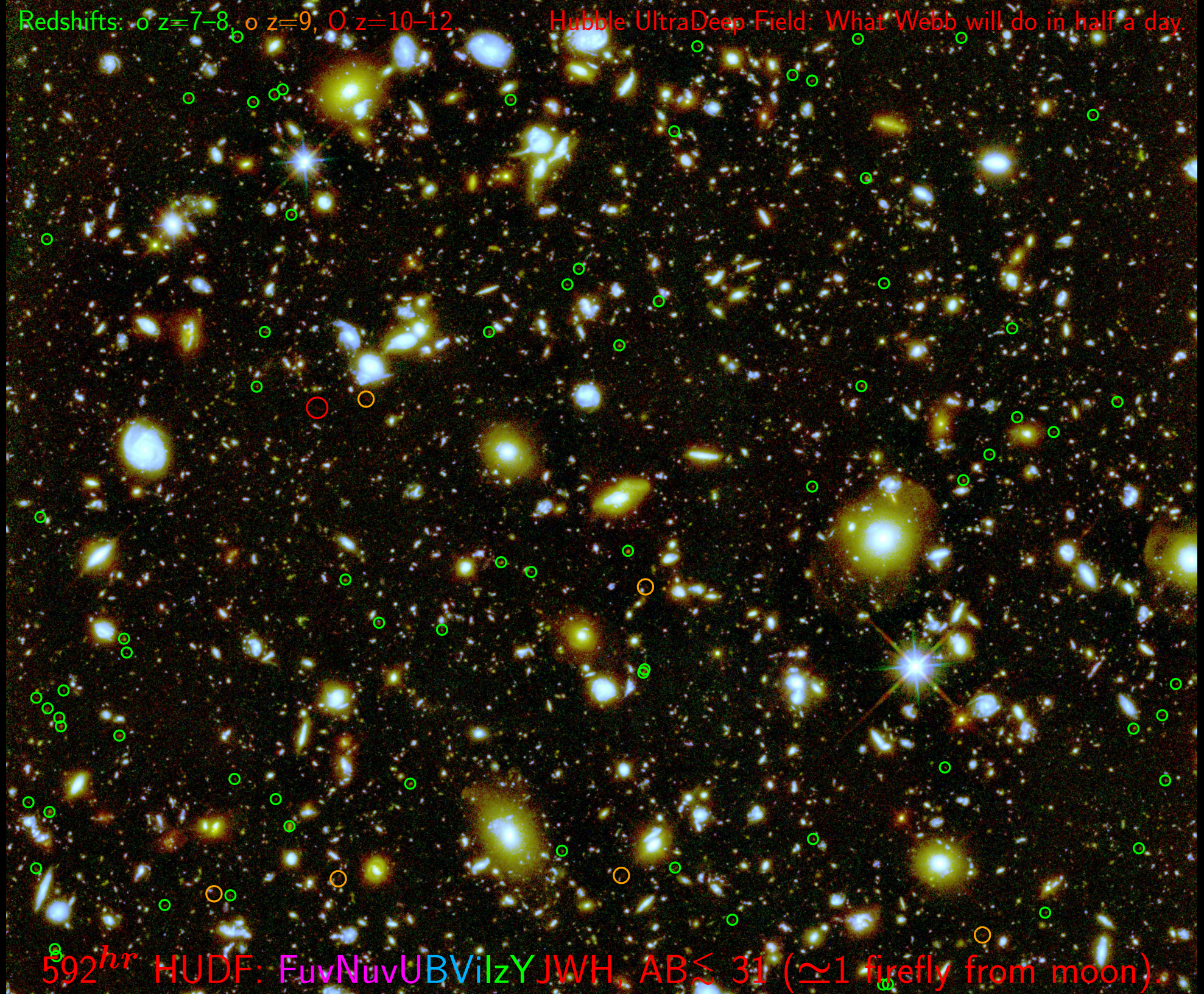


Rhoads, Hibon, Malhotra et al. 2012 (Picked up by Astronomy Magazine and other news outlets)

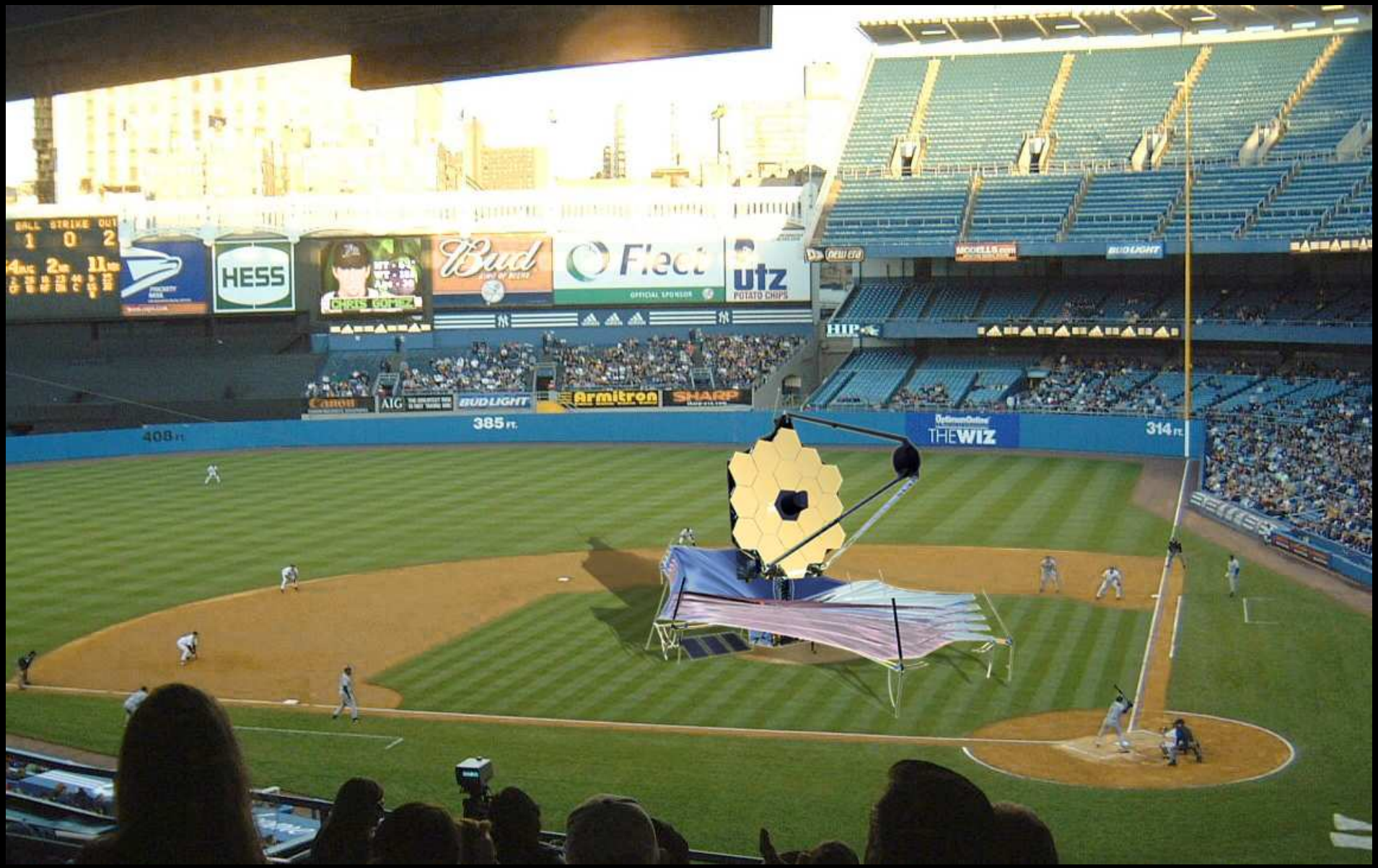
Work on Cosmic Dawn on th 6.5m Magellan Telescope in Chile.

JWST, GMT, ATLAST will measure the history of Hydrogen in the Universe, from the formation of the first stars to the first galaxies.


Panchromatic 13 filter Hubble UltraDeep Field:
What ATLAST will do in half an hour!
592^{hr} HUDF: FuvNuvUBViIzYJWH, AB$\lesssim$31 ($\simeq$1 firefly from moon).


Redshifts: o z=7–8, o z=9, O z=10–12.
Hubble UltraDeep Field: What Webb will do in half a day.
592^{hr} HUDF: FuvNuvUBVIlzYJWH, AB$\lesssim$ 31 ($\simeq$1 firefly from moon).

(2) Space Telescopes — Near Future: James Webb Space Telescope (JWST)

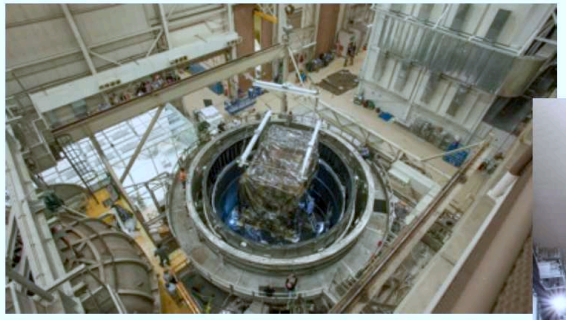


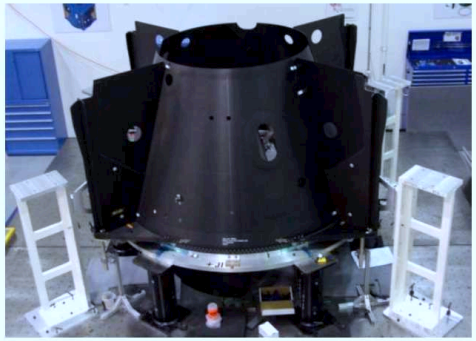
Future Telescopes are BIG: JWST compared to the Yankee ballpark ...

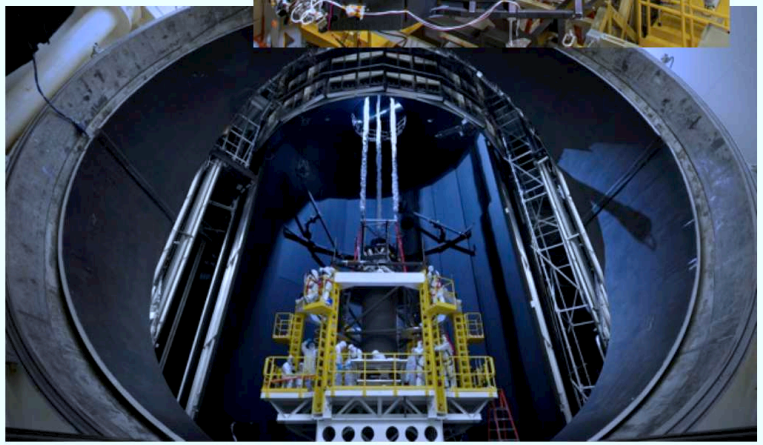
Both GMT and ATLAST facility would fill the Yankee ballpark ...

- New paradigm: They are too large for an individual university to take on.

JWST Hardware Progress







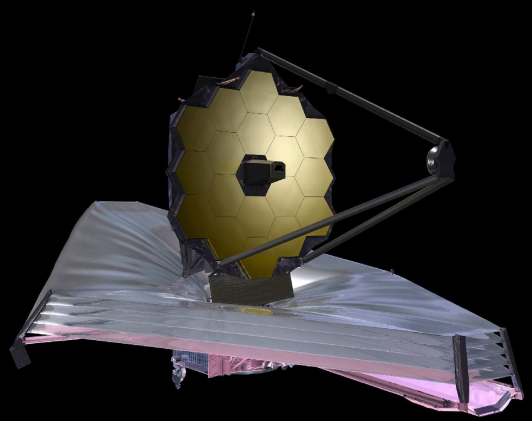
JWST remains on track for an October 2018 launch within its replan budget guidelines

July 2014: • Secondary Mirror Support deployment successfully tested.

2015: • Engineering sunshield successfully deployed at Northrop (CA).

(3) Future: Next generation 20-39 m ground-based telescopes and ATLAST

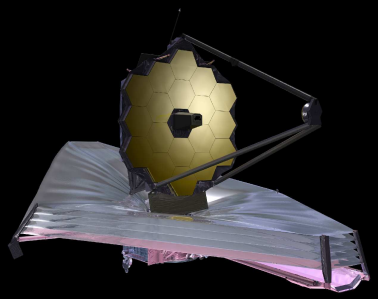
True relative size: Hubble, James Webb, & Giant Magellan Telescope

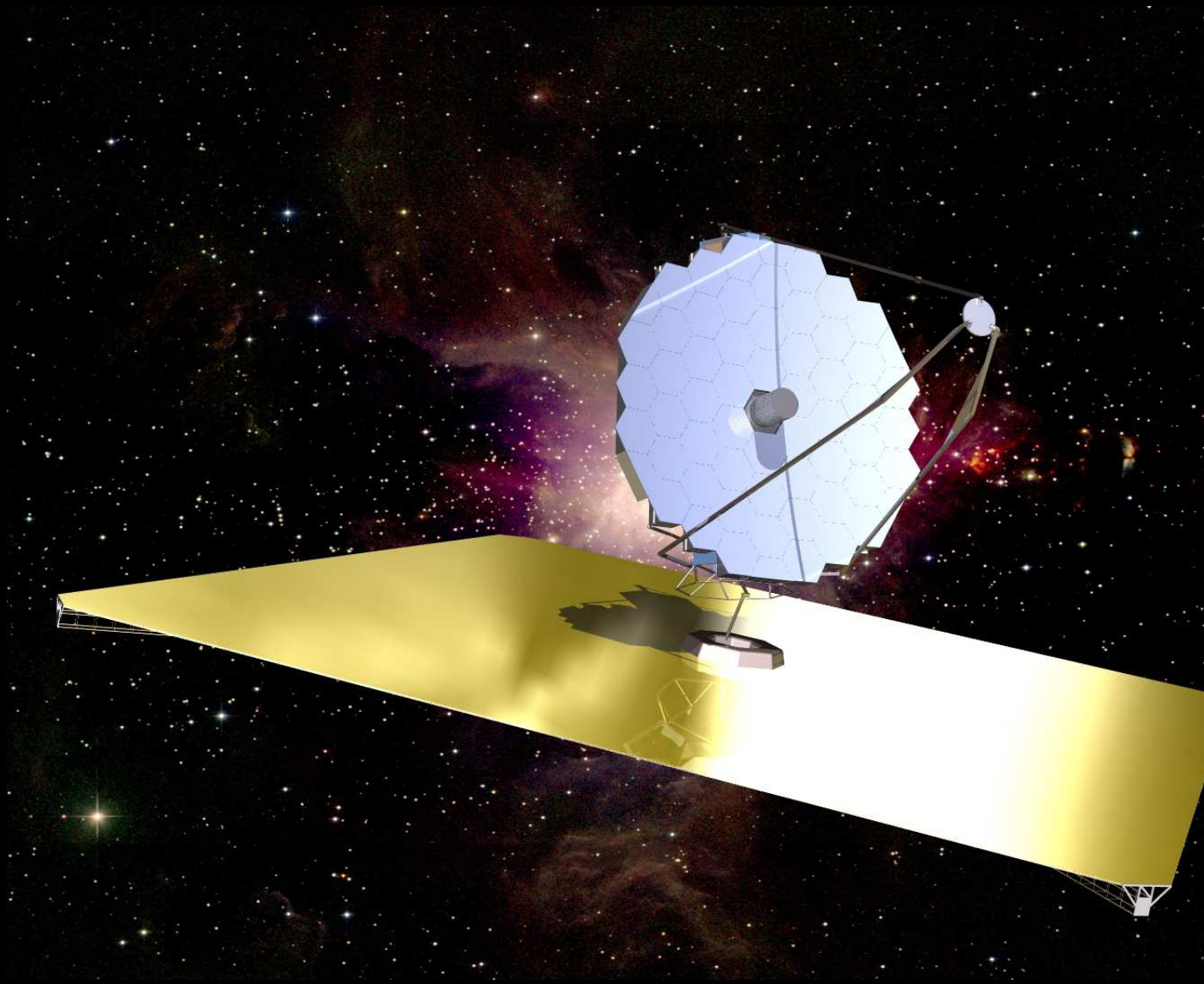


18 B$ (1973∼2018); 9 B$ (1996∼2029); ∼1 B$ (2000∼2050^{+}).

(4) Future: Next generation 20-39 m ground-based telescopes and ATLAST

True relative size: Hubble, James Webb, and ATLAST ...





18 B$ (1973∼2018); 9 B$ (1996∼2029); 15–20 B$ (2020∼2050^{+}?).

(4) What do our Astrophysics College Graduates do?

Future Careers at NASA:

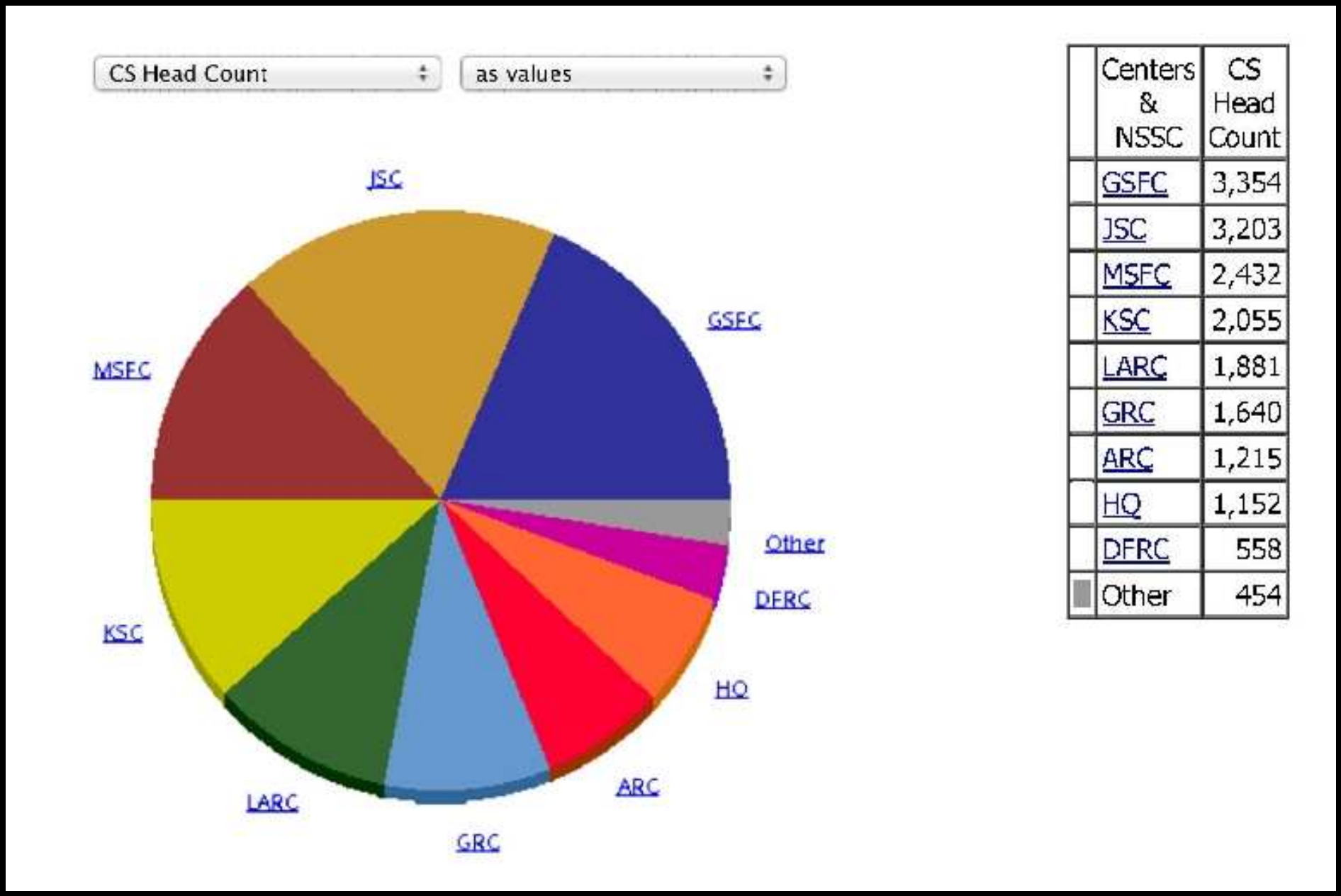
- Over the last 25 years, (ASU) Astrophysics College Graduates typically:
- (0) Have very low unemployment ($\lesssim$few %).
- (1) About 30% are faculty at Universities or 4-year colleges.
- (2) About 30% are researchers at NASA or other government centers.
- (3) About 20% work in Aerospace or related industries.
- (4) About 20% are faculty at Community Colleges or Highschools.

See also: http://aas.org/learn/careers-astronomy

http://www.aip.org/statistics/astronomy/

https://webapp4.asu.edu/programs/t5/careerdetails/19-2011.00?init=false&nopassive=true

http://scitation.aip.org/content/aip/magazine/physicstoday/article/68/6/10.1063/PT.3.2815



	Centers & NSSC	CS Head Count
	GSFC	3,354
	JSC	3,203
	MSFC	2,432
	KSC	2,055
	LARC	1,881
	GRC	1,640
	ARC	1,215
	HQ	1,152
	DFRC	558
	Other	454

NASA workforce as pie-chart and in numbers — 2013 total: about 18,000).

Nation-wide NASA contractors (Northrup, Lockheed, Boeing, etc): 150,000.

See also: `https://wicn.nssc.nasa.gov/generic.html`

Some of our ASU grad students do important outreach events:

Annual Girl Scout Stargazing at the White House South lawn (July 2015).

Our own Amber Straughn (right; now at NASA GSFC working for Nobel Laureate Dr. John Mather) informs the Obama's about NASA.

SPARE CHARTS

- References and other sources of material shown:

http://www.asu.edu/clas/hst/www/jwst/ [Talk, Movie, Java-tool]

http://www.asu.edu/clas/hst/www/ahah/ [Hubble at Hyperspeed Java–tool]

http://www.asu.edu/clas/hst/www/jwst/clickonHUDF/ [Clickable HUDF map]

http://www.jwst.nasa.gov/ & http://www.stsci.edu/jwst/

http://ircamera.as.arizona.edu/nircam/

http://ircamera.as.arizona.edu/MIRI/

http://www.stsci.edu/jwst/instruments/nirspec/

http://www.stsci.edu/jwst/instruments/fgs

Gardner, J. P., et al. 2006, Space Science Reviews, 123, 485–606

Mather, J., & Stockman, H. 2000, Proc. SPIE Vol. 4013, 2

Windhorst, R., et al. 2008, Advances in Space Research, 41, 1965

Windhorst, R., et al., 2011, ApJS, 193, 27 (astro-ph/1005.2776).