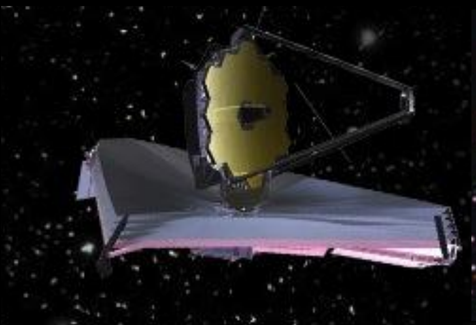
Transit Spectra with the James Webb Space Telescope

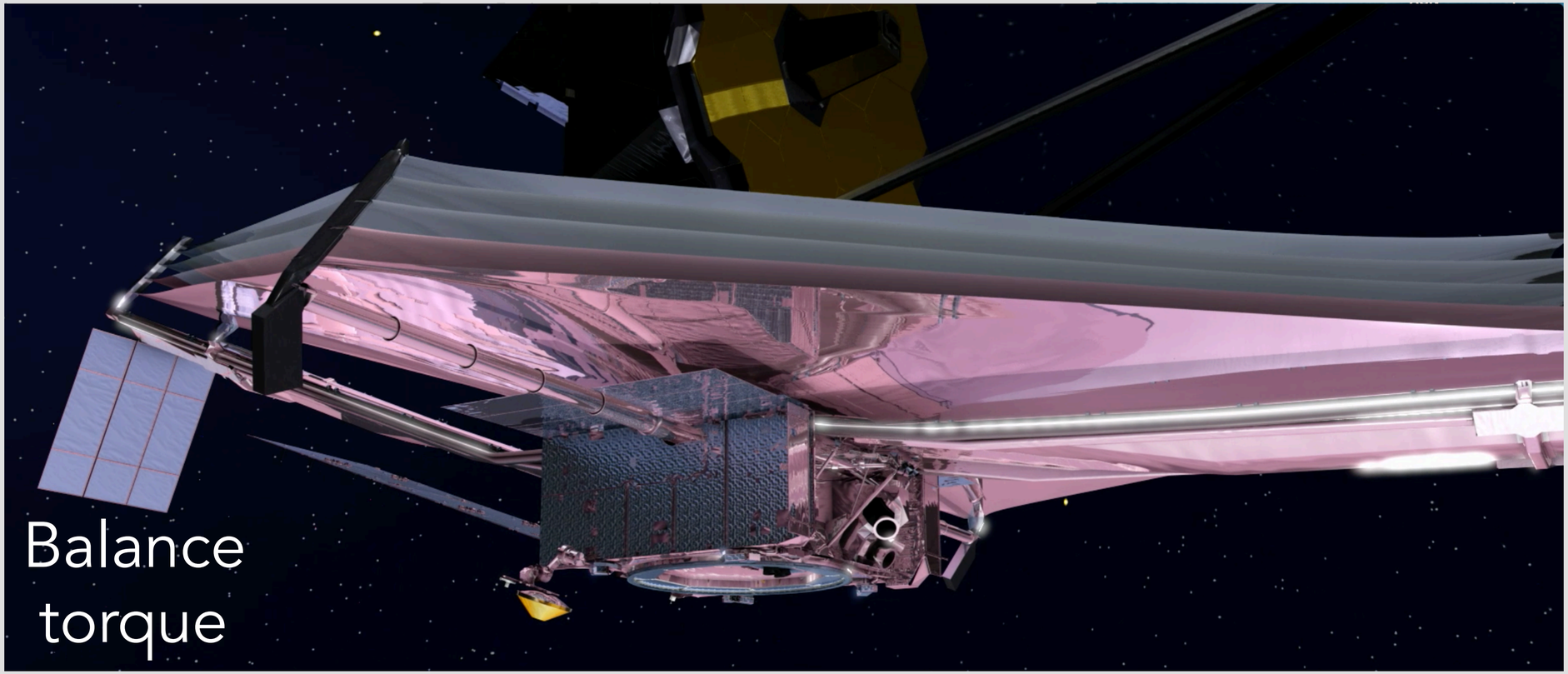
Nikole K. Lewis
JWST Project Scientist
Space Telescope Science Institute



Sagan Summer Work 2016
Is There a Planet in My Data?


Mission Elapsed Time
00:00:00:00
DAY HOUR MIN SEC

Spacecraft on hot side of sunshield

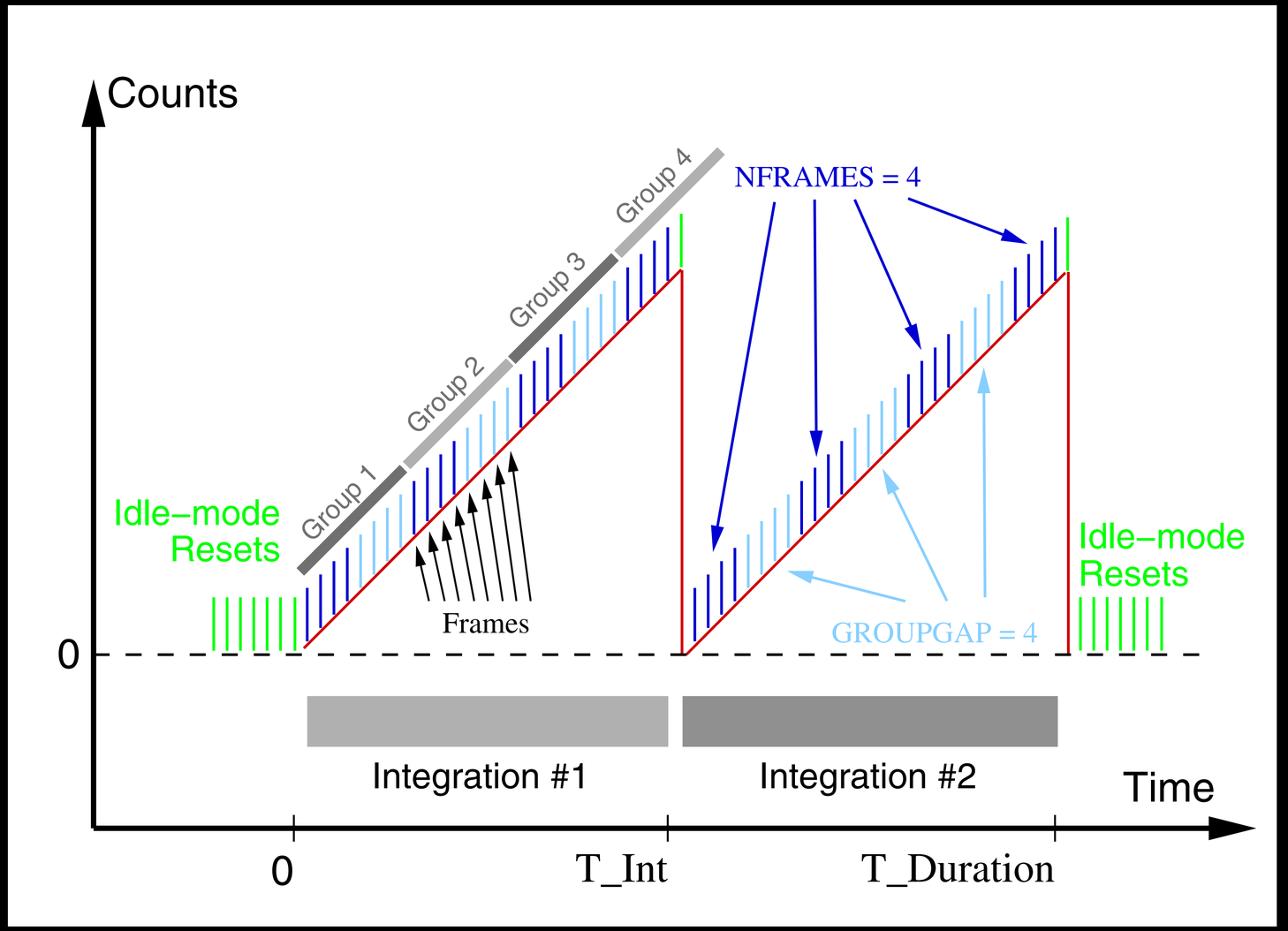


Steerable!!!!

High gain
antenna

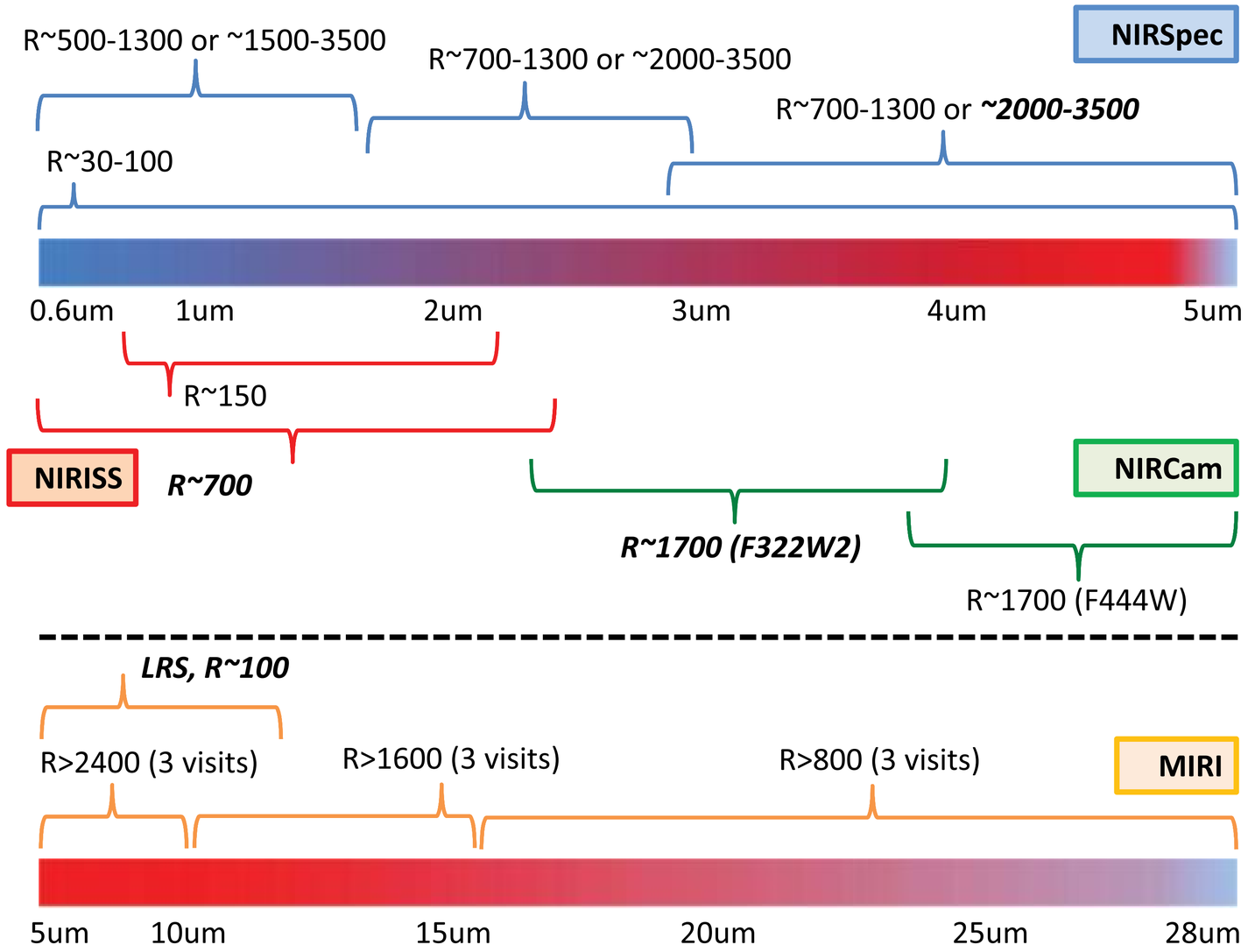
Star
trackers

JWST Detector Operations



Beichman et al (2014)

The *Webb* Complement of Spectroscopic Modes



Beichman et al (2014)

NIRISS SOSS (0.6 - 2.8 microns)

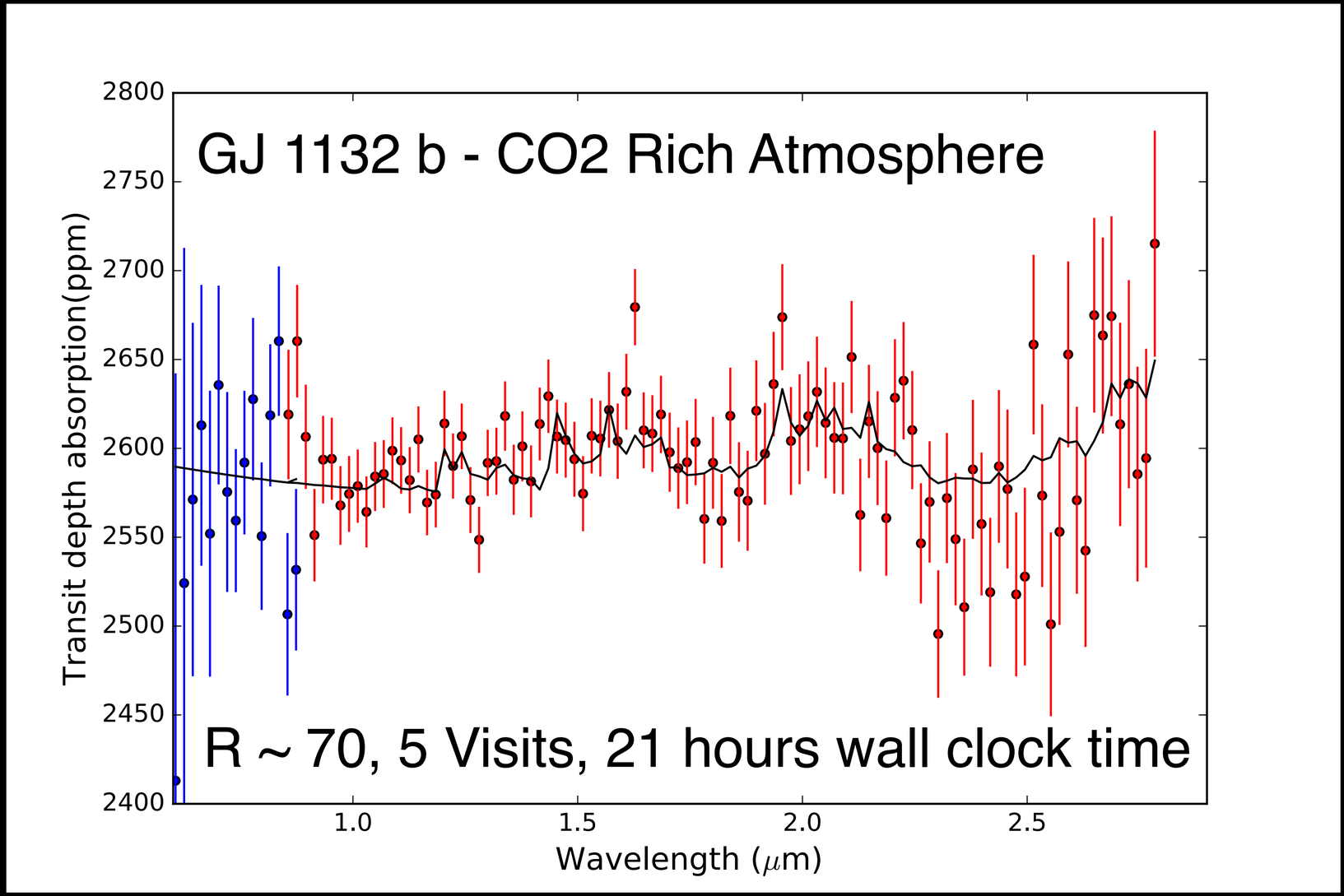
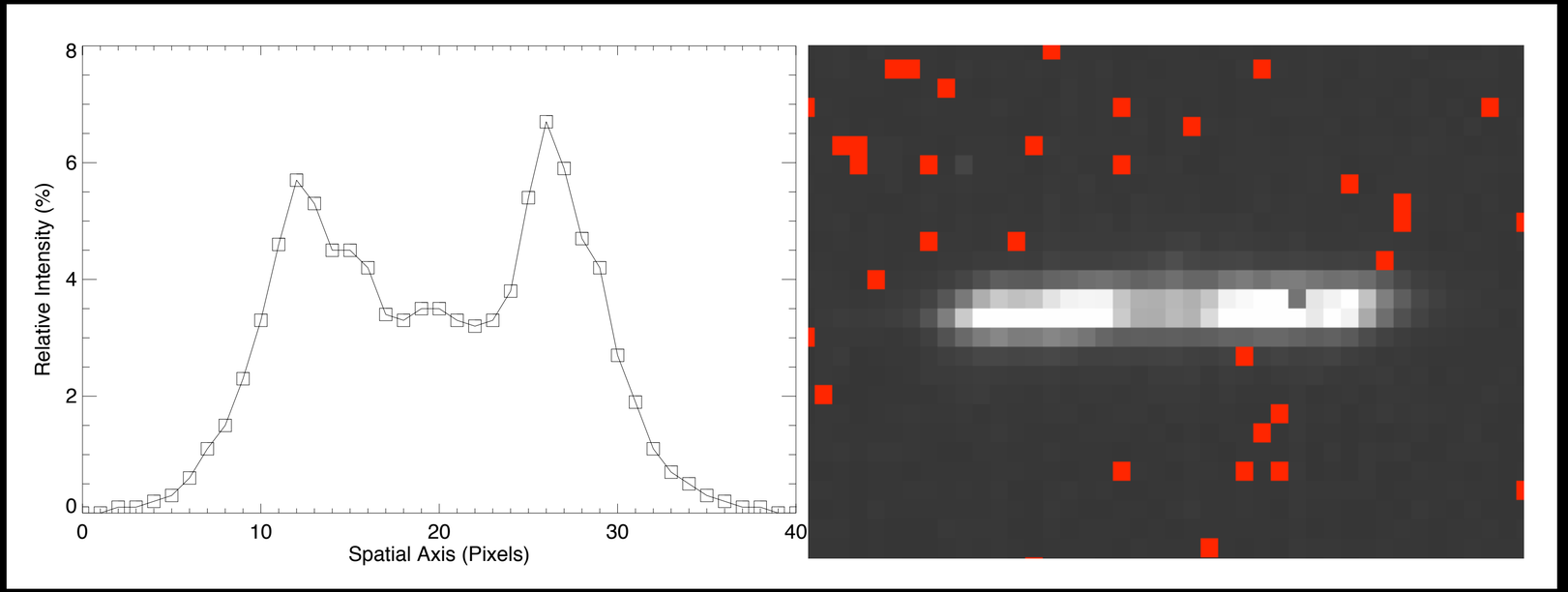
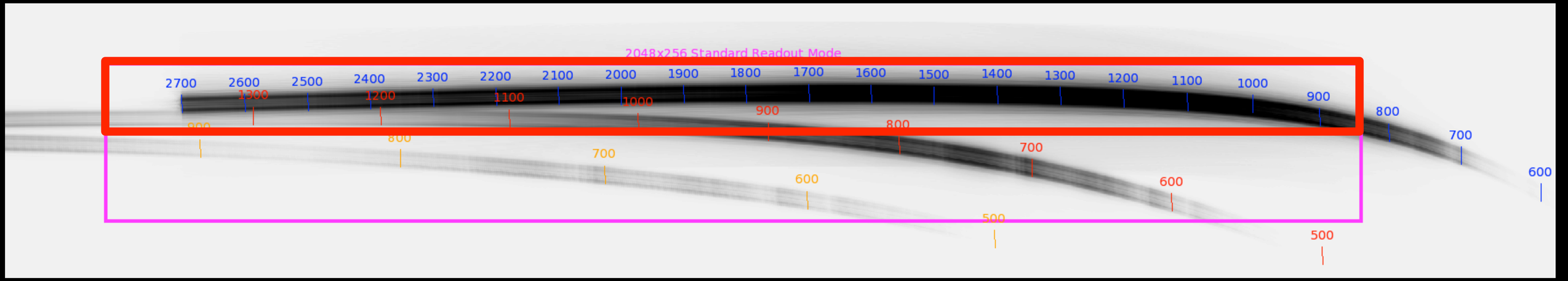


Figure Courtesy of Rene Doyon (UdeM), Models E. Kempton (Grinnell)

NIRISS SOSS
0.6 - 2.8 microns



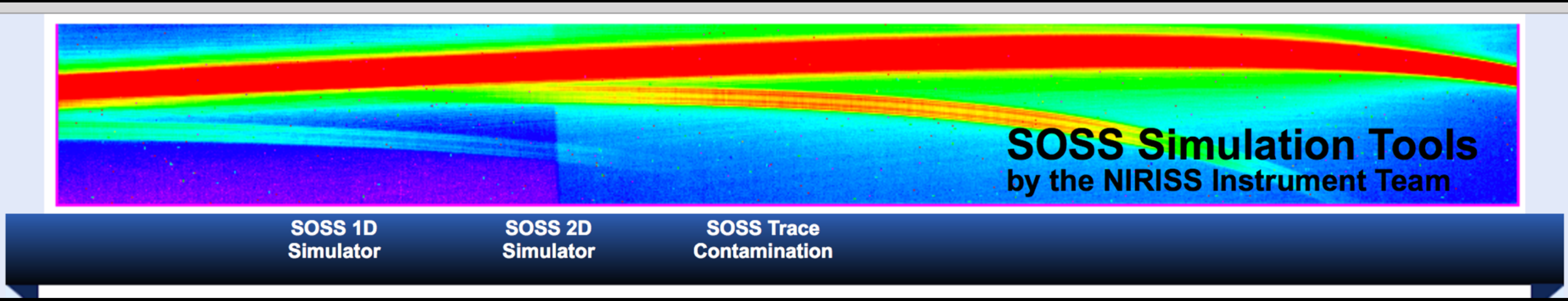
Beichman et al (2014)



Saturation Limits: J~7.2 (256 x 2048 subarray) J~6.2 (96 x 2048 subarray)

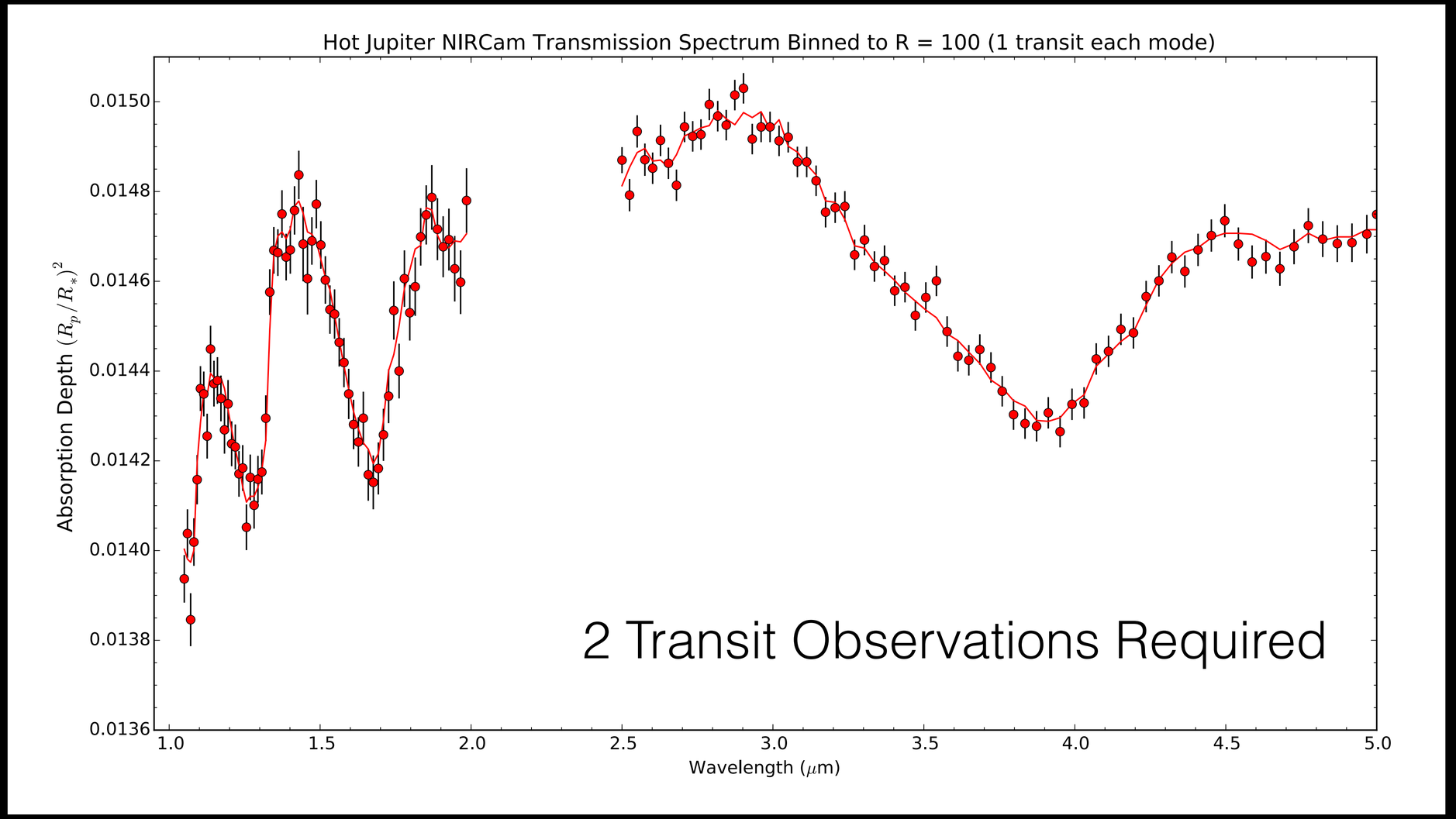
NIRISS SOSS
0.6 - 2.8 microns

On Line Tools



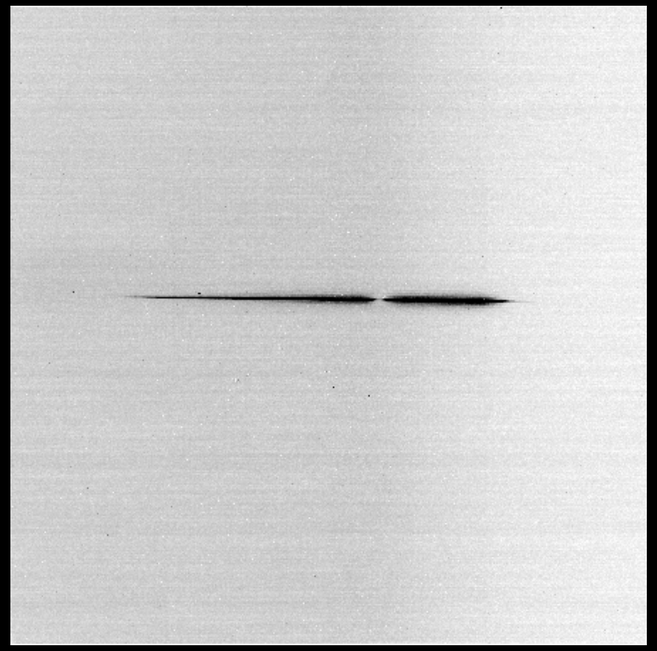
maestria.astro.umontreal.ca/niriss/simu1D/simu1D.php

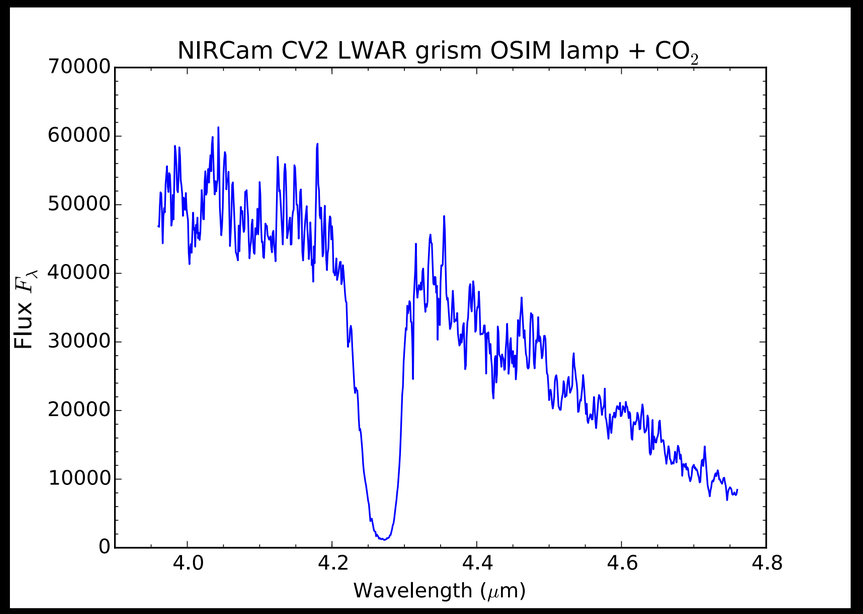
NIRCam Grisms (1 - 5 microns)



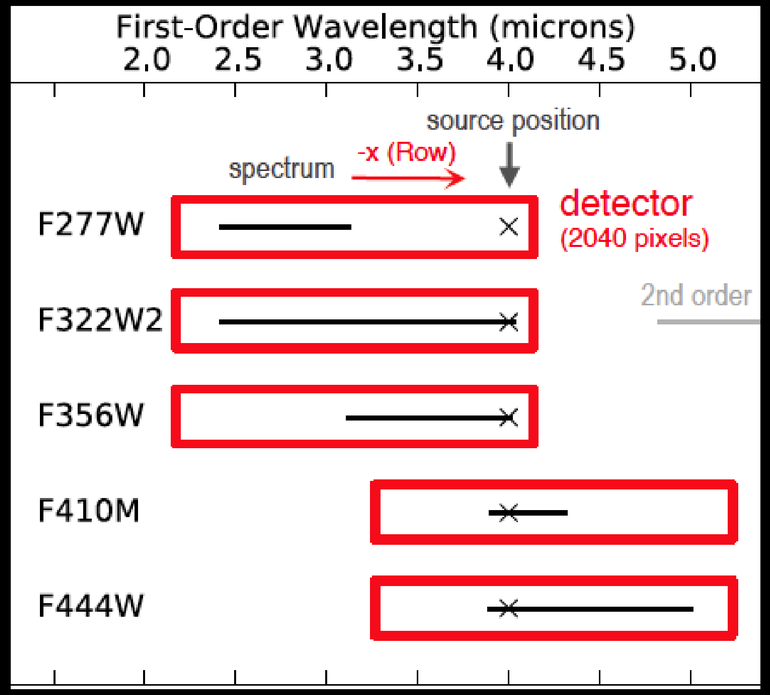
Greene et al. (2016) - SPIE

NIRCam Grisms
1 - 5 microns





Long Wavelength (LW) Grisms



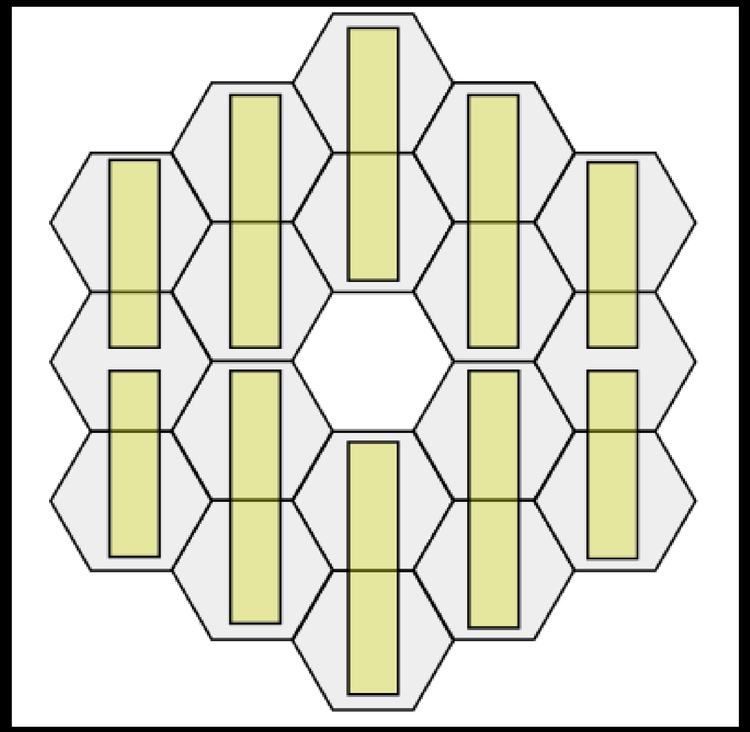
Greene et al. (2016) - SPIE

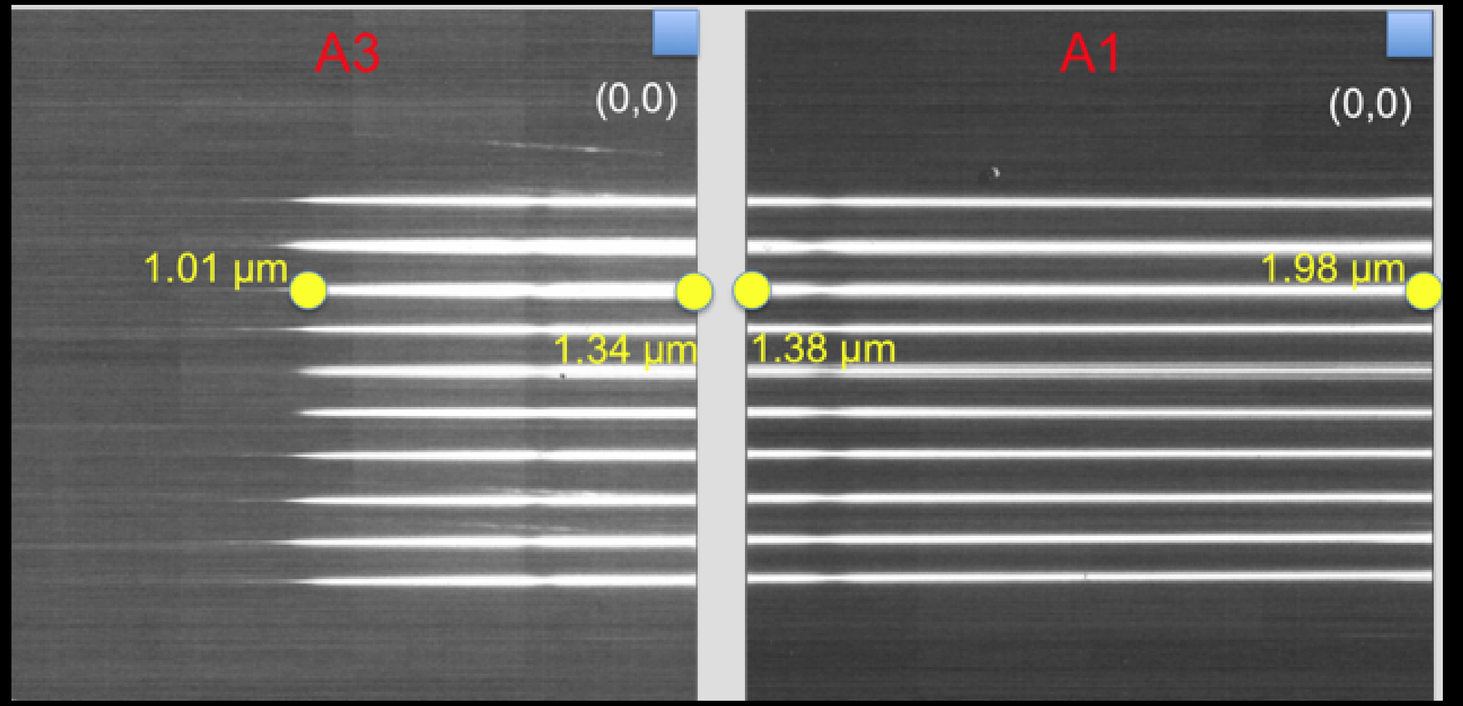
Subarrays: 64 x 2048
128 x 2048
256 x 2048
2048 x 2048

1 or 4 amp (“stripe mode”) output

NIRCam Grisms
1 - 5 microns

Dispersed Hartmann Sensors (DHS)

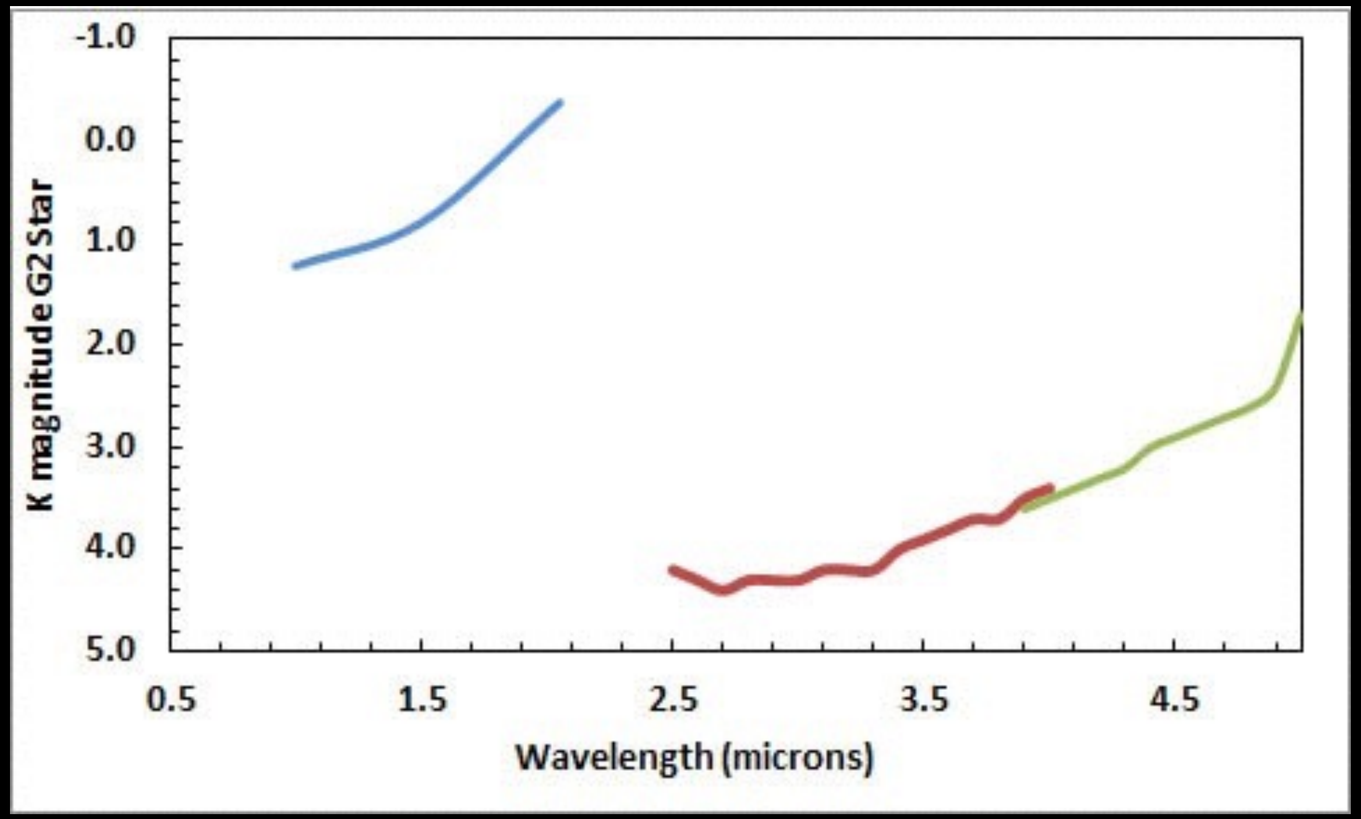




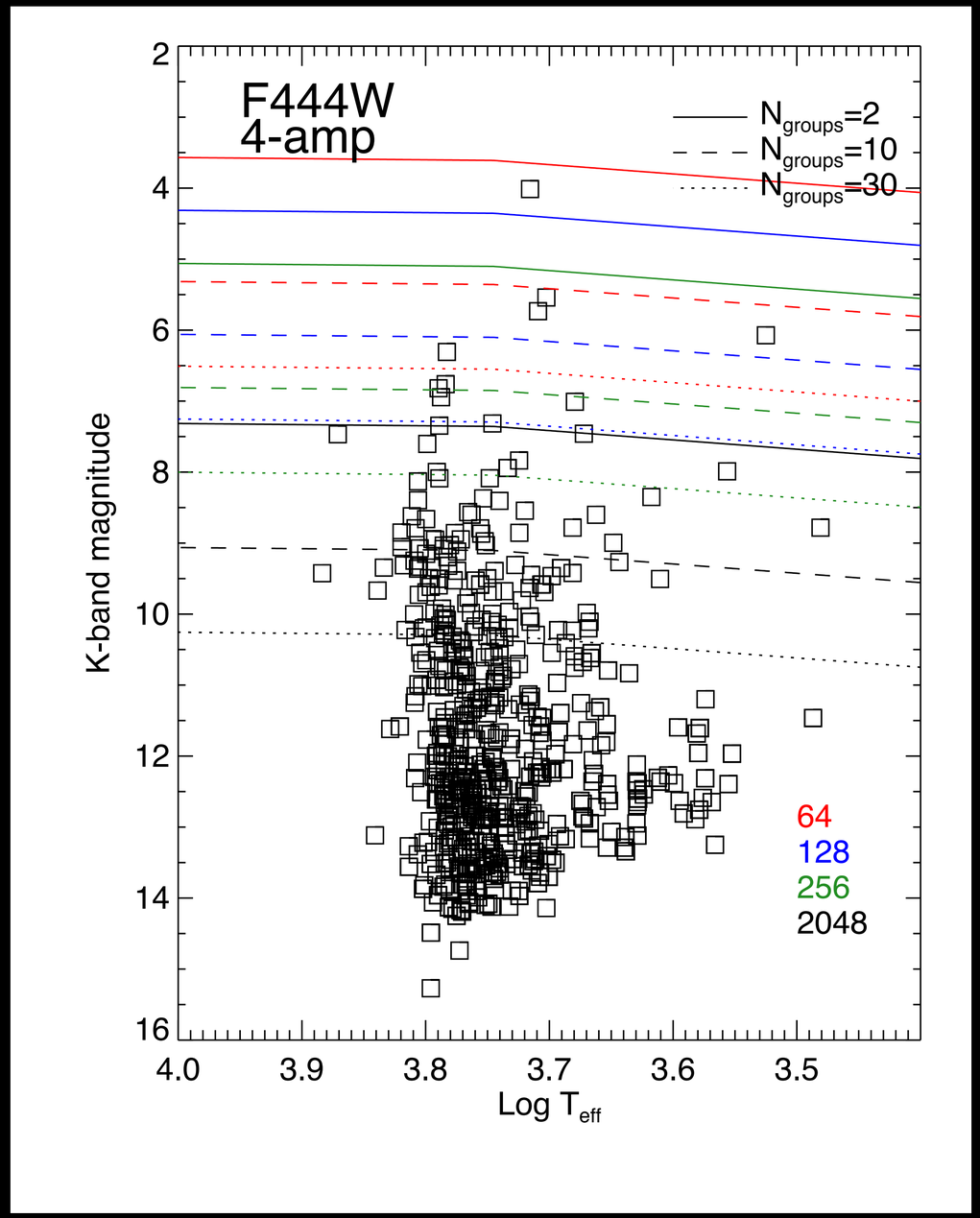
Greene et al. (2016) - SPIE

Not Currently Available for Science Operations, Stay Tuned!!!!

NIRCam Grisms
1 - 5 microns



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



NIRSpec Fixed “Slit”, 0.6 - 5 microns

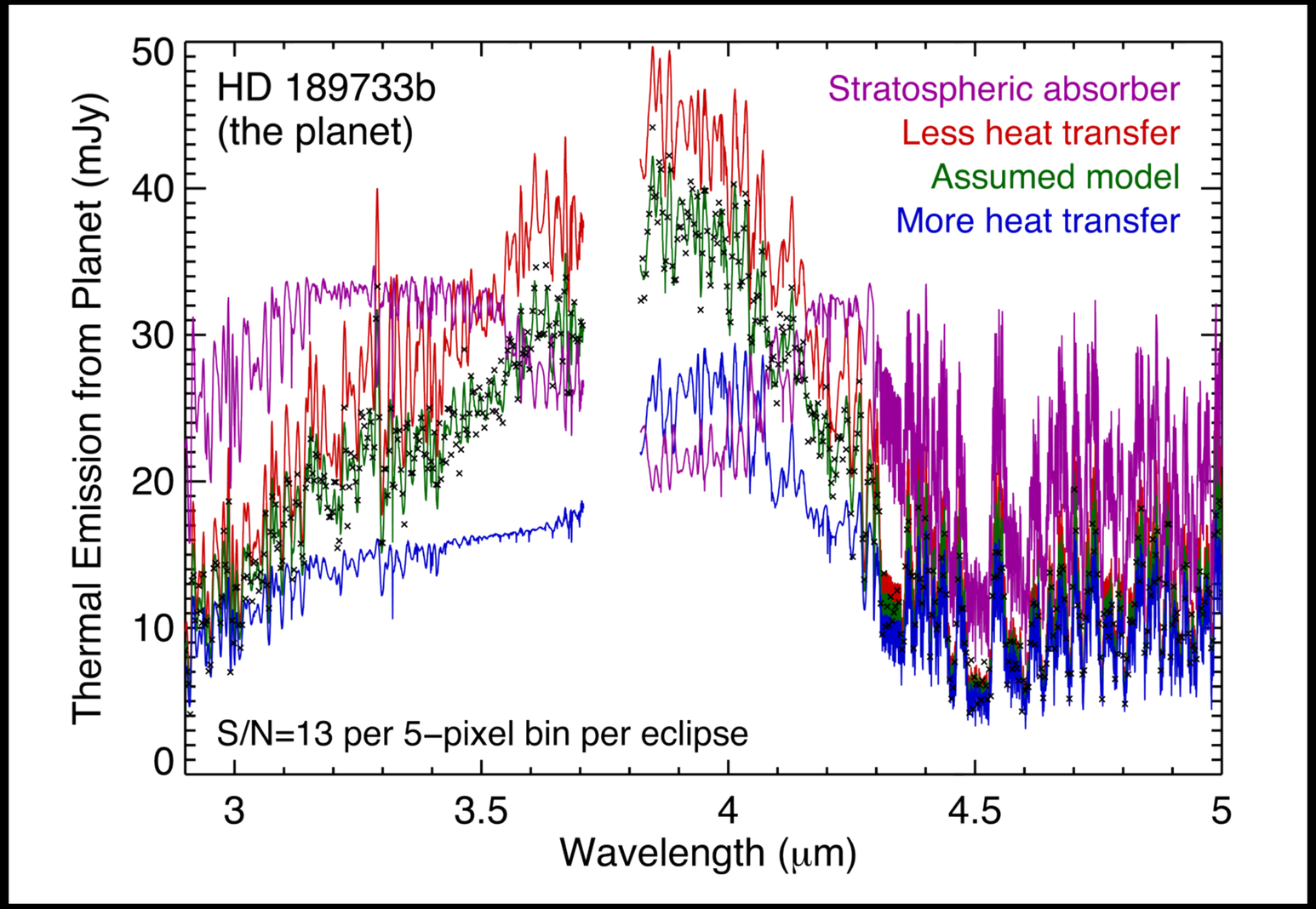
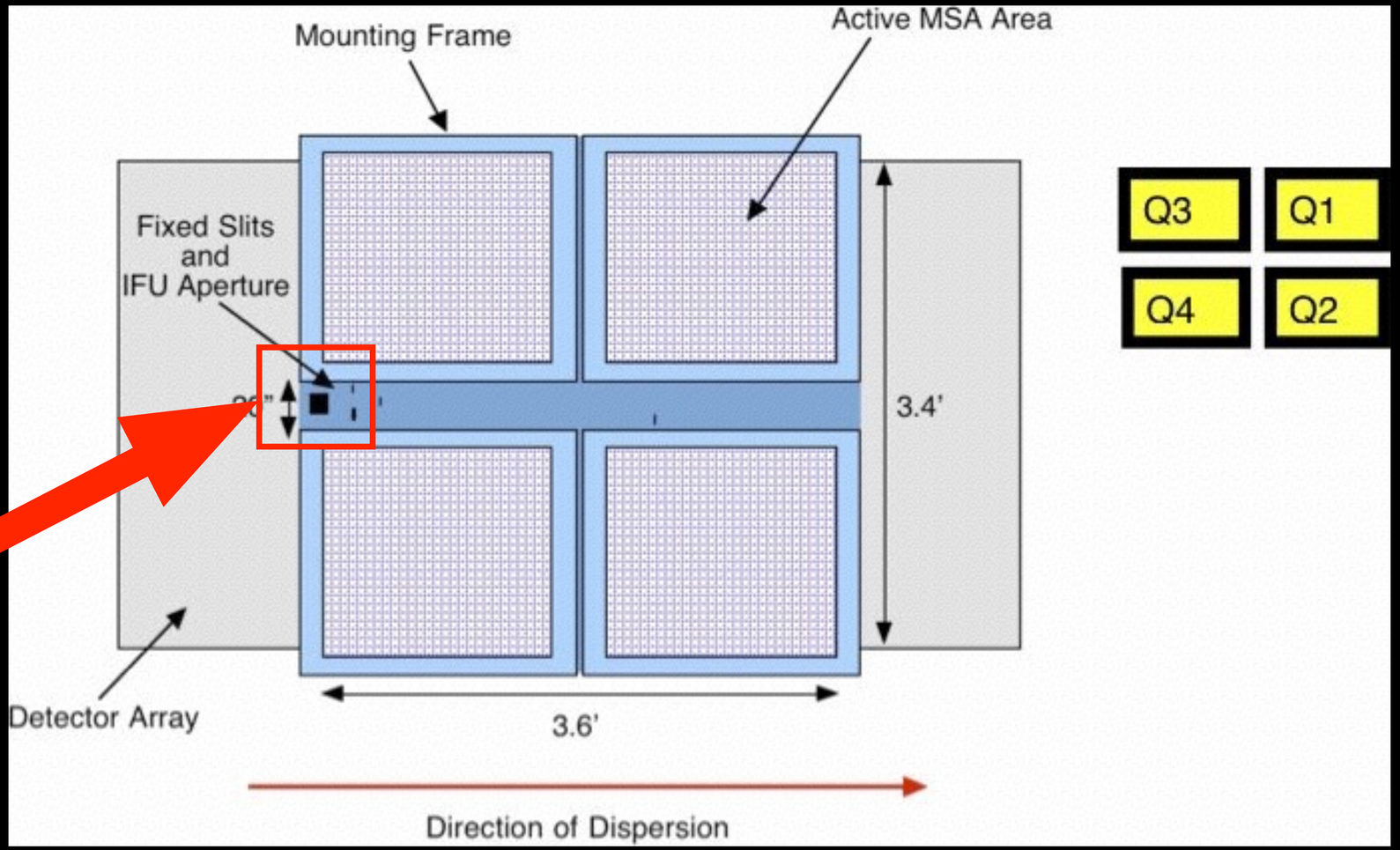


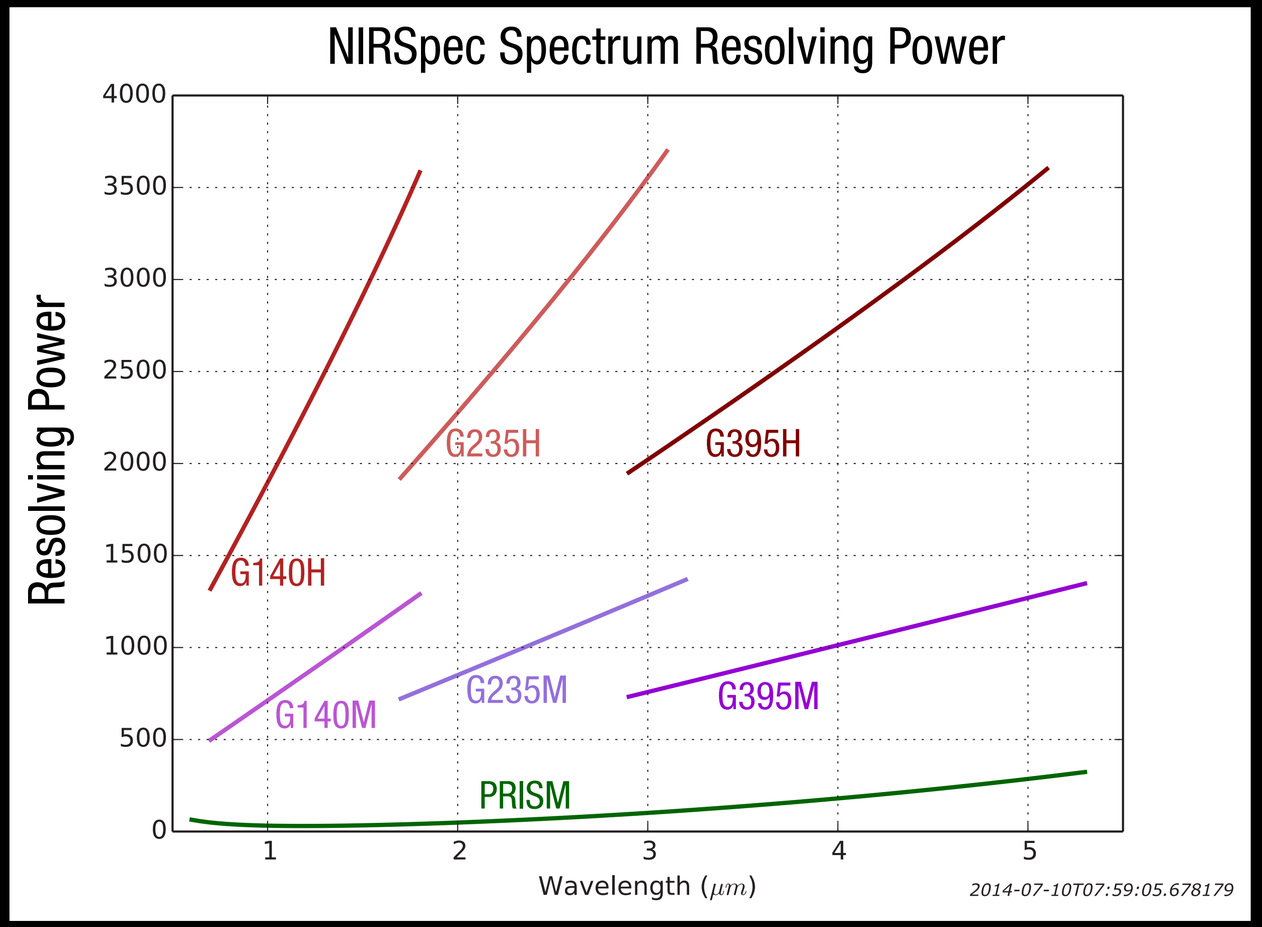
Figure Courtesy of Jeff Valenti (STScI), Models from Burrows et al. (2009)

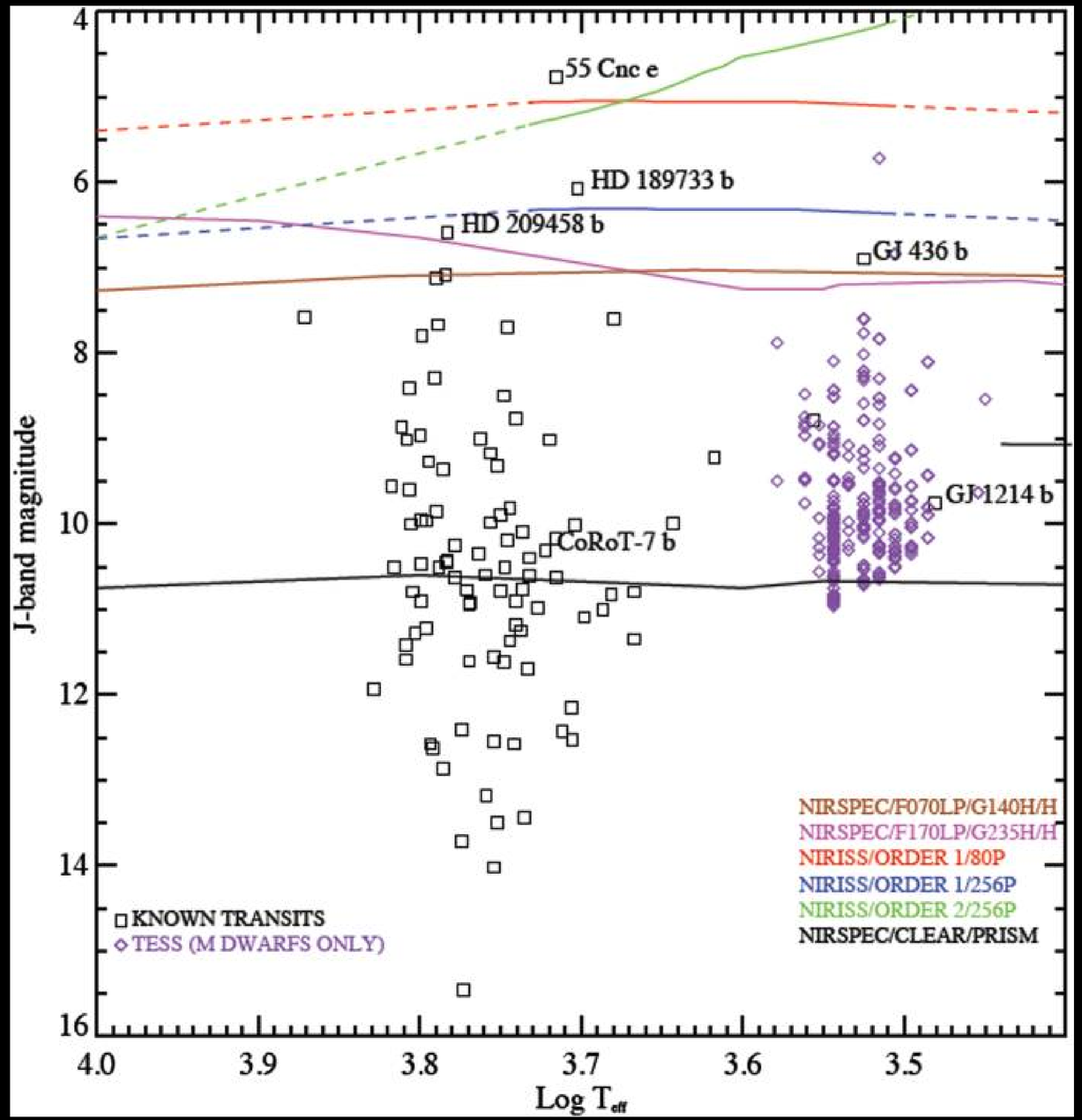
NIRSpec Fixed “Slit”
0.6 - 5 microns



1.6” x 1.6” large aperture

NIRSpec Fixed “Slit” 0.6 - 5 microns





Beichman et al (2014)

MIRI LRS, 5 - 12 microns

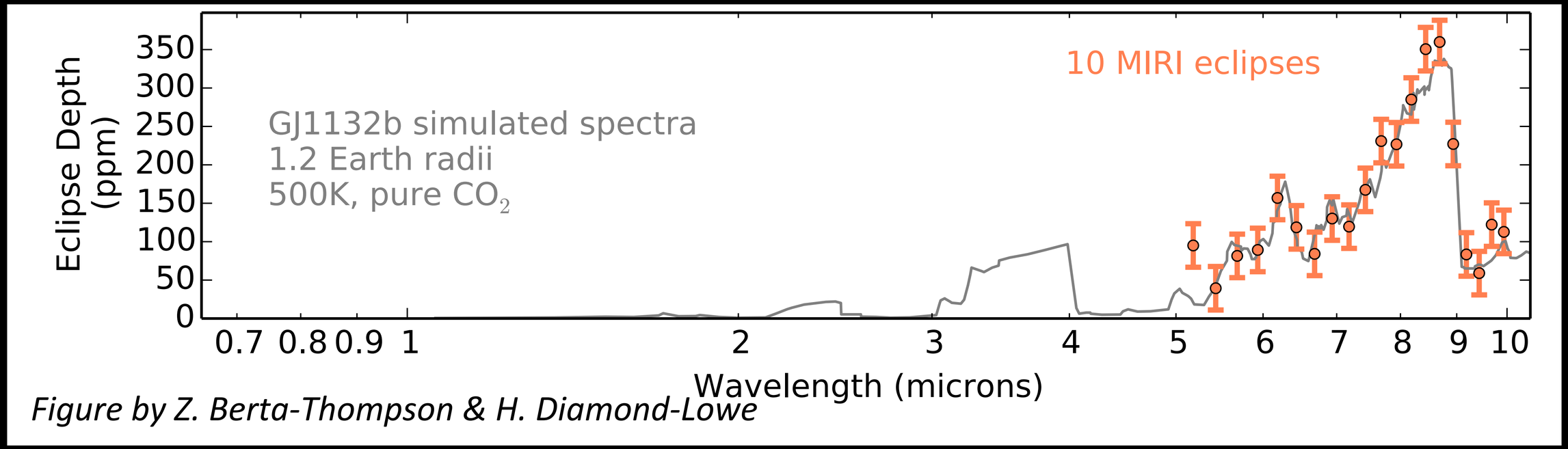
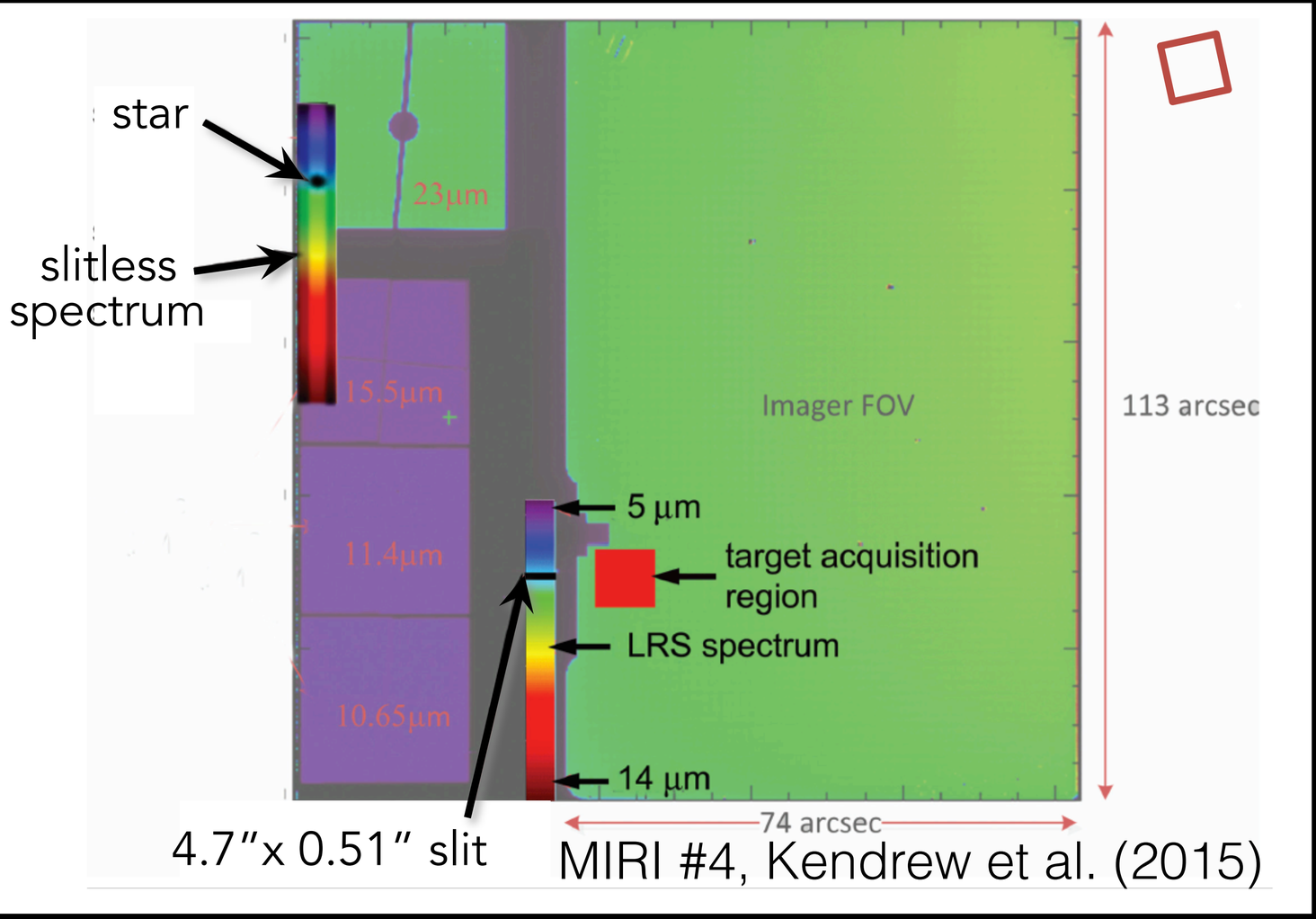


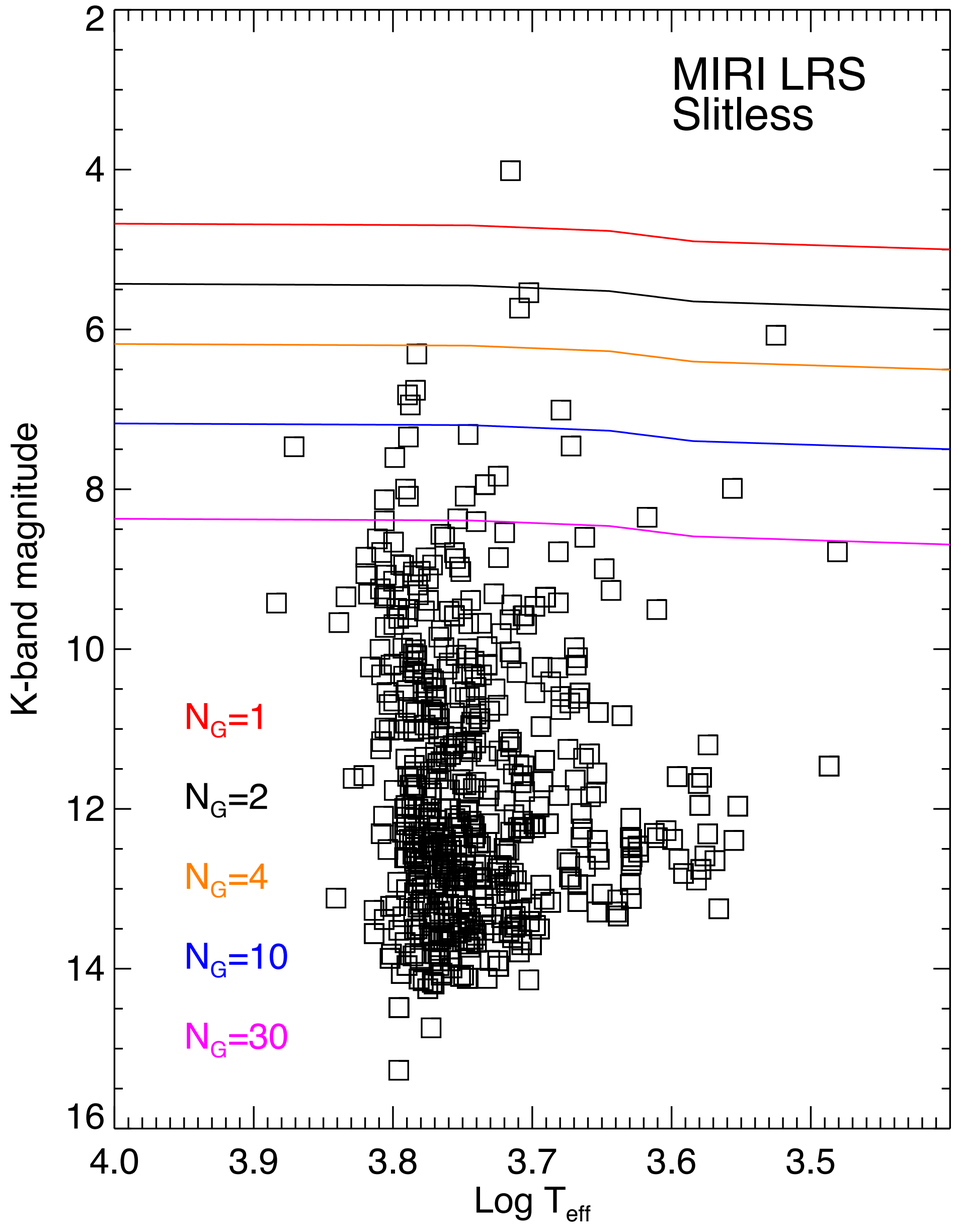
Figure by Z. Berta-Thompson & H. Diamond-Lowe

We will probe exoplanets at wavelengths beyond 5 microns for the first time since the end of the *Spitzer* Cryogenic Mission!!!!!

MIRI LRS
5 - 12 microns



MIRI #4, Kendrew et al. (2015)



Pandexo Dashboard New Calculation PennState Center for Exoplanets and Habitable Worlds SPACE TELESCOPE SCIENCE INSTITUTE Operated for NASA by AURA NASA

An Exoplanet ETC

Tools to help the community with planning exoplanet observations.

Instrument Information

Here you will find photon-electron conversion efficiency figures for time series modes and other helpful planning information.

View details »

Exoplanet Simulations

Here you will find a data base of simulations for known exoplanets.

View details »

Tables from Paper...

Here I'd like to put tables from the paper with magnitude limits for different molecular features

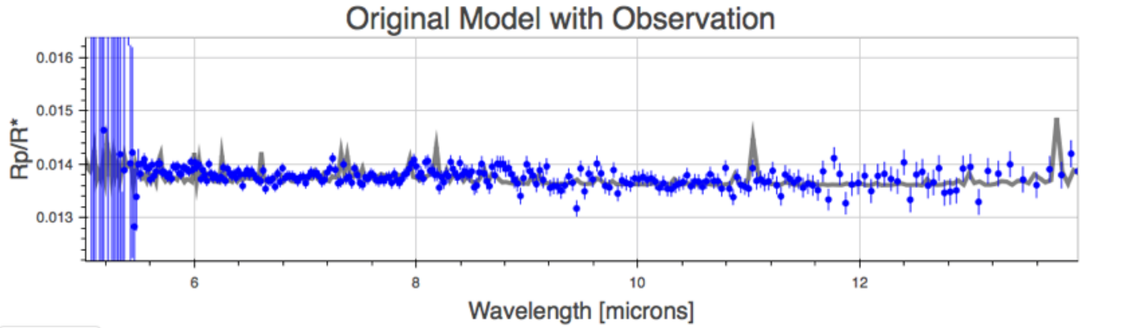
View details »

Pandexo Dashboard New Calculation

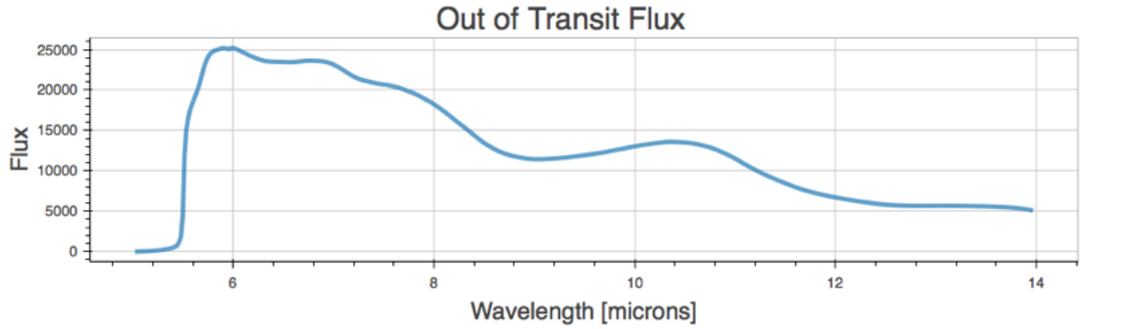
Analyze

1D Plots | 2D Images | Timing Info | Warnings

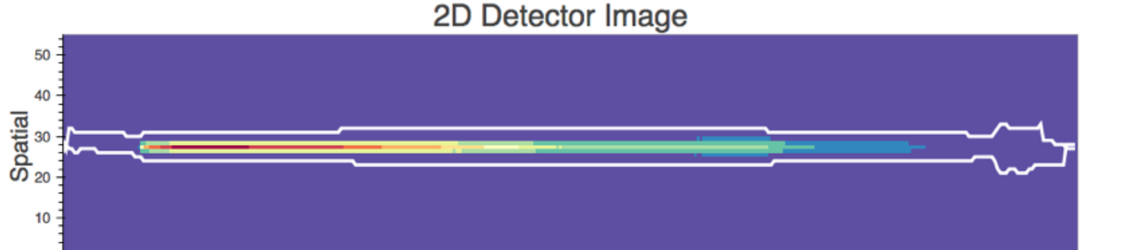
1D Plots



Total Flux | Background Flux | SNR | Error | Not Happy?



2D Images



Pandexo Dashboard New Calculation

Table of Original Inputs

All inputs used for the calculation

	Component	Values
0	Filter	f070lp
1	Instrument	nirspec
2	Target Mag	8
3	Mode	fixed_slit
4	Saturation Level (electons)	48000
5	Aperture	s1600a1
6	Subarray	s1600a1
7	Disperser	g140m
8	Readmode	nrsrapid

Timing Info

All the timing info needed for your observation. Overhead calculation assumes 30 minute target acquisition time.

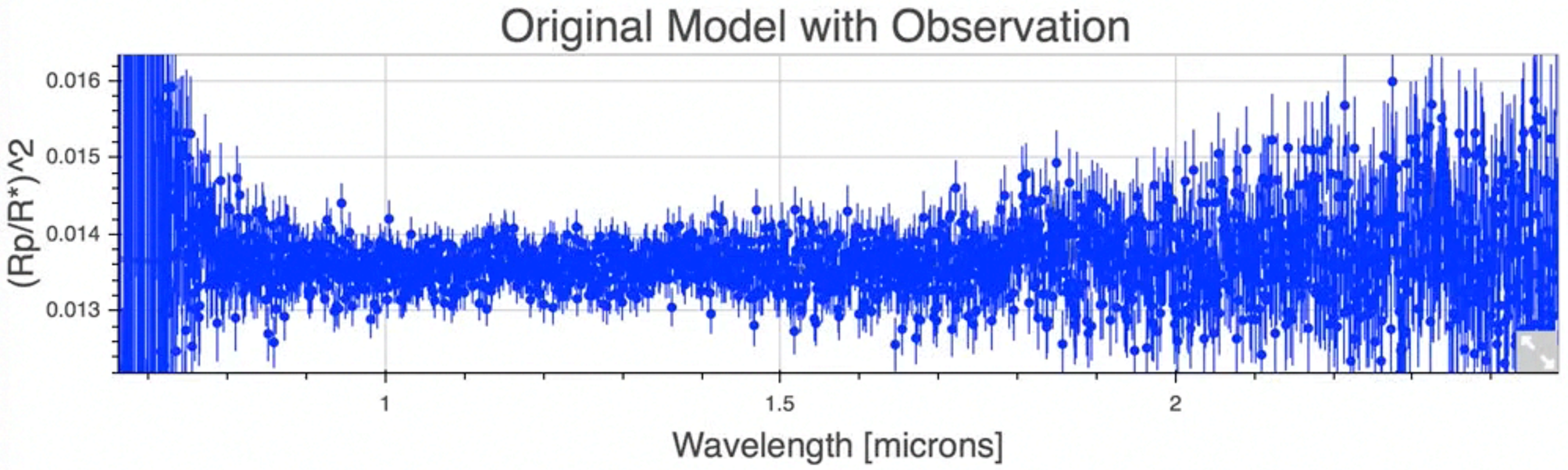
	Timing Info	Values
0	Seconds per Frame	0.216000
1	Exposure Time Per Integration (secs)	1.080000
2	Reset time Plus TA time (hrs)	1.194440
3	Num Integrations In Transit	5787.000000
4	Num Groups per Integration	6.000000
5	Num Integrations Out of Transit	5787.000000
6	Observing Efficiency (%)	71.428571
7	Num Integrations per Occultation	11574.000000
8	Number of Transits	2.000000
9	Observing Hours	8.333280

Warnings

Pay attention to these warnings! If you do not see 'All good' written in each box, reconsider your run.

	Check	Status
0	Non linear?	All good
1	Group Number Too Low?	All good

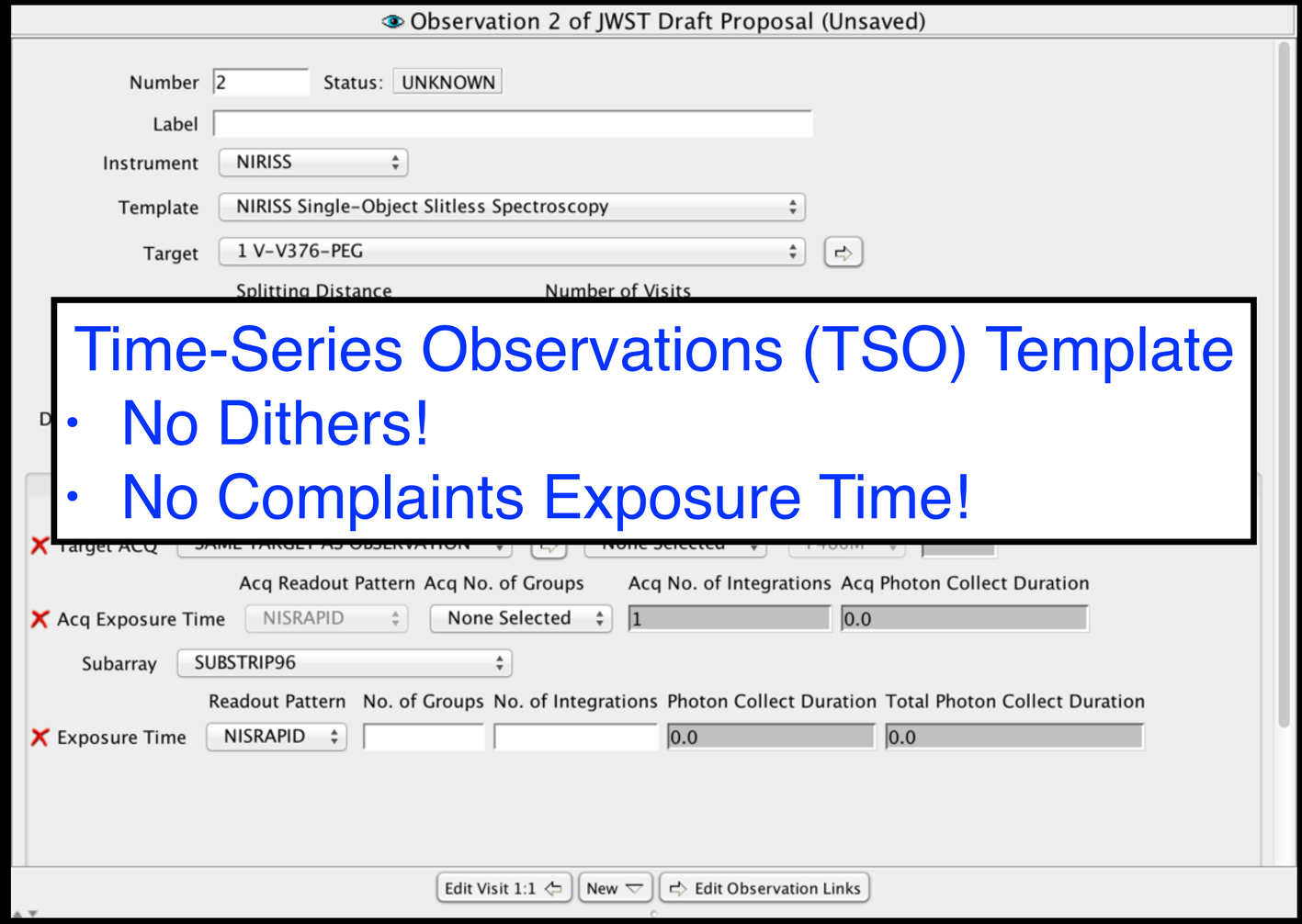
binning: -3.06867



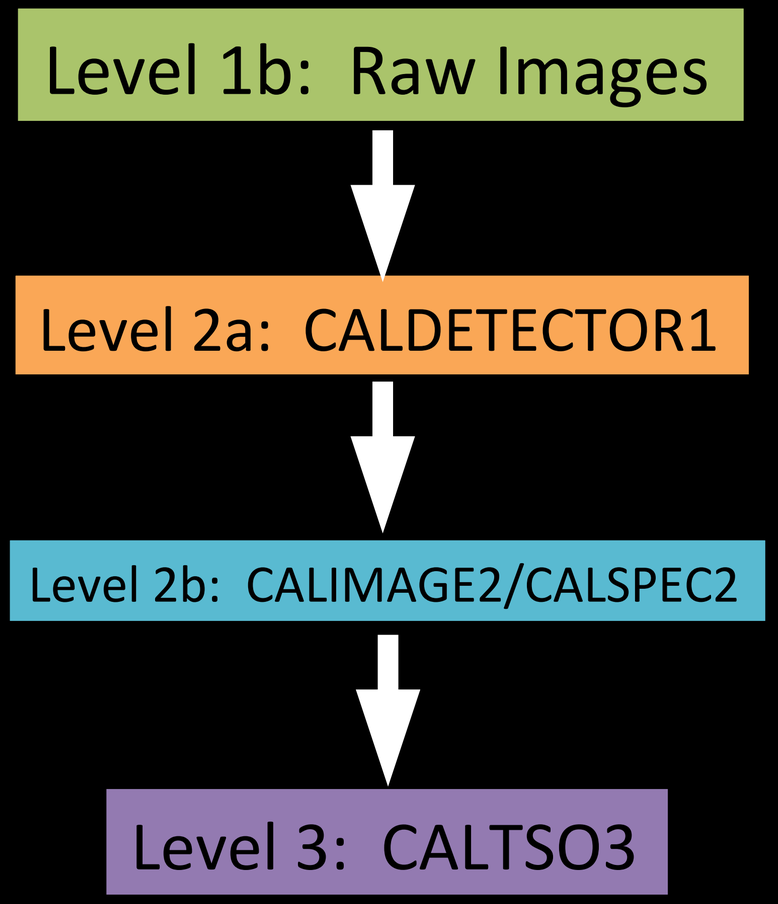
Planning, Pipeline, Archive

Astronomer Proposal Tool (APT)

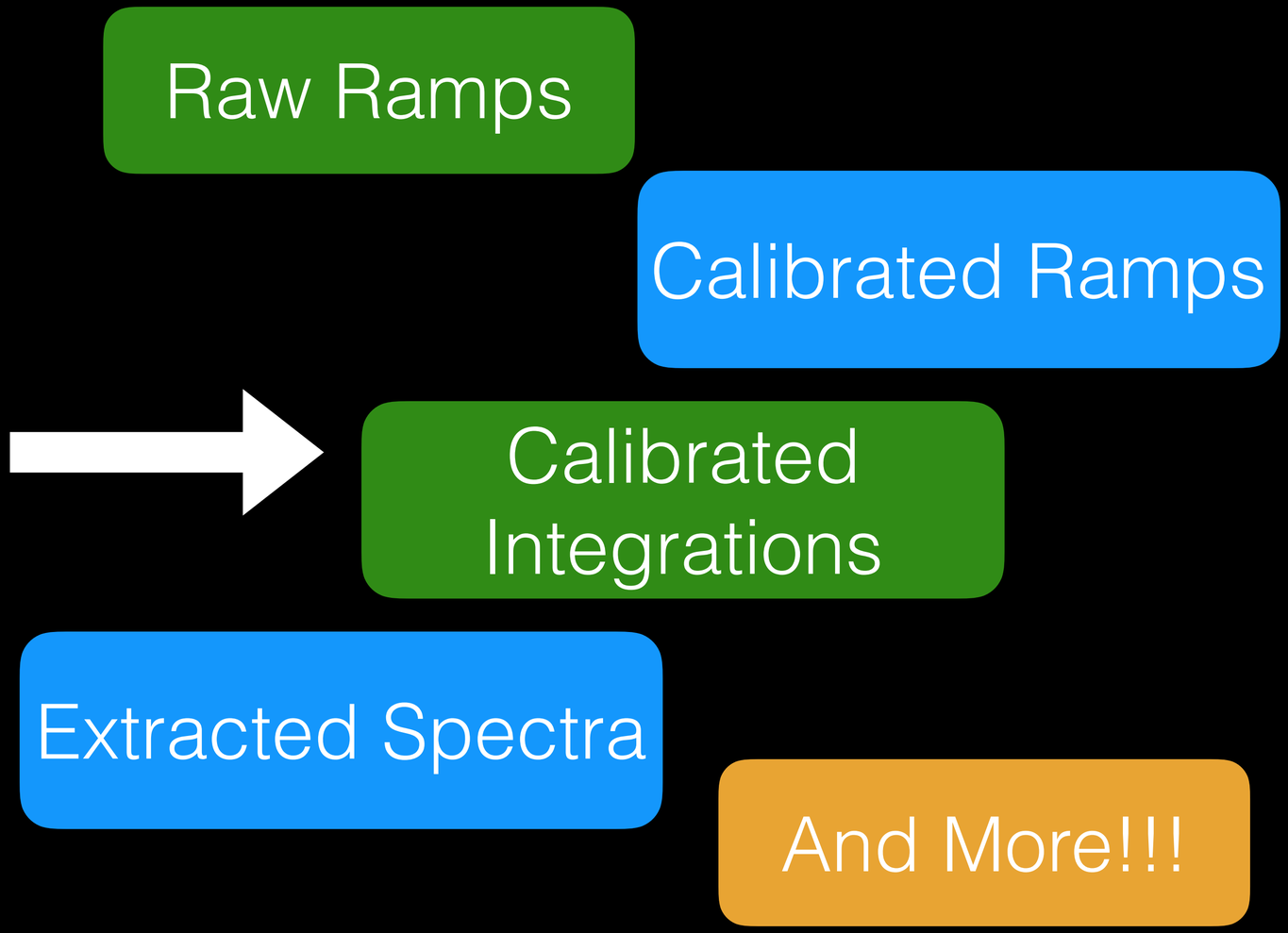
http://www.stsci.edu/hst/proposing/apt



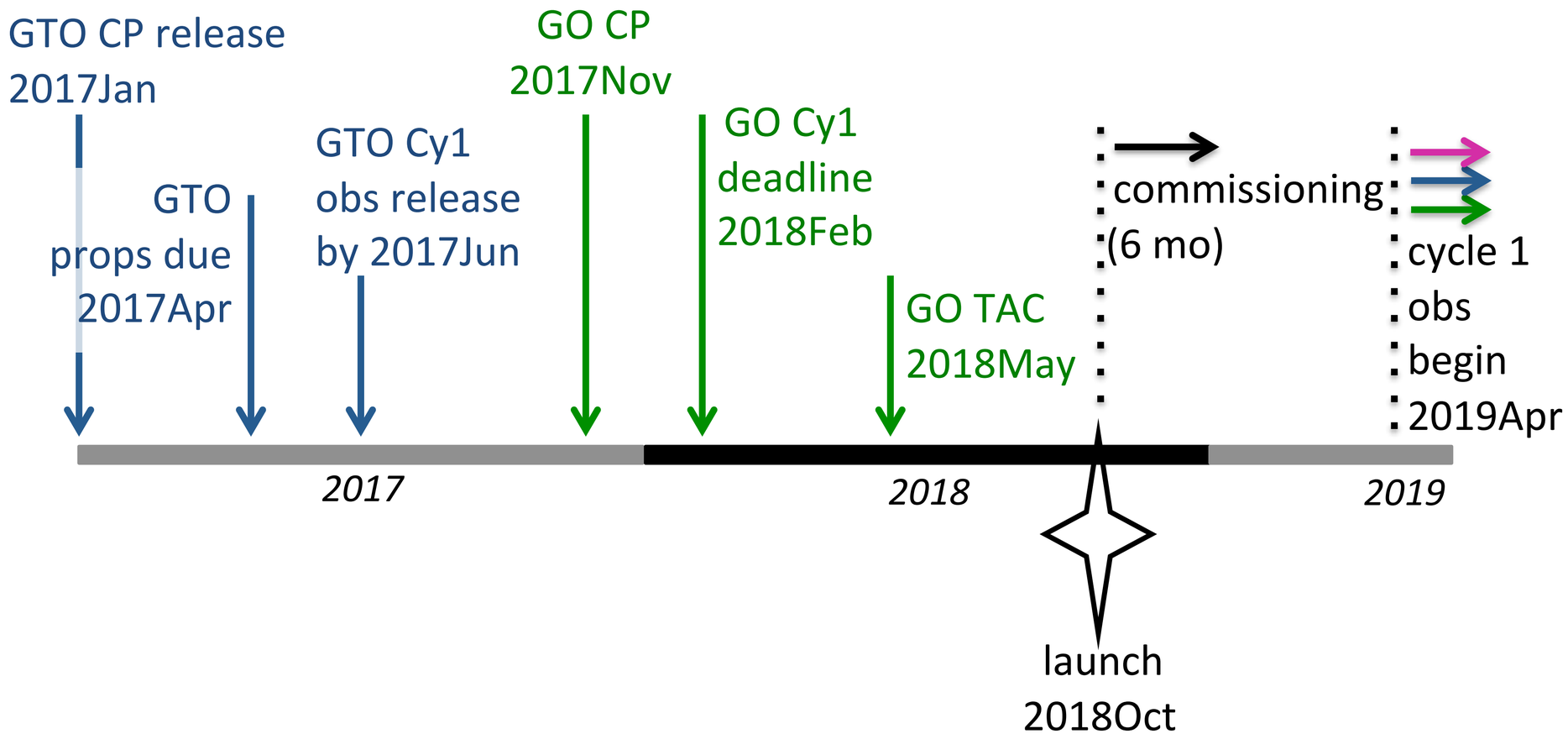
Planning, Pipeline, Archive



JWST Pipeline

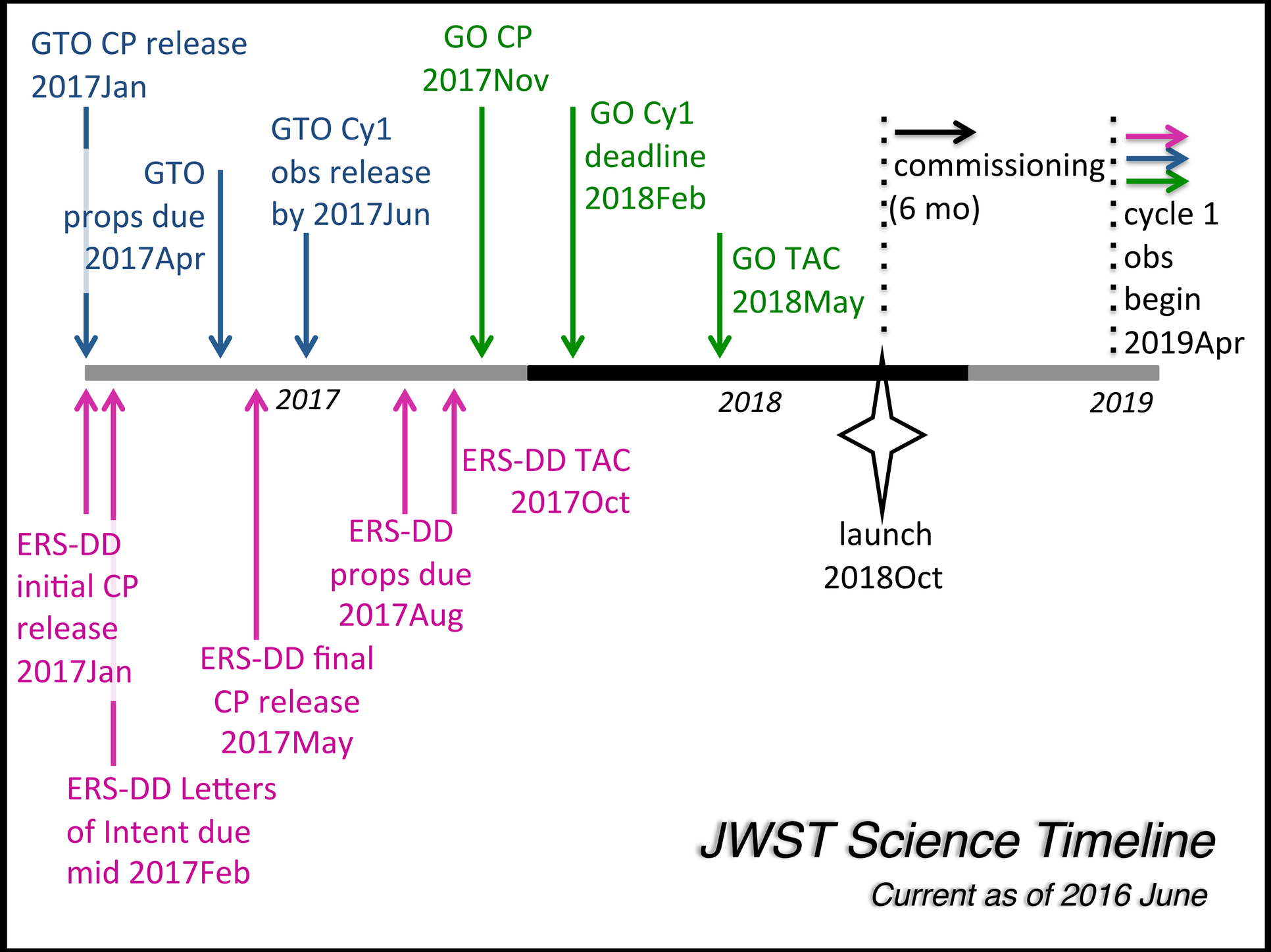


MAST Archive



JWST Science Timeline

Current as of 2016 June


GTO CP release
2017Jan
GTO
props due
2017Apr
GTO Cy1
obs release
by 2017Jun
GO CP
2017Nov
GO Cy1
deadline
2018Feb
GO TAC
2018May
commissioning
(6 mo)
cycle 1
obs
begin
2019Apr
2017
2018
2019
ERS-DD
initial CP
release
2017Jan
ERS-DD Letters
of Intent due
mid 2017Feb
ERS-DD final
CP release
2017May
ERS-DD
props due
2017Aug
ERS-DD TAC
2017Oct
launch
2018Oct
JWST Science Timeline
Current as of 2016 June

Publications of the Astronomical Society of the Pacific

PAPER

Transiting Exoplanet Studies and Community Targets for *JWST*'s Early Release Science Program

Kevin B. Stevenson[1,41], Nikole K. Lewis[2], Jacob L. Bean[1], Charles Beichman[3], Jonathan Fraine[4], Brian M. Kilpatrick[5], J. E. Krick[6], Joshua D. Lothringer[7], Avi M. Mandell[8], Jeff A. Valenti[2], Eric Agol[9], Daniel Angerhausen[10,42], Joanna K. Barstow[11], Stephan M. Birkmann[12], Adam Burrows[13], David Charbonneau[14], Nicolas B. Cowan[15], Nicolas Crouzet[16], Patricio E. Cubillos[17], S. M. Curry[18], Paul A. Dalba[19], Julien de Wit[20], Drake Deming[21], Jean-Michel Désert[22], René Doyon[23], Diana Dragomir[1], David Ehrenreich[24], Jonathan J. Fortney[25], Antonio García Muñoz[26], Neale P. Gibson[27], John E. Gizis[28], Thomas P. Greene[29], Joseph Harrington[30], Kevin Heng[31], Tiffany Kataria[32], Eliza M.-R. Kempton[33], Heather Knutson[34], Laura Kreidberg[1], David Lafrenière[23], Pierre-Olivier Lagage[35], Michael R. Line[29], Mercedes Lopez-Morales[14], Nikku Madhusudhan[36], Caroline V. Morley[25], Marco Rocchetto[37], Everett Schlawin[4], Evgenya L. Shkolnik[38], Avi Shporer[39,41], David K. Sing[32], Kamen O. Todorov[40], Gregory S. Tucker[5], and Hannah R. Wakeford[10,42]

Hide full author list

Published 2016 June 23 •

Publications of the Astronomical Society of the Pacific, Volume 128, Number 967

Other Resources

Observations of Transiting Exoplanets with the James Webb Space Telescope (*JWST*)

Charles Beichman,[1] Bjoern Benneke,[2] Heather Knutson,[2] Roger Smith,[2] Pierre-Olivier Lagage,[3] Courtney Dressing,[4] David Latham,[4] Jonathan Lunine,[5] Stephan Birkmann,[6] Pierre Ferruit,[6] Giovanna Giardino,[6] Eliza Kempton,[7] Sean Carey,[8] Jessica Krick,[8] Pieter D. Deroo,[9] Avi Mandell,[9] Michael E. Ressler,[9] Avi Shporer,[9] Mark Swain,[9] Gautam Vasisht,[9] George Ricker,[10] Jeroen Bouwman,[11] Ian Crossfield,[11] Tom Greene,[12] Steve Howell,[12] Jessie Christiansen,[13] David Ciardi,[13] Mark Clampin,[14] Matt Greenhouse,[14] Alessandro Sozzetti,[15] Paul Goudfrooij,[16] Dean Hines,[16] Tony Keyes,[16] Janice Lee,[16] Peter McCullough,[16] Massimo Robberto,[16] John Stansberry,[16] Jeff Valenti,[16] Marcia Rieke,[17] George Rieke,[17] Jonathan Fortney,[18] Jacob Bean,[19] Laura Kreidberg,[19] David Ehrenreich,[20] Drake Deming,[21] Loïc Albert,[22] René Doyon,[22] and David Sing[23]

Received 2014 June 29; accepted 2014 November 05; published 2014 December 19

Beichman et al (2014)

https://jwst.stsci.edu

Other Resources

https://webcast.stsci.edu/webcast/searchresults.xhtml?searchtype=20&eventid=232&sortmode=2

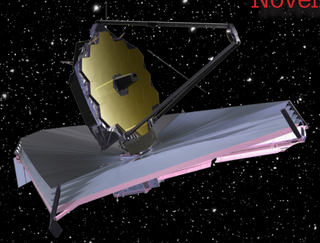
Transiting Exoplanet Science/ Proposal Planning Workshop slated for Summer 2017!

Enabling Transiting

EXOPLANET SCIENCE with JWST

A Mini Workshop

November 16-18, 2015



This workshop will provide a forum for the exoplanet community to learn about and discuss the capabilities of JWST to characterize transiting exoplanets. Talks will inform potential observers about the cutting edge science that JWST will enable. Discussion sessions will allow for community dialog on how best to enable exoplanet science with JWST. As JWST proposal opportunities approach, this workshop will serve as an important opportunity to understand how JWST will impact the field of exoplanet science.

Scientific Organizing Committee:

Suzanne Aigrain
Adam Burrows
Drake Deming
Sherita Hanna (coordinator)
Heather Knutson
Nikole Lewis (chair)
Mercedes Lopez-Morales
Mark Marley
Peter McCullough
Sara Seager
David Sing
Jeff Valenti

INVITED SPEAKERS:

Joanna Barstow (Oxford)

Adam Burrows (Princeton)

David Charbonneau (Harvard)

Nicolas Cowan (Amherst)

Neale Gibson (ESO)

Mercedes Lopez-Morales (Harvard-Smithsonian CfA)

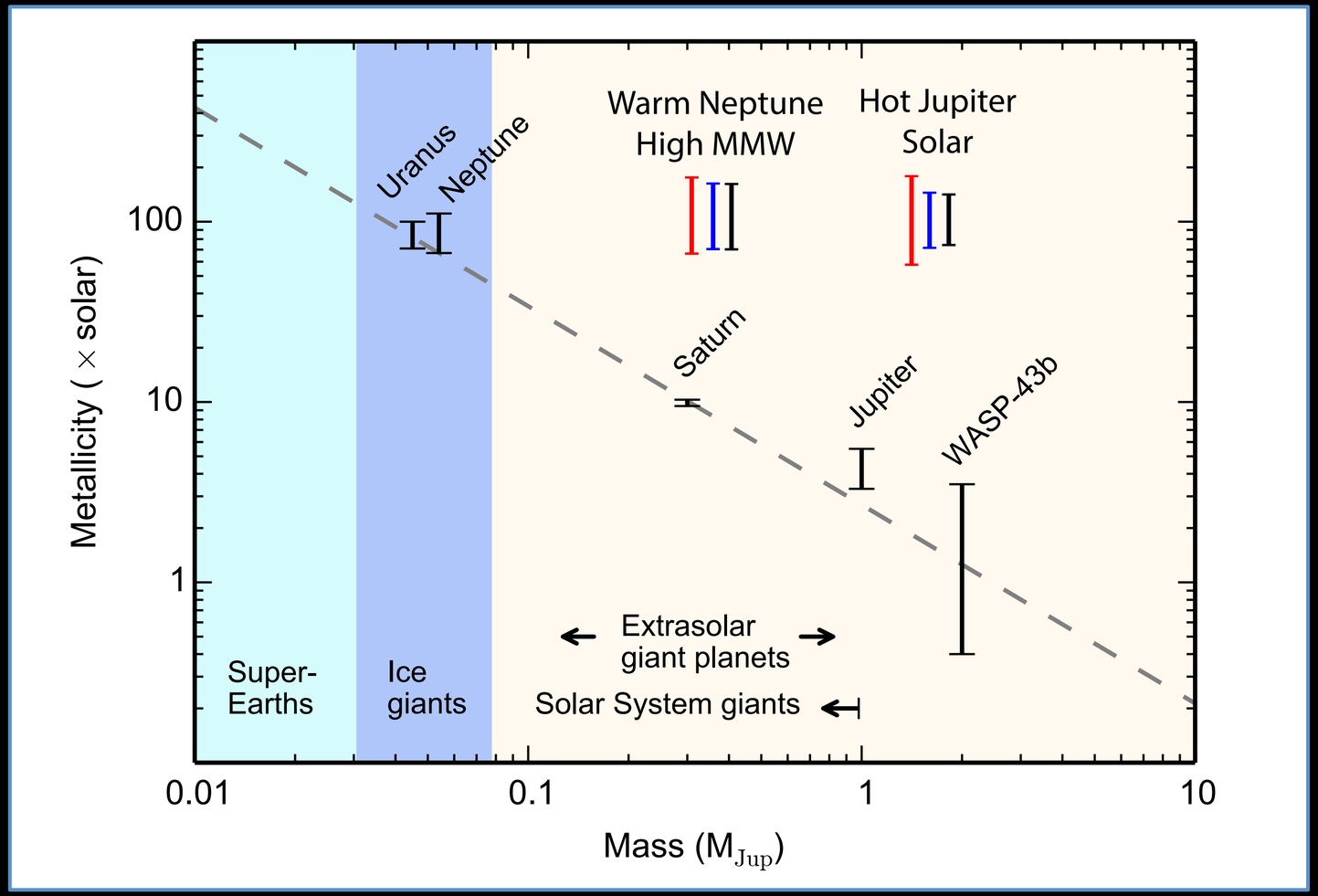
Victoria Meadows (Washington)

Caroline Morley (UC Santa Cruz)

SPACE TELESCOPE SCIENCE INSTITUTE
Operated for NASA by AURA

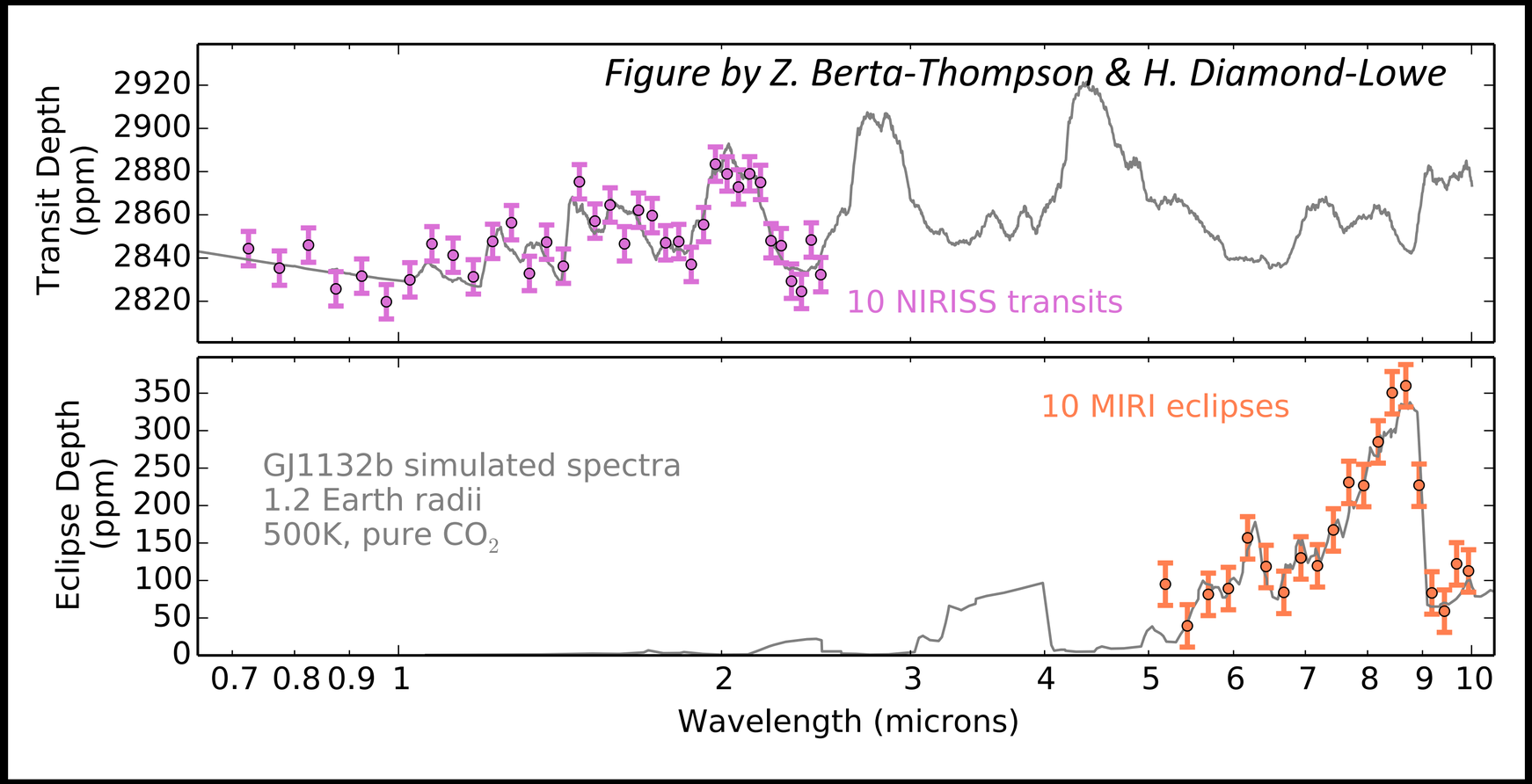
For more information: exosci2015@stsci.edu or to register http://www.cvent.com/d/l4qtdl

JWST will answer fundamental questions about planet formation and evolution

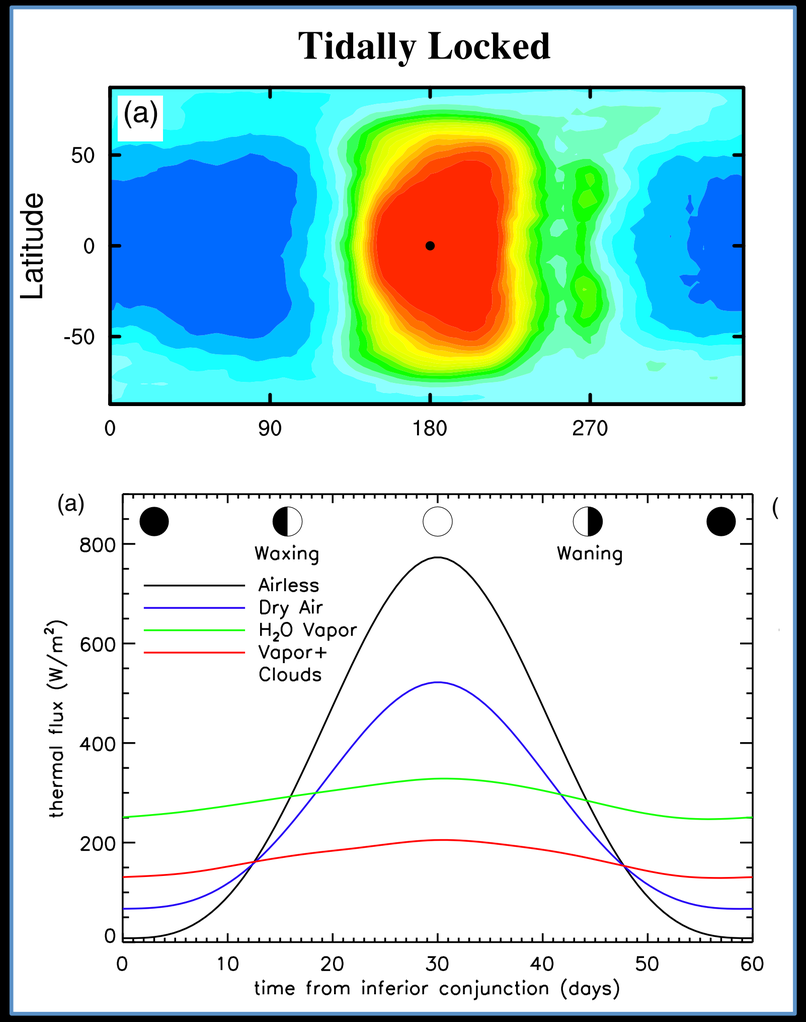


Greene et al (2016)

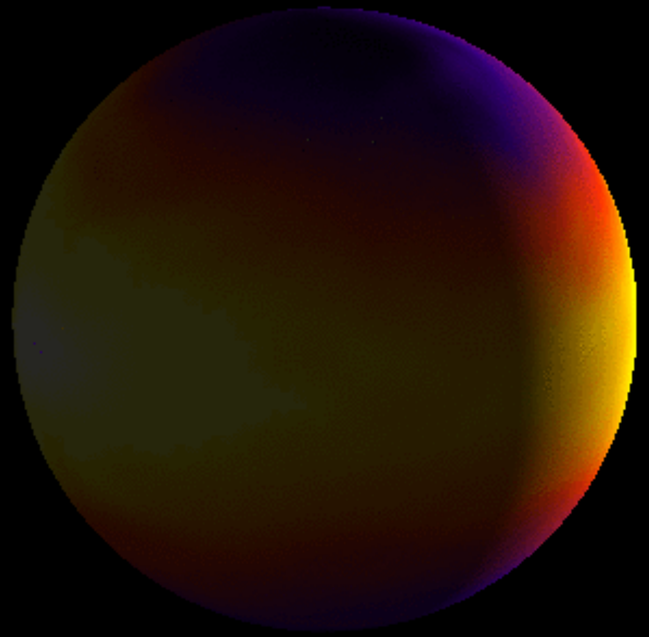
JWST will give us among the first insights into rocky planet atmospheres beyond our Solar System



JWST will allow us probe the climates of distant worlds



Yang et al. (2013)



Lewis et al. (2010)

JWST will revolutionize exoplanet science on the path to answering the question Are we alone?