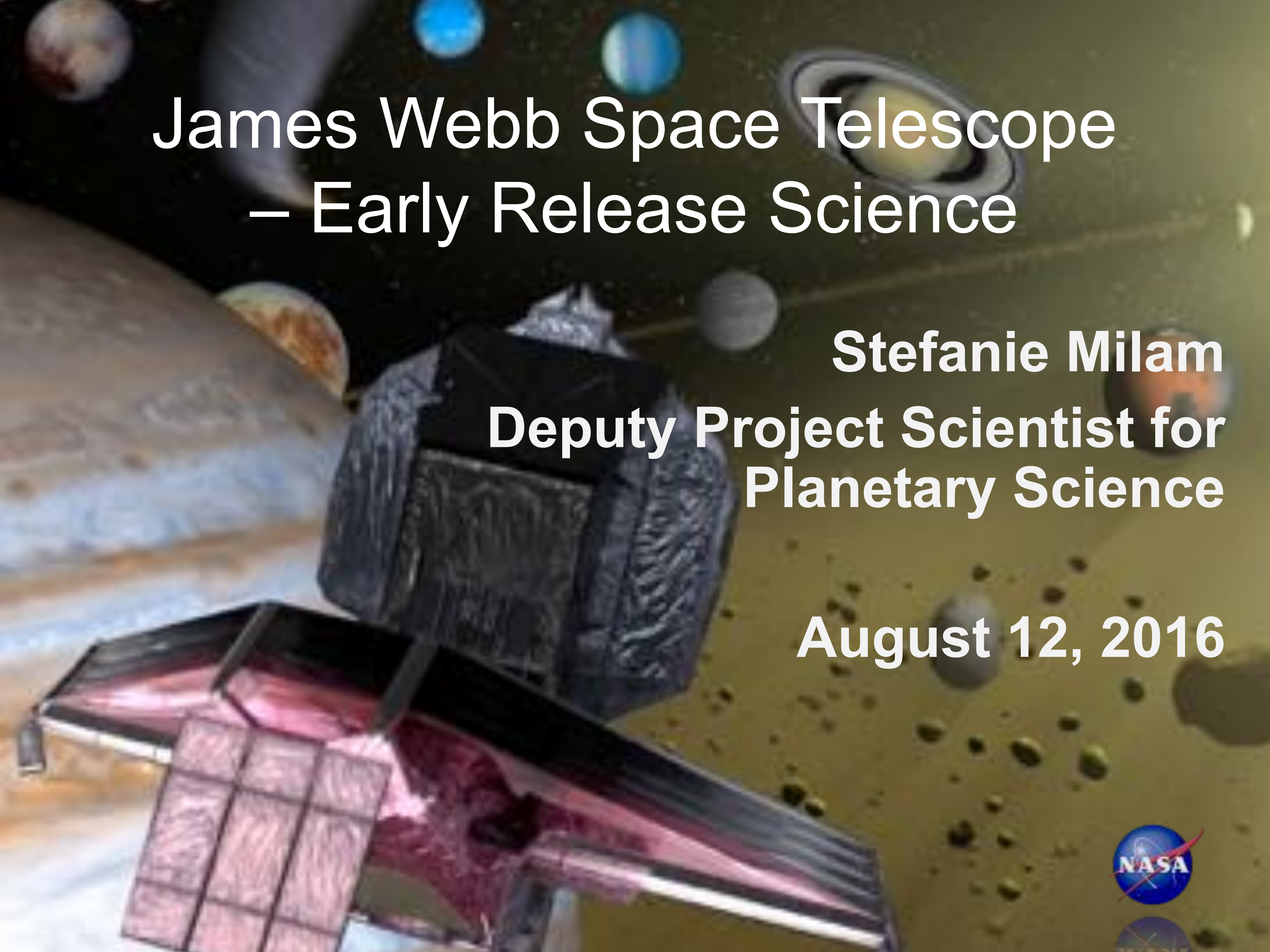


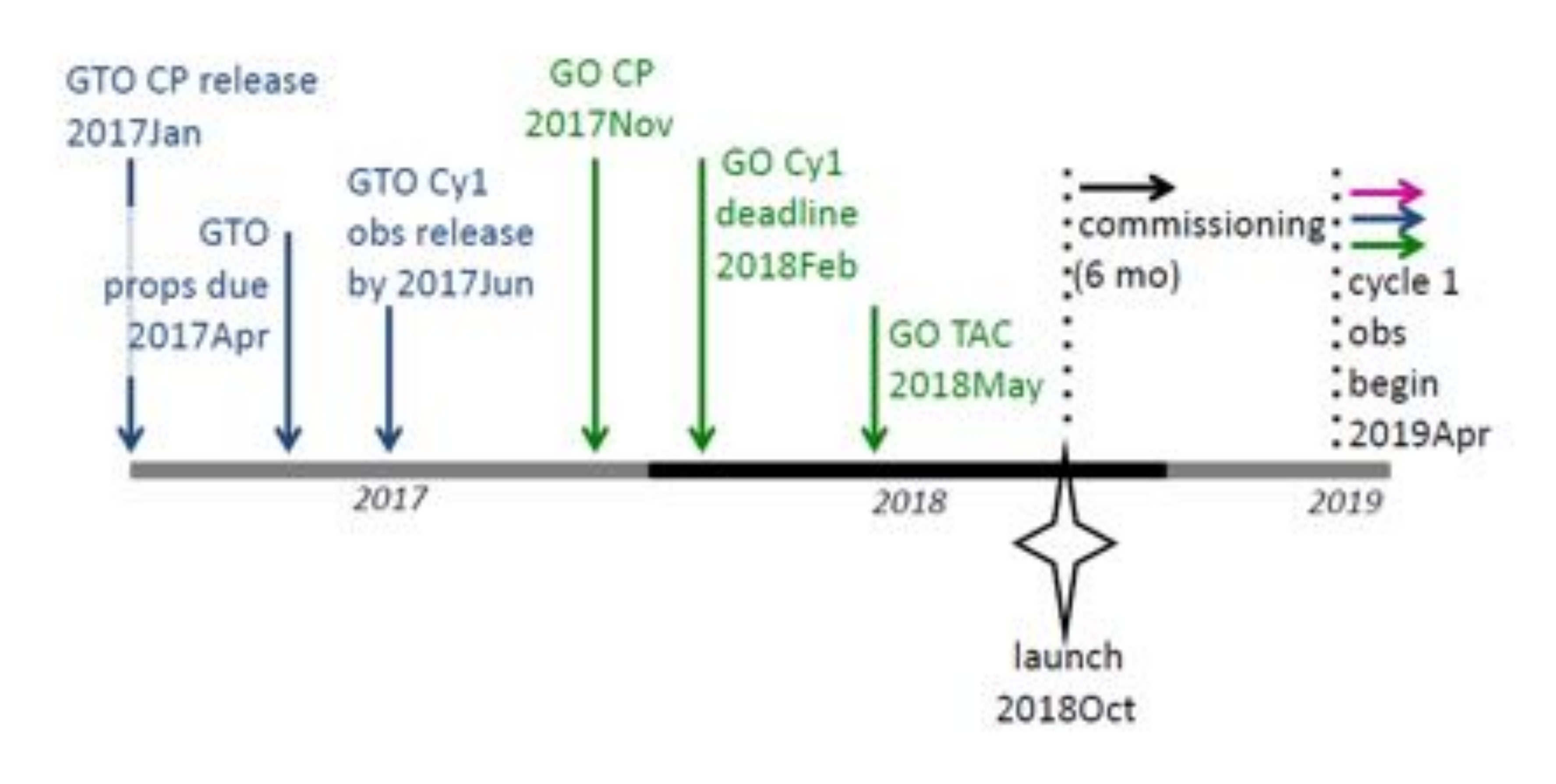
James Webb Space Telescope – Early Release Science

Stefanie Milam

Deputy Project Scientist for Planetary Science

August 12, 2016

JWST Science Timeline



JWST Data & Calls for Proposals

The Director will seek recommendations from a multi-disciplinary committee of experts for up to 12 medium-scale proposals (between about 30-70 hours) for observation and funding.

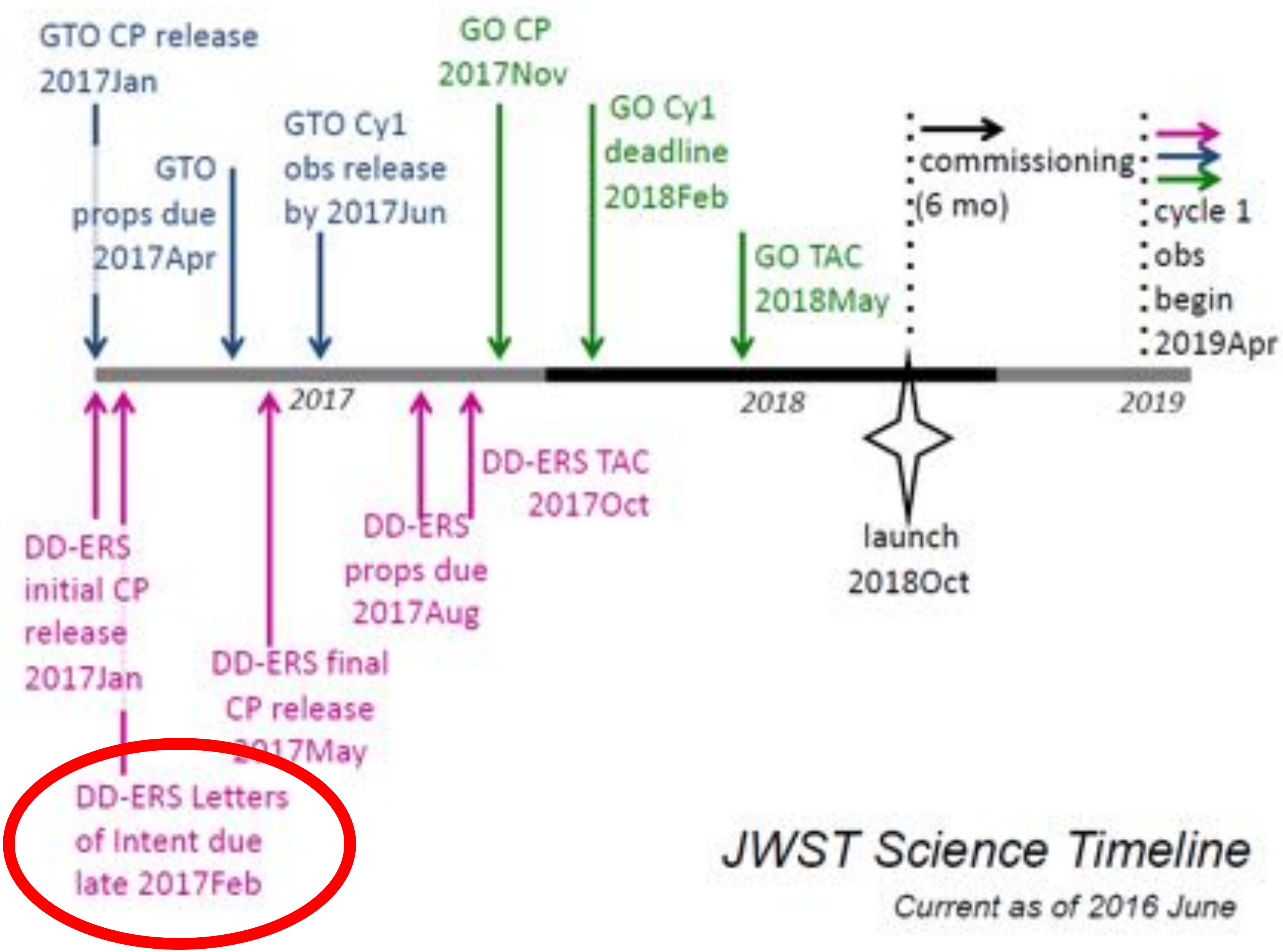
Limited (non-proprietary) data available to the community for Cycle 2 Proposals.

How are DD-ERS programs distinguished from standard GO programs?

DD-ERS programs will enable the community at-large to learn to exploit the science capabilities of JWST early in its mission. Selected programs will:

1. be substantive, science-driven, and of broad interest to the community.
2. be designed by teams with robust and diverse representation of community members in an area of study, to help ensure that studies will be of broad interest.
3. result in extensive, coherent datasets with lasting archival value. Studies utilizing multiple observing modes encouraged, though not required.
4. design, create, and deliver science-enabling products to help community at-large learn to effectively observe with JWST and analyze its data.
5. be schedulable early in Cycle 1. Target lists must be flexible to accommodate possible changes to scheduled start of science obs.
6. have zero proprietary time. Both raw and pipeline-processed data will become public immediately after STScI processing and validation.

Slide from: Janice C. Lee & Neill Reid
STScI Science Mission Office


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
DD-ERS initial CP release 2017Jan
DD-ERS final CP release 2017May
DD-ERS props due 2017Aug
DD-ERS TAC 2017Oct
launch 2018Oct
DD-ERS Letters of Intent due late 2017Feb
JWST Science Timeline
Current as of 2016 June

DD-ERS proposal requirements *(not your standard GO proposal...)*

1. *Justification for ERS time*
   How will your program help the community learn to do science with JWST and prepare for Cy2? What science-enabling products are proposed for development and release? How will your program demonstrate baseline JW science capabilities?

2. *Scientific Justification*
   Why are the observations scientifically compelling and require JWST?

3. *Team Diversity*
   Demonstration of how the proposing team represents and has input from diversity of experts with broad demographics within sub-discipline.

4. *Description of the Observations*
   Establish feasibility for early execution, and flexibility in target selection to accommodate any change to start date for Cy1 science obs.

5. *Project Management Plan & Budget*
   Data processing and analysis plan, roles, responsibilities, work schedule, budget.

Slide from: Janice C. Lee & Neill Reid
STScI Science Mission Office

Upcoming JWST Events

- Exploring the infrared Solar System with JWST Workshop (London, UK): 31 Aug to 2 Sept 2016

  https://jwst-workshop.eventbrite.co.uk
- Keck/JWST Meeting (Caltech, CA): September 12-13, 2016

  http://www.astro.caltech.edu/ksm2016/index.html

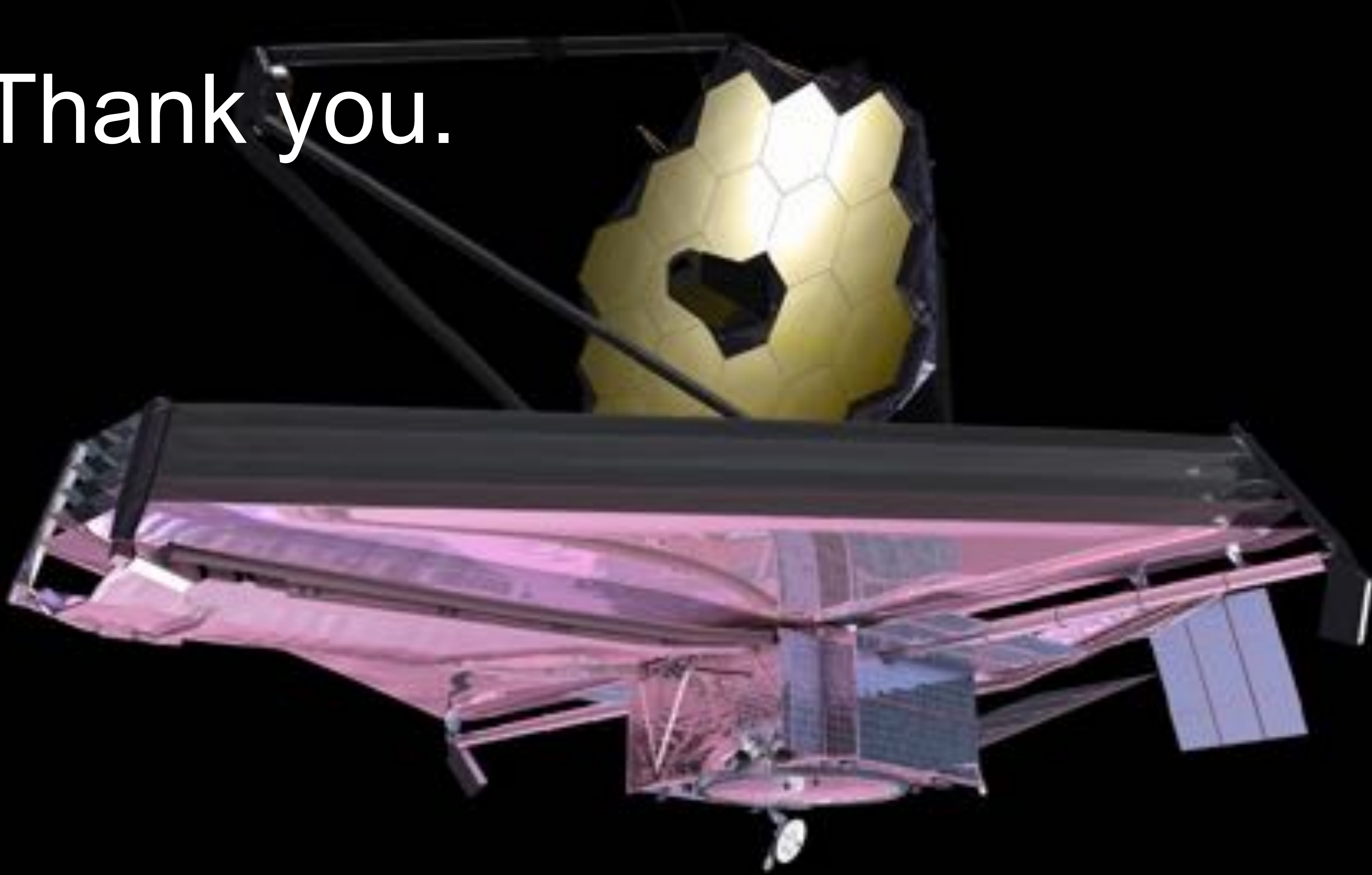
  Registration Closes: August 29, 2016
- ESAC 2016 JWST WORKSHOP (Madrid, Spain): Sept. 26-28, 2016

  http://www.cosmos.esa.int/web/jwst-2016-esac
- **DPS ERS Workshop (Pasadena, CA): October 16, 2016, 1-4 pm**

  https://aas.org/meetings/dps48

  Registration Closes: TODAY (Aug 12, 2016)
- **JWST Townhall at DPS (Pasadena, CA): October 18, 2016**, 12-1:30 pm

Thank you.



Contact: Stefanie Milam

stefanie.n.milam@nasa.gov

Additional Info

PASP Special Issue

(Jan 4, 2016)

Innovative Solar System Science with the James Webb Space Telescope

Stefanie Milam, Special Ed.

http://iopscience.iop.org/1538-3873/128/959.

I. The James Webb Space Telescope's plan for operations and instrument capabilities for observations in the Solar System – S.N. Milam et al.

http://arxiv.org/abs/1510.04567

II. Observing Near-Earth Objects with the James Webb Space Telescope – C.A. Thomas et al.

http://arxiv.org/abs/1510.05637

II. Asteroids and JWST – A. Rivkin et al.

http://arxiv.org/abs/1510.08414

IV. Unique Spectroscopy and Imaging of Mars with JWST – G. Villanueva et al.

http://arxiv.org/abs/1510.04619

V. Giant Planet Observations with the James Webb Space Telescope – J. Norwood et al.

http://arxiv.org/abs/1510.06205

VI. Observing Outer Planet Satellites (except Titan) with JWST: Science Justification and Observational Requirements – L. Keszthelyi et al.

http://arxiv.org/abs/1511.03735

VII. Titan Science with the James Webb Space Telescope (JWST) – C.A. Nixon et al.

http://arxiv.org/abs/1510.08394

VIII. Observing Planetary Rings and Small Satellites with JWST: Science Justification and Observation Requirements – M.S. Tiscareno

http://arxiv.org/abs/1403.6849

IX. Cometary Science with the James Webb Space Telescope – M.S.P. Kelley et al.

http://arxiv.org/abs/1510.05878

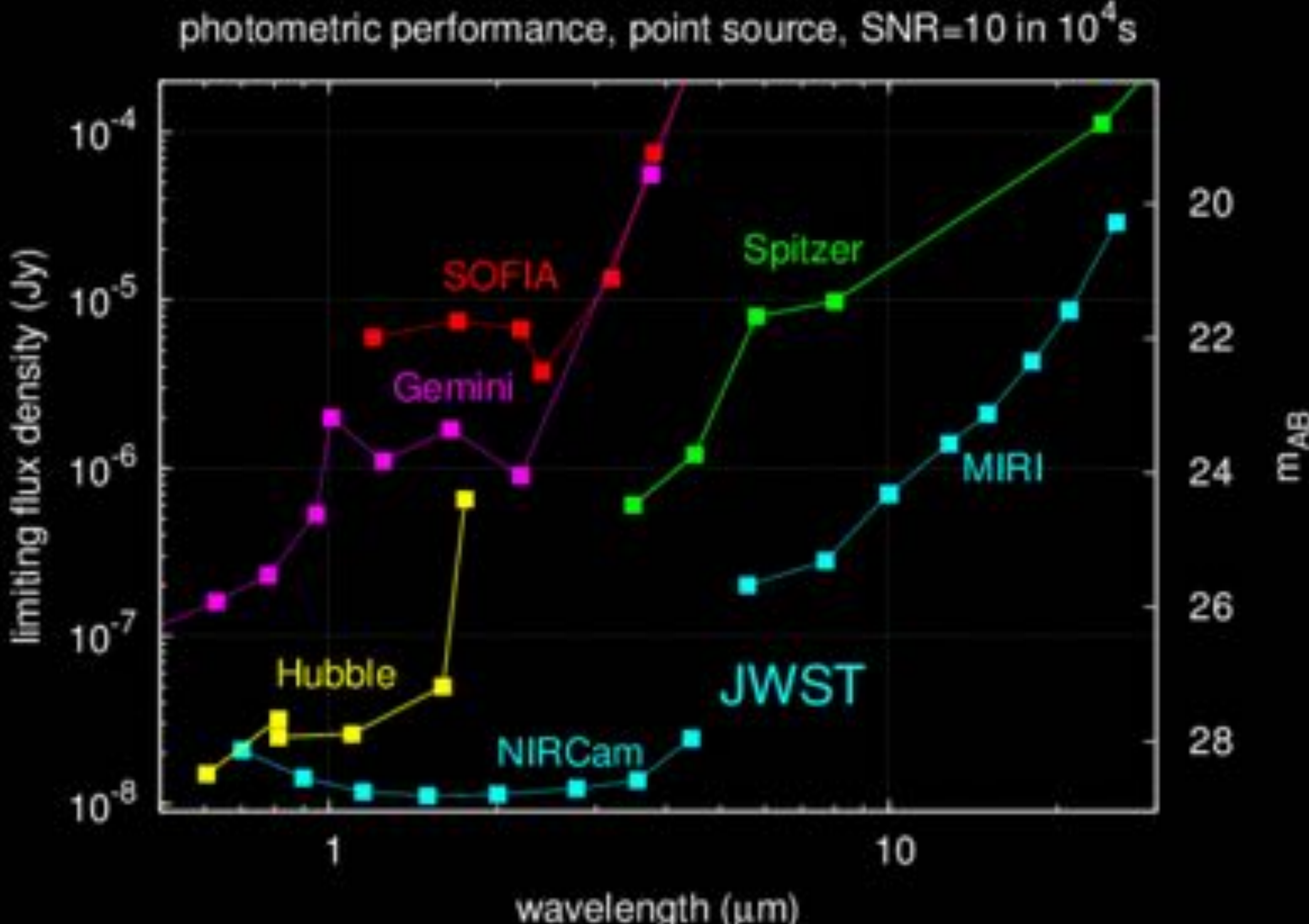
X. Physical Characterization of TNOs with JWST – A. Parker et al.

http://arxiv.org/abs/1511.01112

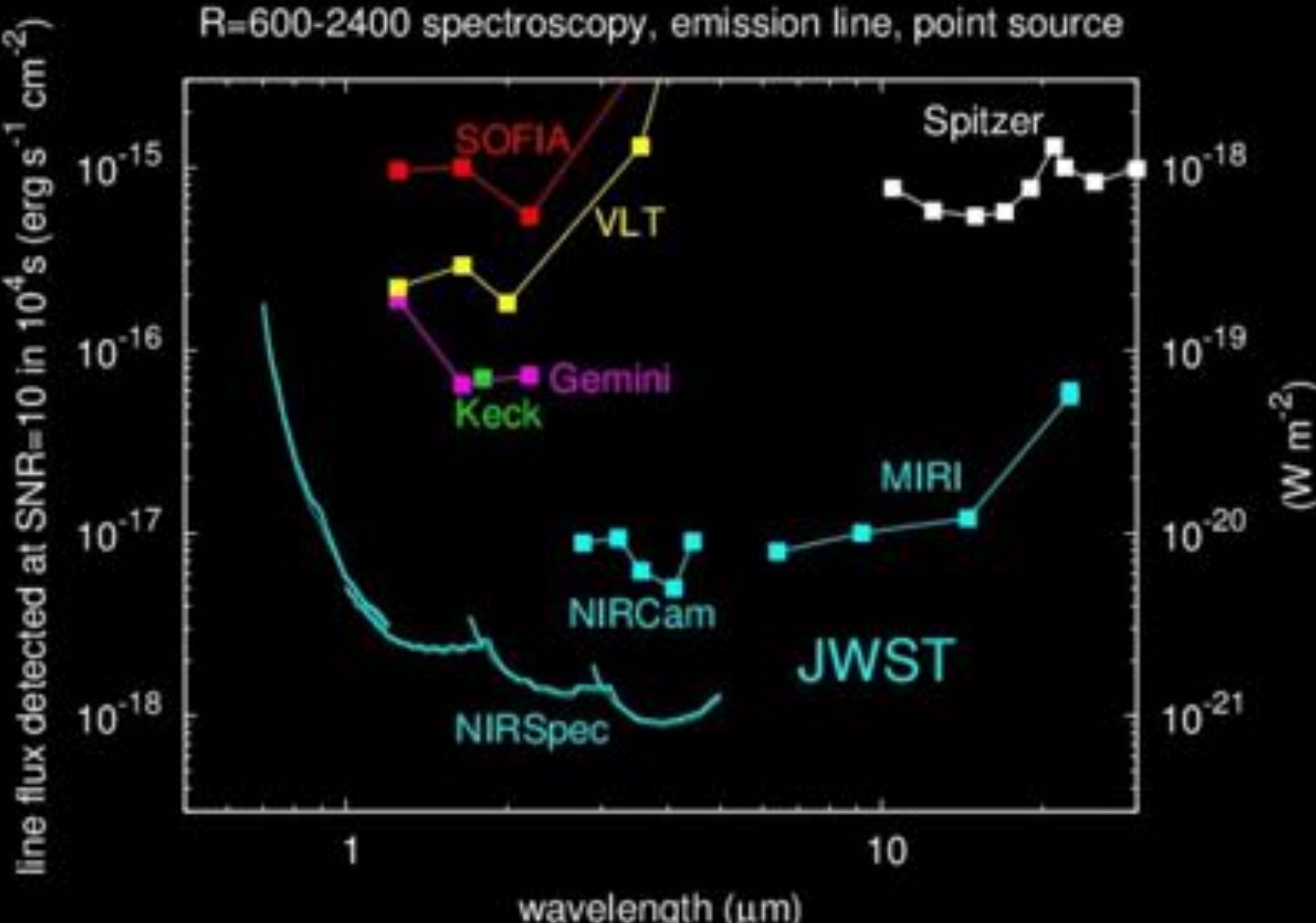
XI. JWST observations of stellar occultations by solar system bodies and rings – P. Santos-Sanz et al.

http://arxiv.org/abs/1510.06575

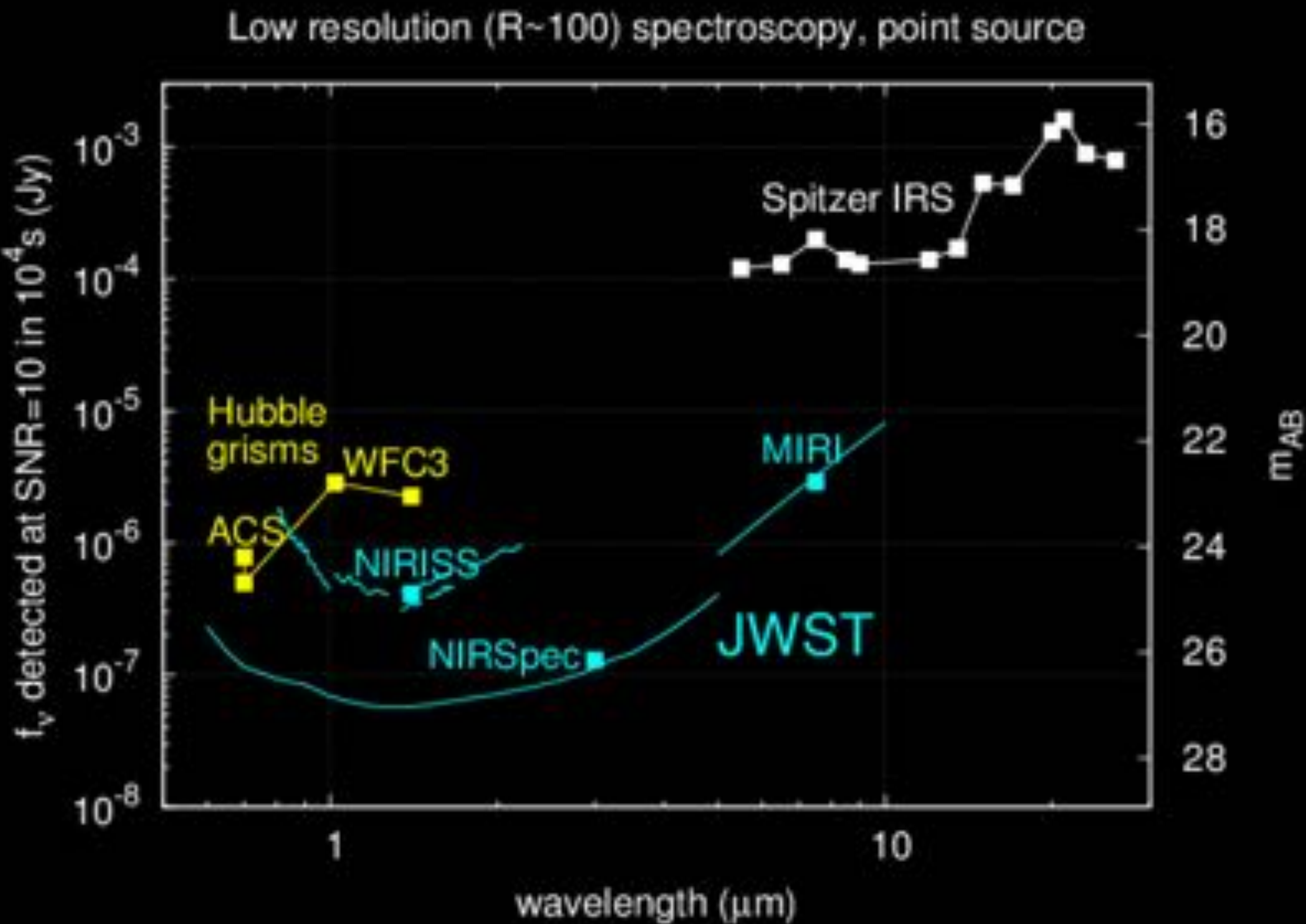
Sensitivity



Sensitivity



Sensitivity



JWST Imaging Modes

Mode	Instrument	Wavelength (microns)	Pixel Scale (arcsec)	Full-Array* Field of View
Imaging	NIRCam*	0.6 – 2.3	0.032	2.2 x 2.2′
	NIRCam*	2.4 – 5.0	0.065	2.2 x 2.2′
	NIRISS	0.9 – 5.0	0.065	2.2 x 2.2′
	MIRI*	5.0 – 28	0.11	1.23 x 1.88′
Aperture Mask Interferometry	NIRISS	3.8 – 4.8	0.065	------
Coronography	NIRCam	0.6 – 2.3	0.032	20 x 20″
	NIRCam	2.4 – 5.0	0.065	20 x 20″
	MIRI	10.65	0.11	24 x 24″
	MIRI	11.4	0.11	24 x 24″
	MIRI	15.5	0.11	24 x 24″
	MIRI	23	0.11	30 x 30″

JWST Spectroscopy Modes

Mode	Instrument	Wavelength (microns)	Resolving Power ($\lambda/\Delta\lambda$)	Field of View
Slitless Spectroscopy	NIRISS	1.0 – 2.5	150	2.2′ x 2.2′
	NIRISS	0.6 – 2.5	700	single object
	NIRCam	2.4 – 5.0	2000	2.2′ x 2.2′
Multi-Object Spectroscopy	NIRSpec	0.6 – 5.0	100, 1000, 2700	3.4′ x 3.4′ with 250k 0.2 x 0.5″ microshutters
Single Slit Spectroscopy	NIRSpec	0.6 – 5.0	100, 1000, 2700	slit widths 0.4″ x 3.8″ 0.2″ x 3.3″ 1.6″ x 1.6″
	MIRI	5.0 – ~14.0	~100 at 7.5 microns	0.6″ x 5.5″ slit
Integral Field Spectroscopy	NIRSpec	0.6 – 5.0	100, 1000, 2700	3.0″ x 3.0″
	MIRI	5.0 – 7.7	3500	3.0″ x 3.9″
	MIRI	7.7 – 11.9	2800	3.5″ x 4.4″
	MIRI	11.9 – 18.3	2700	5.2″ x 6.2″
	MIRI	18.3 – 28.8	2200	6.7″ x 7.7″

THE FAR-INFRARED SURVEYOR*

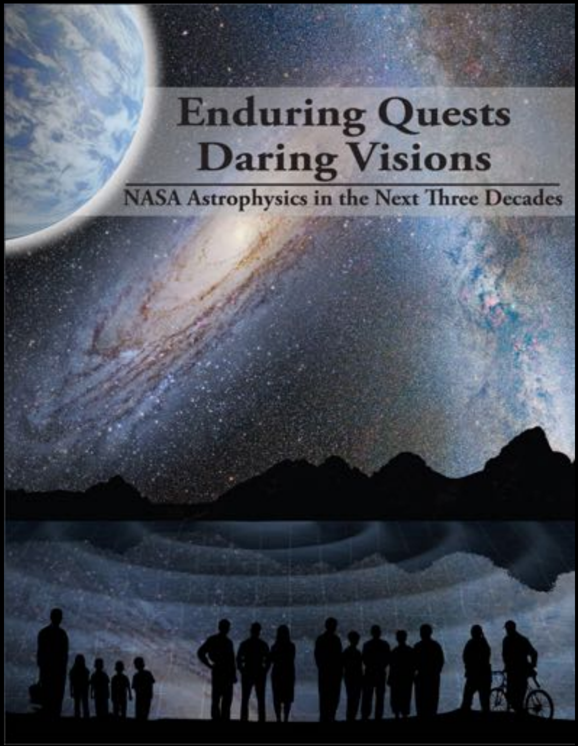
Stefanie Milam
NASA Goddard Space Flight Center
OPAG Report: Aug. 12, 2016

on behalf of the FIRS Science Technology Definition Team

* Name may change to reflect mid-infrared science

What is FIR Surveyor?

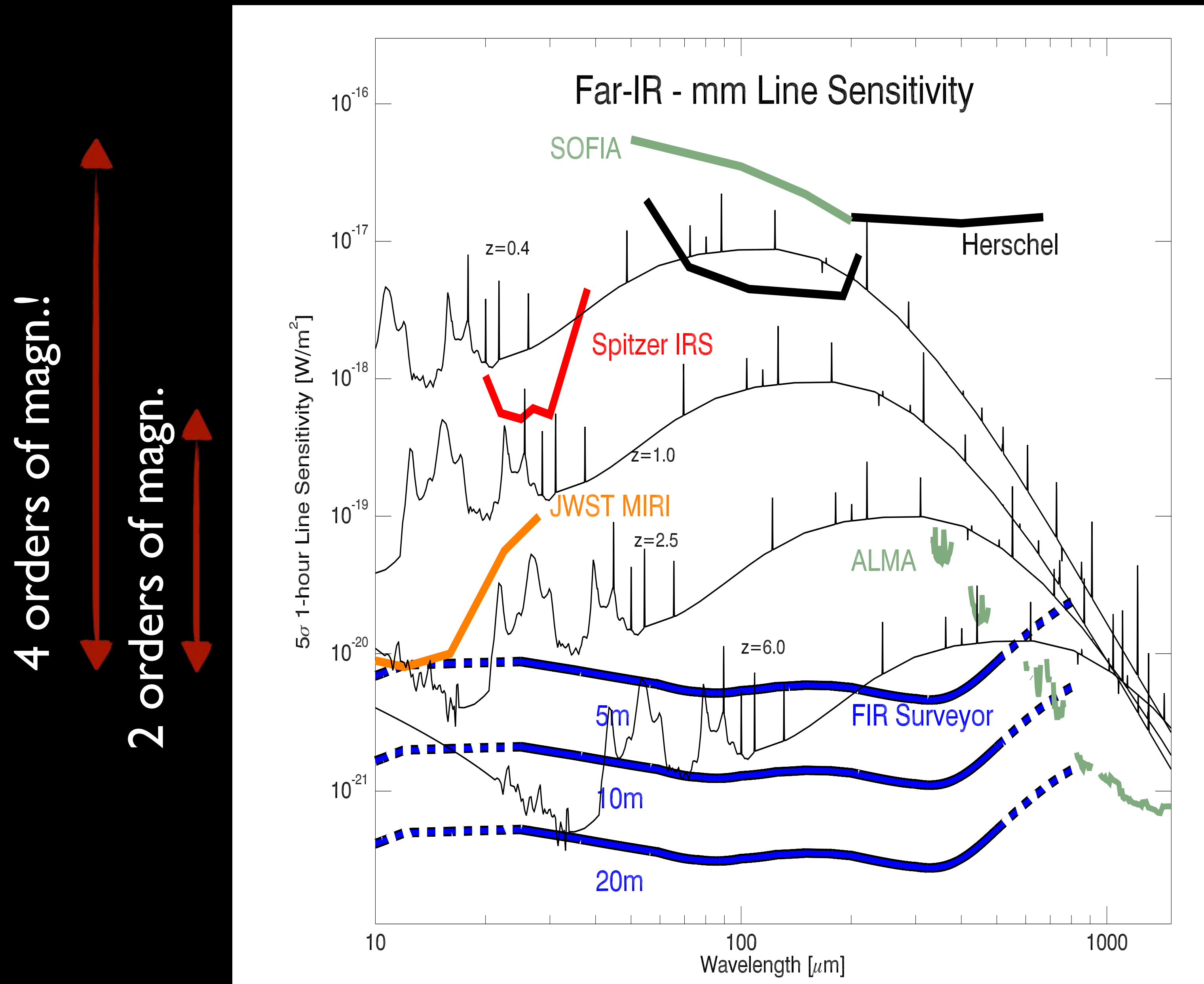
- Comes from the NASA Astrophysics Roadmap, Enduring Quests, Daring Visions
- Roadmap envisages enhanced measurement capabilities relative to those of the Herschel Space Observatory:
  - large gain in sensitivity
  - angular resolution sufficient to overcome spatial confusion in deep cosmic surveys
  - new spectroscopic capability



ALMA, JWST, Stratospheric Observatory for Infrared Astronomy (SOFIA), Wide-Field Infrared Survey Telescope (WFIRST), and new 25m-35m ground-based facilities will change the landscape by the time FIRS flies

- *Science goals and measurement requirements must be in 2030+.*

EXAMPLE SENSITIVITIES



Bradford

COMMUNITY DRIVEN DECADAL MISSION CONCEPT STUDIES SPONSORED BY NASA

- **Deliverable**: A Report to the Decadal 2020 study that describes a Concept Maturity Level 4 Mission with a supporting technology roadmap

- **Exercise Duration** is 3 years
  - Community Chairs will present reports to the Astrophysics Decadal committees in March 2019

- **Efforts have cross talk:** NASA will not choose one study for Decadal but deliver four studies for the Decadal process to prioritize

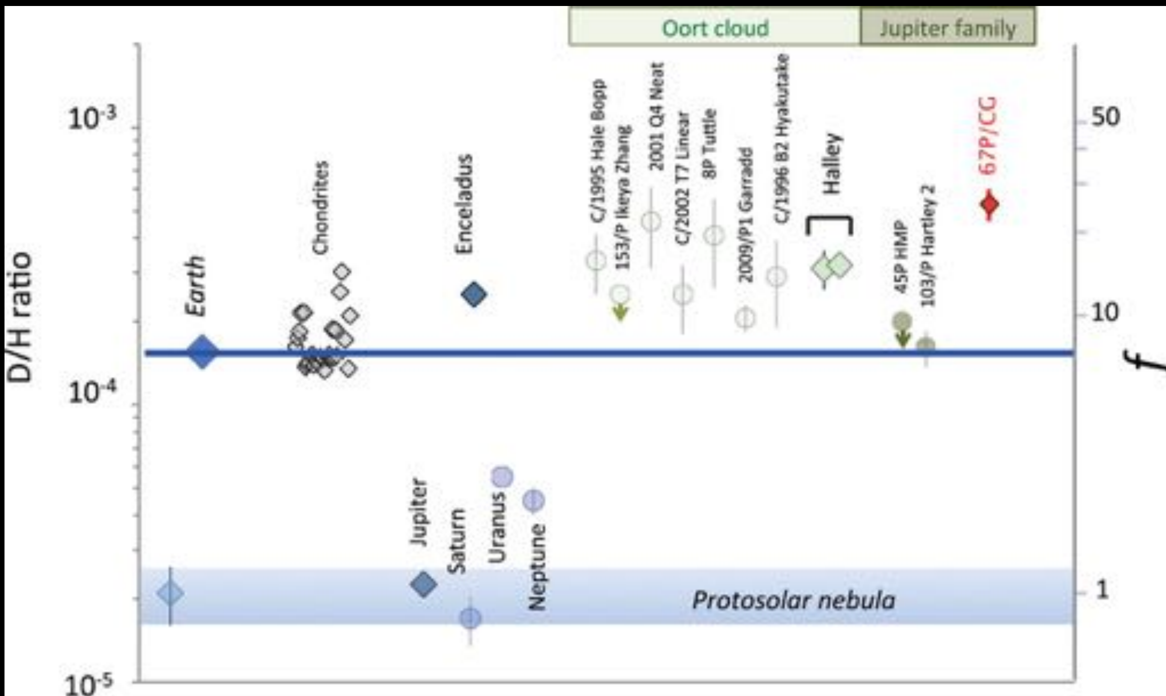
- **Community input is vital**.

STUDY PLAN

- Five science working groups.
- One technical **Mission Concept Working Group**, chaired by T. Roellig
- Teams have produced science questions in the post-JWST, post-WFIRST, 15 years of ALMA, operations in an era of Extremely Large Telescope (ELT), Giant Magellanc Telescope (GMT), Athena, eLISA etc.

Solar system: Stefanie Milam
Planet formation and exoplanets: Klaus Pontoppidan and Kate Su
Milky-Way, ISM and local volume of galaxies: Cara Battersby and Karin Sandstorm
Galaxy and blackhole evolution over cosmic time: Lee Armus and Alexandra Pope
First Billion years: Joaquin Vieira, Matt Bradford

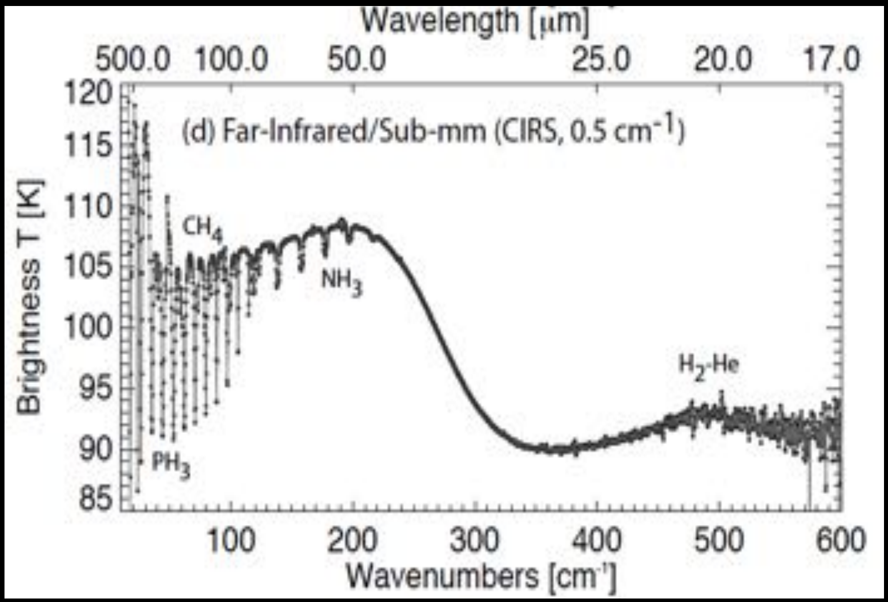
Thermo-Chemical History of Comets and Water Delivery to Earth



With a 20m aperture (2e-21 W/m^2) we can observe nearly ALL short and long period comets at multiple epochs. NOTE: Figure of Merit (FOM) = [30.68 + 1.23 log10 (Delta) - 0.25mV Q(H2O)/Δ(AU)*10^{28}]/Delta.

- **Goal:** *Determining the distribution of D/H values in 100s of comets will reveal their thermo-chemical history and determine their role in delivery of water to the early Earth.*
- **Importance:** *Water has been detected now towards short period comets with a terrestrial D/H, prompting some to suggest that ocean water was delivered by ecliptic comets – though recent Rosetta results suggest an enriched value. A comprehensive survey of the D/H ratio in comets is necessary to address this question.*

Comparative Climate and Thermal Evolution of Giant Planets



Far-IR spectra of Saturn as measured by Cassini/CIRS, showing the lines and the collision-induced continuum that allows temperature, windshear, aerosol, para-H2 and helium sounding.

- **Goal:** *Explore the thermal history, present-day climate and circulation patterns of the four Giant Planets as archetypes for brown dwarf and exoplanetary atmospheres.*
- **Importance:** *Sounding far-IR emission, which probes the bulk of the radiated internal energy, can reveal the spatial and temporal variability of temperature, winds, aerosols, and chemical species. This traces the redistribution of energy and material throughout the different atmospheric layers, which governs the internal thermal evolution of a planet as it cools over billions of years. Furthermore, the abundance of helium remains poorly understood the giant planets, reveals formation details.*

DPS/EPSC Meeting

Meeting workshop "Far-IR Surveyor Meeting for Solar System Science"

Monday, 17 October at 12:30pm-2:00pm

asd.gsfc.nasa.gov/firs

Astrophysics Missions for Planetary Science

- Access to the Outer Solar System in the “Decade of Darkness”
- Complementary capabilities
  - Wavelengths not available from ground
  - Sensitivity
  - Full disk imaging/spectroscopy
  - High resolution spectroscopy
- Not target specific