JWST Revolution

Nao Suzuki (Kavli IPMU)

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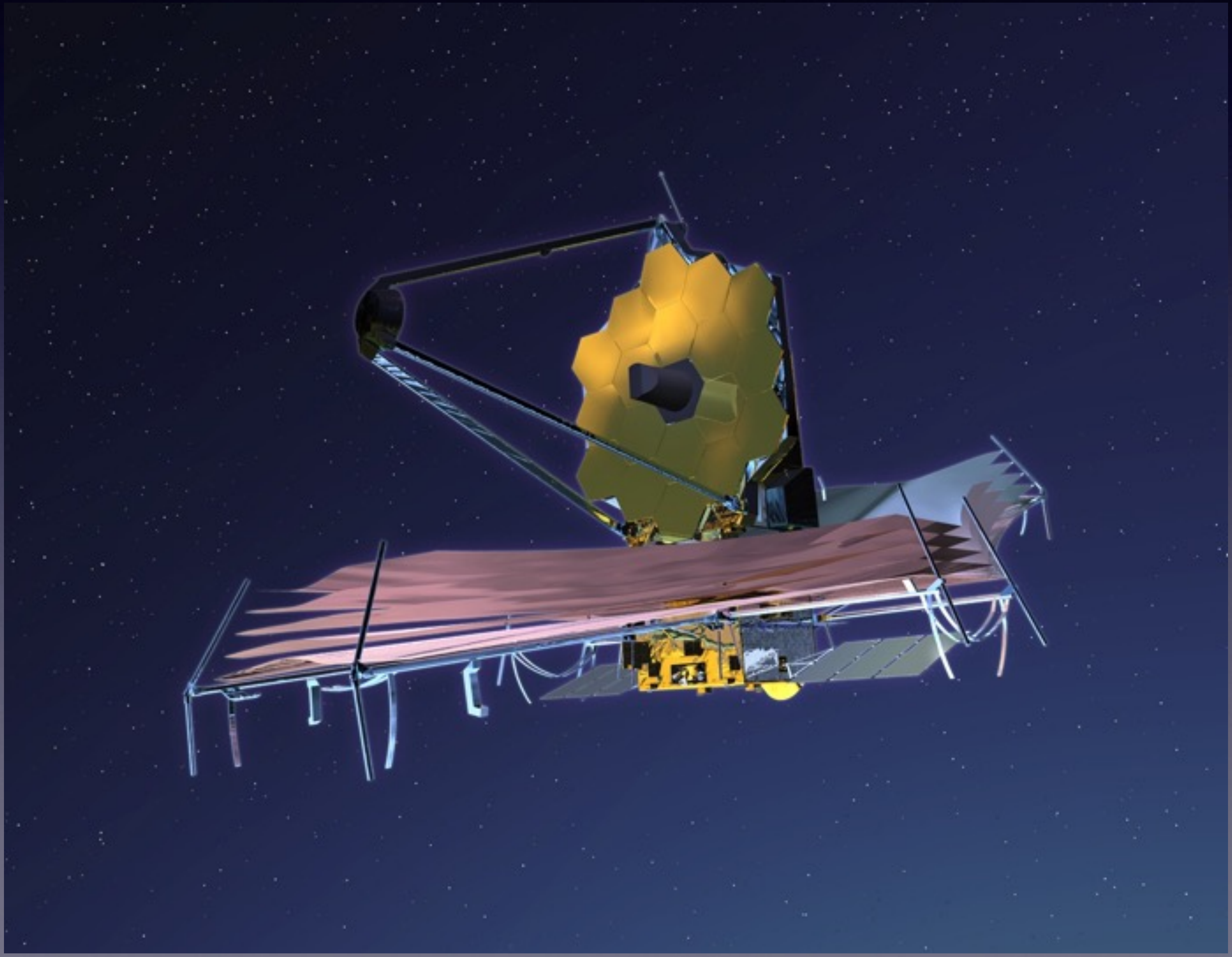
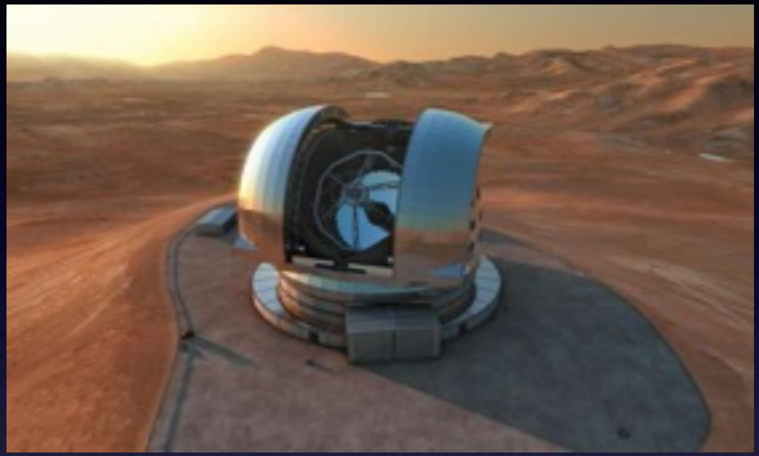
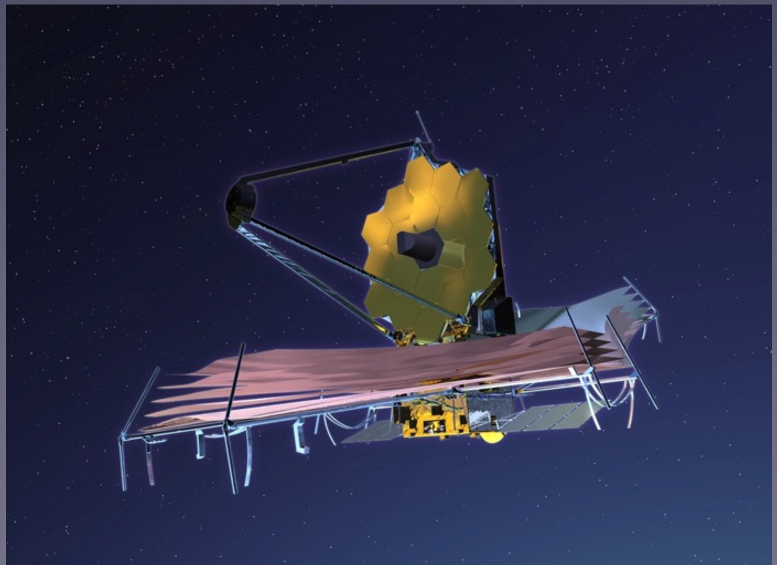
- https://confluence.stsci.edu/display/STUCP/
- https://jwst-docs.stsci.edu/display/JSP/

§1 A Brief Introduction to JWST
JWST 6.5m IR Space Telescope
2018 Oct - 2023 (2028)



Topics at 銀河進化研究会 2020



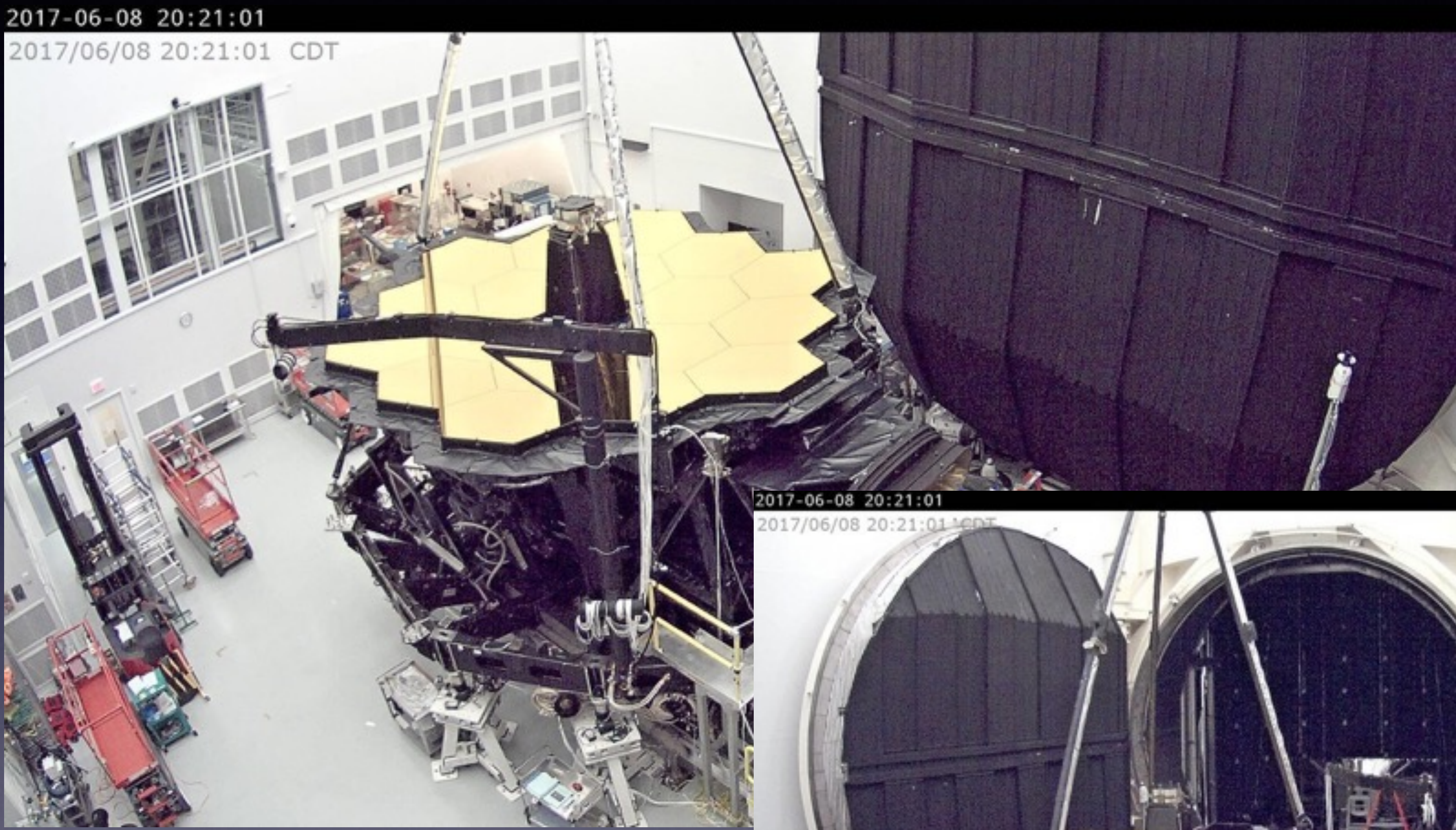


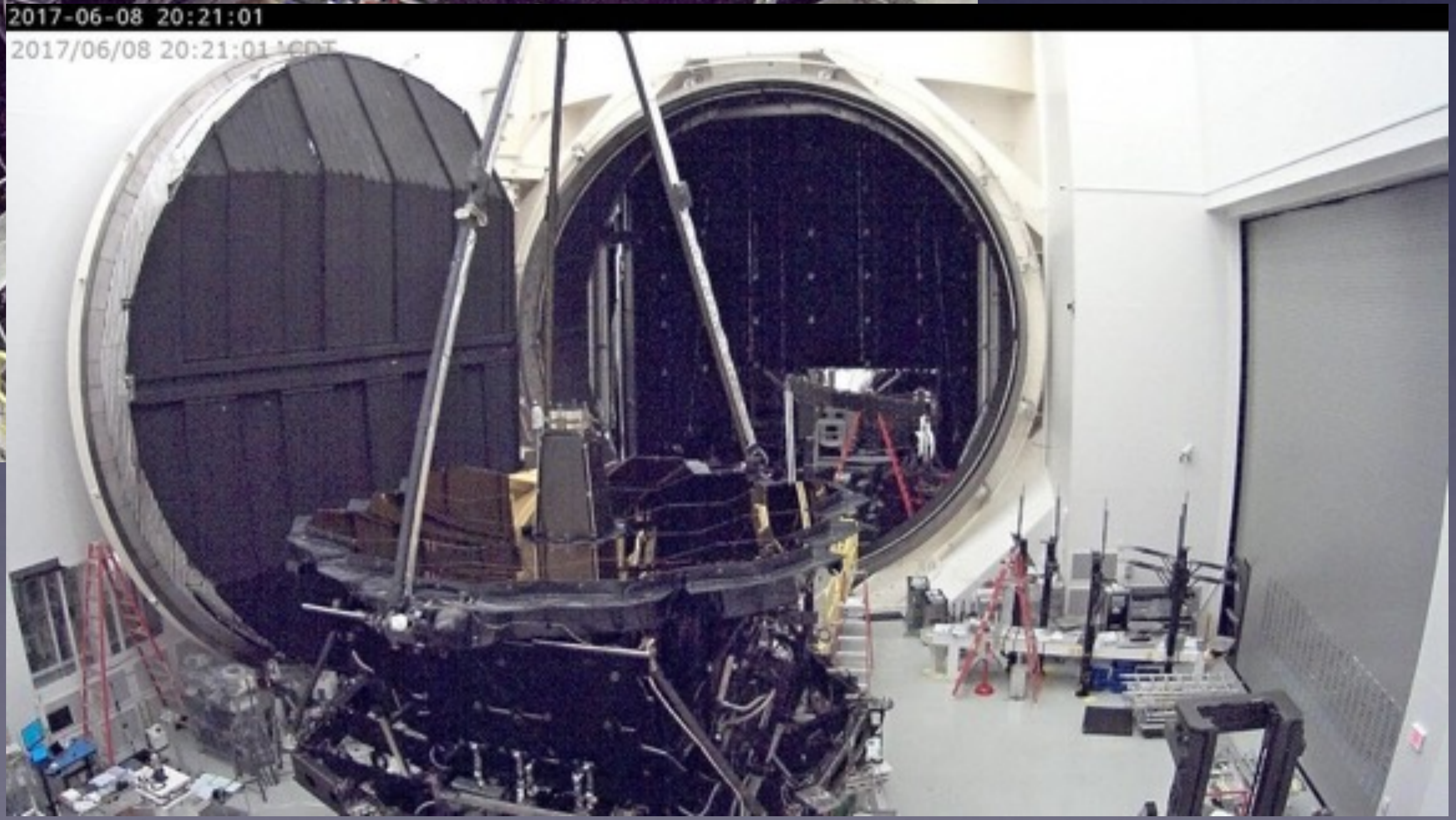
- JWST finds z>10 galaxies
- LSST online
- E-ELT 2024
- PFS Survey starts
- SPICA? WISH-X…

JWST :

Goddard Space Center => Johnson Space Center

JWST Today

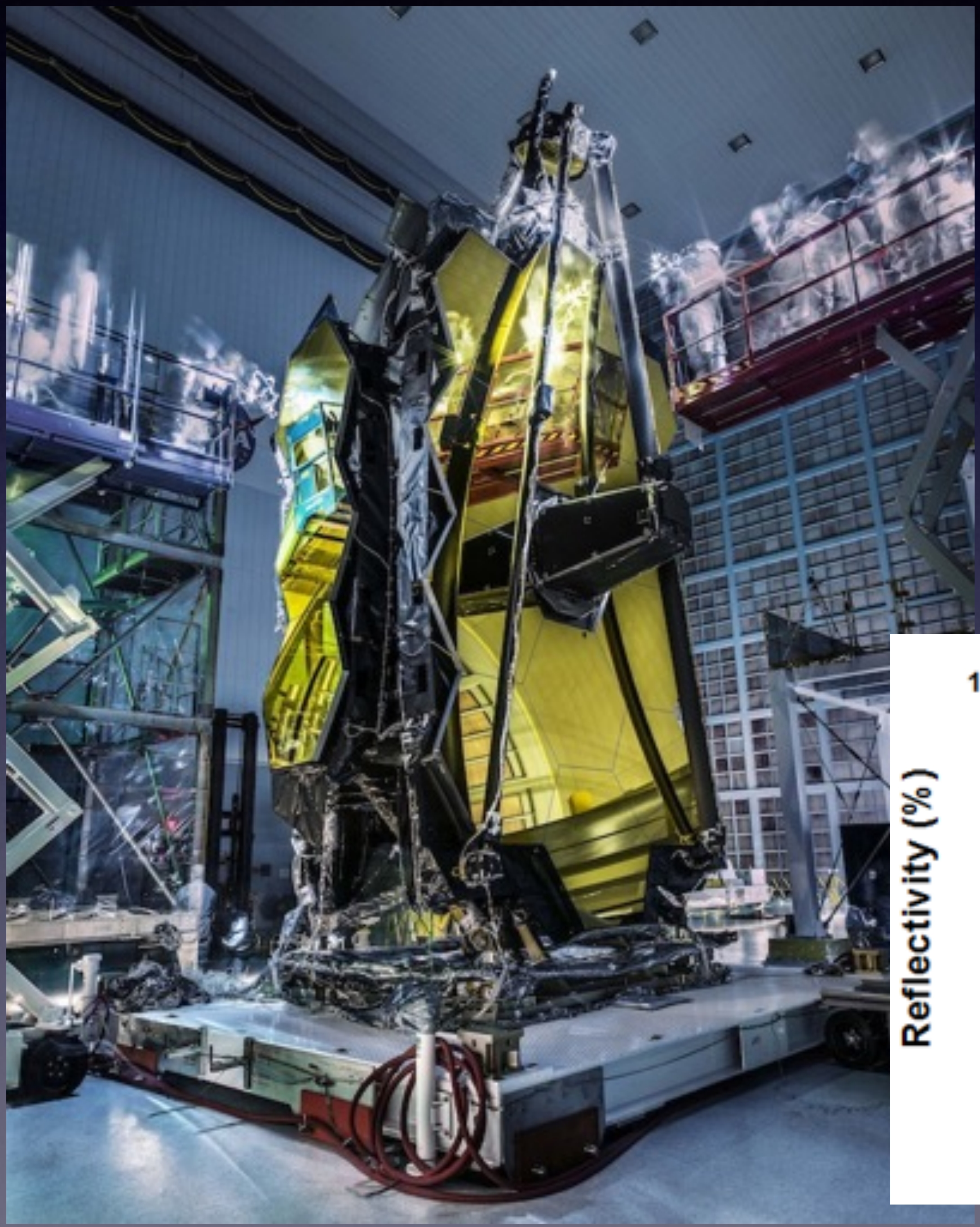


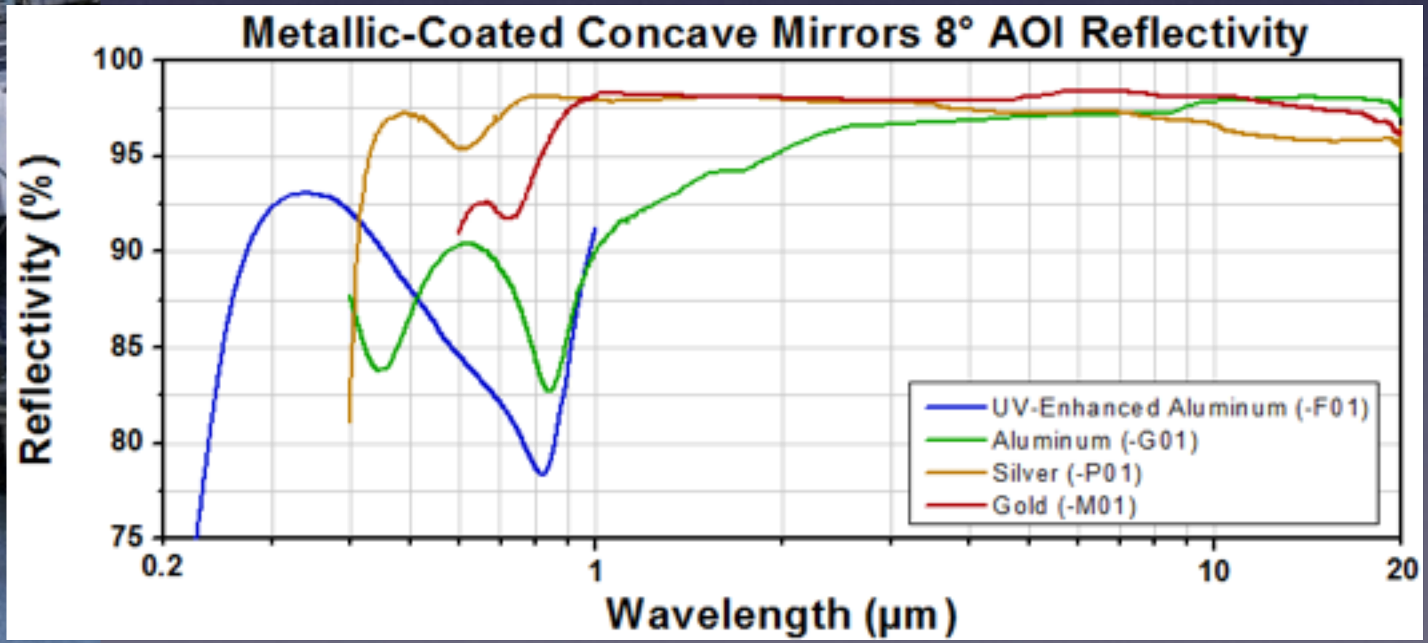


JWST (James Webb Space Telescope)

- 1989-1994 : Concept Studies (note HST launch = Apr 1990)
- 1996 : Next Generation Space Telescope
- 1997-1999 : Design Contests => Lockeed Martin was selected
- 2011 : Cancellation Crisis
- 2018 October Launch ($8.835 billion including 5 year-operation)

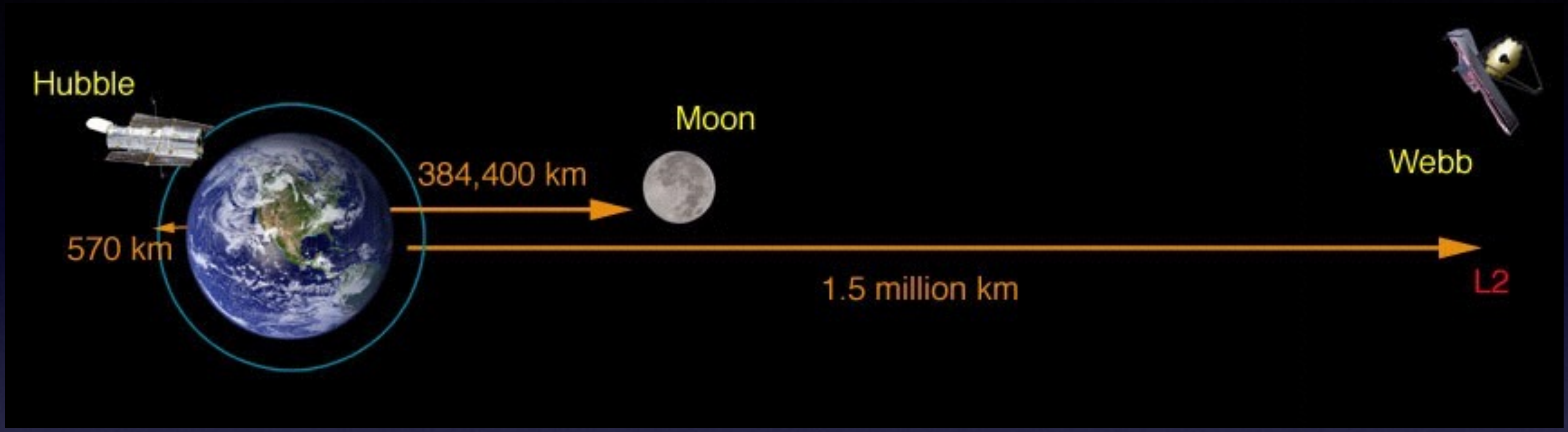
Gold Primary Mirror

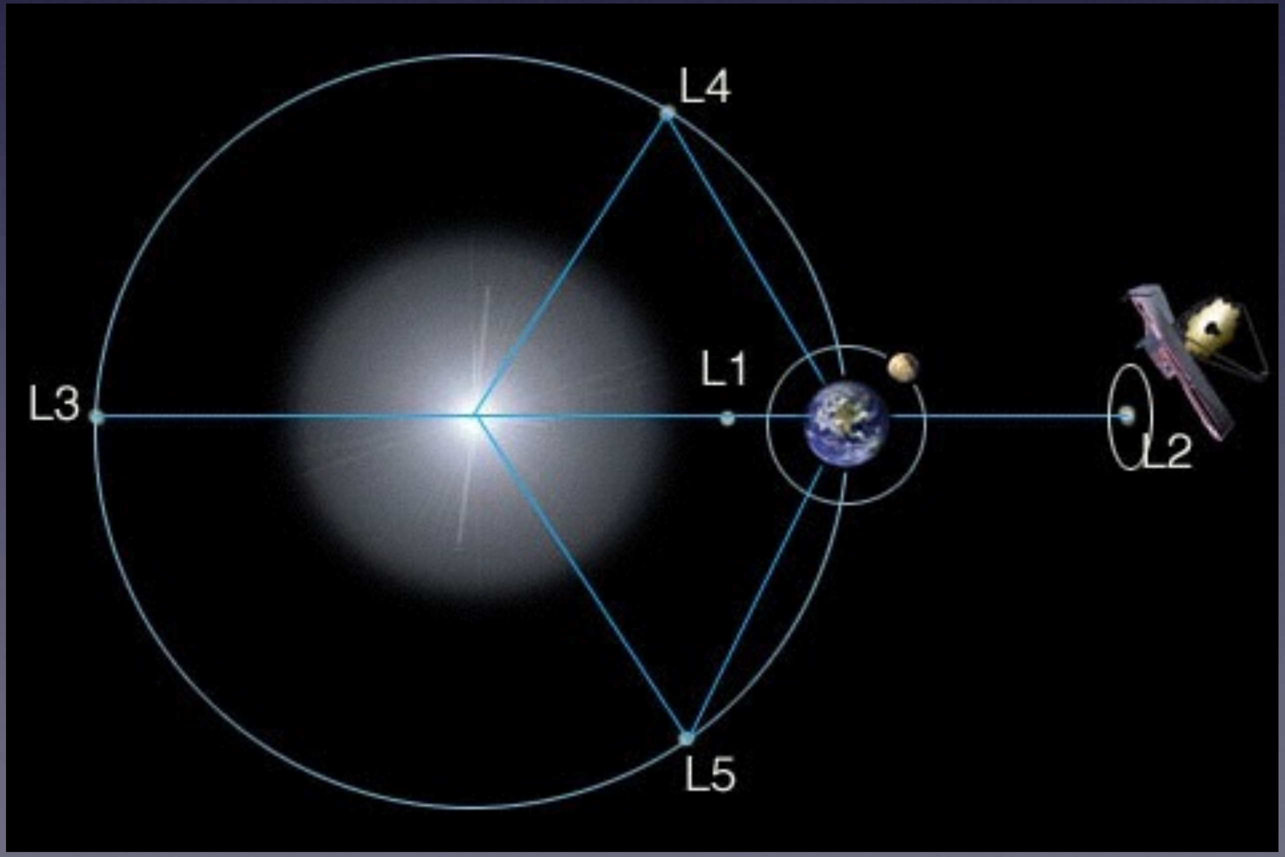


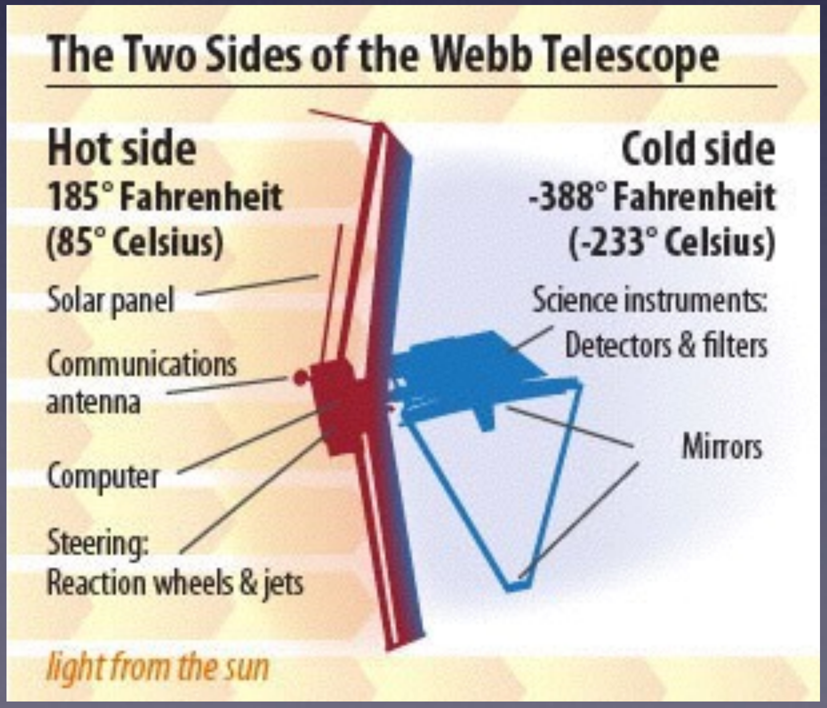


Gold : 48.25g, 1000 Angstrom thick

JWST at L2 Point



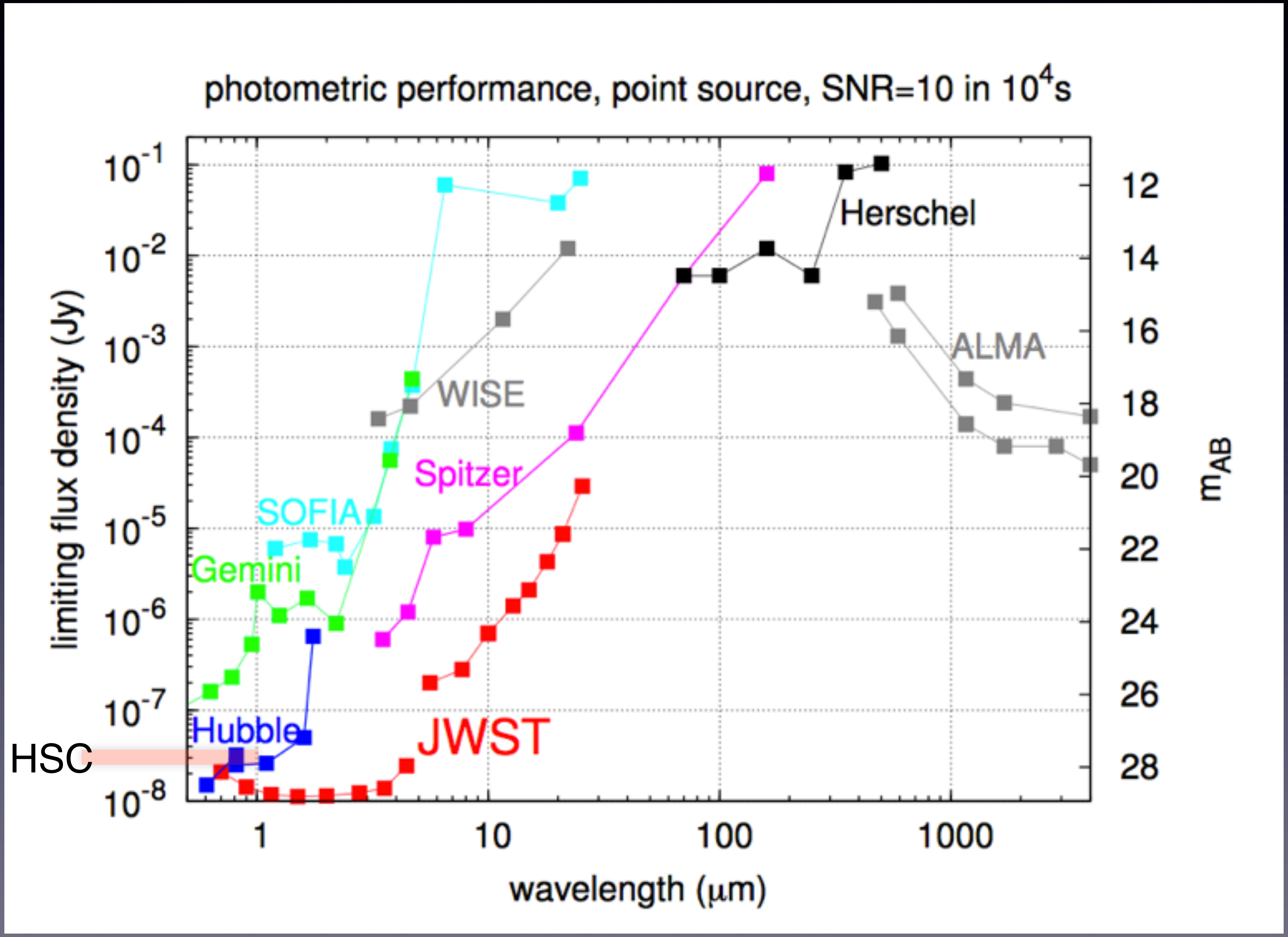




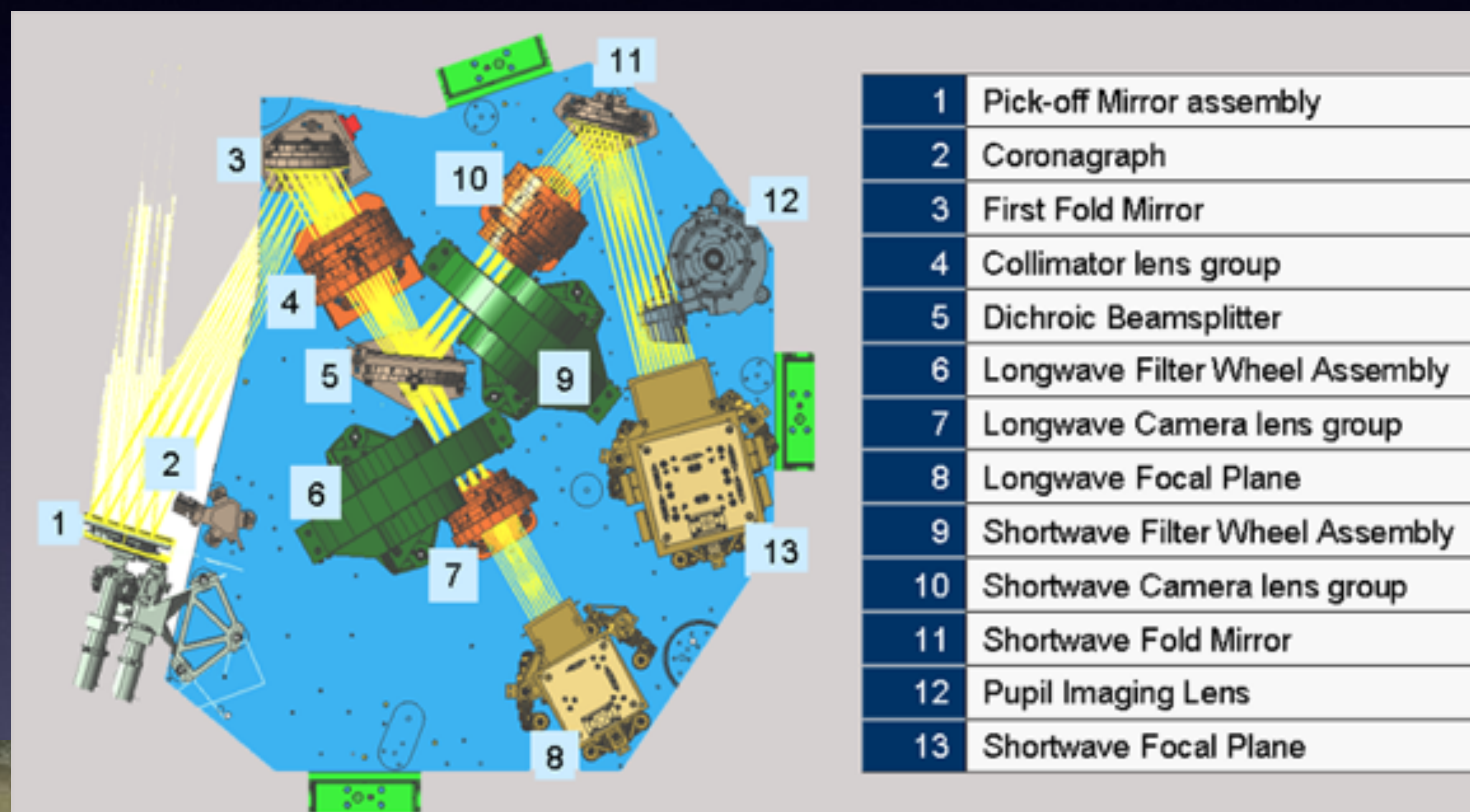
§2 Basic JWST Instruments

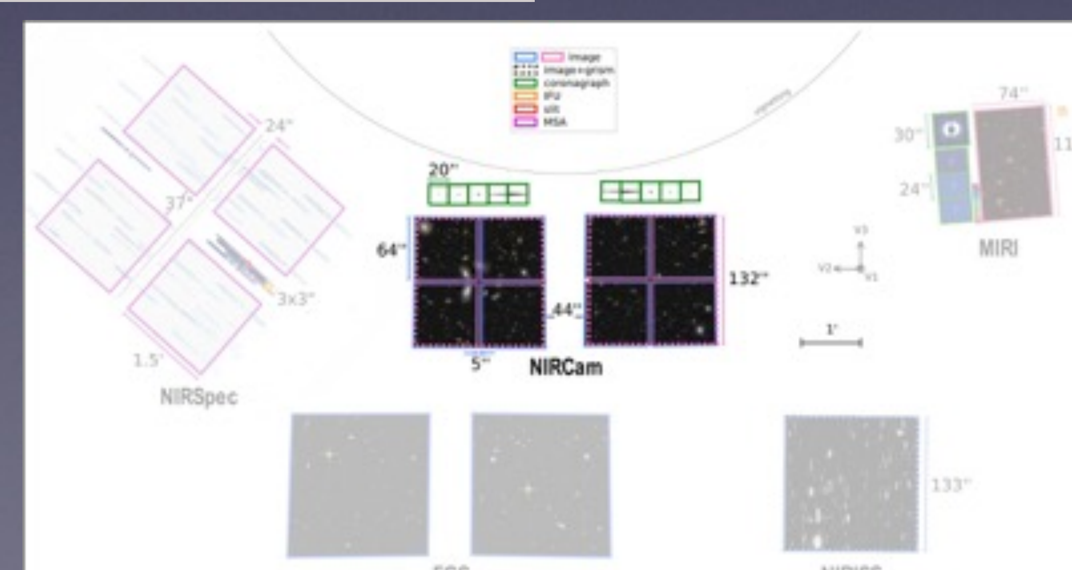
	Wavelength	FoV	Filters or Resolution
NIRCam	0.6 - 5.0 μm	2.2’ x 2.2’	22 Filters 6 NB Filters
MIRI	5 - 28 μm	1.88’ x 2.17’	12 Filters 3”x3” IFU R=3000
NIRSpec	1.0 - 5.0 μm	3.4’ x 3.4’	R=1000 (MOS) R=2700 (IFU) R=100 (Prism)
NIRISS	1.0 - 2.5 μm	2.2’ x 2.2’	R=150 (multi) R=700 (single)

Sensitivity : Imaging (NIR=29th Mag)

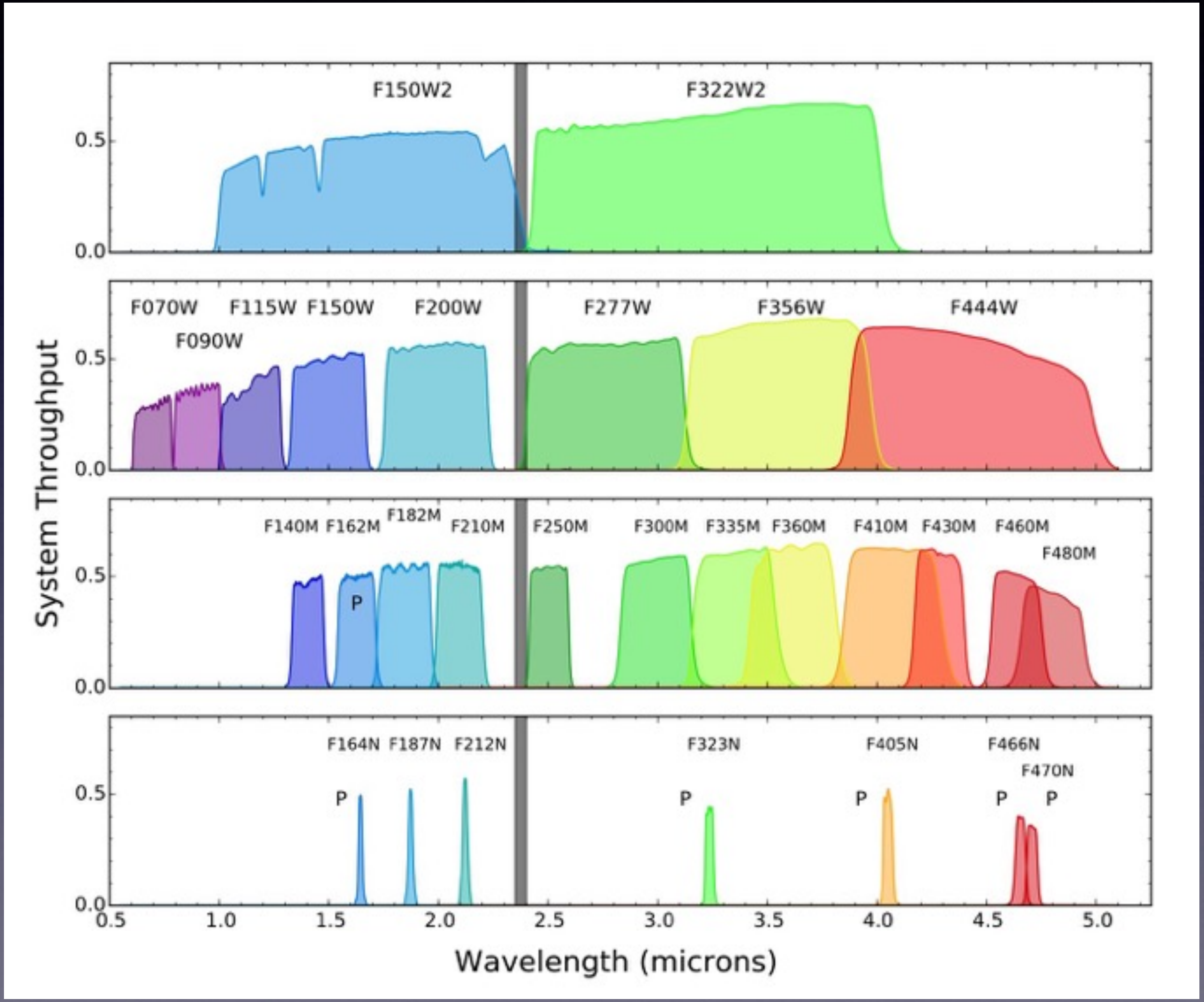


NIRCam 0.6 - 5.0 μm,
FoV : 2.2' x 2.2', HgCdTe

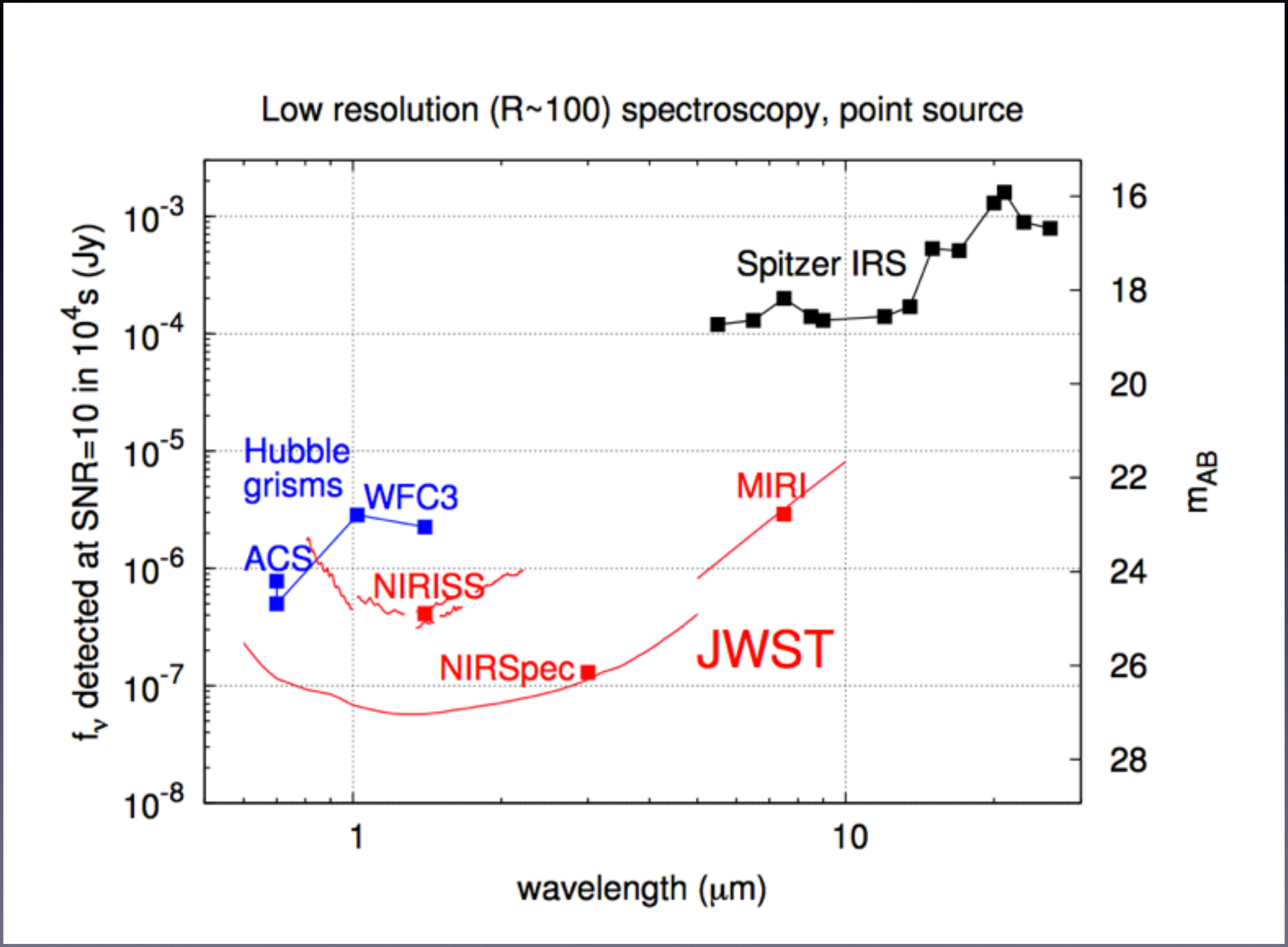




NIRCam Filters

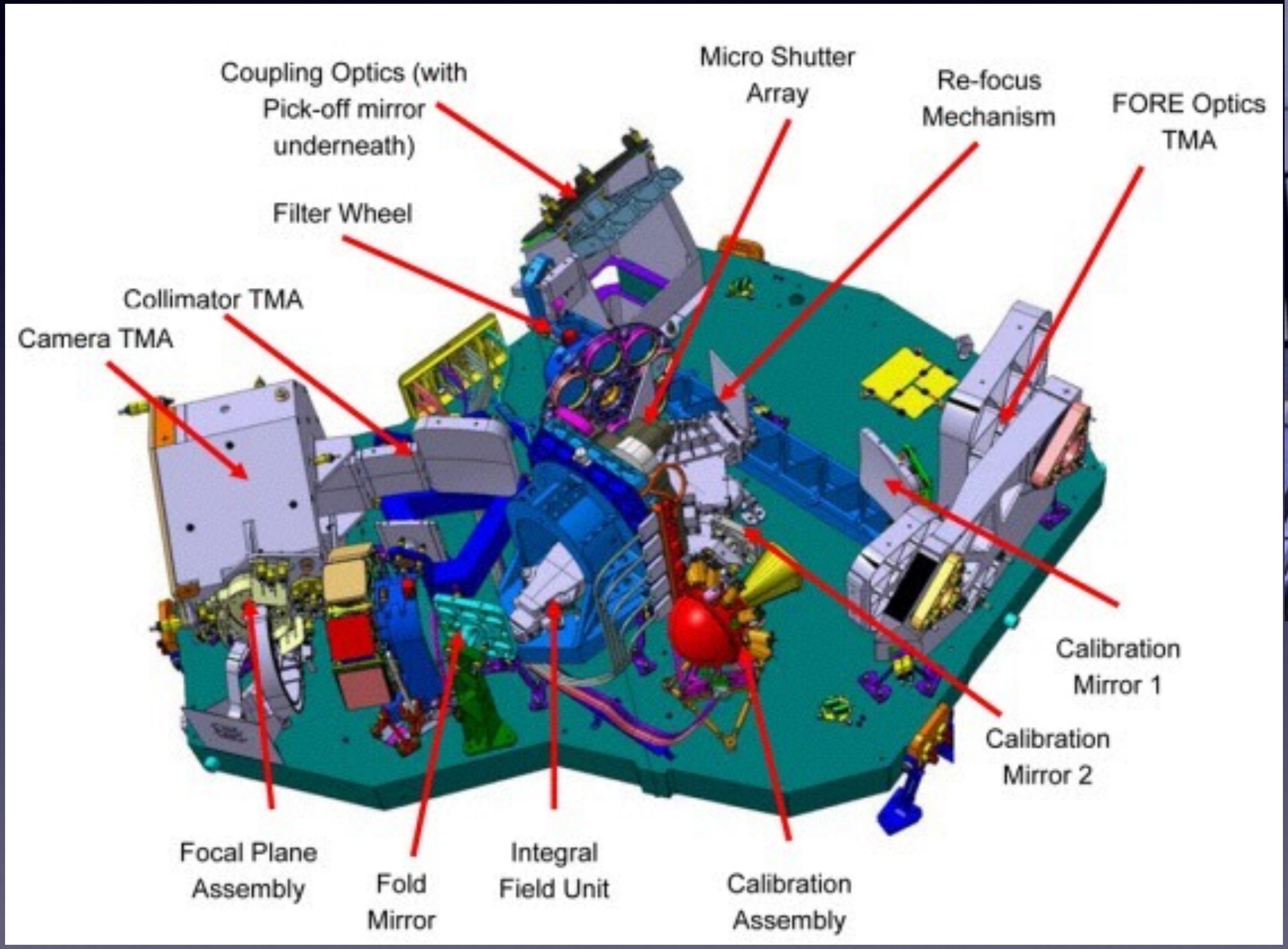


Sensitivity : Spectroscopy (NIR=27th Mag)

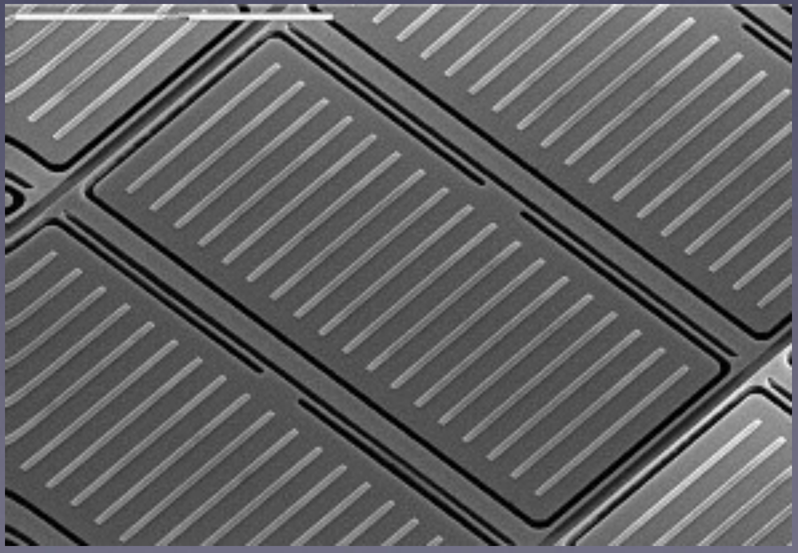


NIRSpec

Low R=30-300, Mid :R=500-1300, High R=1400-3600
FoV=3.4’ x 3.6’   MOS : 100 objects



Micro Shutter Array



Access to JWST Data I
§3 GTO Time
June 15th 2017 Specification Released!

https://jwst-docs.stsci.edu/display/JSP/JWST+GTO+Observation+Specifications

- GTO : Guaranteed-Time Observer Programs (2019-2020)
- GTO a)NIRCam : 900 hrs (425hrs Galaxy, 125hrs Star Formation in MW, 350hrs Planets)
- GTO b) NIRSpec: 900 hrs (724hrs Galaxy, IGM 42hrs, ExoPlanet 56hrs, Galactic, Solar Obj 72hrs)
- ERS : Early Release Science
- GO : Program (USA/ESA) Cycle 1-5

Instrument	Field	Paintings		Exp Time	#Filter	
NIRCam			425hrs			
	GOODS-N Medium	6		60hrs	4	AB 29th mag
	GOODS-S Medium	12		121hrs	4	AB 29th mag
	GOODS-S UDF Deep	4		244hrs	4	AB 30th mag
NIRSPec			724hrs			
Deep #1	HST UDF	1	74hrs	27.7hrs 25hrs	low med	Prism G140M/G235M/G395M
Deep #2	GOODS-S UDF	1	74hrs	27.7hrs 25hrs	low med	Prism G140M/G235M/G395M
Medium #1	GOODS-S Medium	8	134hrs	11hrs x 8	low med	Prism G140M/G235M/G395M
Medium #2	GOODS-N Medium	4	66hrs	11hrs x 4	low med	Prism G140M/G235M/G395M
Wide	CANDELS	35	106hrs	0.75 x 35 1.0 x 35	low high	Prism G235H/G395H
IFU			270hrs			

NIRCam GTO members

NIRCam Theme Team Members

Extragalactic Team

Leader: Daniel Eisenstein
Harvard University
Deputy: Alan Dressler
Carnegie Observatories

Stacey Alberts	U. Arizona
Stefi Baum	U. Manitoba
Eiichi Egami	U. Arizona
Laura Ferrarese	NRC Canada – HAA
Brenda Frye	U. Arizona
Kevin Hainline	U. Arizona
Don Hall	U. Hawaii
Jerry Kriss	STScI
Simon Lilly	ETH Zurich
George Rieke	U. Arizona
Brant Robertson	UC Santa Cruz
Dan Stark	U. Arizona
Christina Williams	U. Arizona
Christopher Willmer	U. Arizona

Star Formation Team

Leader: Michael Meyer
University of Michigan
Deputy: Tom Greene
NASA Ames

Klaus Hodapp	U. Hawaii
Dan Jaffe	U. Texas
Doug Johnstone	NRC Canada – HAA
Doug Kelly	U. Arizona
Jarron Leisenring	U. Arizona
Peter Martin	U. Toronto
Karl Misselt	U. Arizona
Massimo Robberto	STScI
Tom Roellig	NASA Ames
John Stauffer	Spitzer Sci.
Erick Young	USRA

Exoplanets, Debris Disk, and Solar System

Leader: Chas Beichman
Jet Propulsion Lab
Deputy: Tom Greene
NASA Ames

Adam Burrows	Princeton
René Doyon	Université de Montréal
Jonathan Fortney	UC Santa Cruz
Jonathan Fraine	U. Arizona
Andras Gaspar	U. Arizona
David Golimowski	STScI
Scott Horner	Damogran Consulting
John Krist	JPL
Jarron Leisenring	U. Arizona
Michael Line	ASU
Don McCarthy	U. Arizona
Michael Meyer	U. Michigan
George Rieke	U. Arizona
Kailash Sahu	STScI
Everett Schlawin	U. Arizona
Josh Schlieder	NASA Goddard
John Stansberry	STScI
John Trauger	JPL
Marie Ygouf	IPAC/CIT

NIRCam GTO :

Search for highest redshift galaxies without any limitation

NIRCam Extragalactic Surveys

Program lead(s): Daniel Eisenstein
Program duration: 425 hours
Program overview:
NIRCam with its wavelength coverage extending to five microns affords the opportunity to search for the highest redshift galaxies without the limitation imposed by hydrogen absorption in the intergalactic medium. Every NIRCam pointing has thousands of galaxies, spanning a wide range of redshifts, luminosities, environments, and histories, so our science is inevitably multiplexed in every image with the sweep of galaxy evolution being of prime importance but unusual objects are also of interest. The NIRCam GTO Deep Survey will image two regions of the sky with exposure times per spatial point per filter varying from an average of ~7 ksecs to ~42 ksecs as tabulated below. A peak depth of 98 ksecs will be achieved in the deepest overlap areas. We are opting for a "blind" field survey, as opposed to targeting low-redshift lensing clusters, so as to gain access to superb external multi-wavelength data sets. We will use 8 bands from F090W to F444W, including F410M. We plan to observe GOODS-S (Ultra Deep Field) and the GOODS-N (Hubble Deep Field North).

	Dithers	Mean Exposure Time (ksec)	# Filters	Pointings	Time Including Overheads
GOODS-N Medium	6	7.0	4	6	60 hrs
GOODS-S Medium	6	7.0	4	12	121 hrs
GOODS-S Deep	36	41.8	4	4	244 hrs
Total					425 hrs

Simulated Image by ESA

NIRSpec GTO Members

Last name	First name	Affiliation	Category
Alves de Oliveira	Catarina	ESA	NIRSpec SOT
Amorin	Ricardo	Univ. of Cambridge	associate scientist
Arribas	Santiago	INTA/CSIC	NIRSpec IST
Baraffe	Isabelle	Univ. of Exeter	associate scientist
Beck	Tracy	STScI	NIRSpec IST
Birkmann	Stephan	ESA	NIRSpec SOT
Böker	Torsten	ESA	NIRSpec SOT
Bunker	Andy	Univ. of Oxford	NIRSpec IST
Carniani	Stefano	Univ. of Cambridge	associate scientist
Chabrier	Gilles	ENS de Lyon	associate scientist
Charlot	Stéphane	IAP	NIRSpec IST
Chevallard	Jacopo	ESA	associate scientist
Cresci	Giovanni	INAF/Arcetri	associate scientist
Curtis Lake	Emma	IAP	associate scientist
de Marchi	Guido	ESA	associate scientist
Dorner	Bernhard	ADS	associate scientist
Ferruit	Pierre	ESA	NIRSpec IST -ESA JWST PS
Franx	Marijn	Univ. of Leiden	NIRSpec IST
Giardino	Giovanna	ATG Europe / ESTEC	NIRSpec SOT
Guilbert Lepoutre	Aurélie	CNRS/UTINAM	associate scientist
Husemann	Bernd	MPIA	associate scientist
Jakobsen	Peter	DARK	associate scientist
Luhman	Kevin	Penn State univ.	associate scientist
Lützgendorf	Nora	ESA	NIRSpec SOT
Maiolino	Roberto	Univ. of Cambridge	NIRSpec IST
Martinsson	Thomas	INTA/CSIC	associate scientist
Maseda	Michael	Univ. of Leiden	associate scientist
Moseley	Harvey	NASA/GSFC	NIRSpec IST
Muzerolle	James	STScI	associate scientist
Pacifici	Camilla	NASA/GSFC	associate scientist
Panagia	Nino	STScI	associate scientist
Parker	Richard	Univ. of Sheffield	associate scientist
Rauscher	Bernie	NASA/GSFC	NIRSpec IST
Rawle	Tim	ESA	NIRSpec SOT
Rix	Hans-Walter	MPIA	NIRSpec IST
Rodriguez del Pino	Bruno	INTA/CSIC	associate scientist
Sirianni	Marco	ESA	ESA JWST DM
Tremblin	Pascal	CEA	associate scientist
Valenti	Jeff	STScI	associate scientist
Willott	Chris	NRC	NIRSpec IST

NIRSpec GTO Deep:

150 galaxies at z>6 and z>10 galaxies : R=1000 or R=100

The physics of galaxy assembly: the DEEP MOS survey

Program lead(s): NIRSpec instrument science team (IST)

Program duration: 148 hours

Program overview:

This part of our galaxy assembly survey contains the deepest multi-object spectroscopy (MOS) exposures, targeting candidate galaxies at high redshift ($z > 6$), observed within the first billion years of our Universe and potentially just after the end of the Dark Ages. We propose to take very deep integrations with R = 100 and R = 1000 spectral configurations for 2 slightly different pointings in the UDF/GOODS-S region. Our main goals are: (i) to measure secure spectroscopic redshifts of the photometrically-selected population at $z > 7$, (ii) to determine the luminosity function and its evolution based on these spectroscopic redshifts; (iii) to measure the stellar continuum slopes in the UV rest-frame, and hence to study the role of dust, stellar population age, and other effects; (iv) to measure emission lines, and constrain the dust extinction, star formation rates, metallicity, chemical abundances, ionization and excitation mechanisms; (v) to determine stellar populations (age, star formation histories, abundances) of galaxies and provide the information to correct their broad-band spectral energy distribution for likely line contamination; (vi) to test for the presence of Pop. III stars through HeII (only) emission; (vii) to test whether Lyman-α emission is quenched in some redshift intervals ($6\text{-}7 < z$) due to absorption by neutral hydrogen, hence constraining the end of reionization; (viii) to investigate the escape fraction of ionizing photons by comparing the UV stellar continuum with the Balmer line fluxes. We expect to study 150 galaxies at $z > 6$, with (presumably) galaxies to $z \approx 10$ and beyond. Part of this program will be conducted jointly with the NIRCam GTO team.

NIRSpec IFS (270hrs)

Integral Field Spectroscopy

30 Star Forming Galaxies, 20 AGNs at z=7

The physics of galaxy assembly: spatially resolved IFS observations of high-redshift galaxies

Program lead(s): NIRSpec instrument science team (IST)

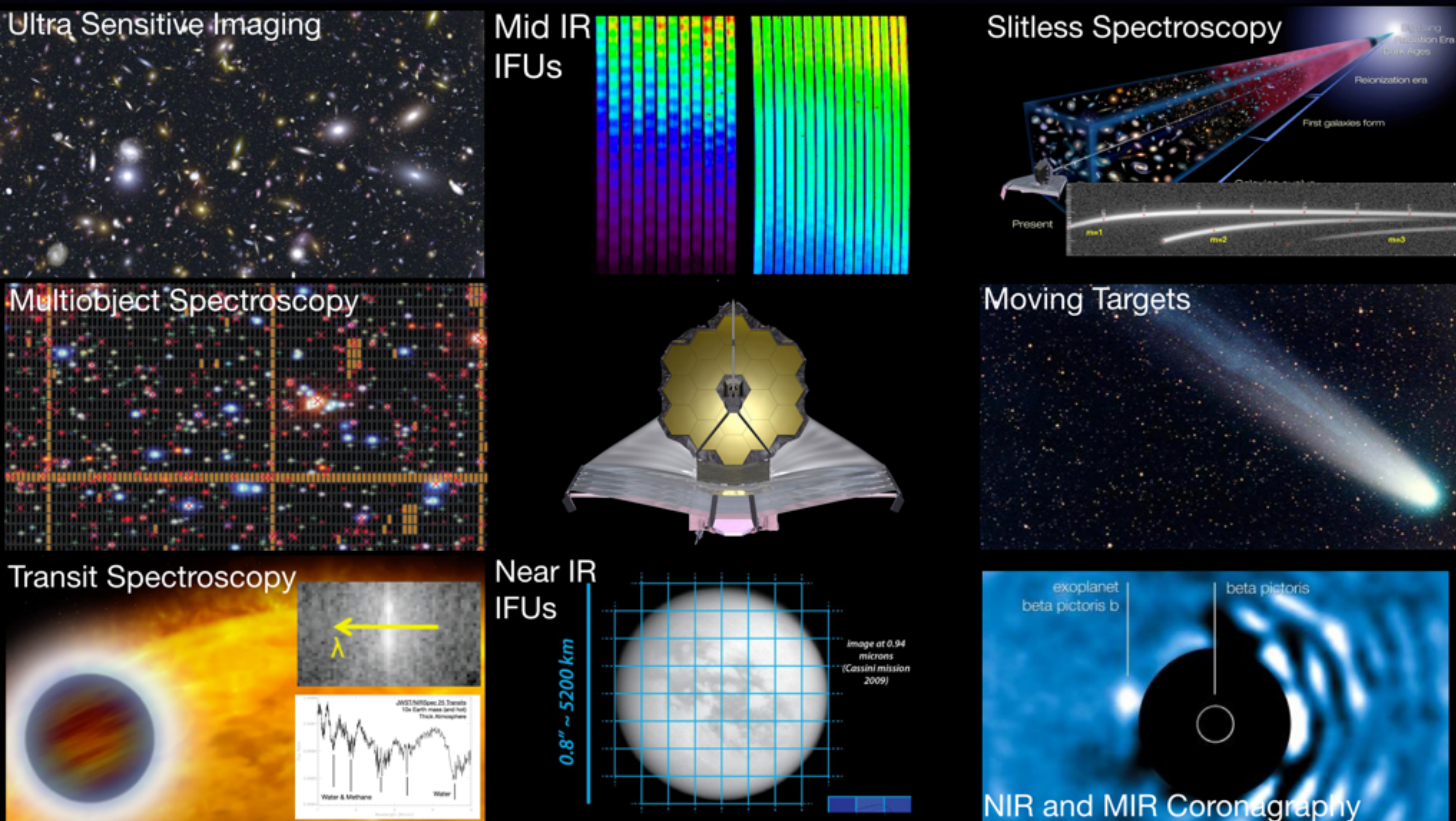
Program duration: 270 hours

Program overview:

Integral-field spectroscopy (IFS) observations of individual high-redshift galaxies with NIRSpec will enable us to investigate in detail the most important physical processes driving galaxy evolution across the cosmic epoch. The main goals of these observations are: to trace the distribution of star formation, to map the resolved properties of the stellar populations, to trace the gas kinematics (i.e. velocity fields, σ_v) and, therefore, determine dynamical masses and also identify non-virial motions (outflow and inflows), and to map metallicity gradients and dust extinction. These quantities will be mapped both for star forming galaxies and galaxies hosting active galaxy nuclei (AGNs). With this program we will extend up to z~6, and higher, the current ground-based studies relying on observations of the Hα line, which are limited to $z \simeq 2.5$ and which are affected by low sensitivity and modest angular resolution. The galaxy sample will be selected to be a good representation of the most massive Main Sequence (MS) of star-forming galaxies (including a few off-MS cases) and AGNs in the range 2<z<7. It will also include the most luminous and extended objects at z > 5 (both powerful starbursts and quasars). The samples will be drawn from previous optical, near-IR, and sub-mm and mm surveys. We aim at observing ~30 star-forming galaxies, ~15-20 AGNs up to z~ 7, and ~15 very luminous galaxies at z>5. The latter group includes 6 Lyman alpha emitters (LAE), 3 sub-mm galaxies (SMG), and 6 hosts of some of the most luminous QSOs.

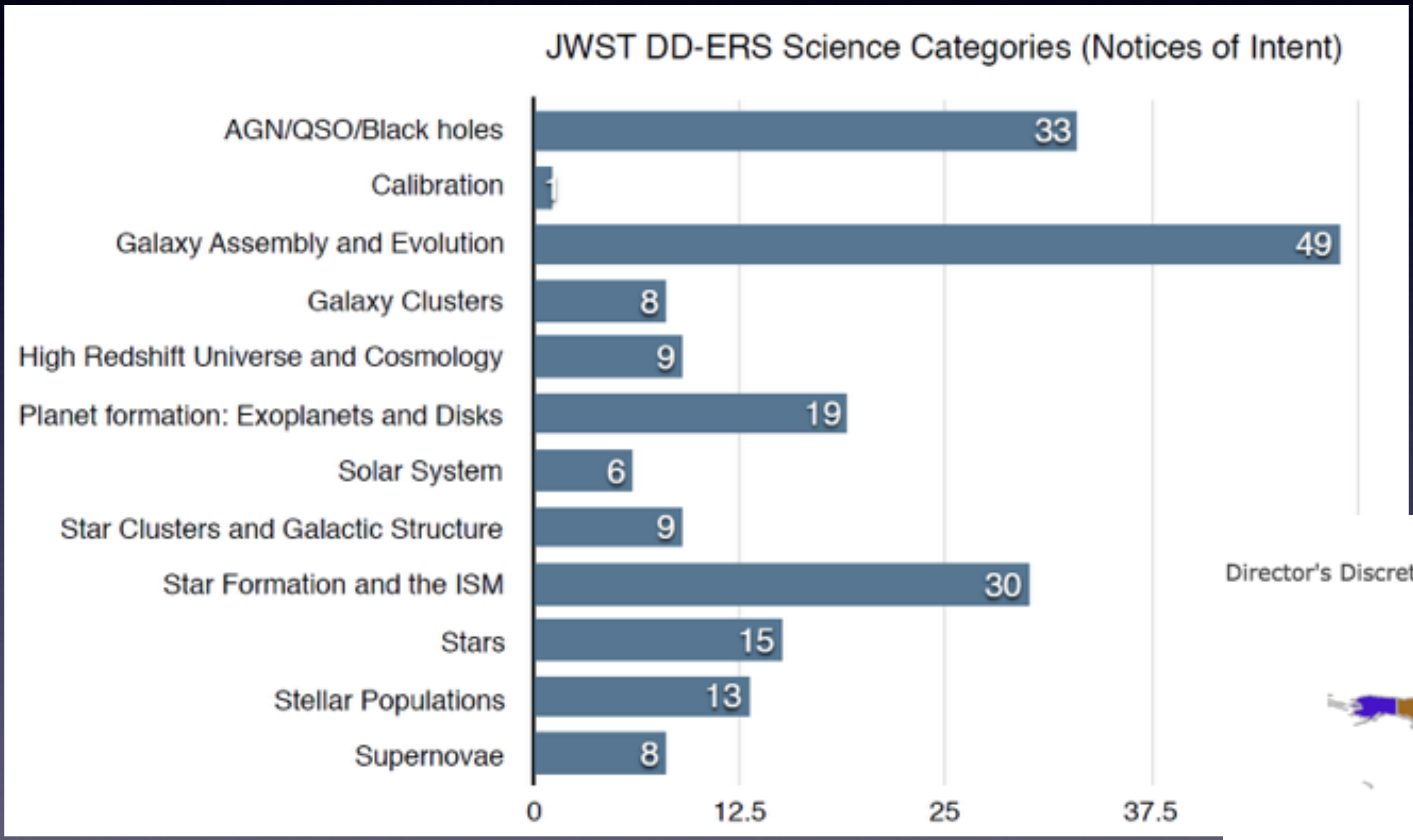
Access to JWST Data II

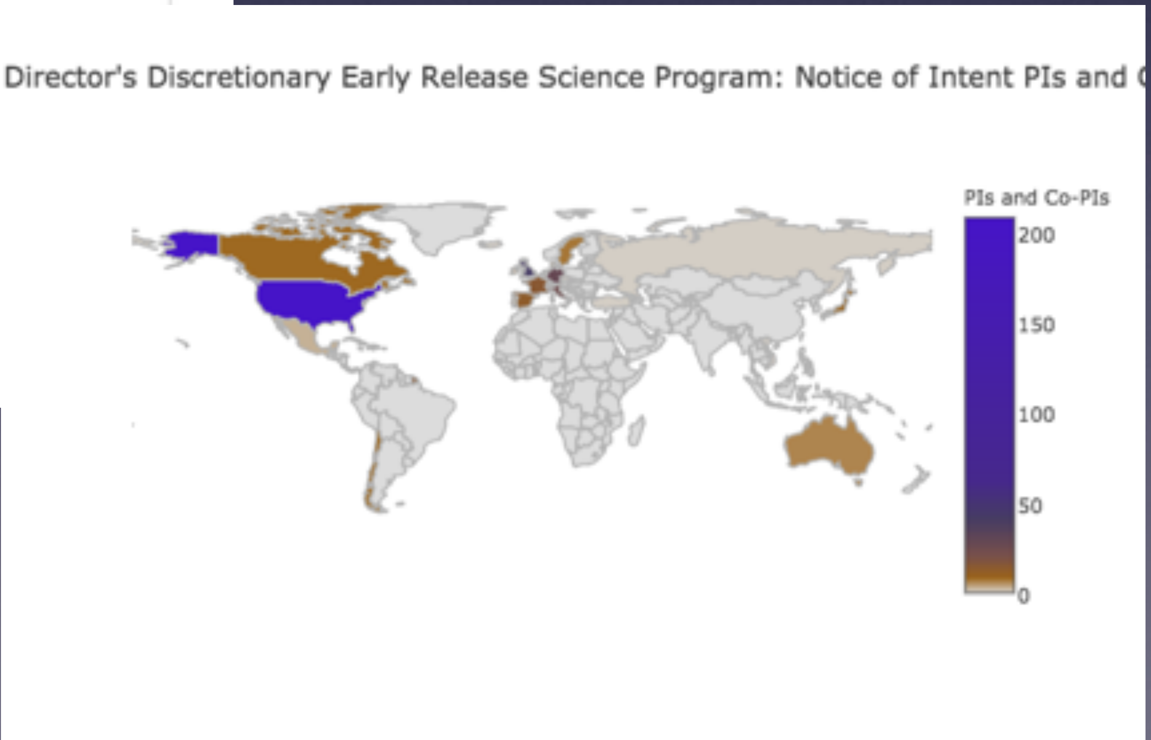
§4 ERS: JWST Early Release Science Proposal (Aug 18th 2017)



JWST Early Release Science Proposal (Aug 18th 2017)

Letter of Intent had to be filed by March 2017





Access to JWST Data III

§5 Call for Cycle 1 Proposal : Nov 30th 2017
Deadline Mar 2nd 2018

Important Dates

Rows are color coded by opportunity, where red = GTO, green = DD ERS, and white = Cycle 1 GO

Release of the Cycle 1 Call for GTO Proposals	January 6, 2017
Release of the Cycle 1 Call for DD ERS Notices of Intent	January 6, 2017
DD ERS Letters of Intent due	March 3, 2017, 8pm ET
Cycle 1 GTO Science Descriptions and Observation Specifications due	April 1, 2017, 8pm ET
Release of the Cycle 1 Call for DD ERS Proposals	May 19, 2017
APT version 25.1 Released (with updated Cycle 1 overhead calculations)	June 1, 2017
GTO Observation Specifications Published (public)	June 15, 2017
APT version 25.2 Released (primarily HST updates)	June 21, 2017
GTO APT Technical Reviews and Revisions Begin	July 28, 2017
DD ERS Proposal Deadline	August 18, 2017, 8pm ET
GTO APT Technical Reviews and Revisions End	September 15, 2017
APT version 25.4 Released (further updates for Cycle 1 GO Call)	November 1, 2017
DD ERS Results Released	November 2017
Release of the Cycle 1 Call for GO Proposals	November 30, 2017
Formal DD ERS Budget Proposals	Early December 2017
GTO APT Files Published (public)	December 15, 2017
DD ERS APT Files Published (public)	December 2017
Cycle 1 GO Proposal Deadline	March 2, 2018

GTO published

Cycle 1 Dead Line

Path to JWST Proposal

Let's write a JWST proposal

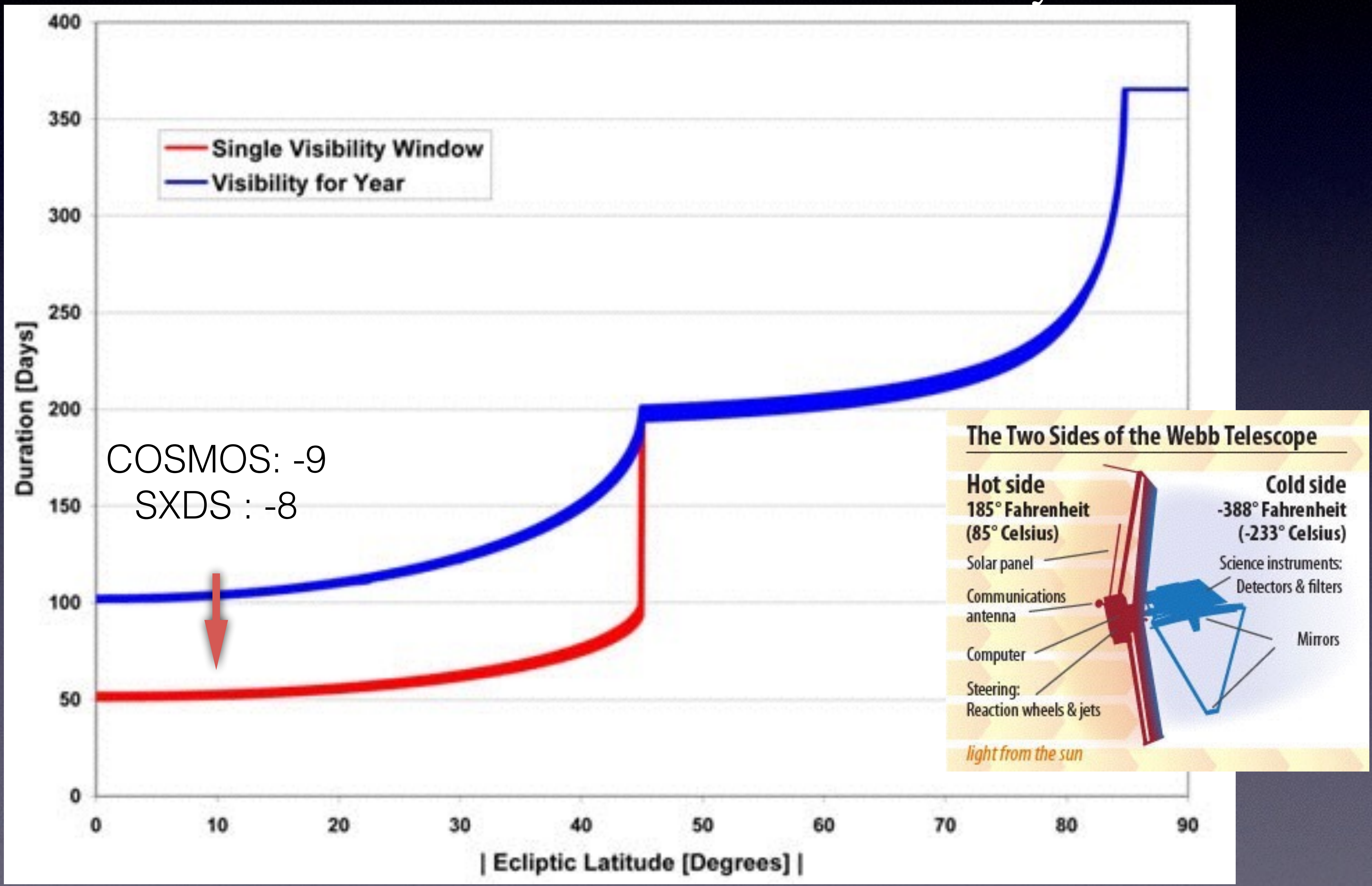
- Basic Info
- Technical Advice
- Have US/ESA Co-PI and collaborators
- Be Unique, Be First, Be Best
- Take advantage of HSC/PFS/ALMA
- HST example, my case

Basic Info

- HST/JWST (or NASA space telescope) time (GO program) is associated with budget so that researchers can hire people to analyze the data
- Have a financial PI from the US
- You can be a PI and you can have a Co-PI
- It is essential to have USA/ESA Co-Is
- Proposal must be filed by APT software

Technical Info : JWST Visibility

Note : Visibility is limited, ToO is difficult
Eclectic Plane=IR background is high
COSMOS and SXDS are not an ideal field: visibility is limited



§6 HST Example & JWST Ideas
Co-PI and US Admin Co-I

N Suzuki : Perfect Blackbody Spectra for JWST and Next Generation UV-Opt-IR Standard Star Network

Investigators:

	Investigator	Institution	Country
PI&	N Suzuki	Institute for Physics and Mathematics of the Universe	JPN
CoI	M Fukugita	Institute of the Physics and Mathematics of the Universe	JPN
CoI	J Cooke	Swinburne University of Technology	AUS
CoI	R Bohlin	Space Telescope Science Institute	USA/MD
CoI#&	S Deustua (Co-PI)	Space Telescope Science Institute	USA/MD
CoI	A Fruchter	Space Telescope Science Institute	USA/MD
CoI	A Riess	The Johns Hopkins University	USA/MD
CoI	S Bailey	Lawrence Berkeley National Laboratory	USA/CA

Number of investigators: 8

US Admin CoI: S Deustua

& Phase I contacts: 2

Hubble Space Telescope(HST) Time is awarded

Cycle 24-25 (2016-2018)

First Time for Japanese Institution to win large project

Infrared Part is Observed by Hubble Space Telescope(HST)

Optical Part is Observed by Subaru (HSC)

Dear Dr. Suzuki,

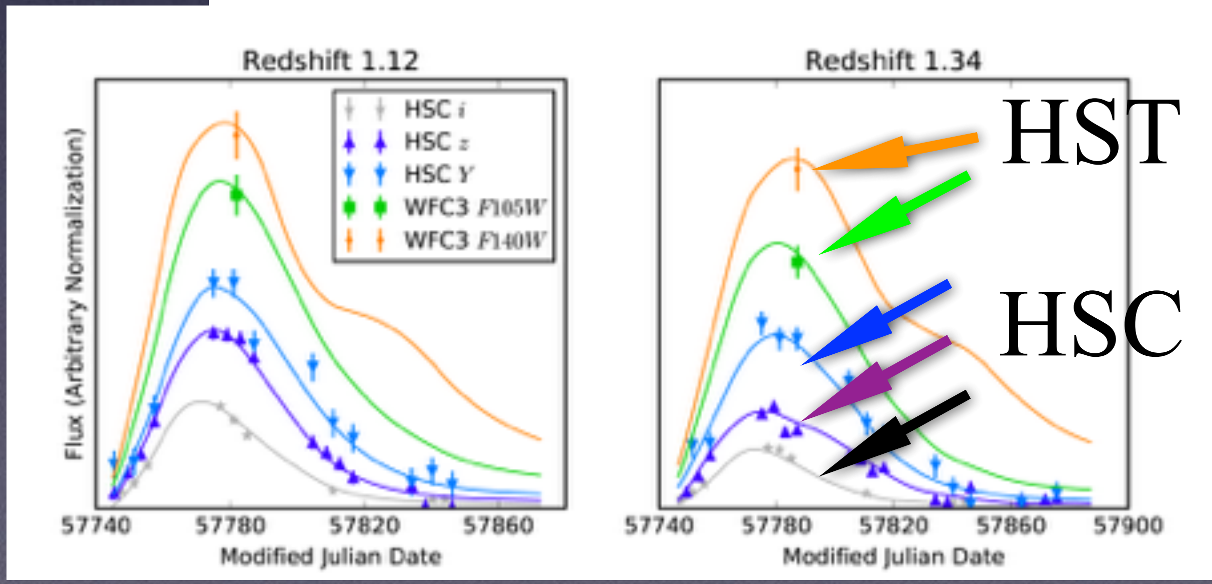
We are pleased to inform you that your Hubble Space Telescope Cycle 24 proposal

Title: SUbaru Supernovae with Hubble Infrared (SUSHI)
ID: 14808

has been approved for Hubble Space Telescope Cycle 24 General Observer time, following detailed consideration by the Cycle 24 Peer Review Panels and final review by the STScI Director. Your proposal was graded in the first quintile of proposals in your Panel, with the first quintile being the top proposals before the panel.

The allocations approved for your program in Phase I are:

46 Primary Spacecraft Orbits in Cycle 24
50 Primary Spacecraft Orbits in Cycle 25



Strengths: This was a very highly ranked proposal among all the Large Proposals, and very well written. The scientific argument for obtaining more Type Ia supernovae at higher redshifts to improve the dark energy figure-of-merit is carefully crafted and compelling. This project is a key part of the Subaru telescope search, and both the search and ground-based follow-up for spectra are well documented and convincing. The idea of finding the supernovae from the ground and obtaining optical (observed frame) light curves that characterize the light curve shape, while getting a few near-ir (observed frame) points with HST to anchor the light curves in rest frame passbands that have been shown to be standard candles, is a technique that the supernova cosmology community has recently developed as an excellent way to find and measure supernovae in the most efficient manner. It is important that more than one team find and characterize distant Type Ia supernovae, and this rather modest proposal relative to the scientific impact makes a strong case for this approach and for the team's ability to arrive at their goals.

HSTプロポーザルの個人的感想

Hubble Space Telescope Cycle 24 GO Proposal 583

SUbaru Supernovae with Hubble Infrared (SUSHI)

Scientific Category: Intergalactic Medium and Cosmology
Scientific Keywords: Cosmological Parameters & Distance Scale, Supernovae
Instruments: WFC3
Proprietary Period: 0 months

Proposal Size: Large

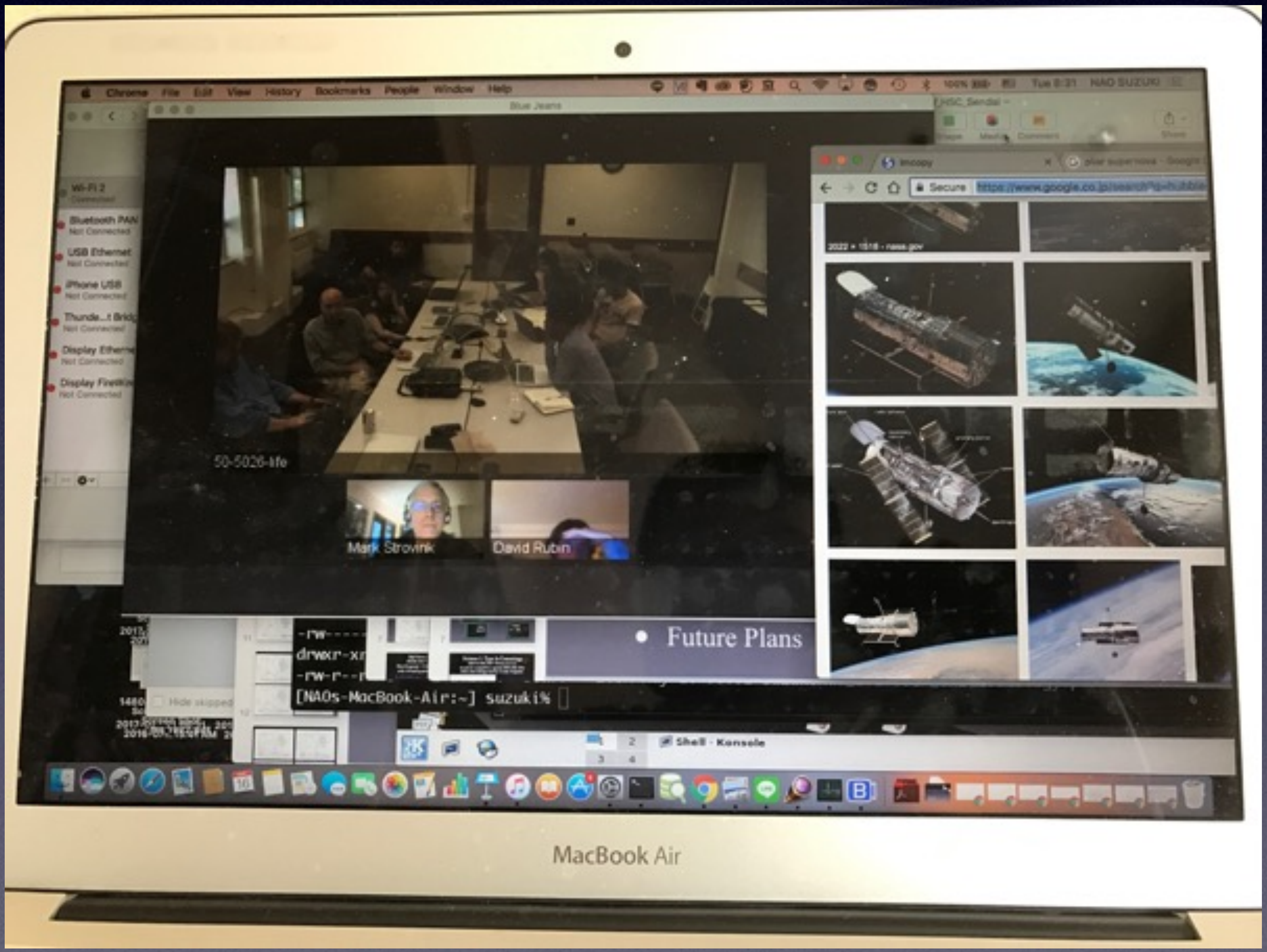
Orbit Request	Prime	Parallel
Cycle 24	46	0
Cycle 25	50	0
Total	96	0

Abstract

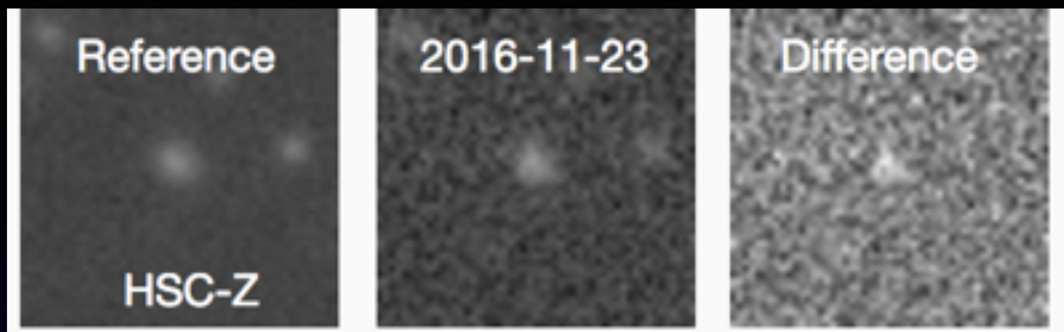
During the next two HST Cycles, the Subaru Strategic Program (SSP) will conduct a rolling search with Hyper Suprime-Cam (HSC) that will discover and study scores of very high quality SNe Ia up to redshift of ~1.5. However, above a redshift of one, the Subaru photometry will be limited to the UV and blue rest-frame of the SNe. By combining the HSC light curve with just one non-disruptive ToO observation and a "reference image" (after the SN has faded) from HST for each of 46 SNe, we will improve the dark energy Figure of Merit (FoM) obtainable from all past and present high-redshift SN searches by a factor of 2.3. This opportunity is unique. Because this search requires frequent changes of the massive HSC at the Subaru prime focus, it will not be repeated for the foreseeable future.

- 読みやすい（英語）
- 読んでいて楽しい
- 必ずできる確証がある
- HST/JWSTでなければできない
- 他の追従を許さない
- 専門外の人にもわかる
- できない約束をしない

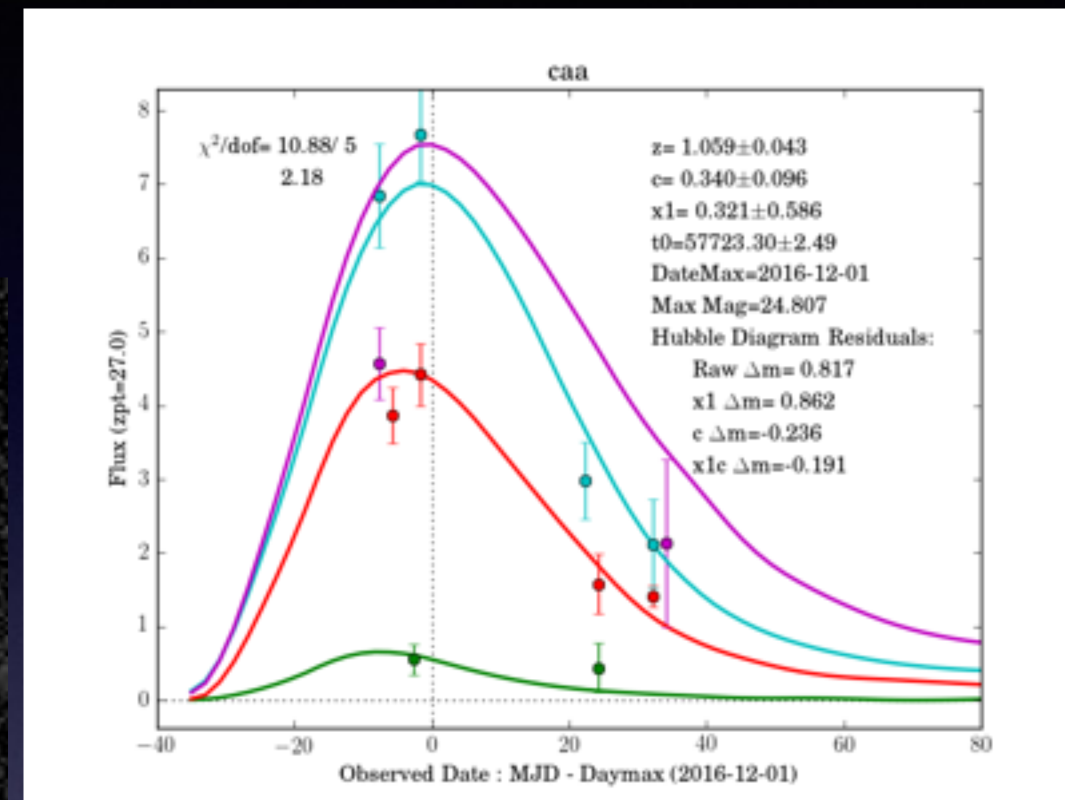
Preparation
2 years of discussion and meetings
2 paper equivalent of work
24 hour TV conference before the deadline

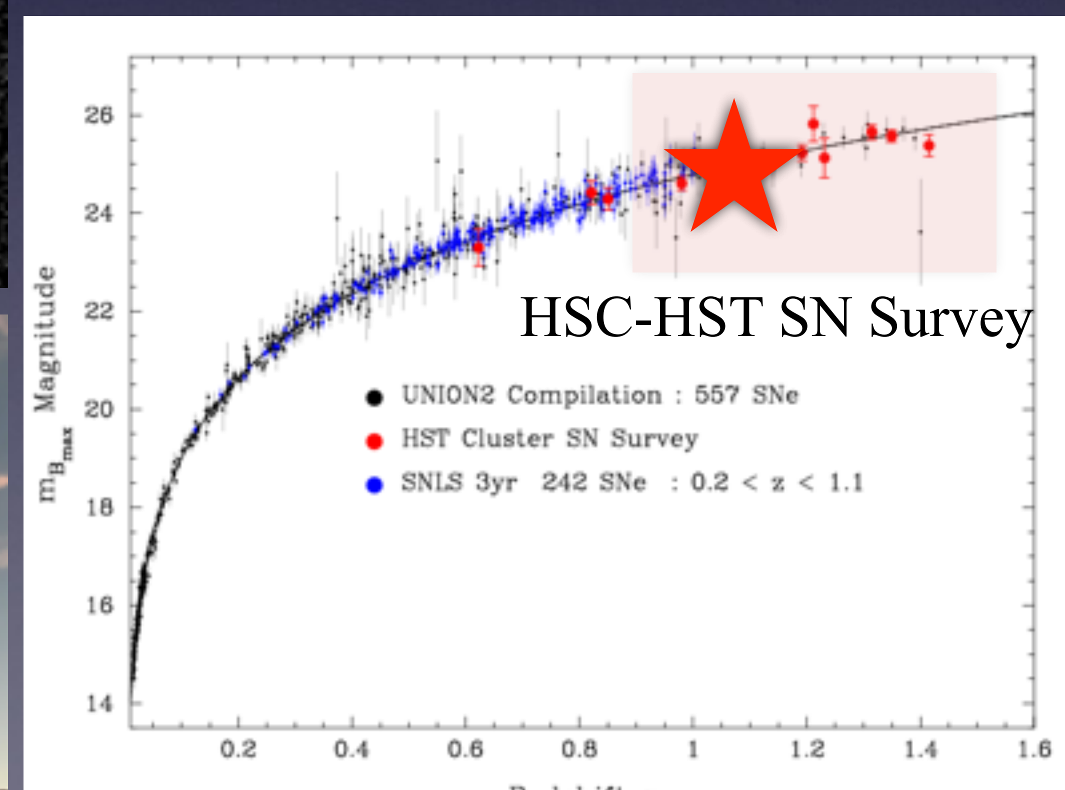


HSC Supernova Survey : Nov ‘16 - Apr‘17



z=1.06





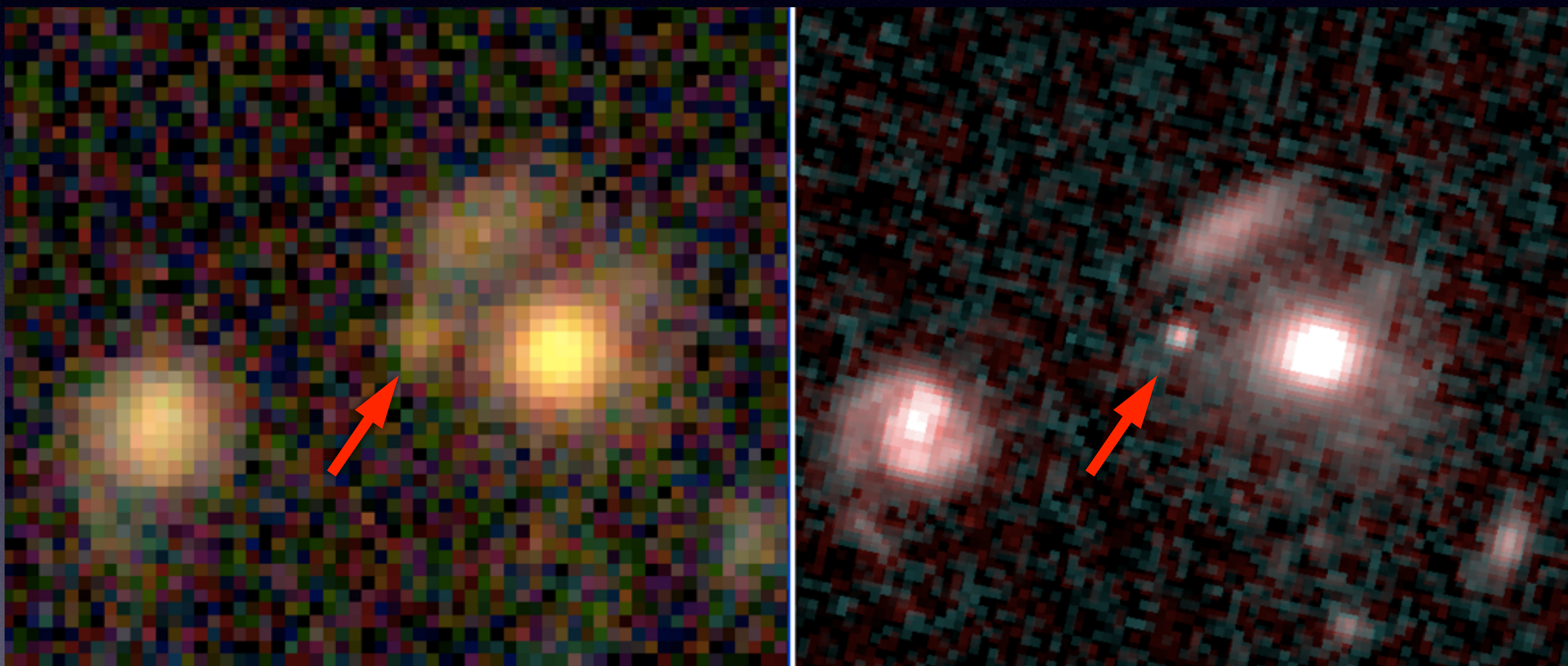
HSC: r2, i2,z vs HST WFC3 : F105(J), F140(H)

Subaru/HSC (Optical) Hubble Space Telescope (IR)

HSC: r2, i2,z vs HST WFC3 : F105(J), F140(H)

17siv : z=1.234 SNIa, 8.57 G light years

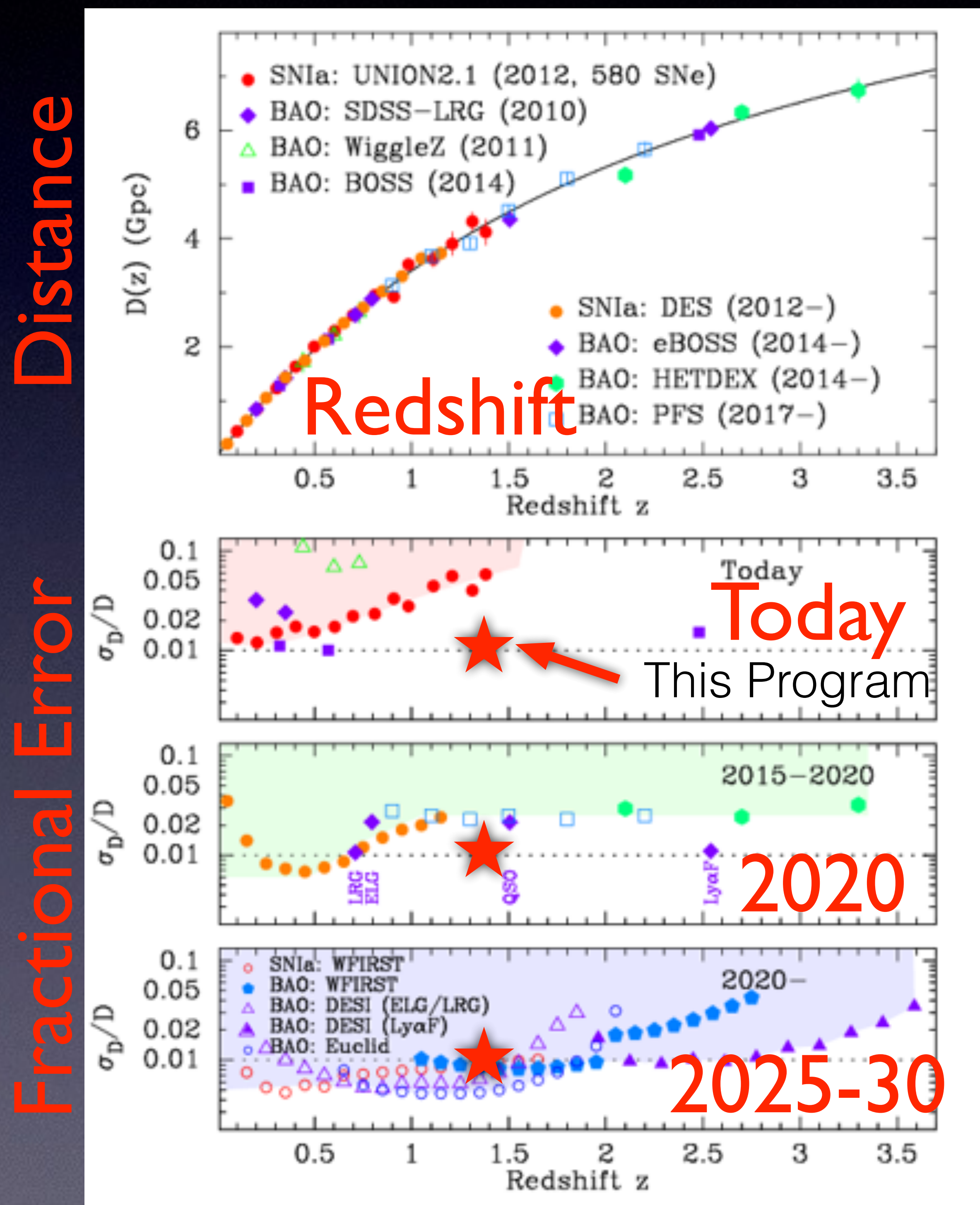
Subaru/HSC (Optical) Hubble Space Telescope (IR)



10-15% Color Measurement 1-3% Color Measurement

HSC+HST legacy Survey

SNIa Cosmology in 2017-2025



- $1.0 < z < 1.4$ 70-100 HSC SNeIa
- HSC+HST 46 SNeIa can become competitive against 2000 DES SNe
- Keck/VLT/Gemini/HST Follow-up
- Aiming to have 0.5% calibration error => 1.0% distance error
- Our Data can survive in LSST era
- LSST-Subaru-WFIRST model : Future is Now
- Calibration Workshop this winter Calibration Geeks x Otaku at IPMU

§7 JWST Ideas

- Ideas?   Introducing a few example
- My ERS proposal : COSMOS First Star Proposal
- PFS COSMOS Survey
- Some attractive proposals: Fast Radio Burst, Gravitational Wave Sources

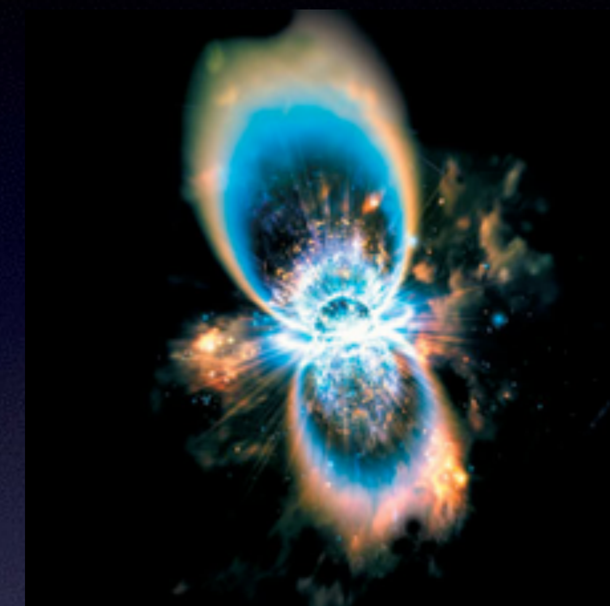
Holy Grail : First Star Explosion
Pair-Instability Supernova

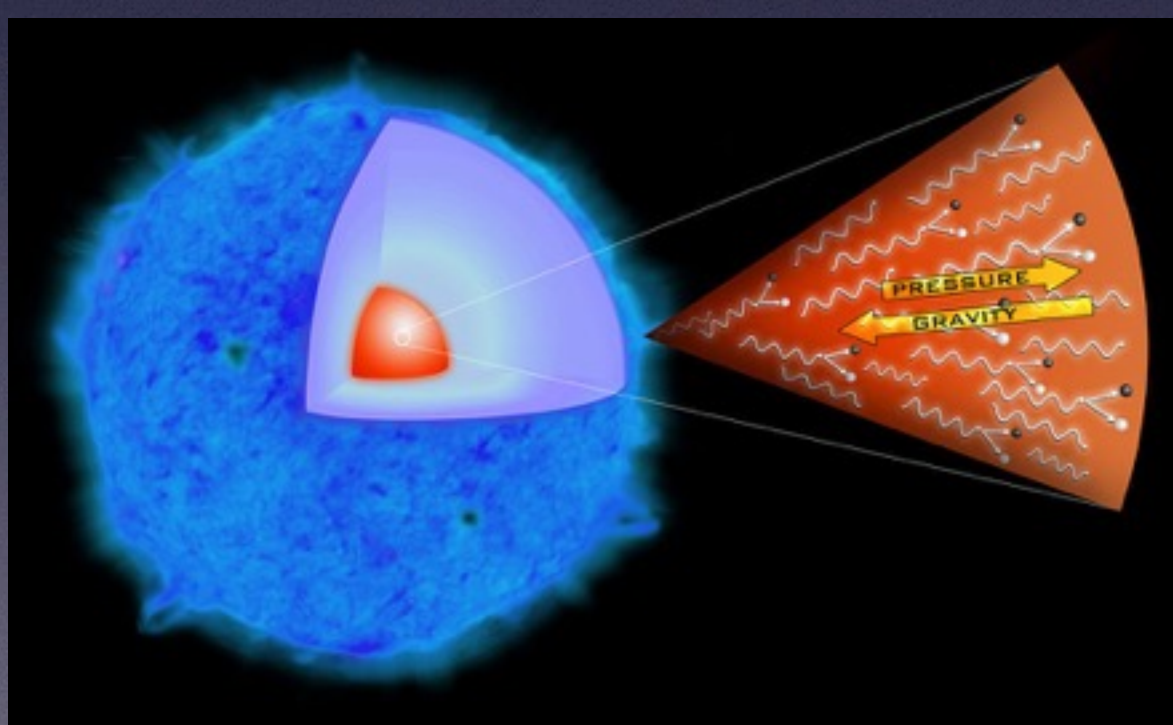
Letter

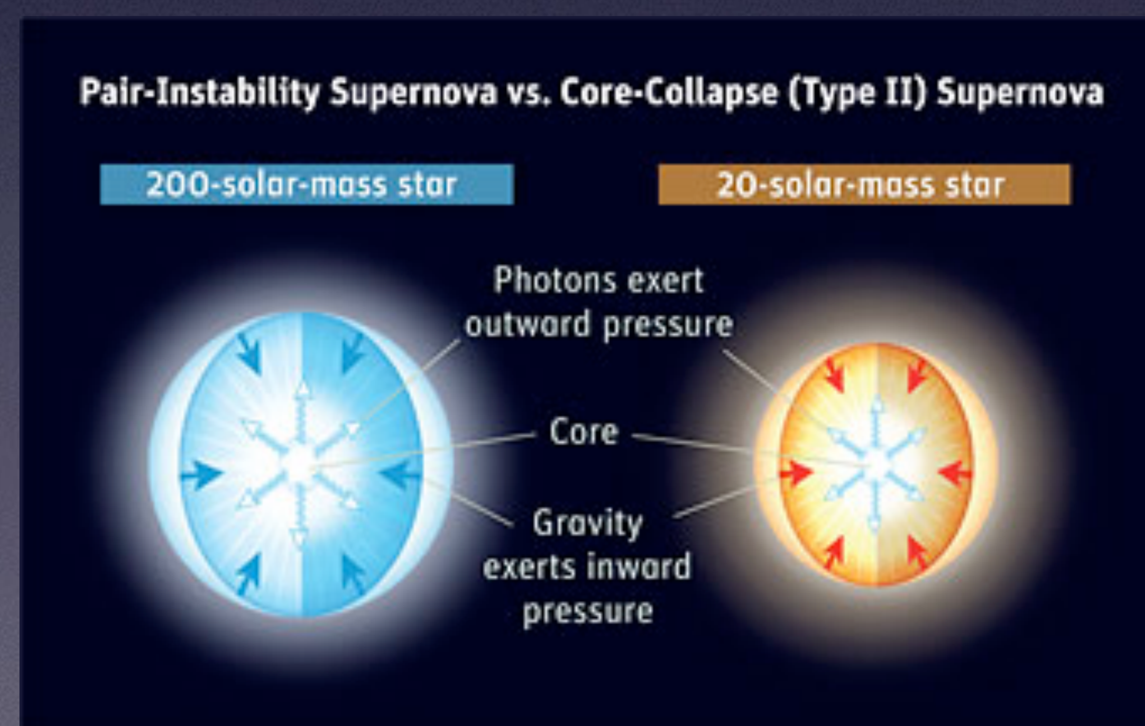
Nature **462**, 624-627 (3 December 2009) | doi:10.1038/nature08579; Received 6 August 2009; Accepted 8 October 2009

Supernova 2007bi as a pair-instability explosion

A. Gal-Yam[1], P. Mazzali[2,3], E. O. Ofek[4], P. E. Nugent[5], S. R. Kulkarni[4], M. M. Kasliwal[4], R. M. Quimby[4], A. V. Filippenko[6], S. B. Cenko[6], R. Chornock[6], R. Waldman[7], D. Kasen[8], M. Sullivan[9], E. C. Beshore[10], A. J. Drake[4], R. C. Thomas[5], J. S. Bloom[6], D. Poznanski[6], A. A. Miller[6], R. J. Foley[11], J. M. Silverman[6], I. Arcavi[1], R. S. Ellis[4] & J. Deng[12]

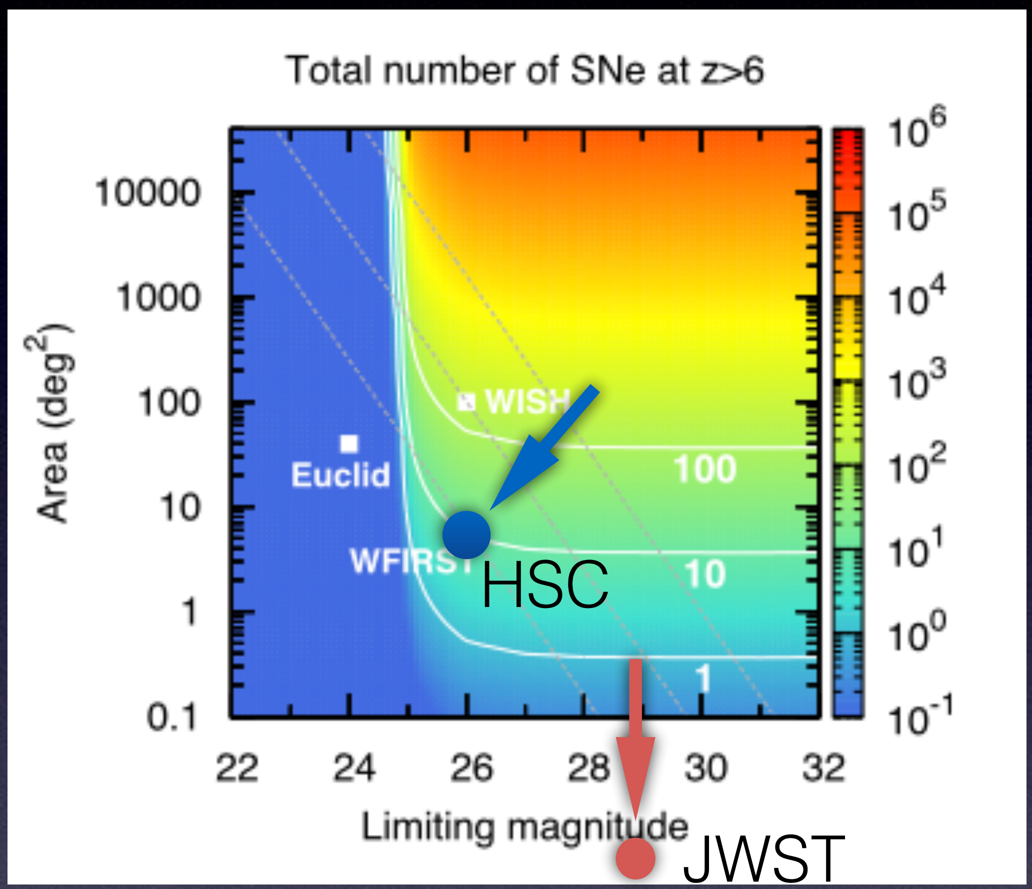




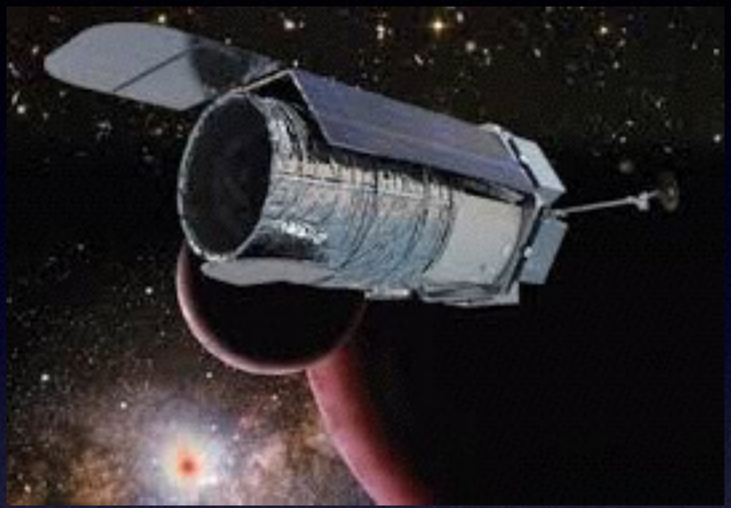


Can we find them with HSC?

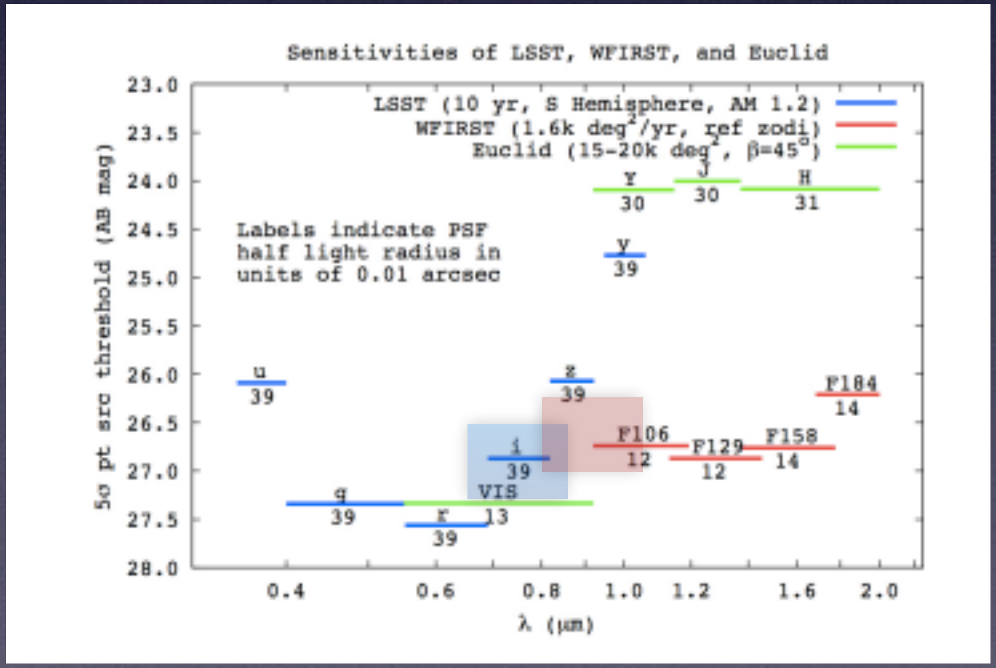
yes we can

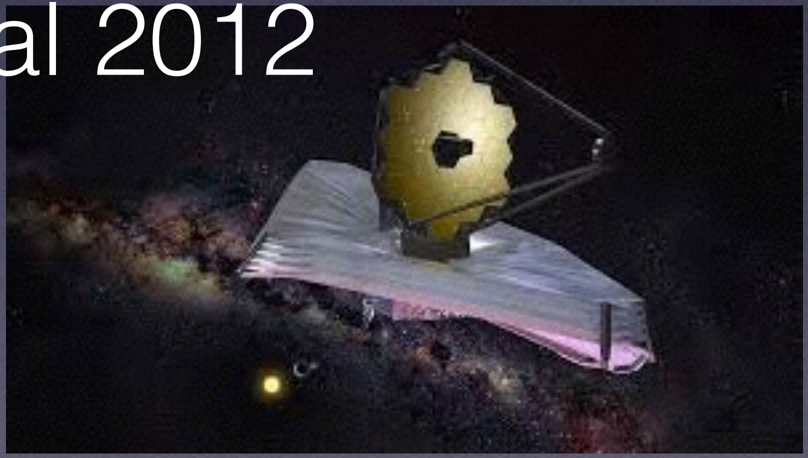


Tanaka et al 2012



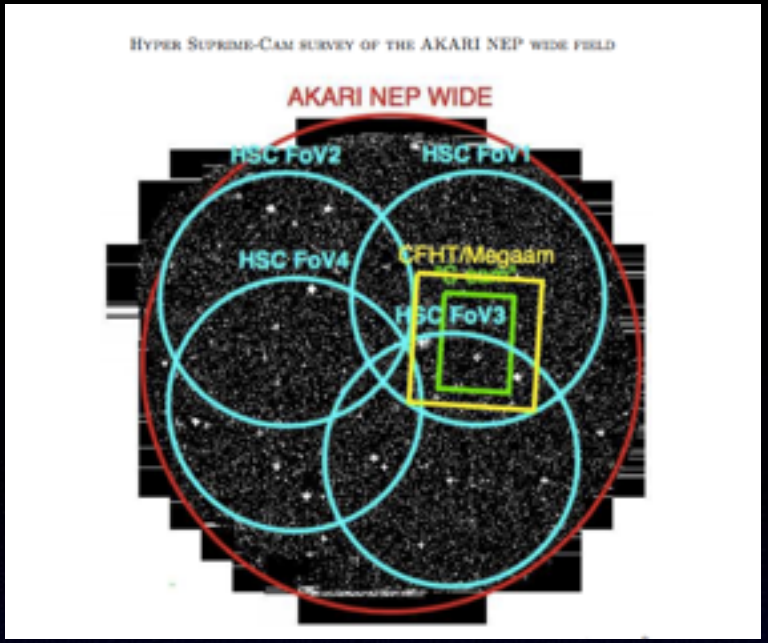
WFIRST : FoV : 0.28 deg^2





JWST : NIRcam FoV 4.4x2.2 arc min =0.0026 deg^2

New HSC x JWST GTO NEP Survey



Title: The JWST North Ecliptic Pole Survey Field for Time-domain Studies

Authors: Jansen, Rolf A.; Alpaslan, Mehmet; Ashby, Matthew; Ashcraft, Teresa; Cohen, Seth H.; Condon, James J.; Conselice, Christopher; Ferrara, Andrea; Frye, Brenda L.; Grogin, Norman A.; Hammel, Heidi B.; Hathi, Nimish P.; Joshi, Bhavin; Kim, Duho; Koekemoer, Anton M.; Mechtley, Matt; Milam, Stefanie N.; Rodney, Steven A.; Rutkowski, Michael J.; Strolger, Louis-Gregory; Trujillo, Chadwick A.; Willmer, Christopher; Windhorst, Rogier A.; Yan, Haojing

Affiliation: AA(ASU), AB(NASA-Ames), AC(CfA), AD(ASU), AE(ASU), AF(NRAO), AG(U.Nottingham), AH(SNS), AI(UofA), AJ(STScI), AK(AURA), AL(LAM), AM(ASU), AN(ASU), AO(STScI), AP(ASU), AQ(NASA-GSFC), AR(UofSC), AS(U.Stockholm), AT(STScI), AU(NAU), AV(UofA), AW(ASU), AX(U.Missouri)

Publication: American Astronomical Society, AAS Meeting #229, id.438.04

Publication Date: 01/2017

Origin: AAS

Bibliographic Code: 2017AAS...22943804J

Abstract

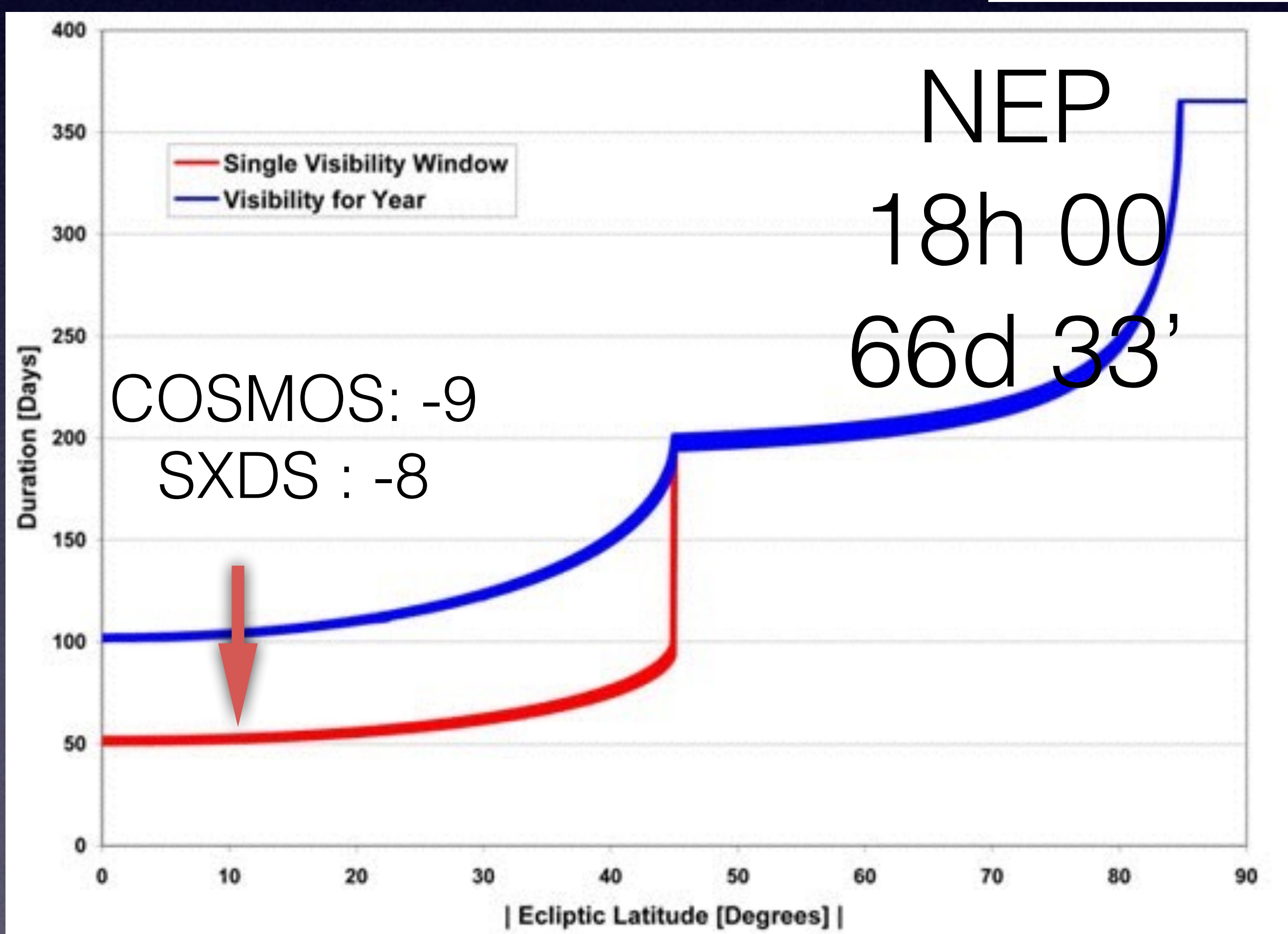
The JWST North Ecliptic Pole (NEP) Survey field is located within JWST's northern Continuous Viewing Zone, will span ˜14· in diameter (˜10· with NIRISS coverage) and will be roughly circular in shape (initially sampled during Cycle 1 at 4 distinct orientations with JWST/NIRCam's 4.4·×2.2· FoV —the JWST "windmill") and will have NIRISS slitless grism spectroscopy taken in parallel, overlapping an alternate NIRCam orientation. This is the only region in the sky where JWST can observe a clean extragalactic deep survey field (free of bright foreground stars and with low Galactic foreground extinction A_V) at arbitrary cadence or at arbitrary orientation. This will crucially enable a wide range of new and exciting time-domain science, including high redshift transient searches and monitoring (e.g., SNe), variability studies from Active Galactic Nuclei to brown dwarf atmospheres, as well as proper motions of extreme scattered Kuiper Belt and Oort Cloud Objects, and of nearby Galactic brown dwarfs, low-mass stars, and ultracool white dwarfs. We therefore welcome and encourage follow-up through GO programs of the initial GTO observations to realize its potential as a JWST time-domain community field. The JWST NEP Survey field was selected from an analysis of WISE 3.4+4.6 micron, 2MASS JHK_s, and SDSS ugriz source counts and of Galactic foreground extinction, and is one of very few such ˜10· fields that are devoid of sources brighter than m_{AB} = 16 mag. We have secured deep (m_{AB} ˜ 26 mag) wide-field (˜23·×25·) Ugrz images of this field and its surroundings with LBT/LBC. We also expect that deep MMT/MMIRS YJHK images, deep 8-12 GHz VLA radio observations (pending), and possibly HST ACS/WFC and WFC3/UVIS ultraviolet-visible images will be available before JWST launches in Oct 2018.

JWST Strategies
North Eclectic Pole

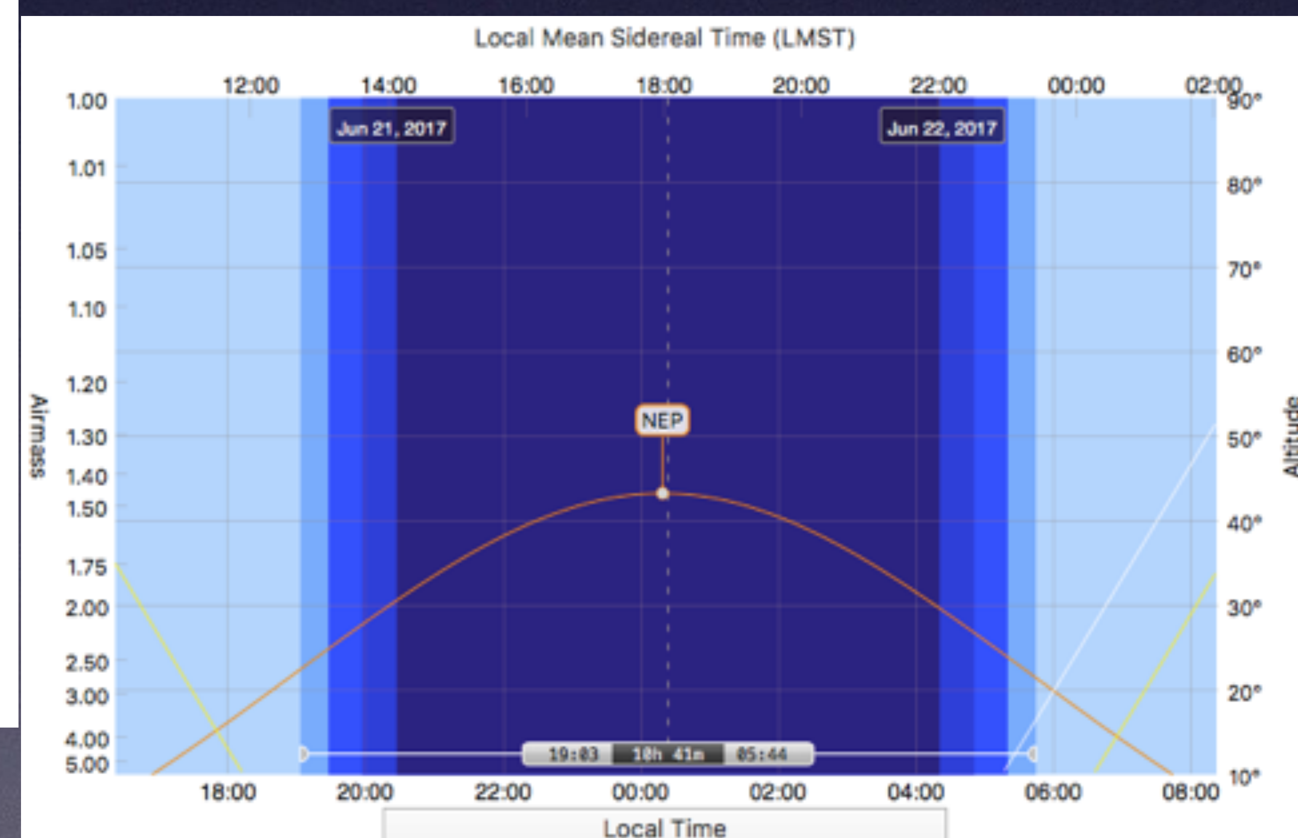
Hyper Suprime-Camera survey of the AKARI NEP Wide field

Tomotsugu Goto [1], Yoshiki Toba[2], Yousuke Utsumi[3], Nagisa Oi[4], Toshinobu Takagi[4], Matt Malkan[5], Youichi Ohayma[6], Kazumi Murata[4], Paul Price[7], Marios Karouzos[8], Hideo Matsuhara[4], Takao Nakagawa[4], Takehiko Wada[4], Steve Serjeant[9], Denis Burgarella[10], Veronique Buat[10], Masahiro Takada[11], Satoshi Miyazaki[12], Masamune Oguri[13], Takamitsu Miyaji[14], Shinki Oyabu[1], Glenn White[9], Tsutomu Takeuchi[15], Hanae Inami[1], Chris Perason[9], Katarzyna Malek[15,16], Lucia Marchetti[15], Lee HyungMoK [8], Myung Im[8], Seong Jin Kim[8], Ekaterina Koptelova[1], Dani Chao[1], Yi-Han Wu[1], AKARI NEP Survey team[4], AKARI All Sky Survey Team[4]

JWST Visibility

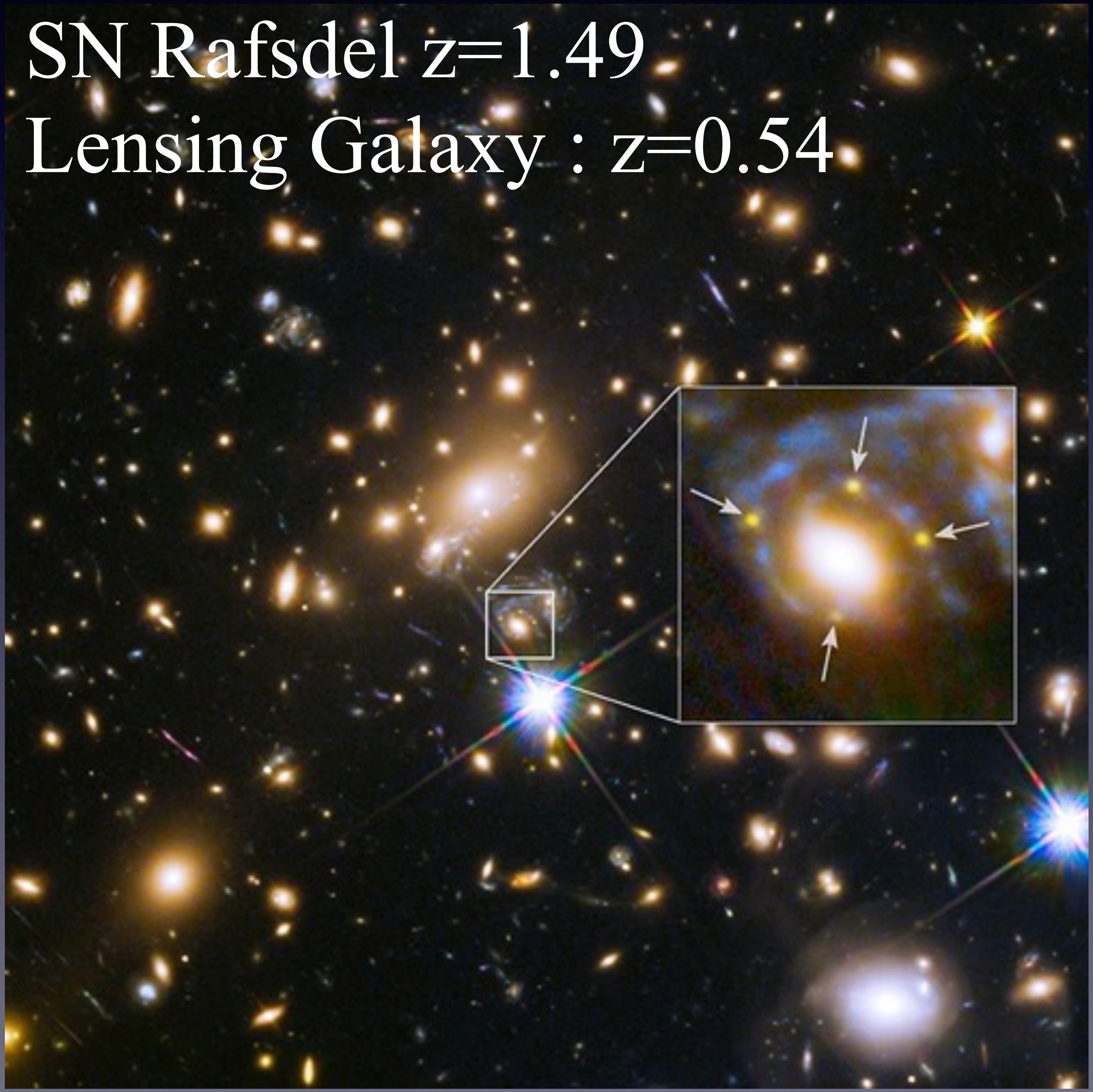


Visible : May - Aug



SNIa 5σ Events for JWST

Gravitationally Lensed Supernova



- SNIa : Great Advantage of having luminosity estimate to test lens models
- JWST is needed to resolve lensed point sources and good photometry
- Lensed SNIa : PS1-10afx is identified by Quimby et al but was not resolved

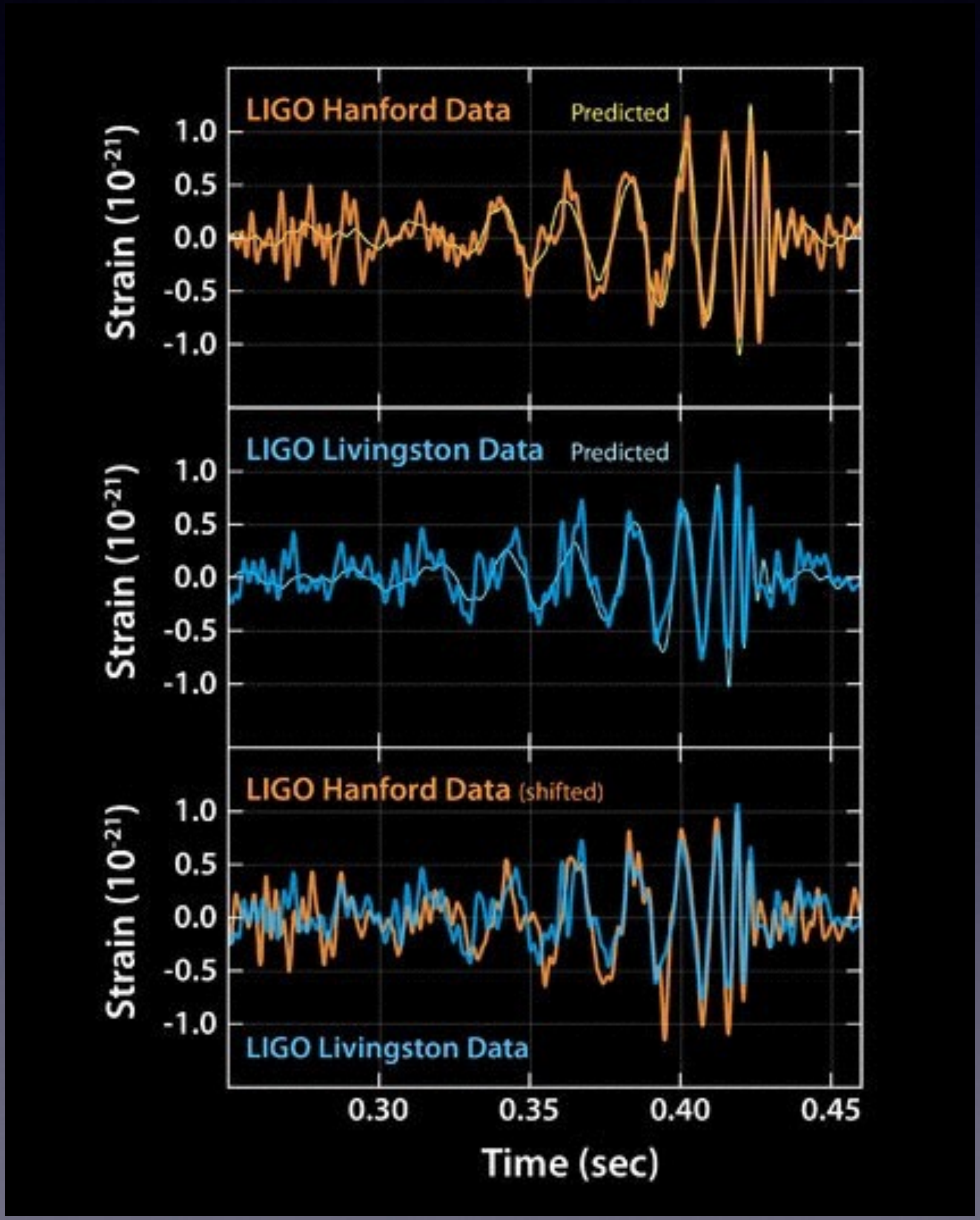
Gravitational Wave : Standard Siren
GW measures Distances

Holz & Hugh (2005)

$$M_{\text{chirp}} = (1+z)\frac{(m_1 m_2)^{3/5}}{(m_1+m_2)^{1/5}}$$

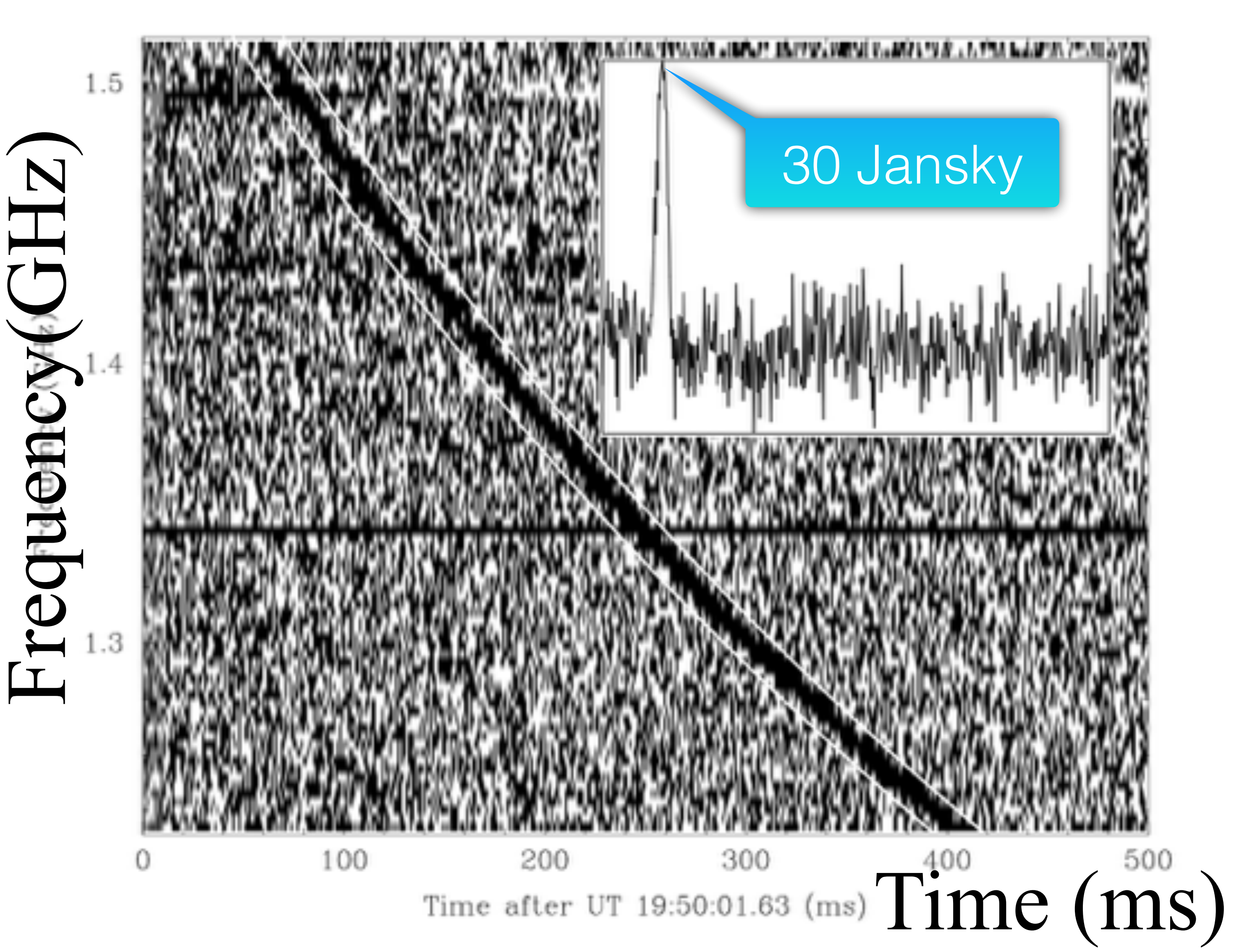
$$h(t) = \frac{M_{\text{chirp}}^{5/3} f(t)^{2/3}}{D_L} \mathrm{F}(\text{angles}) \cos[\Phi(t)]$$

f(t) : Wave Frequency
Φ(t): Phase
DL : Luminosity Distance



Finding Fast Radio Burst (FRB) Source $\Delta t = 0.001$s

- Lorimir et al (2007) reports "A Bright Millisecond Radio Burst of Extragalactic Origin"



Identified in Archival Survey : Data is taken on Aug 24 2001

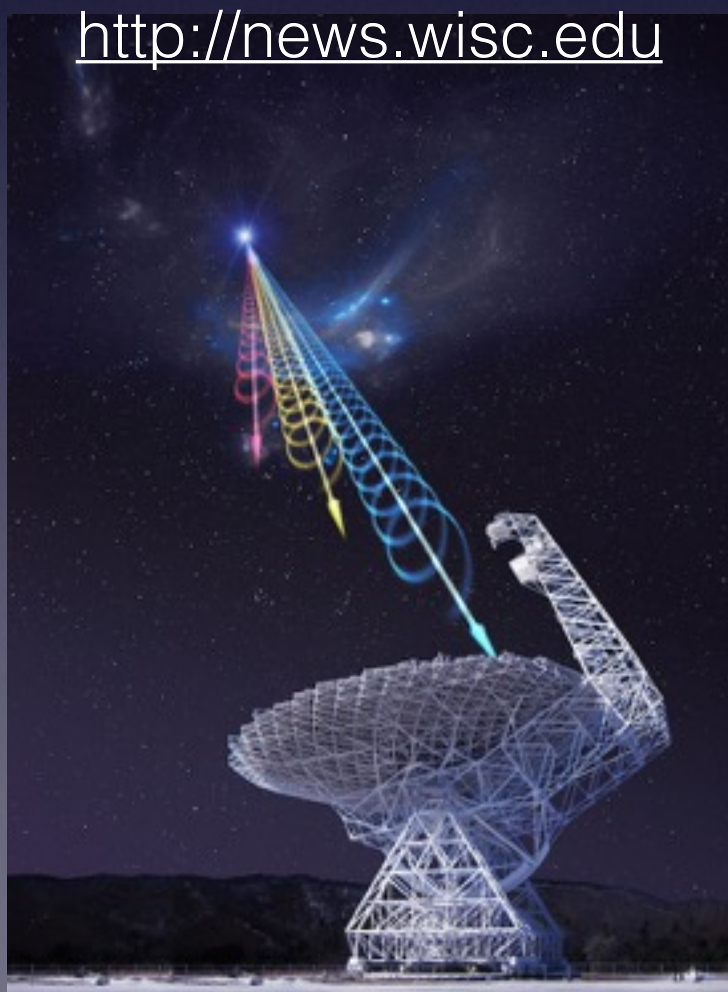
Dispersion Measure (DM) of 375 cm^{-3} pc

Science Nov 2007: Vol. 318, Issue 5851, 777

FRB : Fast Radio Burst
Distances & Reionization
JWST is needed to find the ID & redshift z

"Constraining the CMB Optical Depth through the Cosmological Radio Transients"
Fialkov & Loeb (2016)

http://news.wisc.edu



10,000 FRBs / Day !?!?

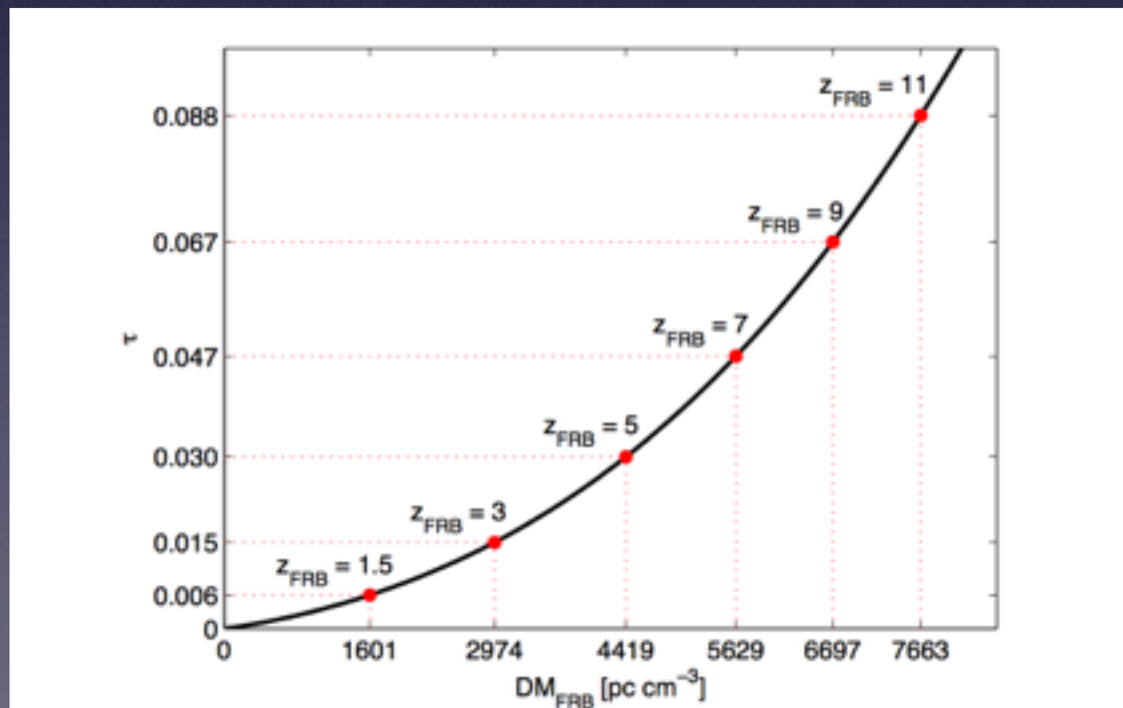


FIG. 2.— τ as a function of the DM in a fully ionized IGM. For a transient at redshift z_{FRB} the horizontal and vertical dotted lines mark $\tau(z_{FRB})$ and the DM of the transient respectively.

$$\mathrm{DM}(z) = \int_0^z \frac{n_e(z')}{1+z'} dl,$$

$$\tau(z) = \int_0^z \sigma_T n_e(z') dl,$$

FRB Host Galaxy
Kokubo et al 2017 (Poster)

z=0.193

1”=3.177kpc

Hα INTENSITY MAP OF THE REPEATING FAST RADIO BURST FRB 121102 HOST GALAXY FROM SUBARU/KYOTO 3DII AO-ASSISTED OPTICAL INTEGRAL-FIELD SPECTROSCOPY*

Mitsuru Kokubo,[1,†] Kazuma Mitsuda,[2,3] Hajime Sugai,[4] Shinobu Ozaki,[5] Yosuke Minowa,[6] Takashi Hattori,[6] Yutaka Hayano,[5] Kazuya Matsubayashi,[5] Atsushi Shimono,[4] Shigeyuki Sako,[3] and Mamoru Doi[3,7]

[1]Astronomical Institute, Tohoku University, 6-3 Aramaki, Aoba-ku, Sendai, Miyagi 980-8578, Japan

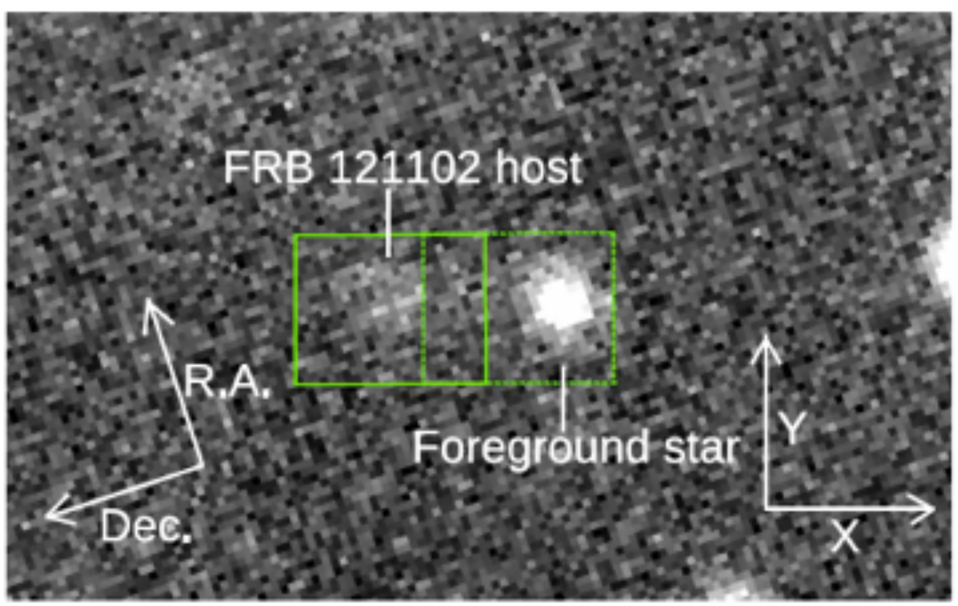


Figure 1. Keck/LRIS optical *R*-band image (0″.135/pixel) of the host galaxy of FRB 121102 ($R = 24.9 \pm 0.1$ AB mag; Chatterjee et al. 2017). Solid and dashed squares denote the Subaru/Kyoto 3DII 3″.21 × 2″.52 FoV locations in which the integral-field spectra of the host galaxy and the no-grism image of the $i = 22.7$ AB mag foreground star are obtained, respectively.

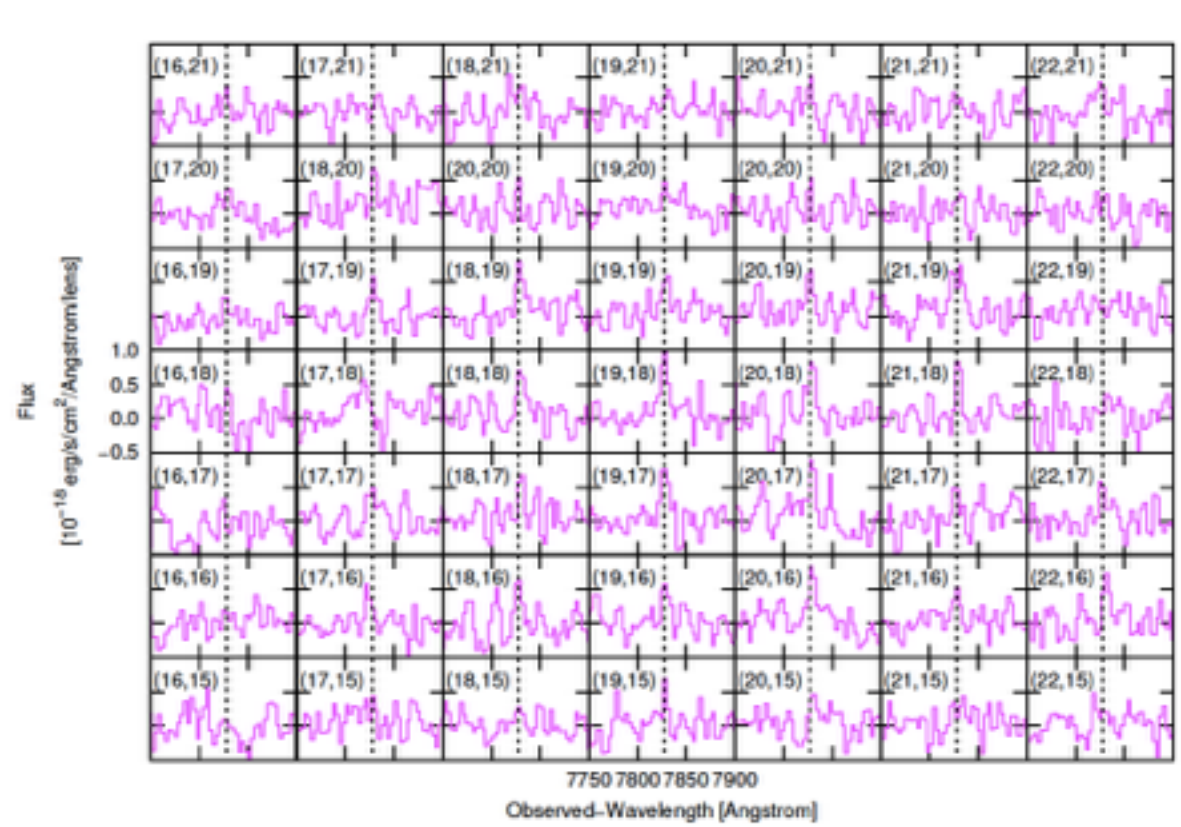
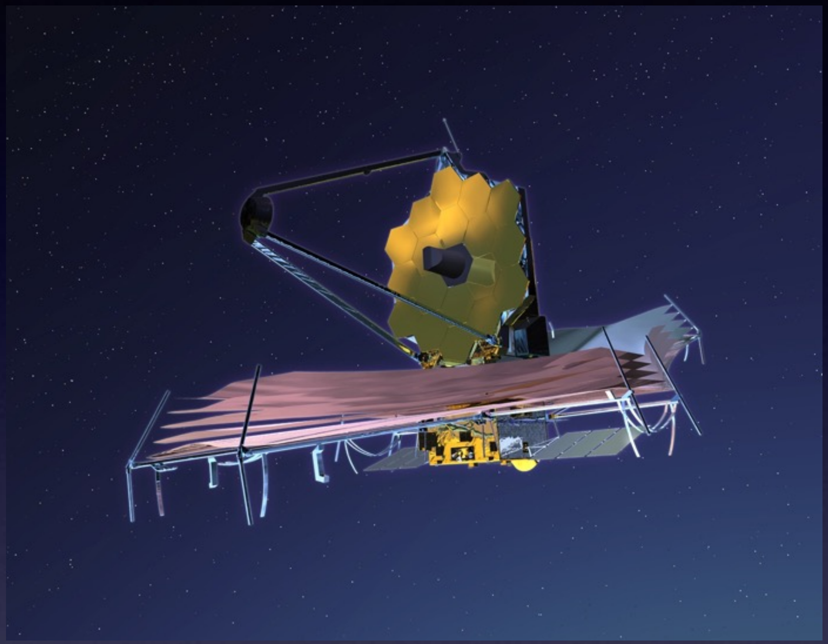


Figure 2. Kyoto 3DII IFU spectra at spaxels around the spaxel with peak Hα intensity $(X, Y) = (19, 18)$ at wavelengths around the rest-frame Hα emission (1 lens = 1 spaxel = 0″.0868 × 0″.0868). Galactic extinction is corrected. Dotted lines indicate the observed-frame wavelength of Hα at a redshift of $z = 0.19273$ (Tendulkar et al. 2017).

Subaru PFS Follow-up

Conclusion : "Must Try JWST"
Let's write JWST Cylcle 1 : Proposal
Release Nov 2017 - Deadline Mar 2nd 2018



Important Dates

Rows are color coded by opportunity, where red = GTO, green = DD ERS, and white = Cycle 1 GO

Release of the Cycle 1 Call for GTO Proposals	January 6, 2017
Release of the Cycle 1 Call for DD ERS Notices of Intent	January 6, 2017
DD ERS Letters of Intent due	March 3, 2017, 8pm ET
Cycle 1 GTO Science Descriptions and Observation Specifications due	April 1, 2017, 8pm ET
Release of the Cycle 1 Call for DD ERS Proposals	May 19, 2017
APT version 25.1 Released (with updated Cycle 1 overhead calculations)	June 1, 2017
GTO Observation Specifications Published (public)	June 15, 2017
APT version 25.2 Released (primarily HST updates)	June 21, 2017
GTO APT Technical Reviews and Revisions Begin	July 28, 2017
DD ERS Proposal Deadline	August 18, 2017, 8pm ET
GTO APT Technical Reviews and Revisions End	September 15, 2017
APT version 25.4 Released (further updates for Cycle 1 GO Call)	November 1, 2017
DD ERS Results Released	November 2017
Release of the Cycle 1 Call for GO Proposals	November 30, 2017
Formal DD ERS Budget Proposals	Early December 2017
GTO APT Files Published (public)	December 15, 2017
DD ERS APT Files Published (public)	December 2017
Cycle 1 GO Proposal Deadline	March 2, 2018

Cycle 1 Dead Line

Summary : JWST "MUST DO Science"

Let's find the best target from HSC!

1 object (100pix) / 25 HSC Trillion Pixels (SSP)

1 / 10^{10}

One in 10 Billion

Discoveries are waiting for us in Deep Space

Lottery

1/20 Million