Razotkrivanje vasione svemirskim teleskopom Džejms Veb
#Unfold the universe

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Džejms Veb (1906 – 1992)

- Drugi direktor/administrator NASA-e (1961-1968)
- Dao je ogroman doprinos američkoj pobedi u svemirskoj trci sa SSSR-om
- Nadgledao je projekte Mariner, Pioneer, Apollo
- 2002. godine *Next Generation Space Telescope* je preimenovan u *JWST*

Hronologija događaja

- 1996. osmišljen projekat Next generation space telescope (8 m) (iako su razmišljanja počela još 80ih)
- 2002. Dobio ime po Džejmsu Vebu, i smanjen na oko 6m

Year	Planned launch	Budget plan (billion USD)
1997	2007[136]	0.5[136]
1998	2007[147]	1[107]
1999	2007 to 2008[148]	1[107]
2000	2009[86]	1.8[107]
2002	2010[149]	2.5[107]
2003	2011[150]	2.5[107]
2005	2013	3[151]
2006	2014	4.5[152]
2008: Preliminary Design Review		
2008	2014	5.1[153]
2010: Critical Design Review		
2010	2015 to 2016	6.5[154]
2011	2018	8.7[155]
2013	2018	8.8[156]
2017	2019[157]	8.8
2018	2020[158]	≥8.8
2019	March 2021[159]	9.66
2021	Dec 2021[160]	9.70

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- 2004. se pridružila ESA (300 miliona + instrumenti + lansiranje)
- 2007. se pridružila CSA (39 miliona + instrumenti)
- 2011. zamalo prekinut projekat, glasao Kongres SAD

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Veb ne izgleda kao uobičajeni svemirski teleskop

Komponente:

-primarno ogledalo od 18 segmenata (1.3m prečnika)

-sekundarno ogledalo 0.74m

-tercijarno ogledalo

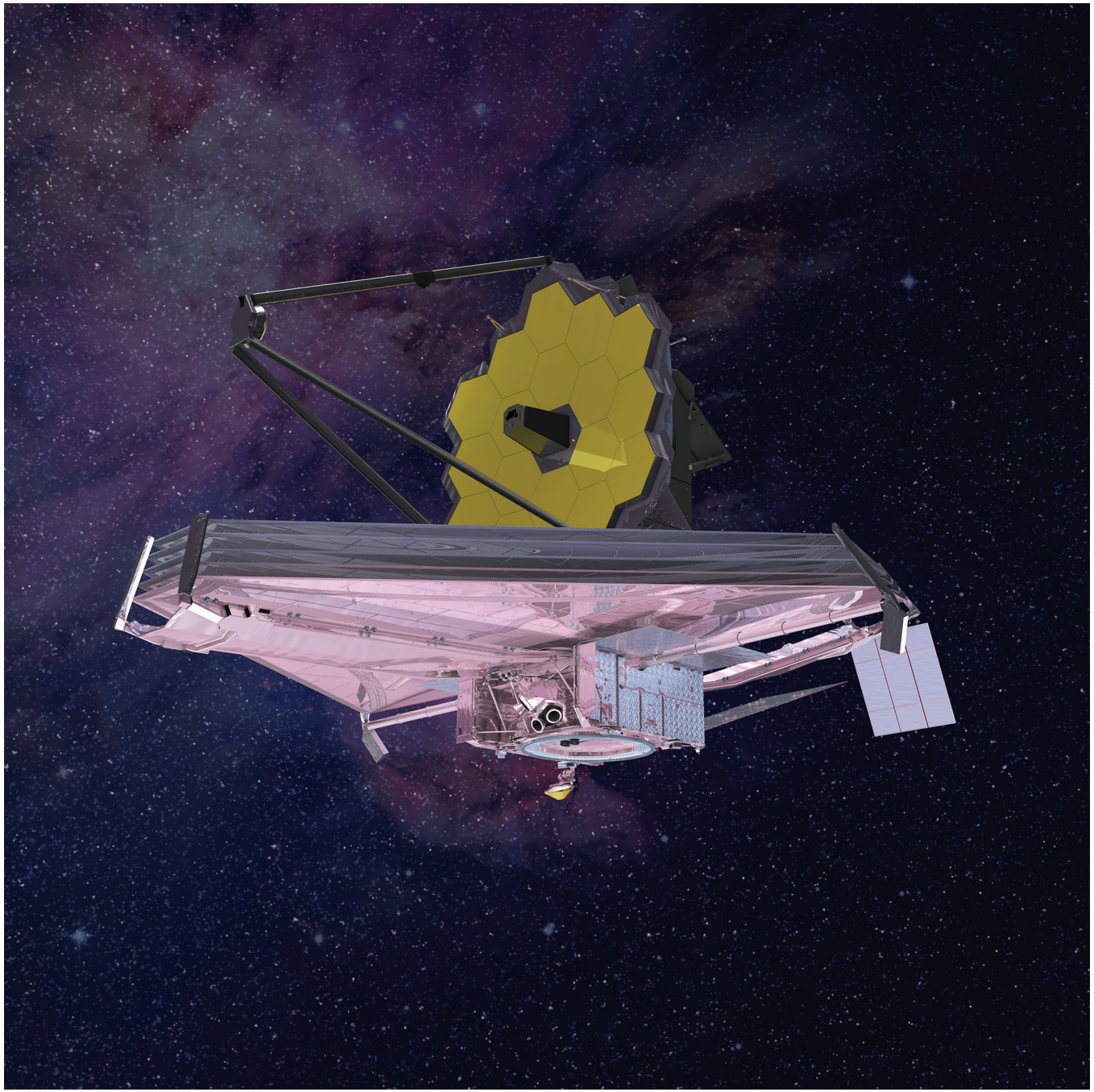
-Štit od Sunca

-Solarni paneli

-Stabilizator (od pritiska Sunčevog zračenja)

-*Spacecraft control systems*

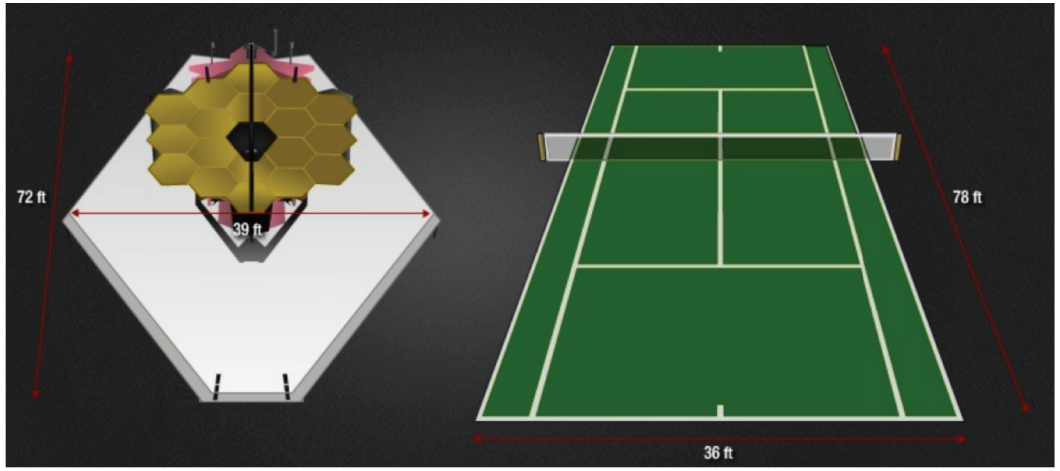
-*Science instruments module*



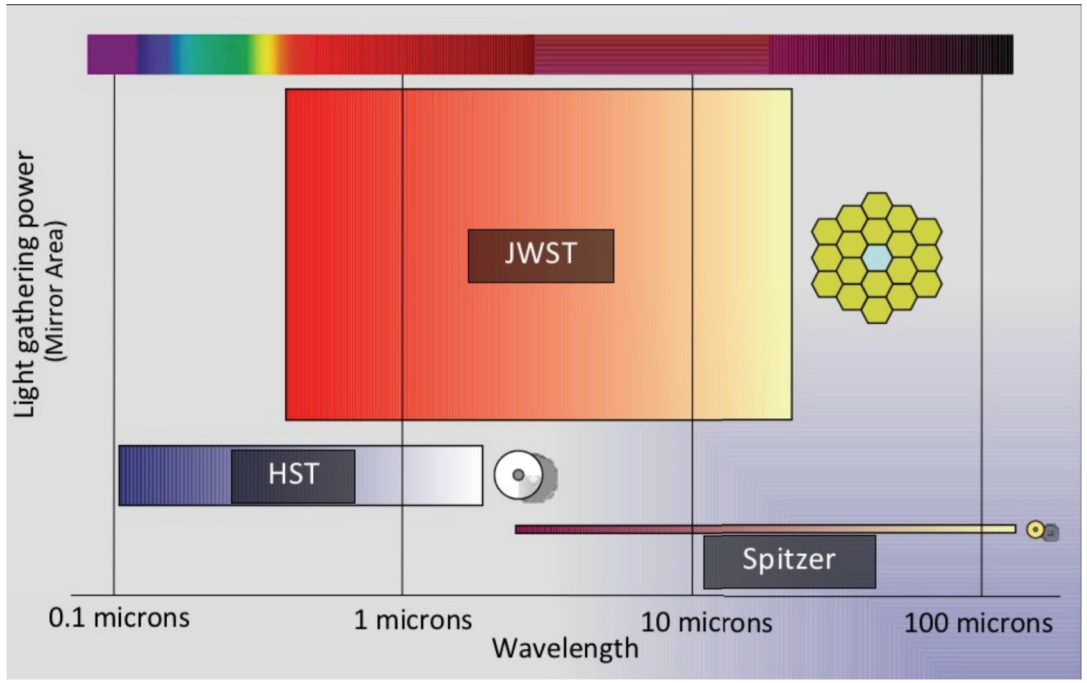
JWST i HST - tehničke karakteristike

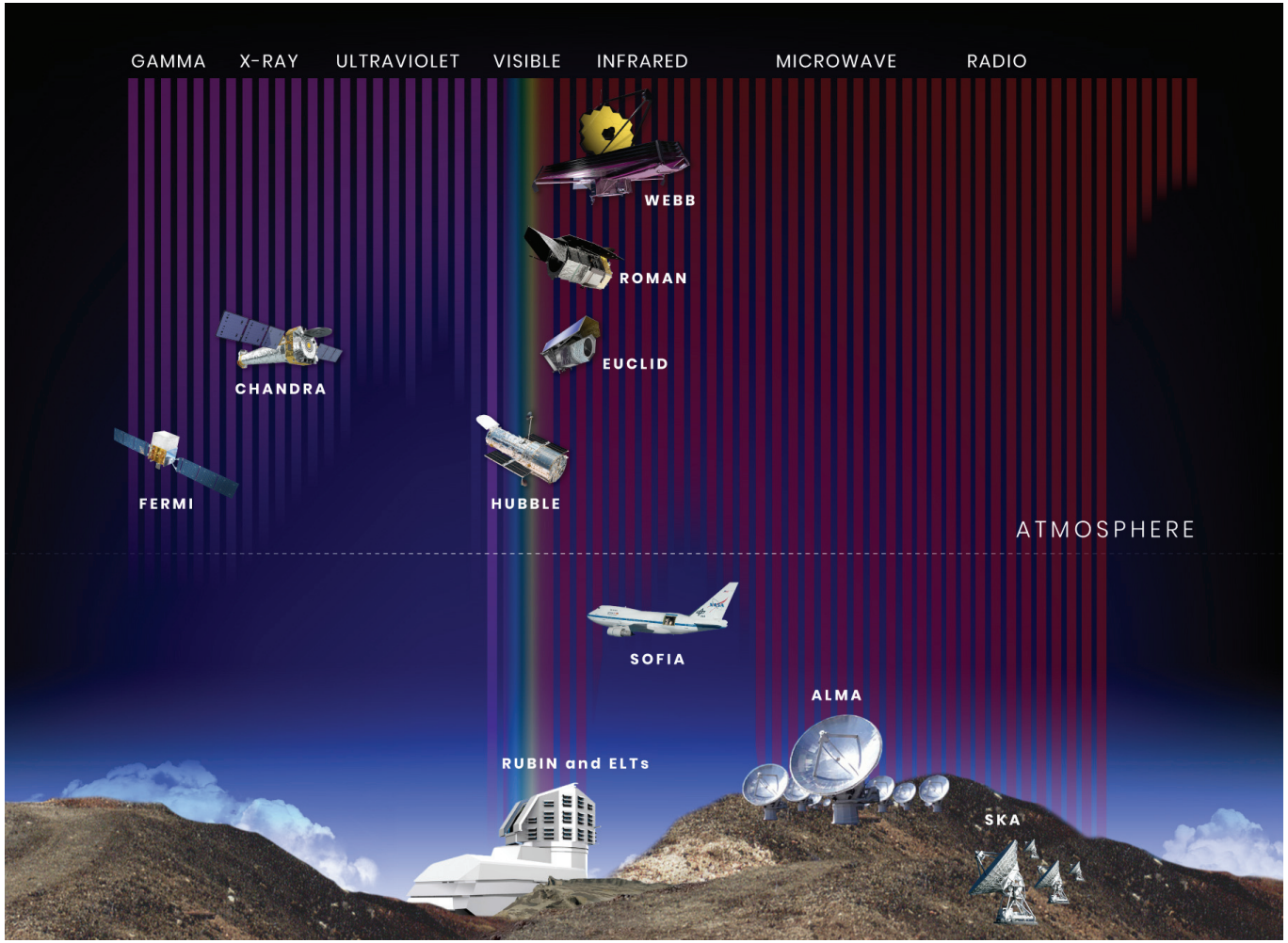
HST
- Veličine autobusa
- Prečnik ogledala: 2,4 m
- Težina: 11 110 kg
- Udaljenost: 540 km
- Period (oko Zemlje): 97 min
- Trajanje misije: do sada 31,5 godina

JWST
- Veličine teniskog terena
- Prečnik ogledala: 6,5 m
- Težina: 6 141 kg
- Udaljenost: oko 1 500 000 km
- Period (oko Sunca): 1 god
- Trajanje misije: najmanje 5 god, planirano 10 god, a možda i 20 god !!!
  - Zbog male potrošnje goriva tokom korigovanja putanje do L2

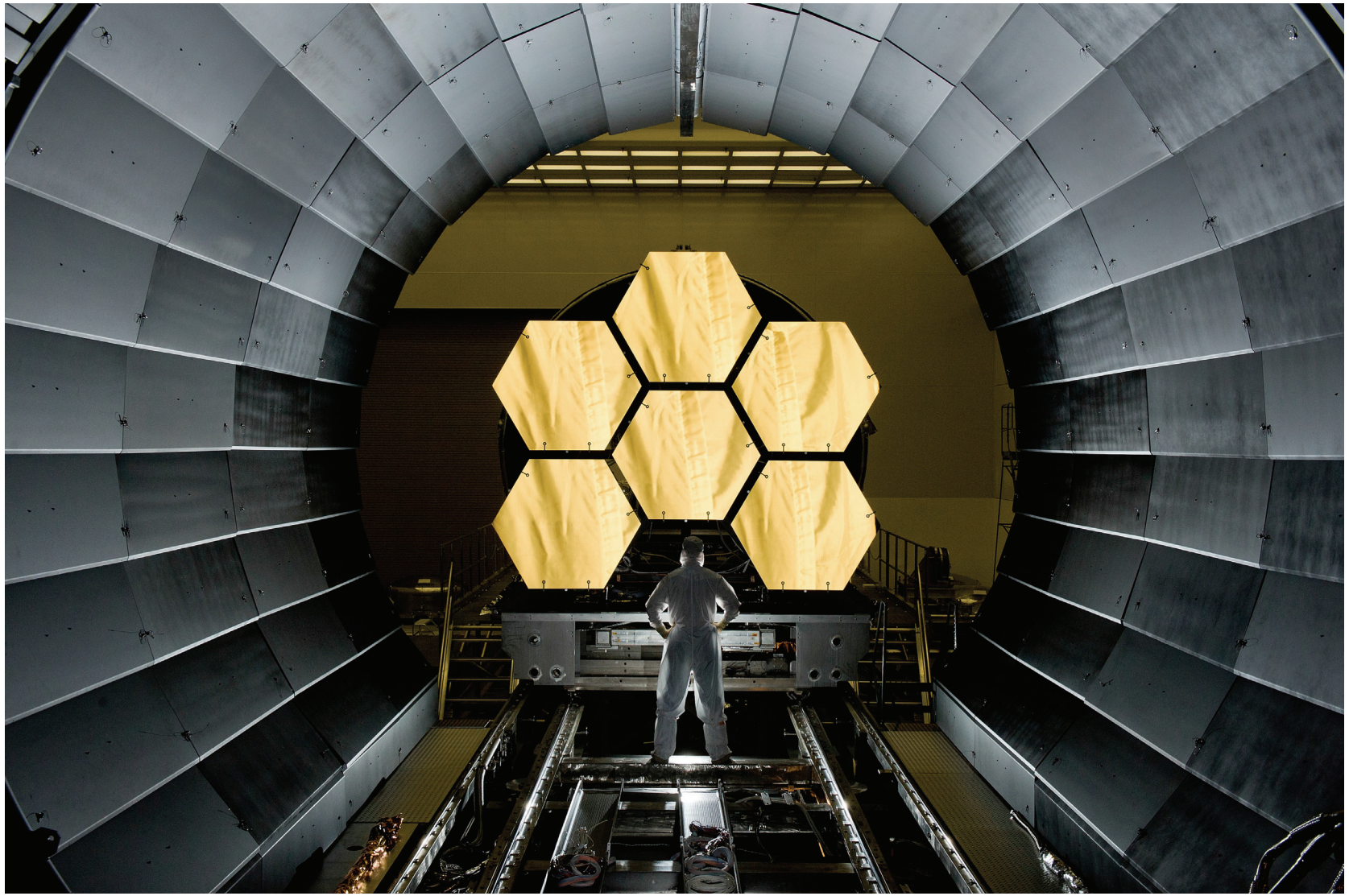


Poređenje osetljivosti Veba i ostalih opservatorija

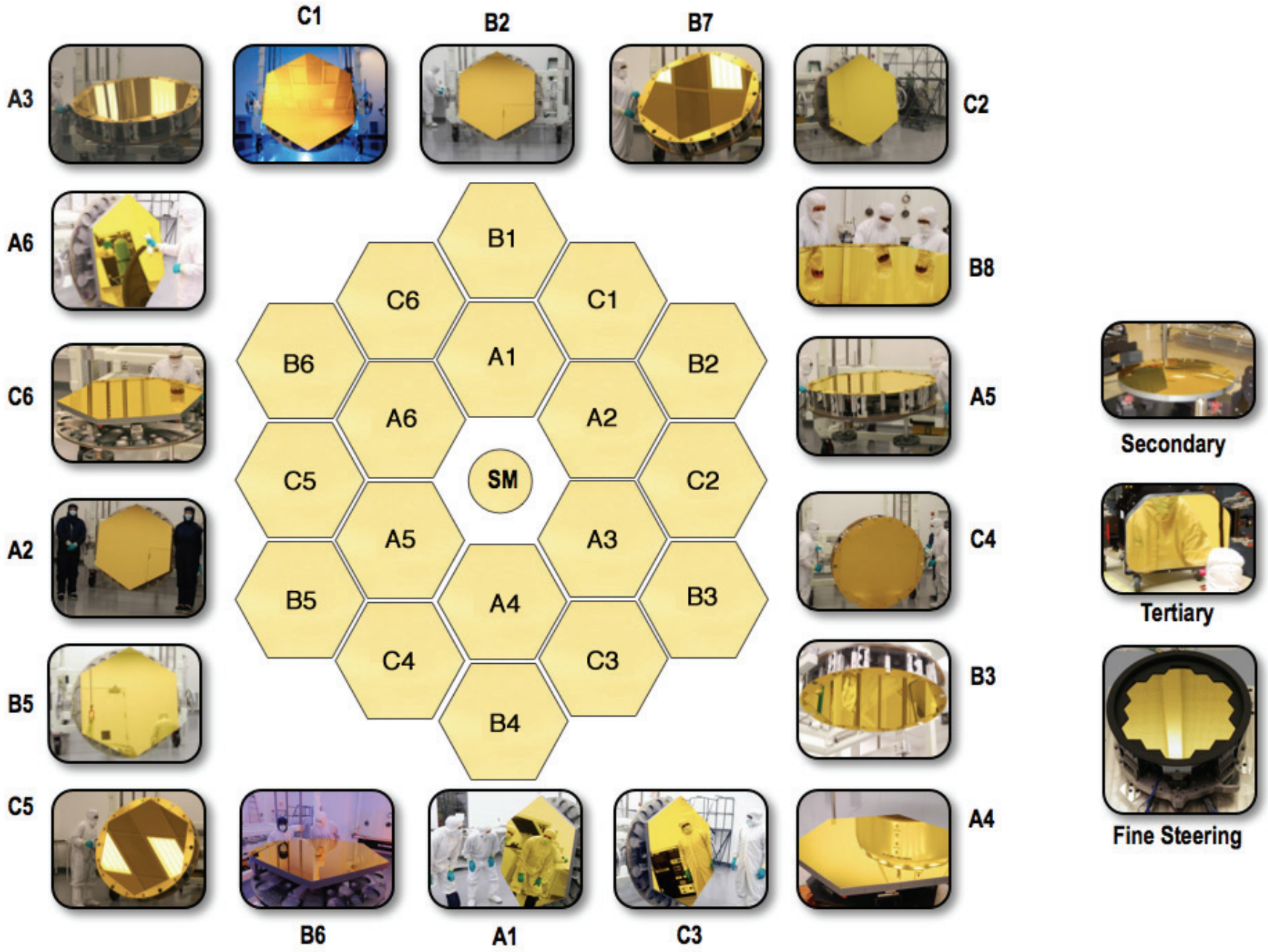




Prvih 6 segmenata spremno za kriogeni test, 2011. god.



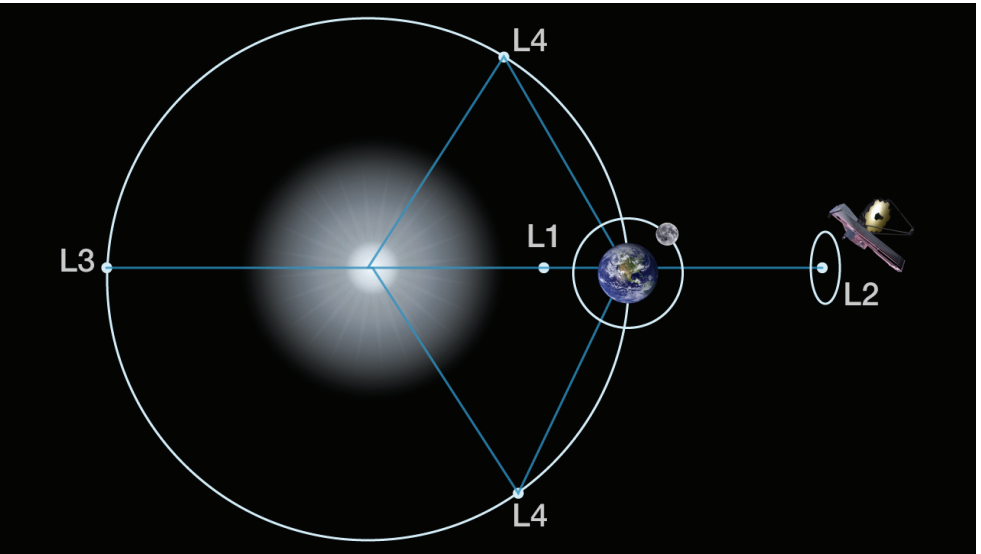
Sklopljeno primarno ogledalo, 2017. god


C1
B2
B7
A3
C2
A6
B8
C6
A5
A2
C4
B5
B3
C5
A4
B6
A1
C3
B1
C6
C1
B6
A1
B2
A6
A2
C5
SM
C2
A5
A3
B5
A4
B3
C4
C3
B4
Secondary
Tertiary
Fine Steering

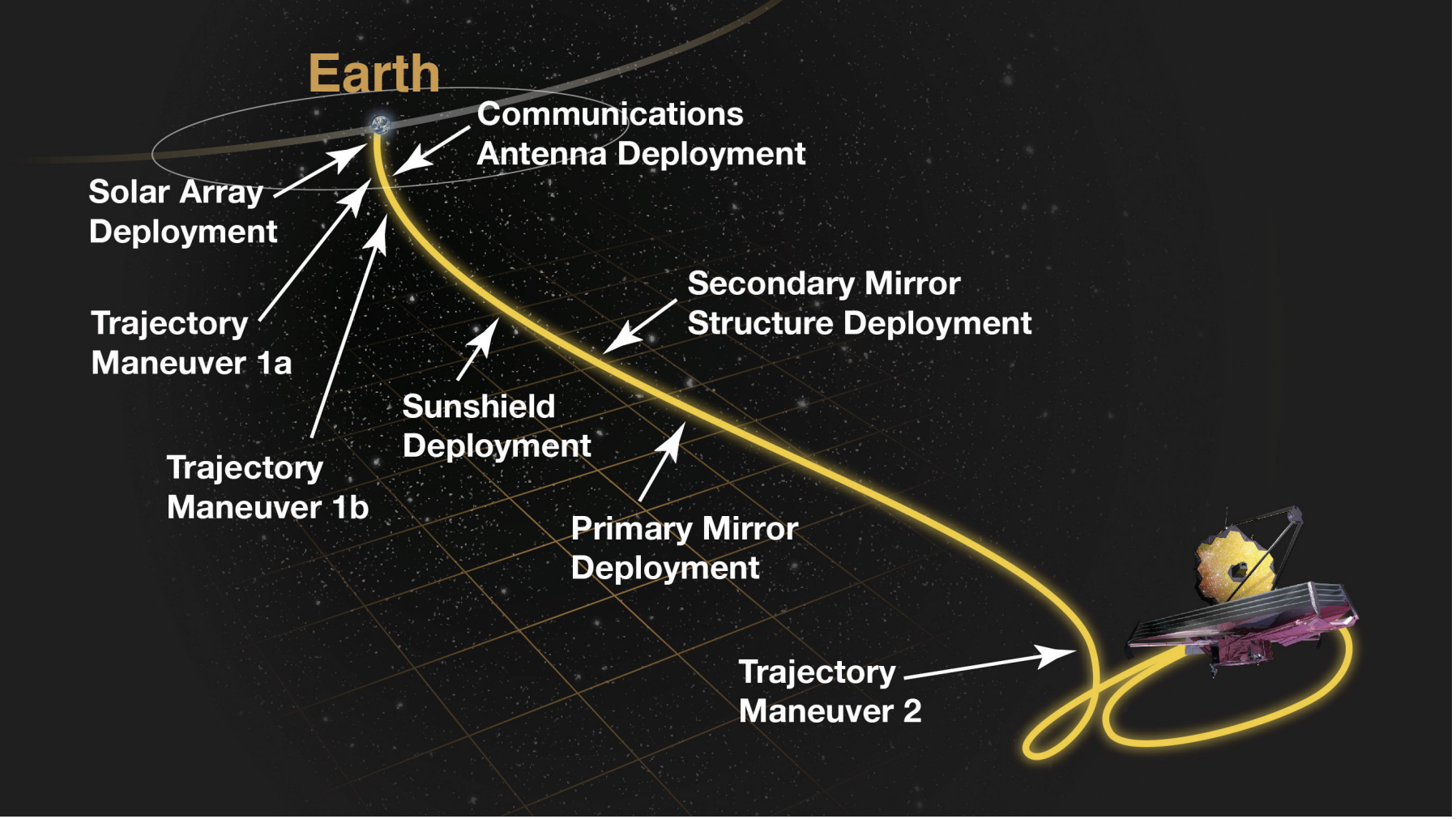
Vebov “suncobran”, 2014. god

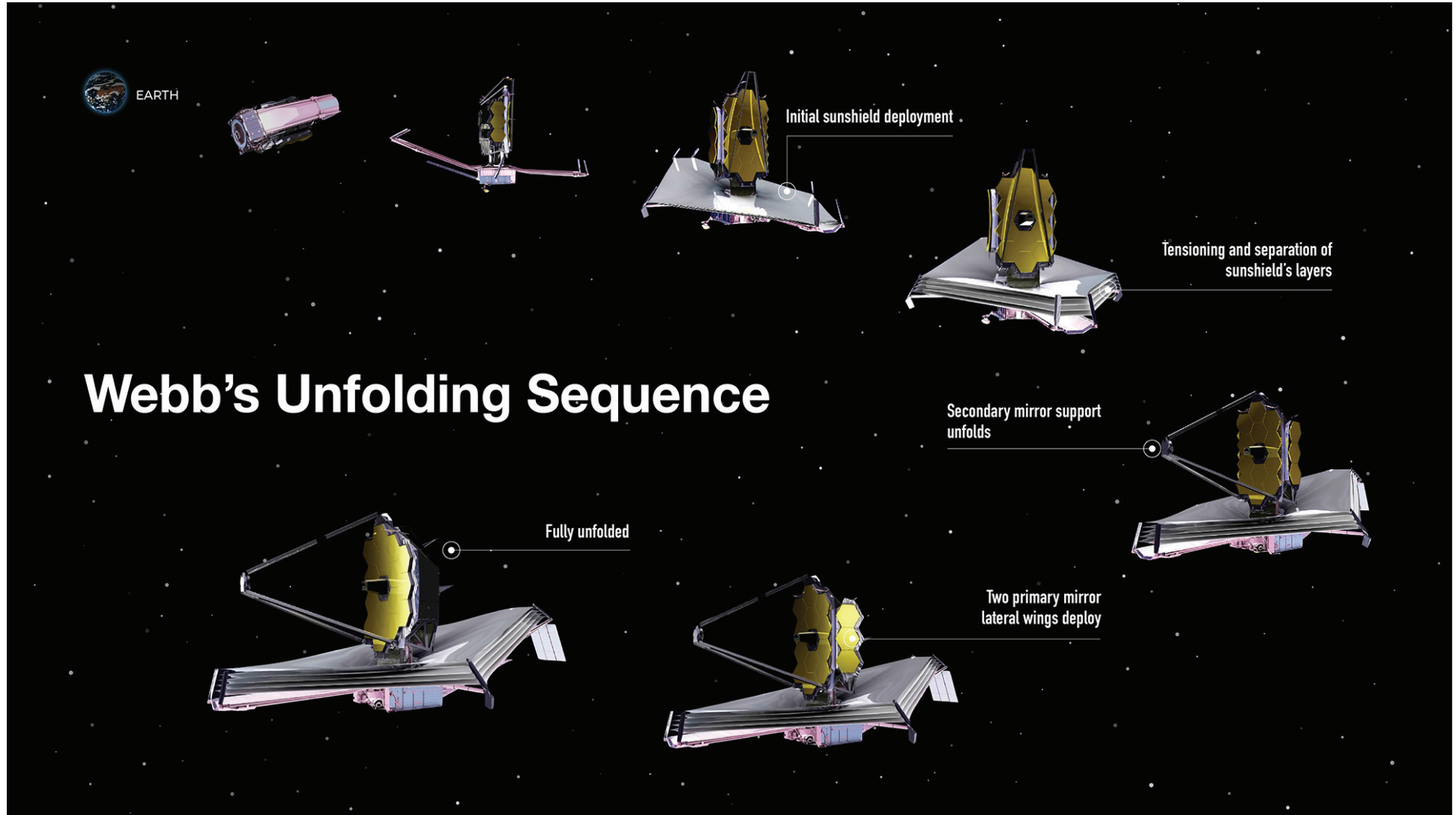
Lansiranje

- 25.12.2021. god. iz Francuske Gvajane sa Ariane 5 ESA raketom



Video na lansiranje

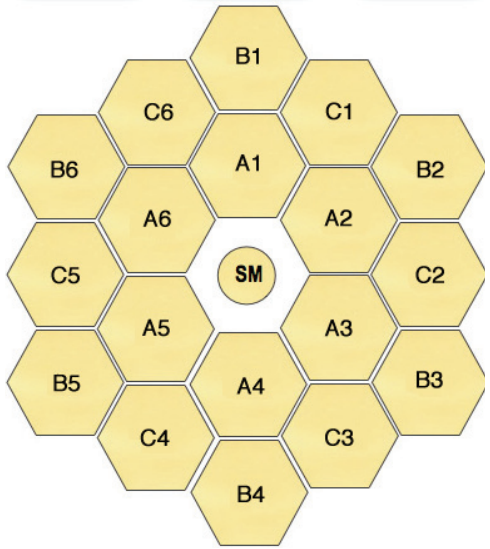

Earth
Communications
Antenna Deployment
Solar Array
Deployment
Trajectory
Maneuver 1a
Trajectory
Maneuver 1b
Sunshield
Deployment
Secondary Mirror
Structure Deployment
Primary Mirror
Deployment
Trajectory
Maneuver 2

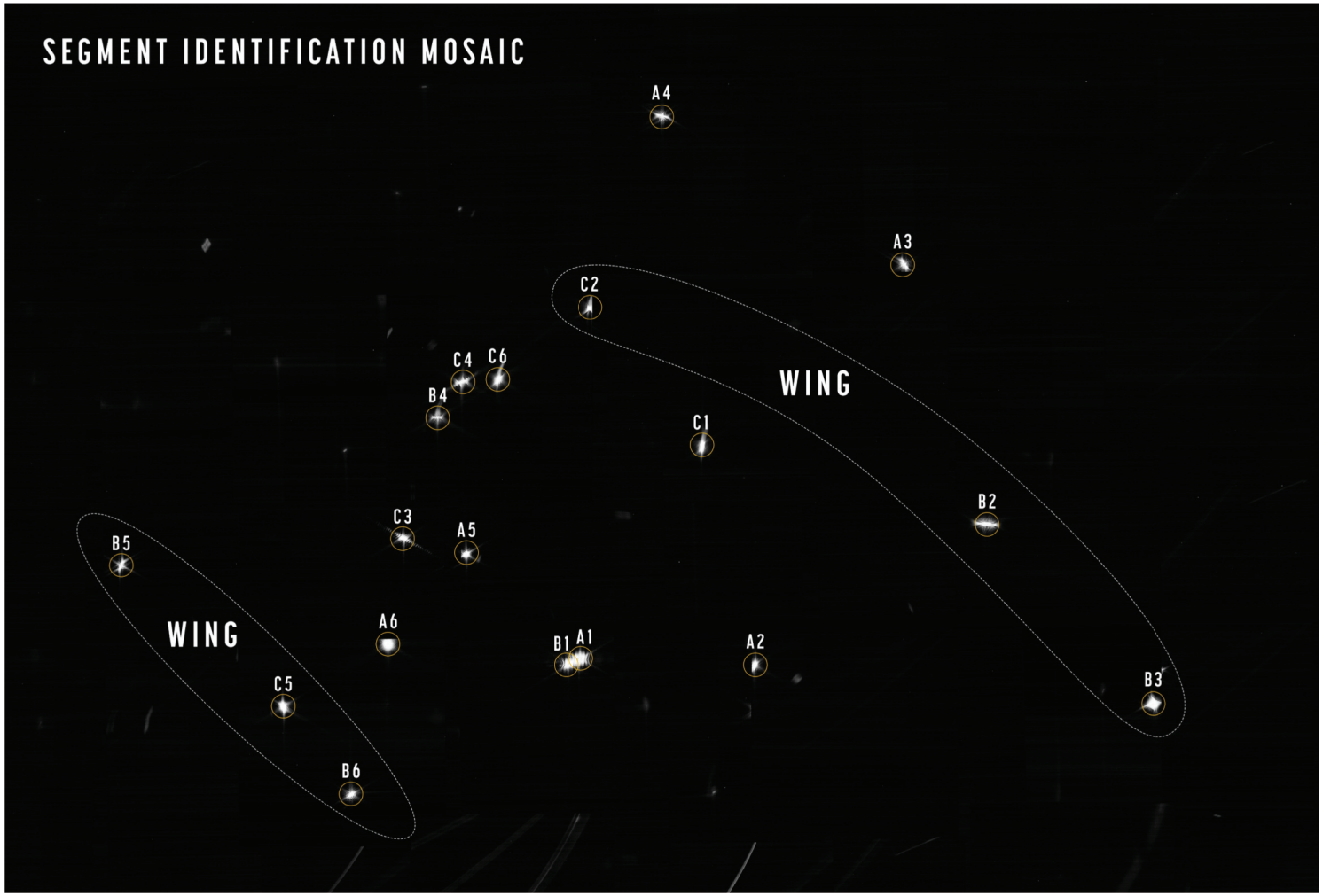

EARTH
Initial sunshield deployment
Tensioning and separation of sunshield's layers
Webb's Unfolding Sequence
Secondary mirror support unfolds
Fully unfolded
Two primary mirror lateral wings deploy

Komunikacija - NASA Deep Space Network

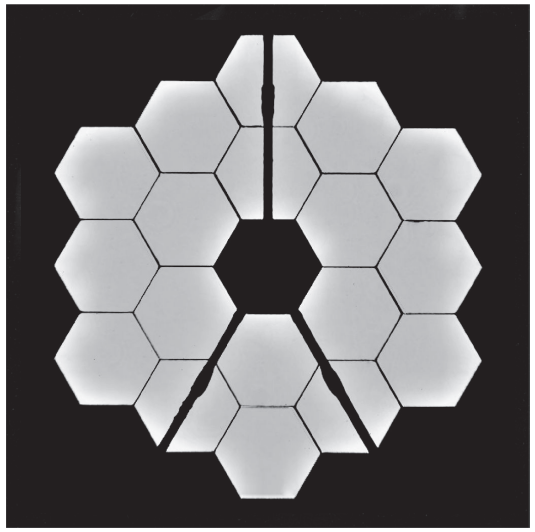
- Nastala 1958. godine
- Komunikacija na 2 – 30 GHz

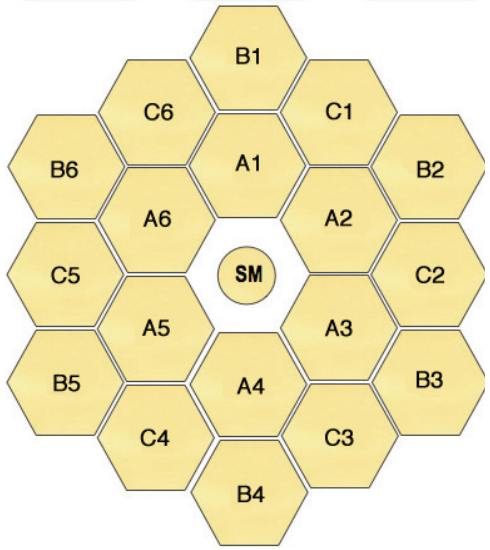
Prve slike 2. - 11. februar

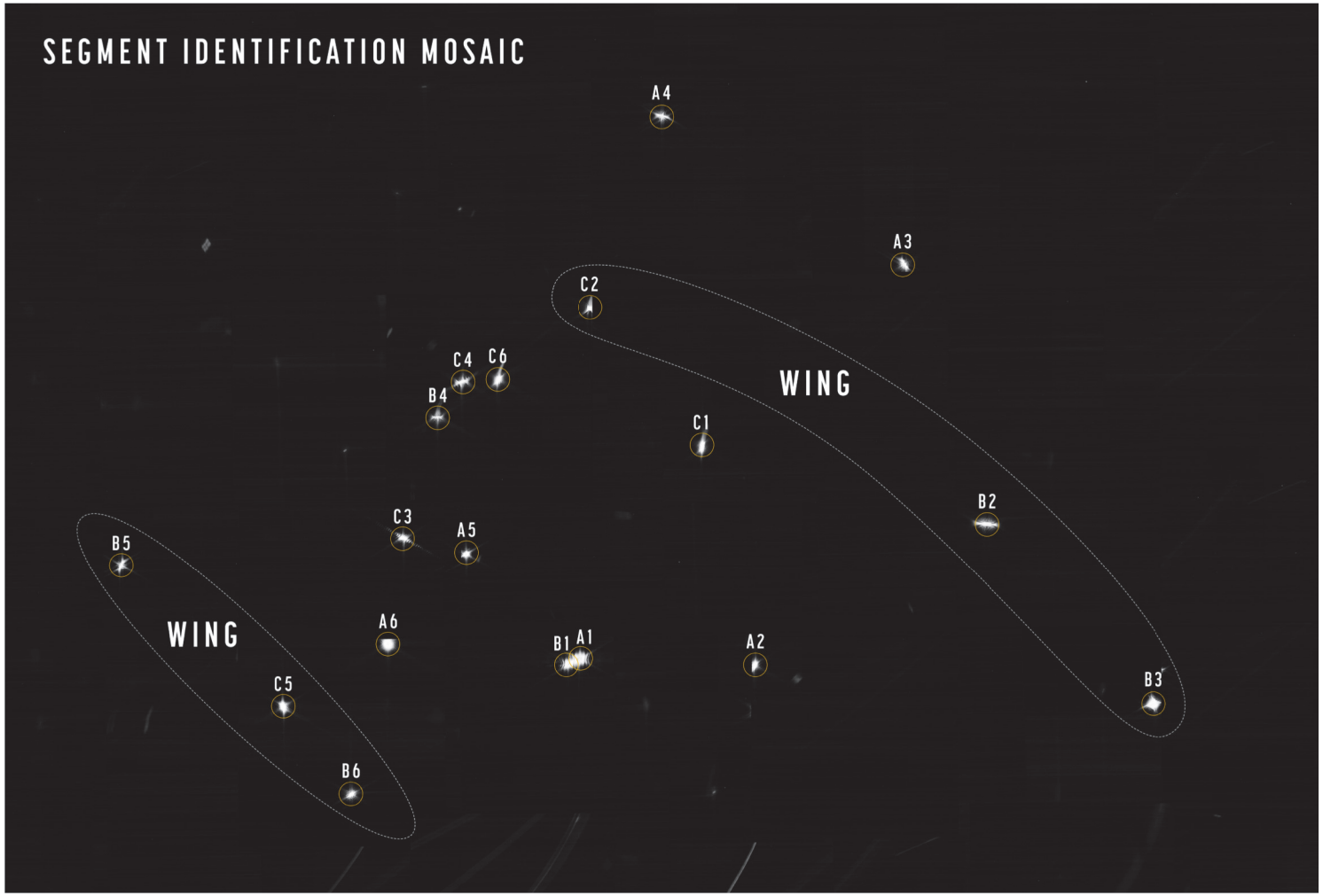




Prve slike 2. - 11. februar



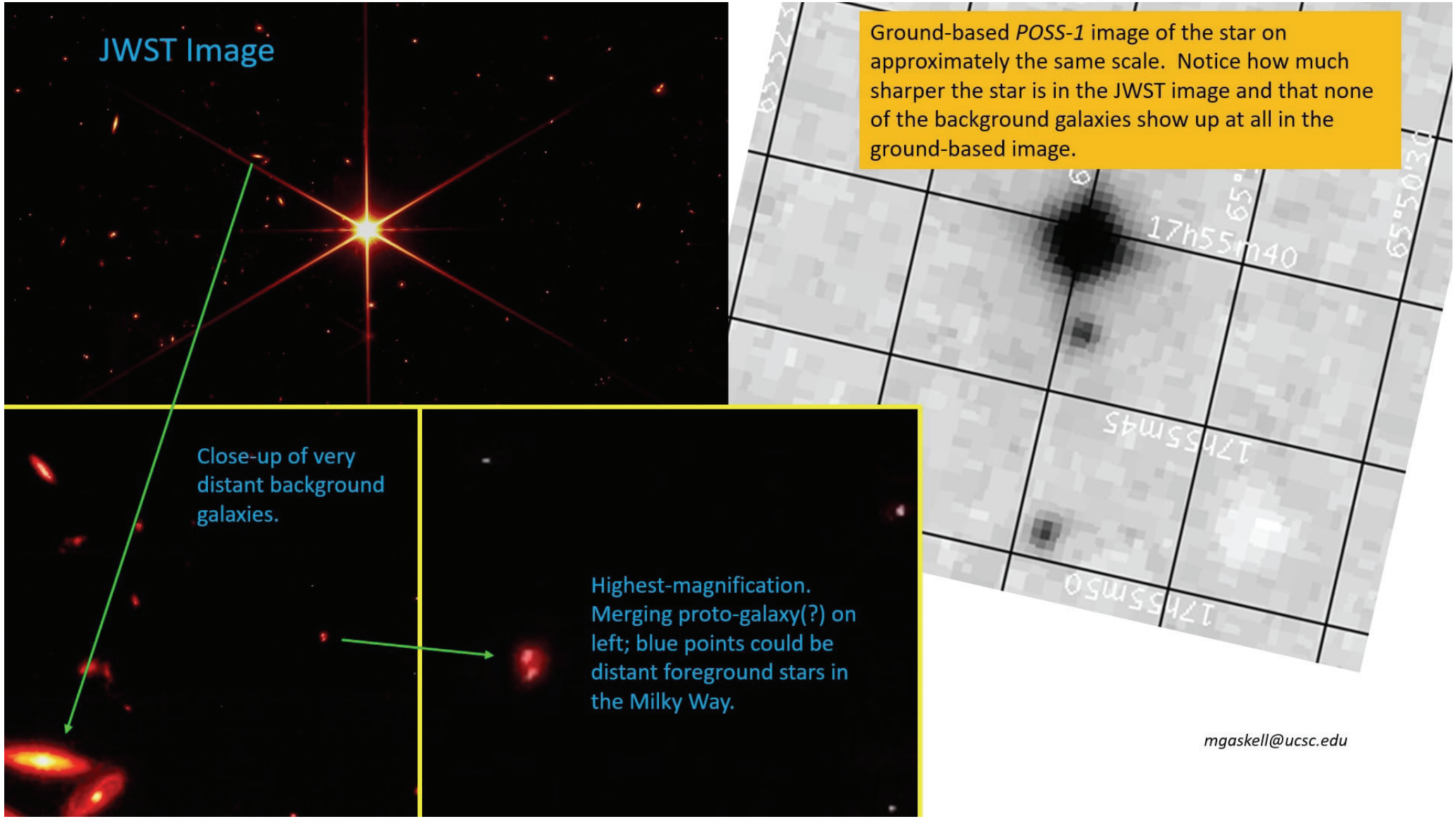




Uspešno fokusirana ogledala 16. marta!

video

Uspešno fokusirana ogledala 16. marta!



Instrumenti: fotometrija, spektroskopija, koronografija

Near Infrared Camera (NIRCam)

- Kamera osetljiva na vidljivo i blisko IC (0.6 – 5 mikrona)
- 2.2’ x 4.4’ vidno polje, 0.1”/pixel (difrakcioni limit)
  - Koronograf

Near Infrared Spectrograph (NIRSpec)

- Multi-object spectrograph (first in space)
- 1 – 5 mikrona
- 3.4’ x 3.4’ vidno polje, 0.1”/pixel
- R = 1000 i 2700 dif.rešetka; R = 100 prizma
- 3” x 3” *IFU*

Mid Infrared Instrument (MIRI)

- Kamera i spektrograf osetljivi na srednje IC zračenje (5 – 28 mikrona)
- 1.9’ x 1.4’ vidno polje, 0.11”/pixel
- R = 100 *slit* spektrograf (5 – 10 mikrona) i *IFU* (R = 3000)
- Koronograf

Near Infrared Imager and Slitless Spectrograph (NIRISS)

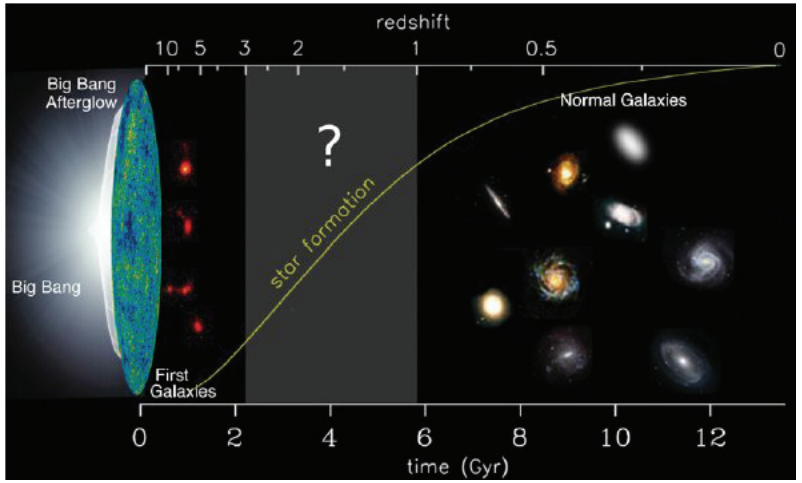
- Kamera i spektrograf bez proreza
- 2.2’ x 2.2’ vidno polje

Fine Guidance Sensor (FGS)

- 2.4’ x 2.4’ kamera za “gidiranje”
- Brzo očitavanje
- 95% verovatnoća za pronalaženje ”*guide star*” bilo gde na nebu

Naučni ciljevi JWST

Planetary Systems and the Origins of Life,
Birth of Stars and Protoplanetary Systems,
Assembly of Galaxies, and First Light and Reionization
(From 2000 Decadal Survey)



- Detekcija prvih formiranih zvezda i galaksija
- Proučavanje nastanka i evolucije galaksija
- Bolje razumevanje nastanka zvezda i planeta
- Proučavanja planetarnih sistema i potraga za “ poreklom života”

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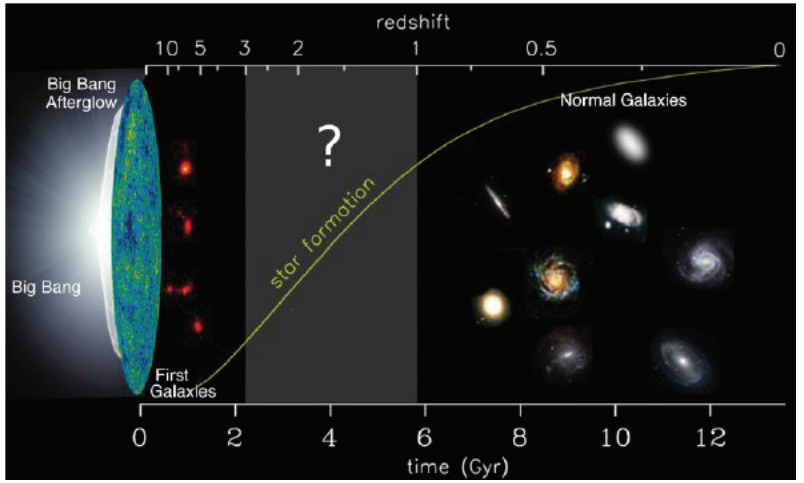

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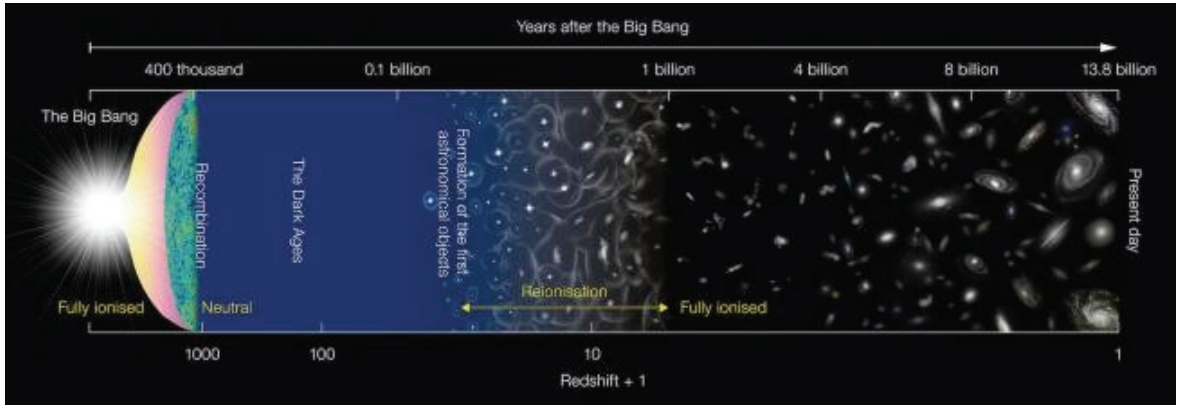
Neka od fundamentalnih pitanja čovečanstva:

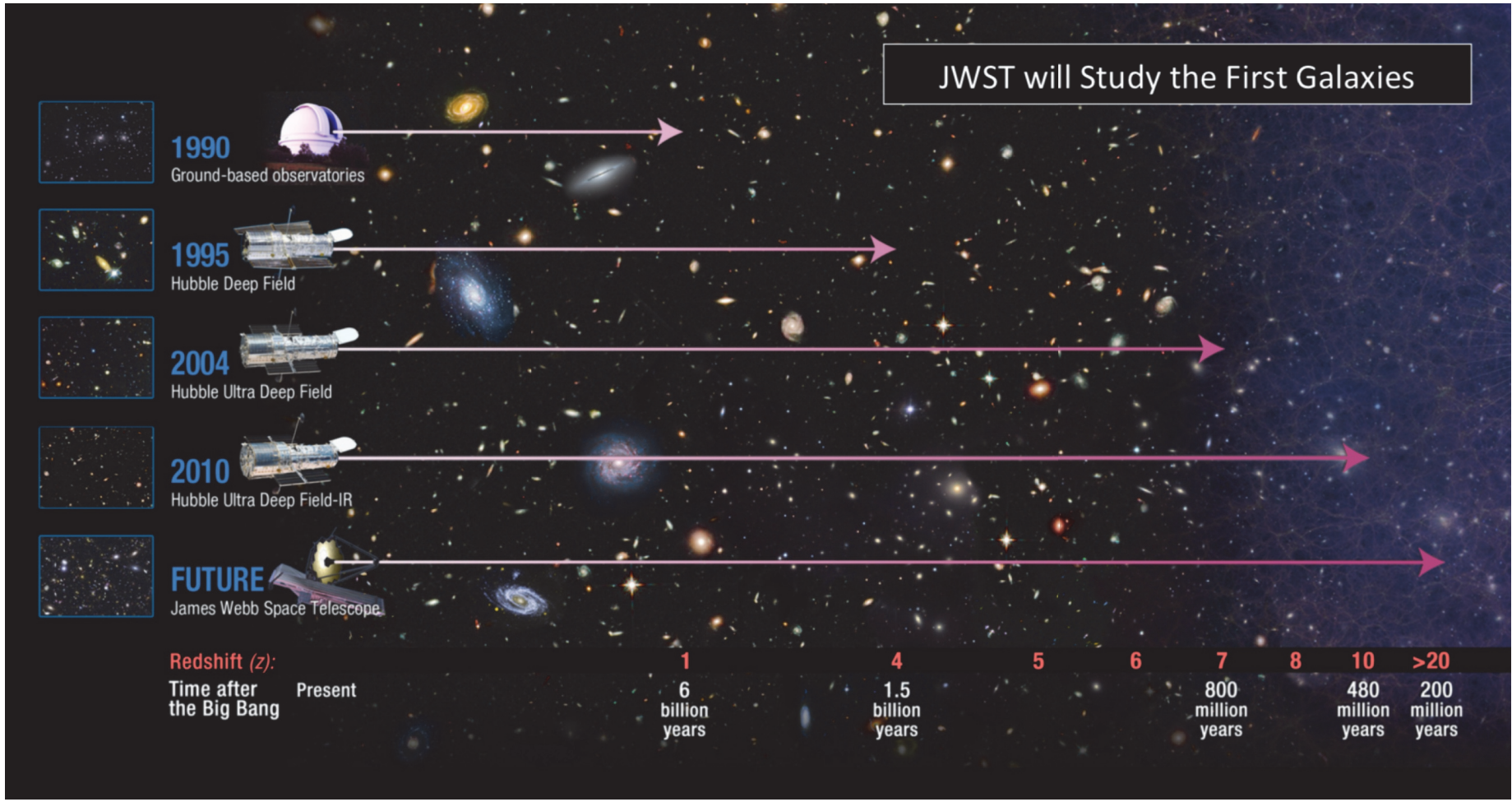
- Kako je nastao Univerzum?
- Da li je Sunčev sistem jedinstven?
- Da li smo sami u Univerzumu?



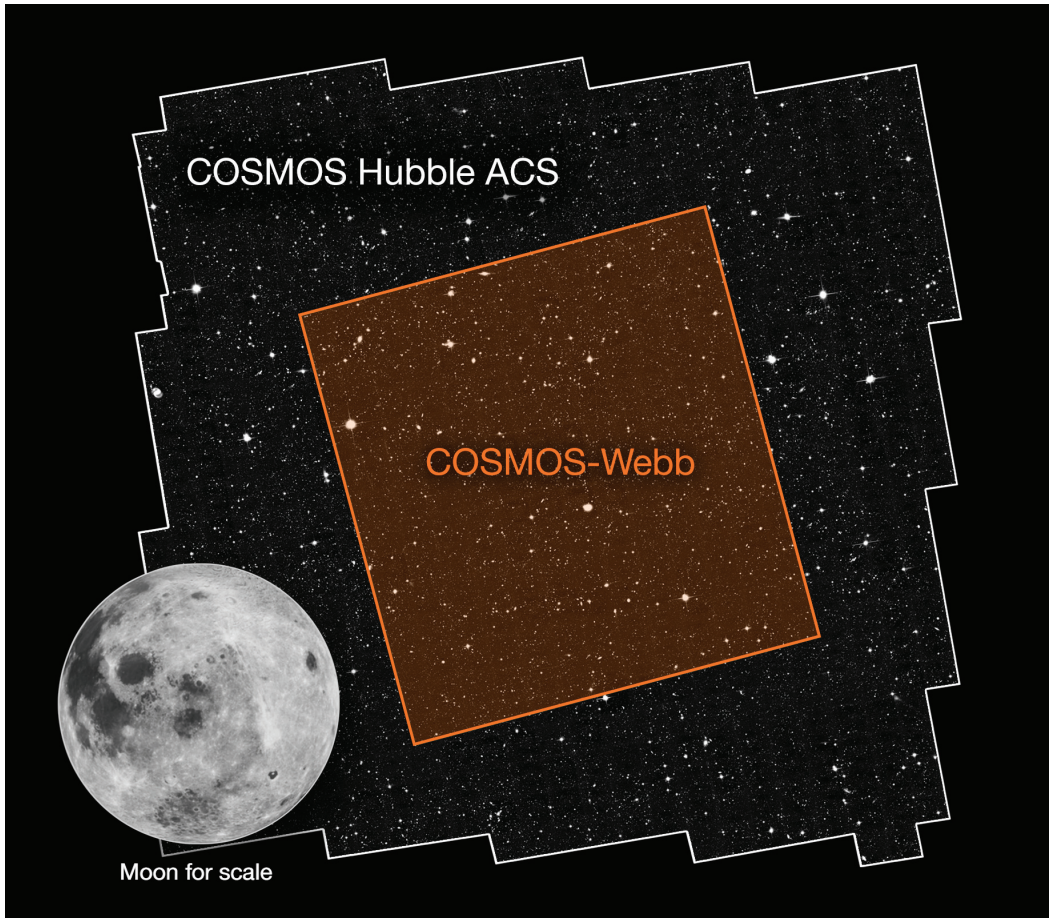
Zašto želimo da posmatramo prve nastale zvezde i galaksije?

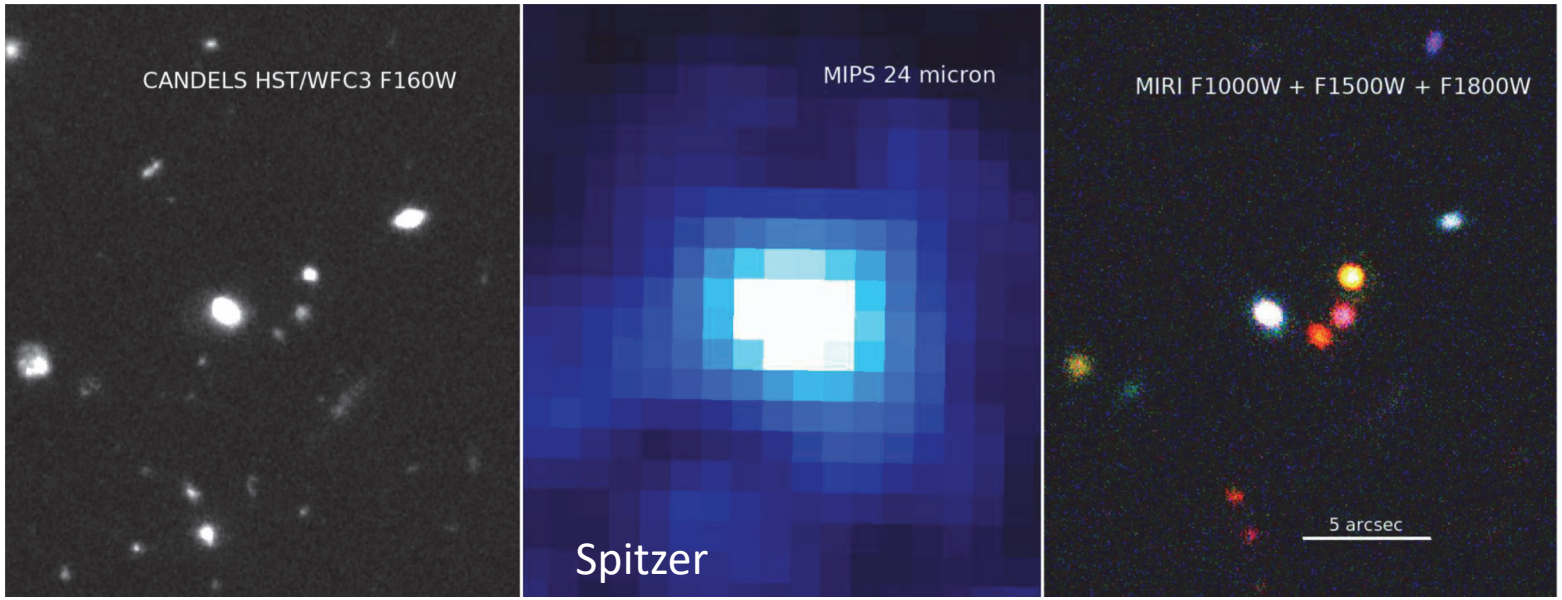
- ***Zato što ih do sad nismo videli!!!***

- Da bismo bolje razumeli rejonizaciju
- Tada je krenulo formiranje crnih rupa koje su centri kasnijih galaksija
- Formiranje prvih metala

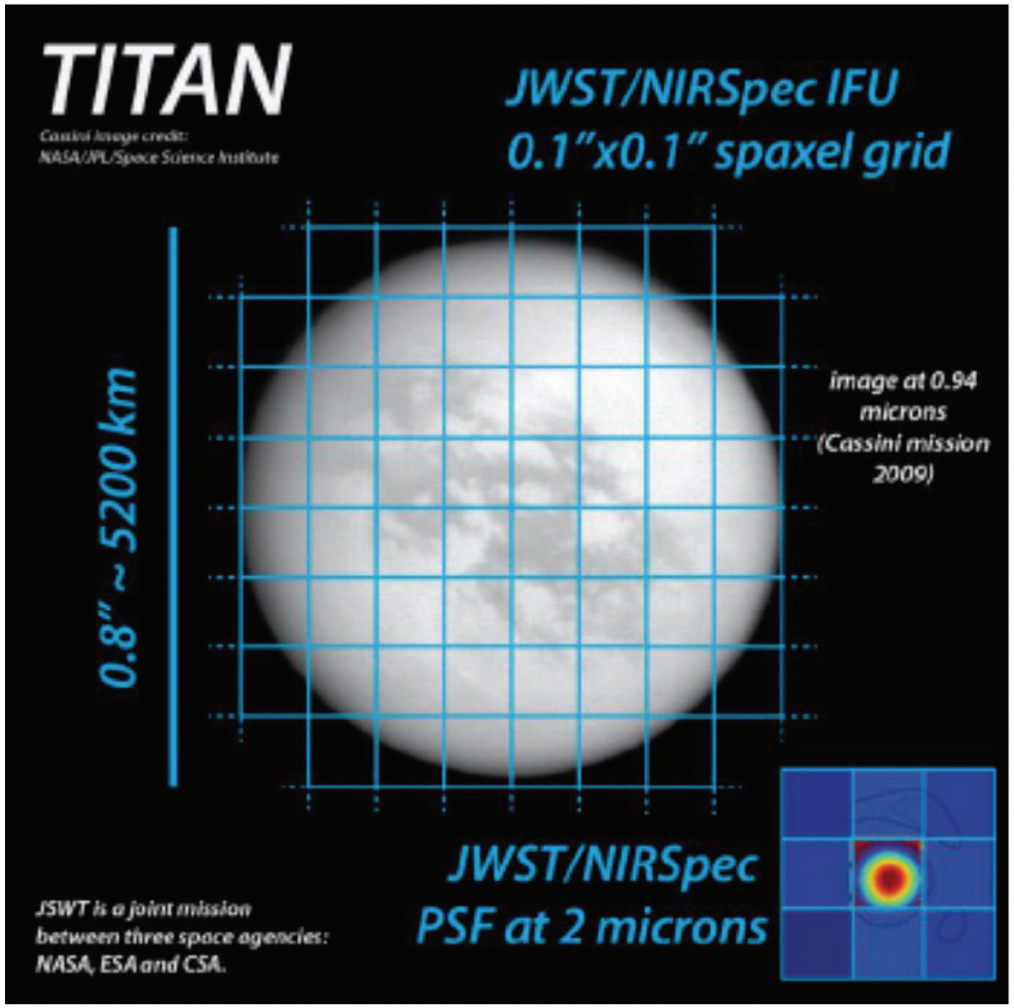


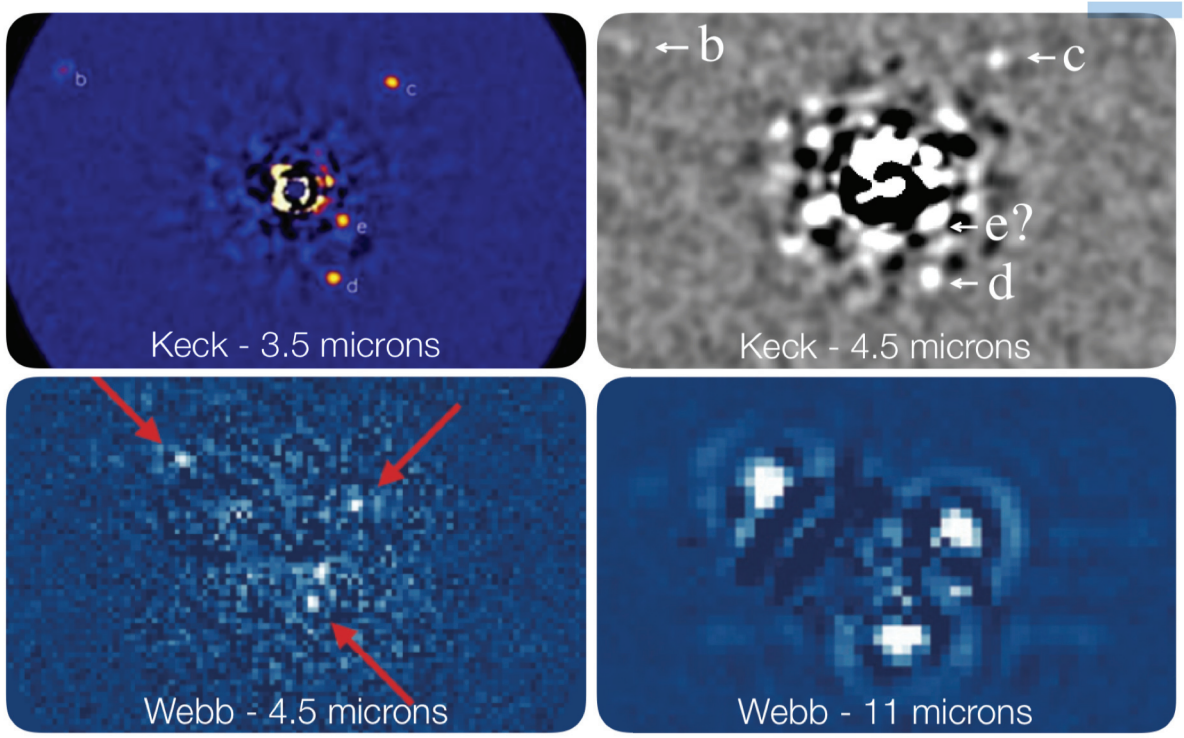
U planu su ”zajednička posmatranja” Habla i Veba




CANDELS HST/WFC3 F160W
MIPS 24 micron
Spitzer
MIRI F1000W + F1500W + F1800W
5 arcsec

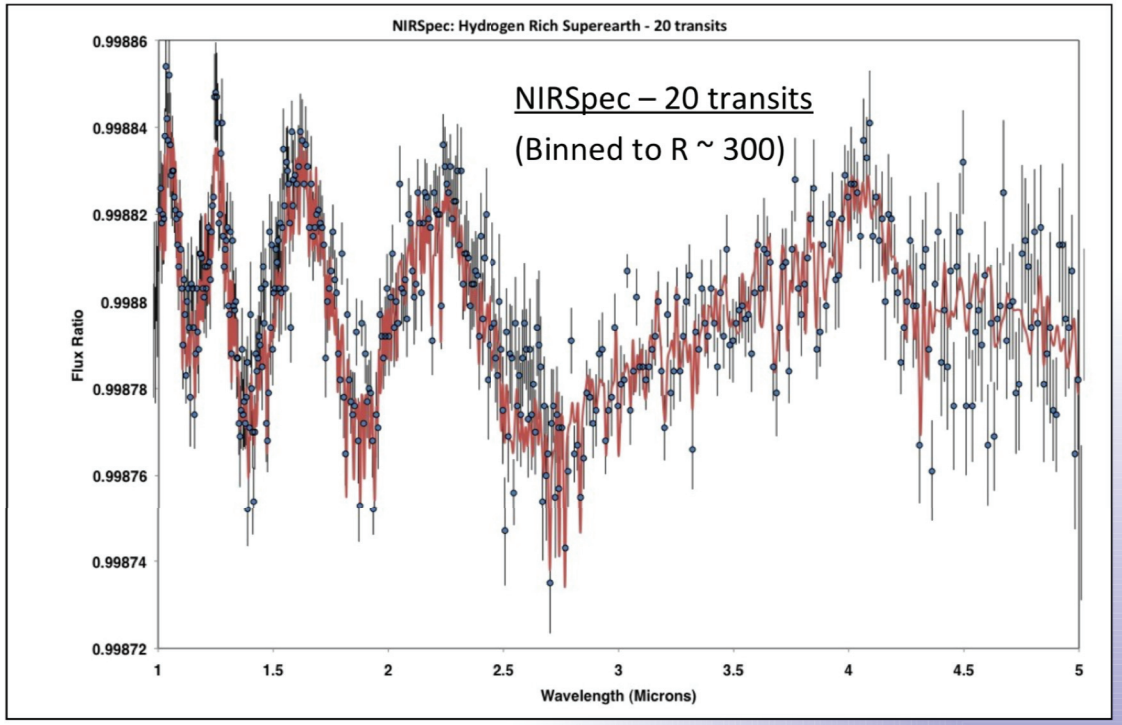
JWST u Sunčevom sistemu, i u drugim planetarnim sistemima



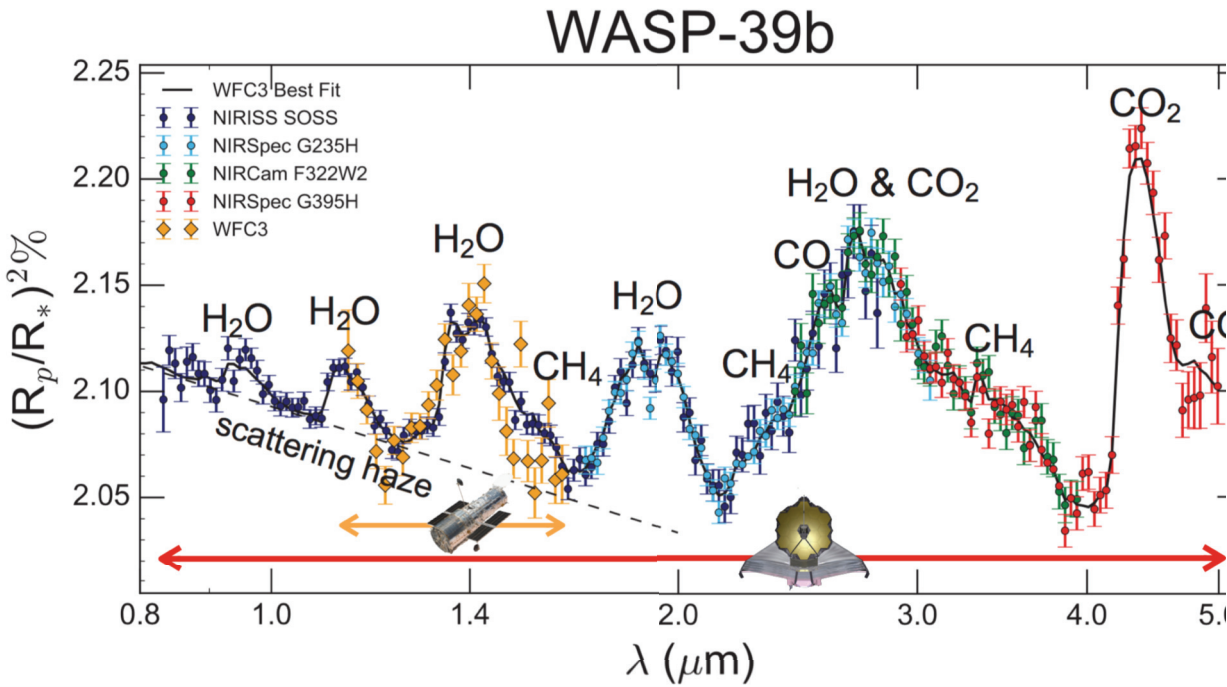


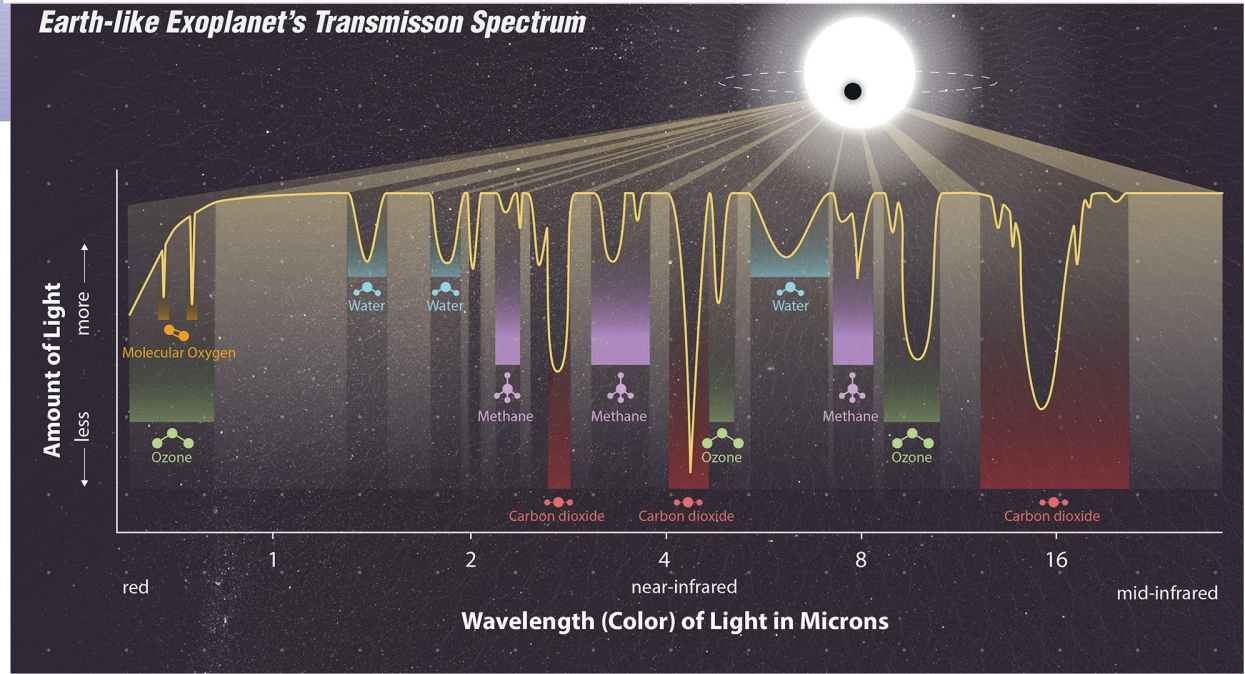
A Simulated JWST/NIRSpec Observation

- Hydrogen-Rich Super Earth (1.4 R_{EARTH}, 5 M_{EARTH})

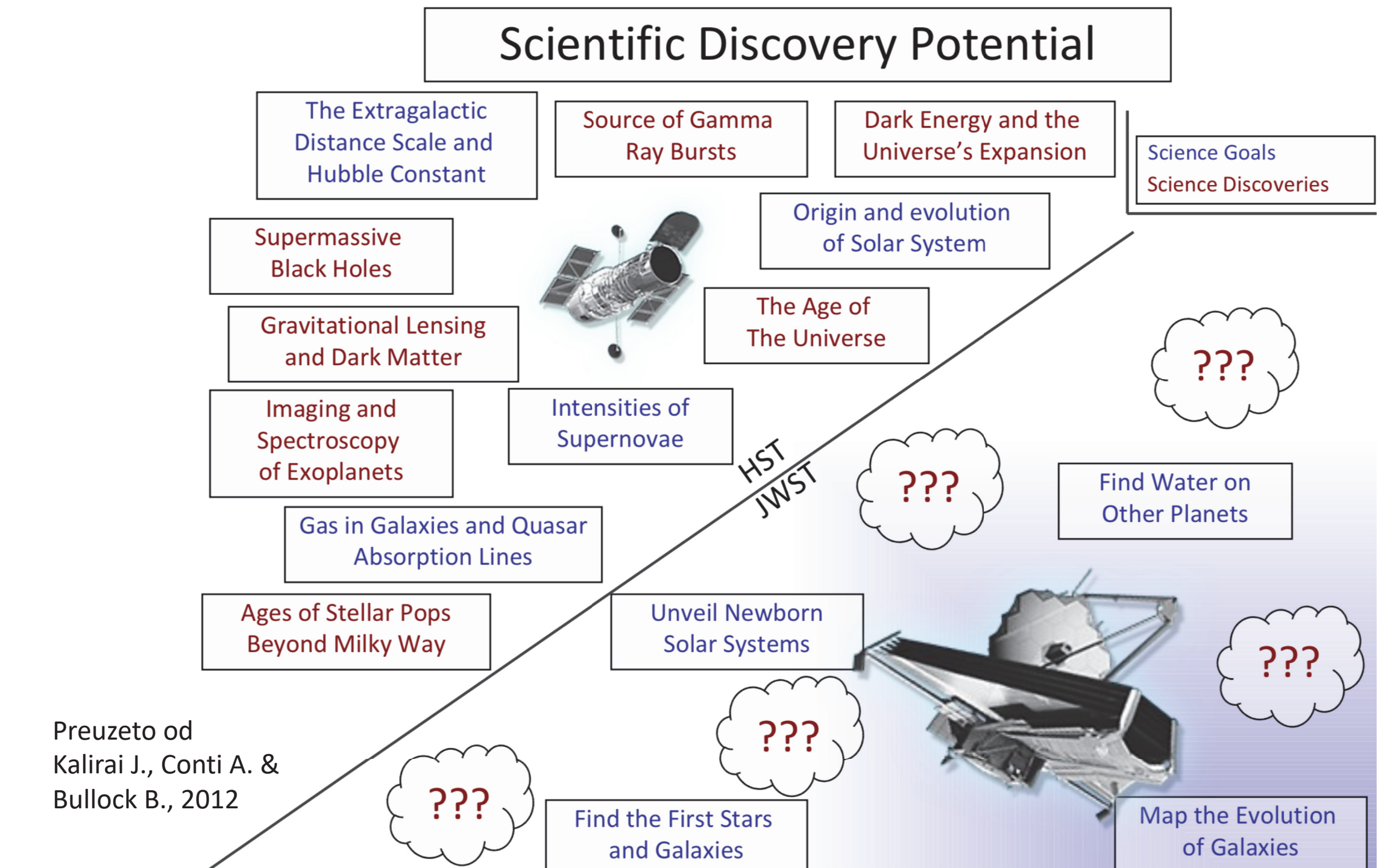


M. Clampin – Model by E. Kempton





Scientific Discovery Potential



Preuzeto od
Kalirai J., Conti A. &
Bullock B., 2012

Kada poredimo JWST, HST i VLT…

- Poredjenje broja referenci na ADSu na ime teleskopa u naslovu ili apstraktu
  - JWST: 6000 (ukupno 51000, a najviše 1600 citata na jednom radu)
  - HST: 43000 (ukupno 809000, a najviše 6400 citata na jednom radu)
  - VLT: 15000 (ukupno 297000, a najviše 2100 citata na jednom radu)

- Cena
  - JWST: 10 milijardi $ (uključujući 10 godina rada teleskopa)
  - HST: 1.5 milijardi $ (1990.), oko 20 milijadi $ (2020.)
  - VLT: izgradnja 0.36 milijardi $ (1999)
  - LSST: 0.7 milijardi $ za sad + 0.7 milijardi $ godišnje za rad
  - ELT 1.5 milijardi $

HVALA NA PAŽNJI!