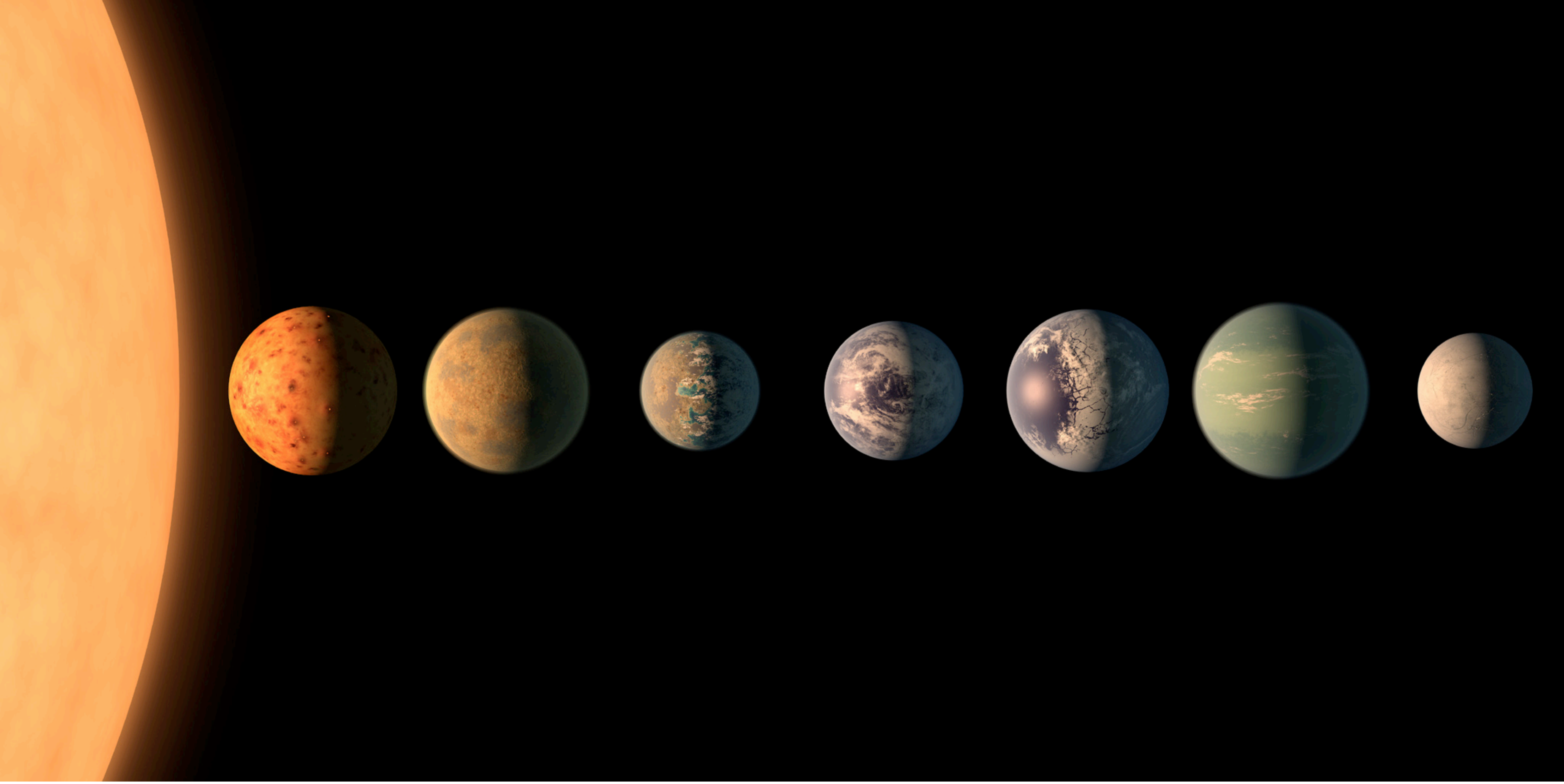

Spitzer Space Telescope

Spitzer Space Telescope Update

Lisa J. Storrie-Lombardi, Project Manager, JPL
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Sean Carey, Spitzer Science Center Manager, Caltech/IPAC

NASA APAC 18 Oct 2017

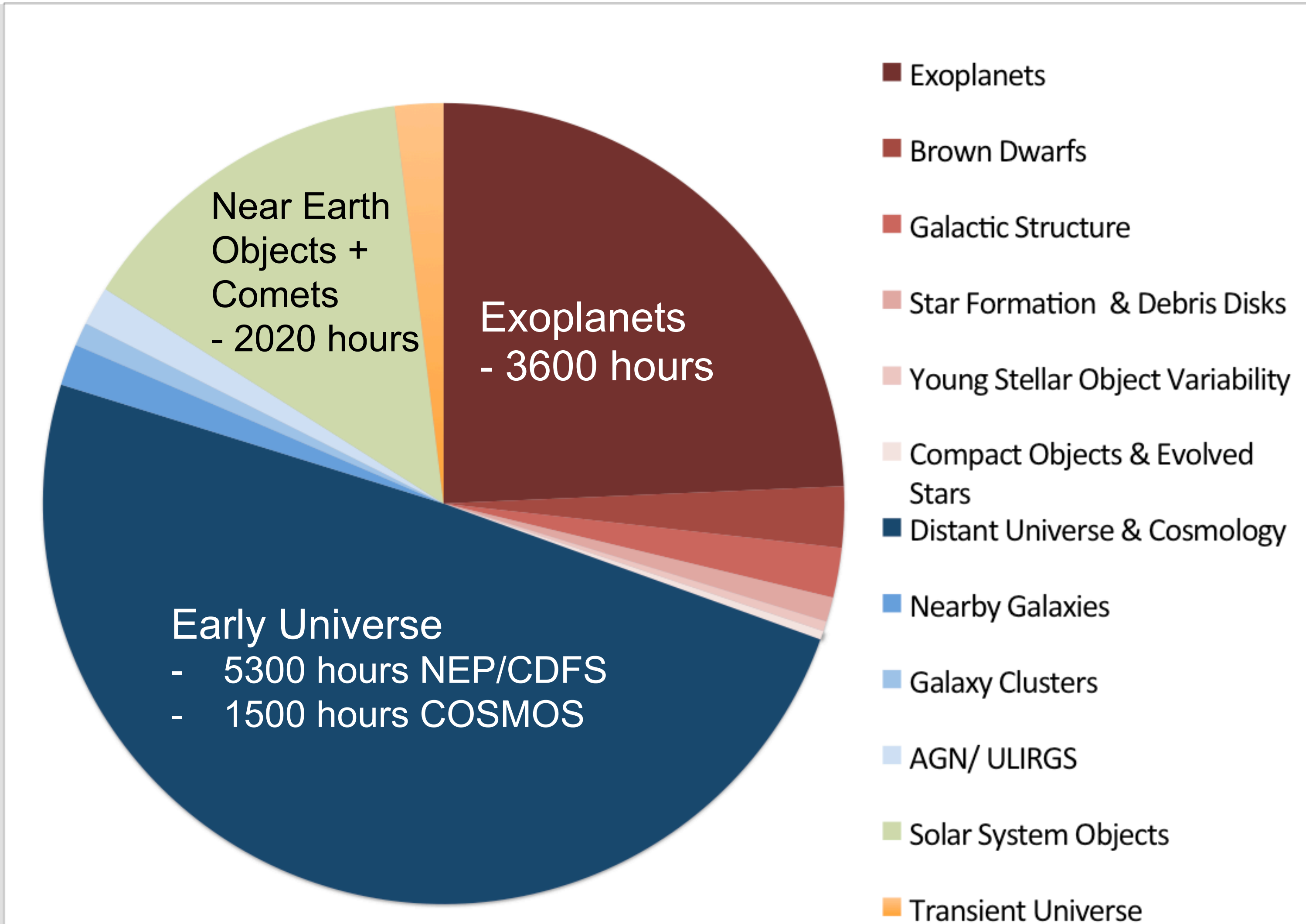
Jet Propulsion Laboratory
California Institute of Technology

Overview

- Science operations funded to 31 Mar 2019
  - Close-out to be completed in FY20
- Observatory & IRAC in excellent health
  - No degradation in sensitivity at 3.6 or 4.5 μm
    - 1 hour, 5σ: 3.6/4.5μm • 720/1040 nJy
    - Routinely achieve near-photon limited performance for high-precision photometric observations, precisions down to 30 ppm
- Orbital geometry is primary ops challenge
  - Spitzer is now ~1.57 au from earth, +0.1 au/year

Cycle-13 Science Oct 2016 – Oct 2018

14,753 hours selected • execute 7000+ hours per year



Selecting New Science

Director's Discretionary Time (DDT)

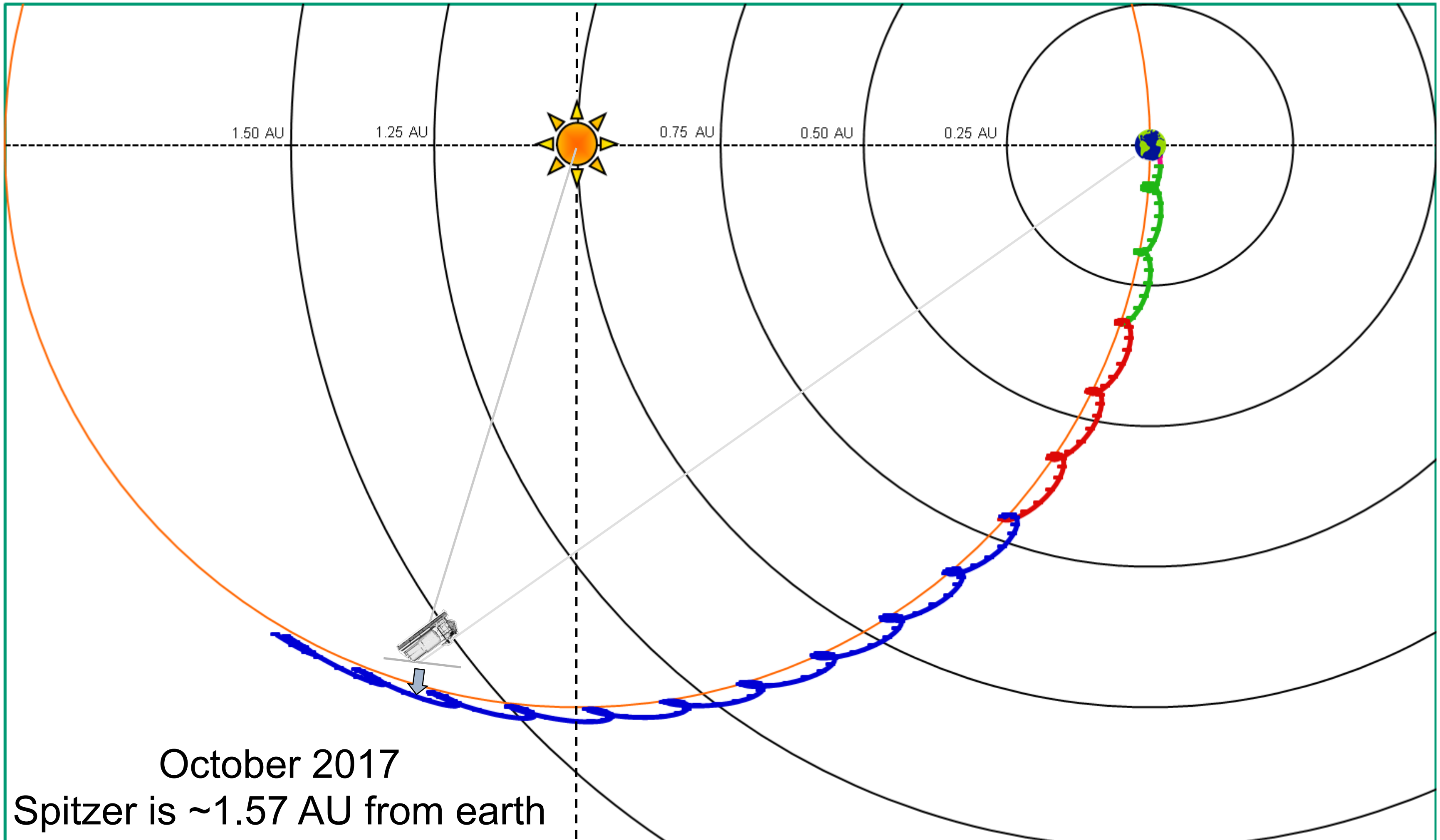
- Two DDT proposal reviews

DDT Review 2017	# Submitted	Hours Submitted	# Selected	Hours Selected
February	20	1773	11	383
September	42	2252	19	467

85% of 2017 DDT time proposed is for exoplanets

- Cycle-14 • April 2018 deadline
  - final 5 months, Nov 2018 – Mar 2019
  - 3,000+ hours

Spitzer’s Earth-trailing Solar Orbit



Benefits from the Orbit

- 20-day long observations with limited interruptions (TRAPPIST-1, GJ1214)
- Thermally stable environment
- One-third of the sky always visible
- Shortest visibility window is ~ 40 days, twice per year, in the ecliptic plane

Constraints from the Orbit

Observatory pitch angle

- Maximum pitch angle occurs in March each year

Year	Maximum Downlink		Data Rate
	Pitch Angle	Hours	(kbps)
2017	44.5°	4	550
2018	48.5°	3.5	550
2019	52.5°	3	550
2020	56.5°	2.5	250

- Have empirically characterized observatory behavior at 48.5° – good through Nov. 2018
- After each downlink, 2 hours of science scheduled at <10° pitch for battery recharge

Impact on Science

- More time in lowest data volume modes due to availability of DSN passes and maximum length of downlinks

- Supporting a few long, higher-data volume observations with custom-built sequences (Instrument Engineering Requests – IERs)

What Spitzer Can Support • 2018 - 2020

Assumes DSN support comparable to 2017

- Extragalactic Surveys: 100-sec full array
- Exoplanets: 2-sec sub-array, 4.5μm
  - source brightness fainter than 7.5 mag
- Microlensing: 2017 level (350 hrs)
  - more hours if no ch2 data

Spitzer's DSN requirements become more restrictive in 2018
> 40°elevation, 70m + 34m array to maintain 550 kbps

SPITZER SCIENCE BEYOND SPRING 2019

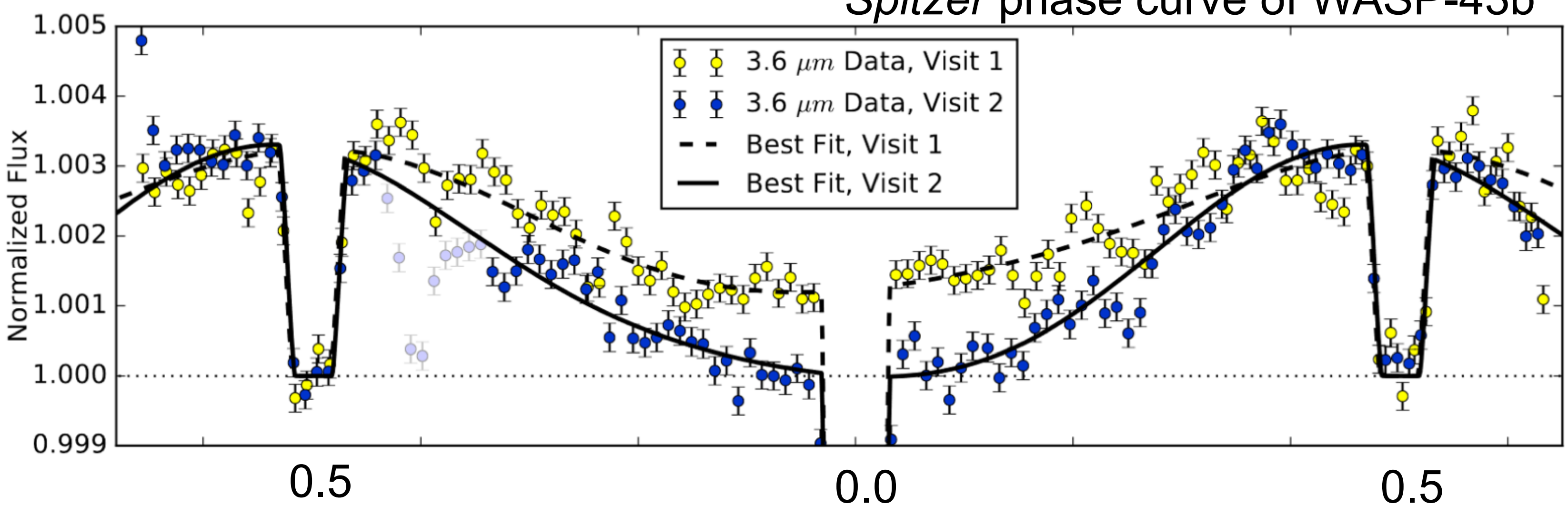
- Exoplanets – Jennifer Yee, David Ciardi, et al.
- Distant Universe – Giovanni Fazio, et al.
- Brown Dwarfs – Davy Kirkpatrick, Stan Metchev, et al.
- Near Earth Objects – David Trilling, et al.

https://arxiv.org/abs/1710.04194

Spitzer Observations support Exoplanet Science with NASA Missions

- Efficient and Effective Observations with JWST and HST
  - ➡ Orbital parameters to enable characterization observations of transits and secondary eclipses of K2 and TESS discoveries
- Long time baseline observations
  - ➡ Discover additional planets in the system
  - \- Transit-timing observations to measure the masses of planets
  - ➡ Phase curves to interpret heat (re)distribution
  - \- Exoplanet atmospheric weather variability
- Complements *JWST*'s far-IR wavelengths and *HST*'s optical wavelengths.

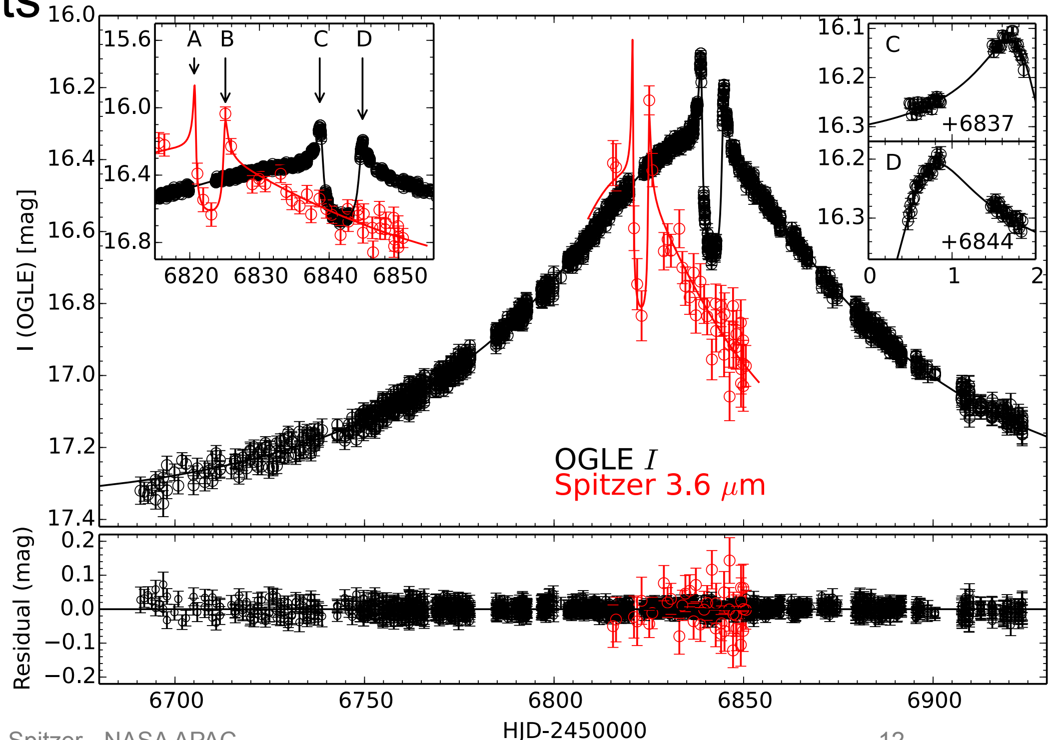
Spitzer phase curve of WASP-43b

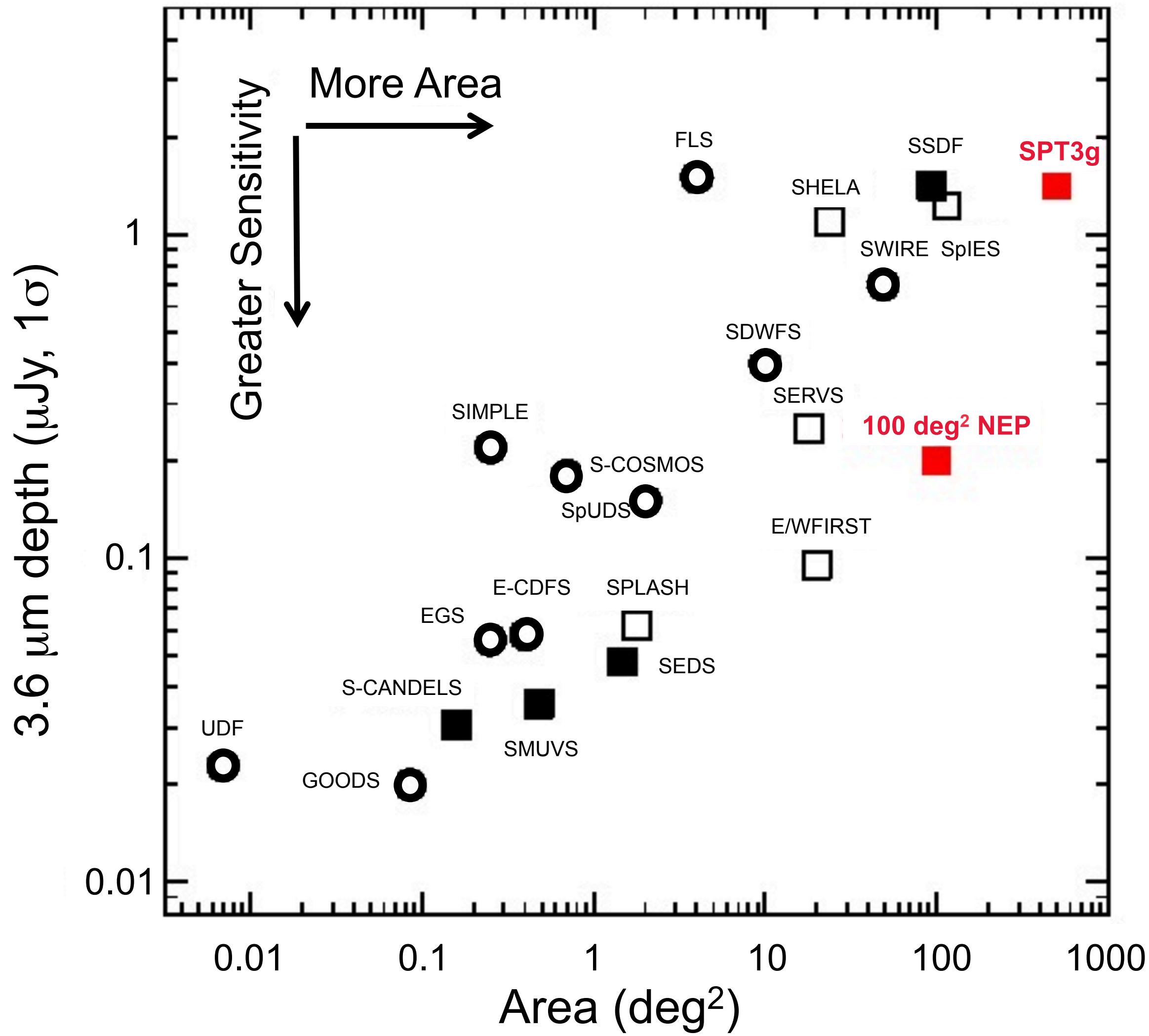


Spitzer microlensing parallax campaign is the most vibrant microlensing program in the United States – and the only space-based program in the world

- Critical role in preparing for the *WFIRST* microlensing mission
    - *Spitzer* program is making the first comparison of the occurrence rate of planets in the disk and the bulge.
    - Spitzer frames the scientific questions to be answered by *WFIRST*
- Validating microlensing techniques that will be used to characterize *WFIRST* microlensing planets

- *Spitzer* characterized a 1 Earth-mass planet around a Brown Dwarf
- The microlens parallax effect is clearly seen because *Spitzer* is ~1 AU from the Earth and able to observe the event simultaneously.



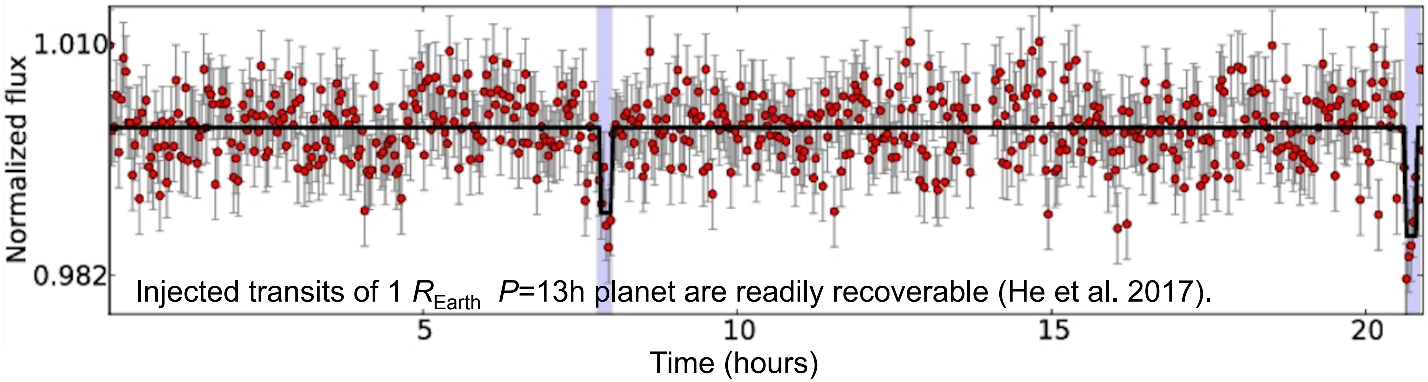


POSSIBLE NEW SPITZER SURVEYS ARE SHOWN IN RED AND DISCUSSED IN DETAIL IN THE WHITE PAPER

Brown dwarfs are prime JWST targets for:

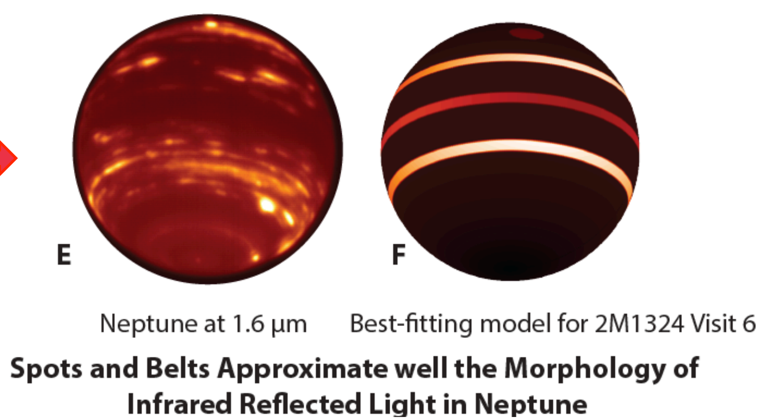
- biosignature detection on habitable exoplanets

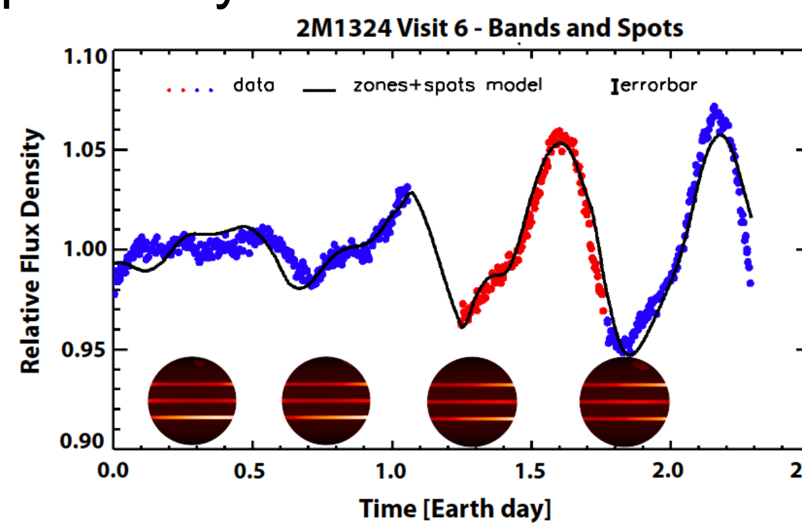
SDSS J1520+3546 (T0 brown dwarf) data from Spitzer GO 80179 (Metchev et al. 2015).



In 2000 hours Spitzer will detect >= 1 habitable exo-Earth around $i > 70^o$ brown dwarf rotators at ~95% confidence.

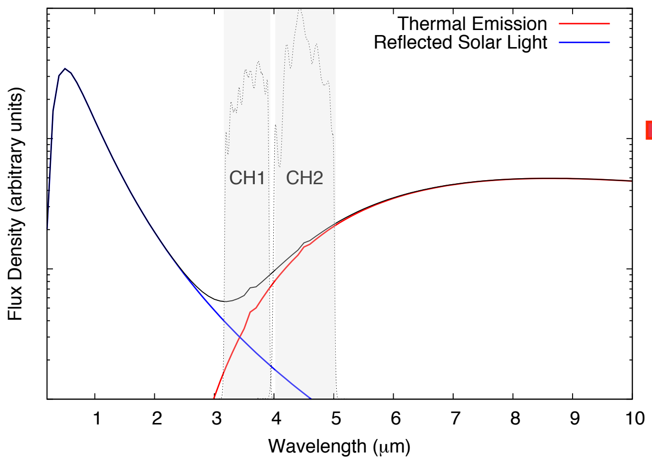
- studying exosolar atmospheric dynamics





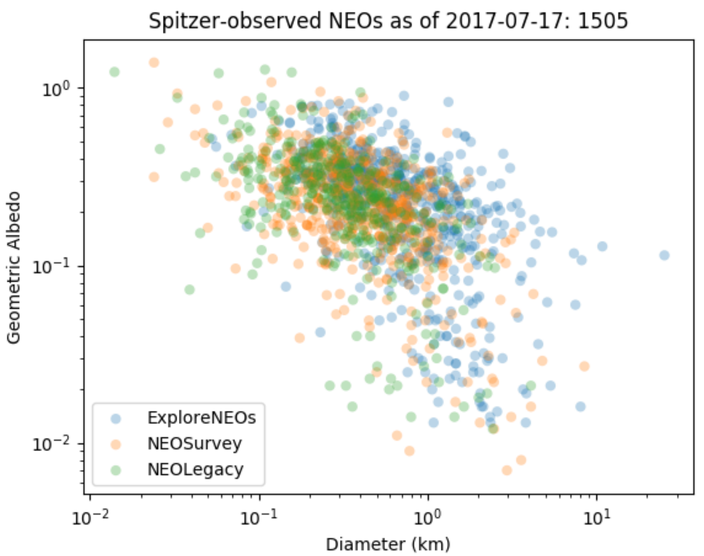
Spitzer monitoring of 3 brown dwarfs revealed zones, spots, and planetary-scale waves (Apai et al. 2017).

Near Earth Objects



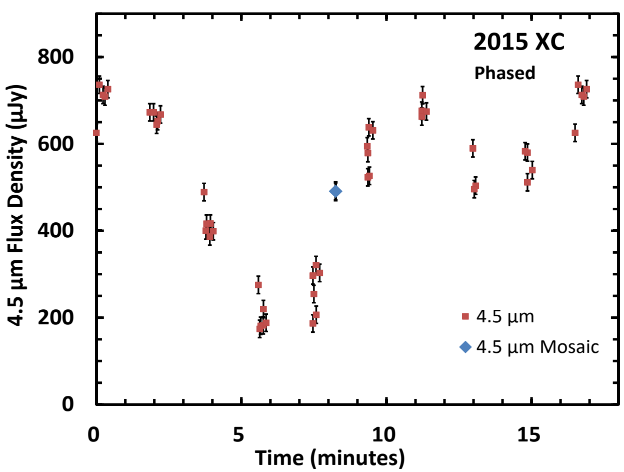
Measure thermal flux from NEOs

➡ Thermal model gives diameter and albedo



Spitzer Extended Mission: About 10% of all NEOs per year

For most objects measure full/partial lightcurves



JWST cannot make these measurements

NEOWISE mission ends 2018

Legacy: LSST

➡ No other facility can do this science

Summary

- Through ~ November 2020
  - Project has shown that Spitzer operations are feasible
  - Community has shown that Spitzer can execute important and exciting science

Jet Propulsion Laboratory
California Institute of Technology