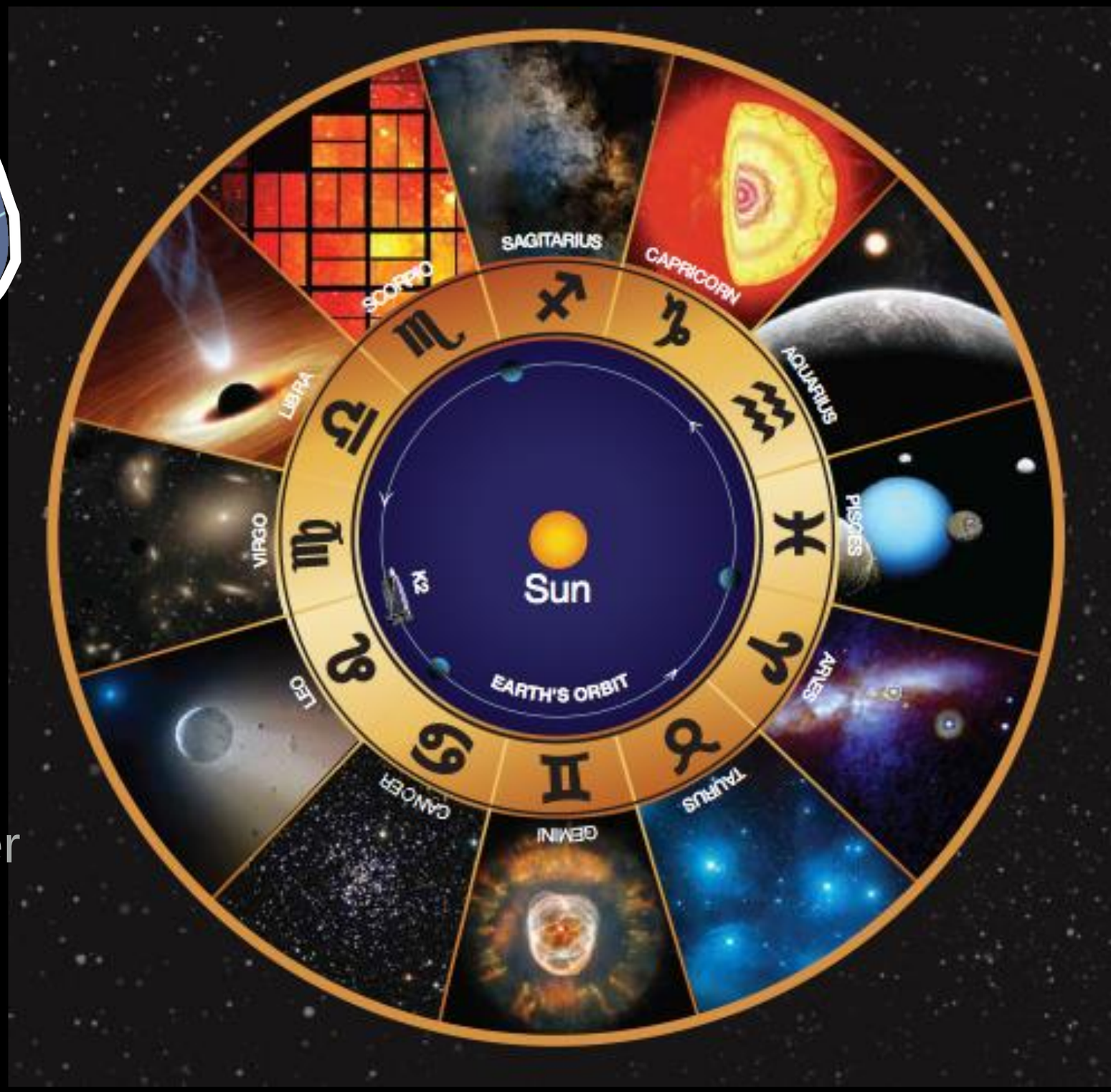


Tom Barclay

K2 Guest Observer Office
Director
NASA Ames Research Center

ExoPAG 14, San Diego
June 12, 2016

K2 Special Session

Monday, June 13. 10.00am

Room: Indigo A (second floor)

Talks on K2 status, exoplanets, supernovae, microlensing,
Spitzer/JWST synergy, ultra-cool dwarfs and clusters

Takeaways

The K2 mission will continue until the end of the spacecraft lifetime

Many earth and super-earth-sized planets have been detected orbiting nearby cool stars

The K2 Microlensing Experiment serves as a pathfinder for microlensing with WFIRST

National Aeronautics and Space Administration

Senior Review 2014
Senior Review 2016

Pisces
Aries
Gemini
Cancer
Leo
Taurus
Ophiuchus
Virgo
Pisces
Aquarius
Libra
Scorpio
Capricorn
Sagittarius
GALACTIC PLANE

8 4 13 0 18 5 14 1 17 10 6 15 2 11 9 7 16 3 12

Data Available
In Progress
Cycle 5
Supernova-focused

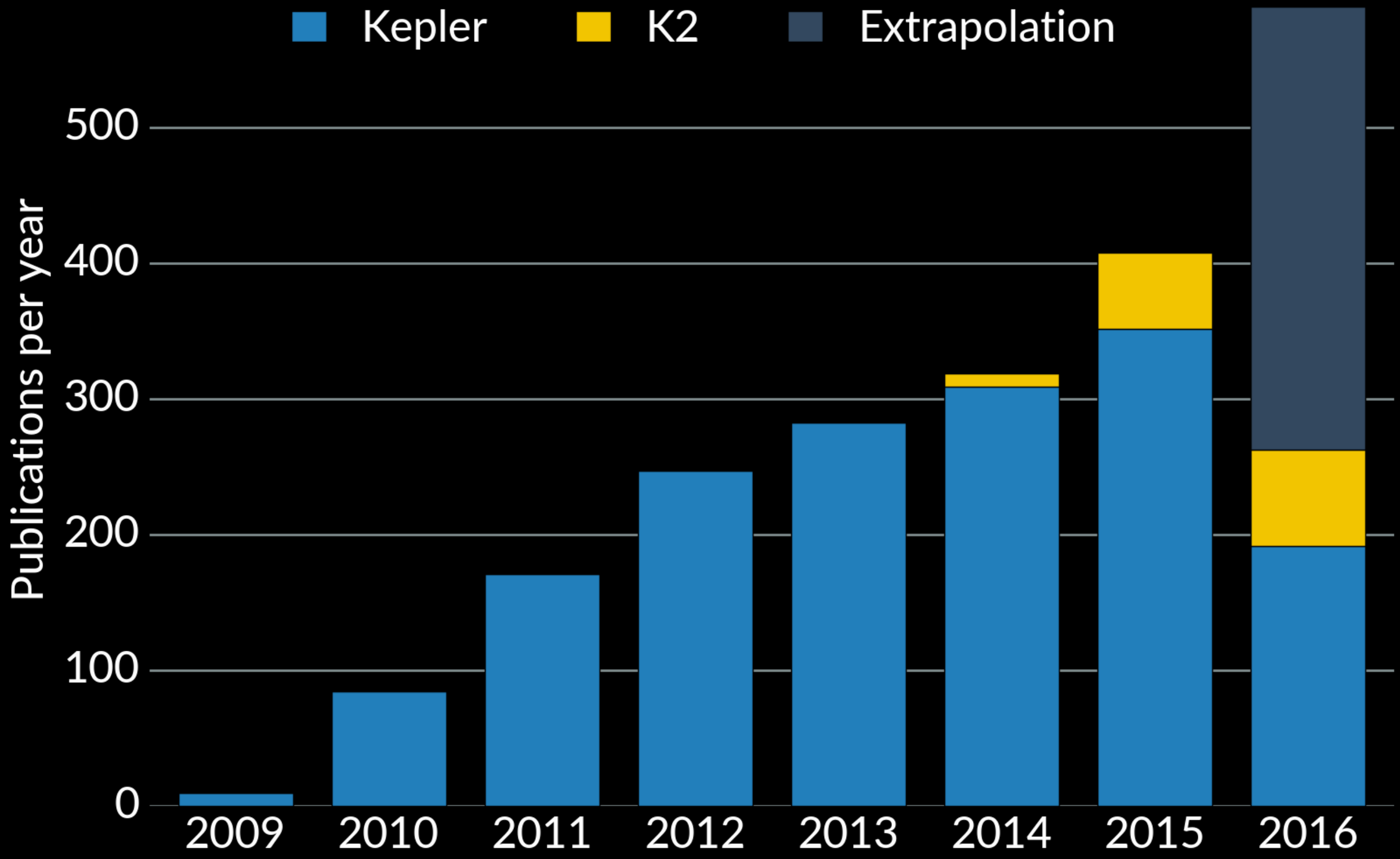
www.nasa.gov

K2 Senior Review Results

- K2 ranked Excellent in all three categories
  - synergies between K2 and Spitzer were emphasized
- Funding recommended in FY 17/18/19
  - through end of the operating lifetime (~mid-2018)
- *"...with a very efficient GO program, the project includes worldwide participation covering every continent except Antarctica. The GO program is recognized as a major reason fo[illegible] scientific results."*

K2-south?

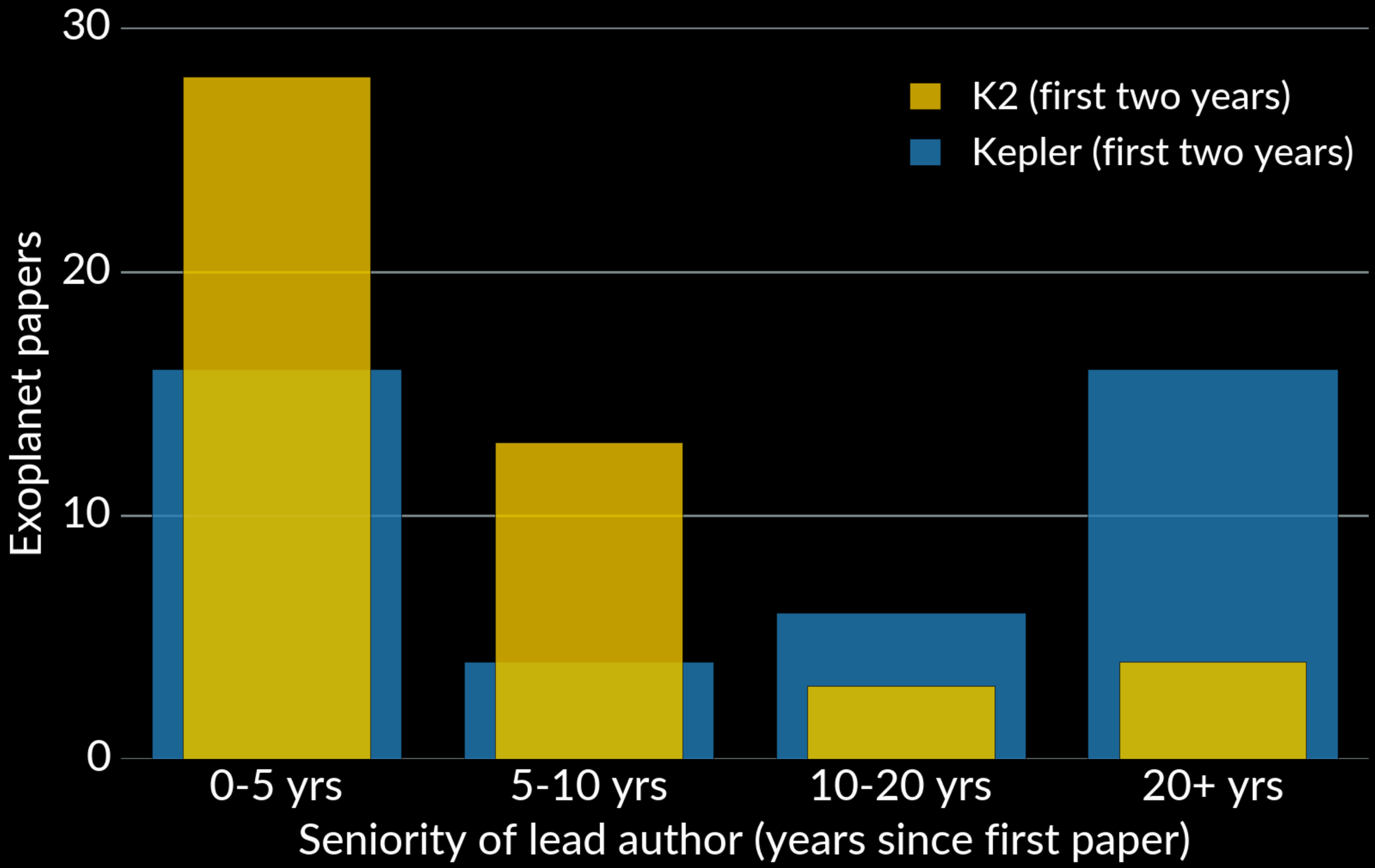
Kepler/K2 Contributed to 1786 Publications So Far



Incentivizing Publication and Innovation

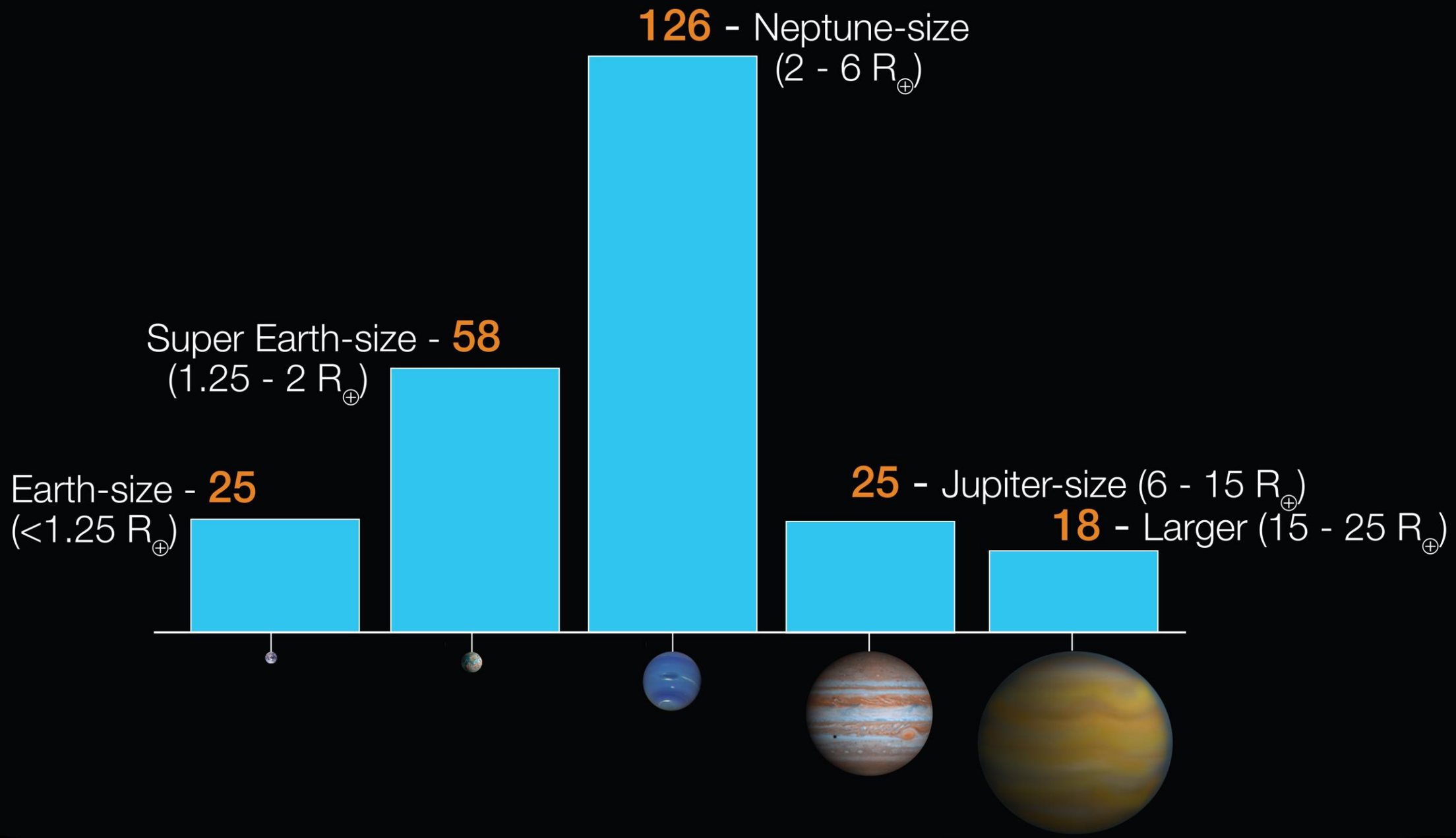
- No proprietary data enables *all* those with skills and talent to benefit from the data collected
- Funding of competing groups to do the *same* science
- Requiring large programs to provide products of value to the community
- We are experimenting with release of science data as soon as it's on the ground
- K2 can inform policies for future missions
  - potential to contrast with Kepler

K2's Open Data Policy Empowers Early-Career Astronomers



Sizes of K2 Planet Candidates

As of June 1, 2016

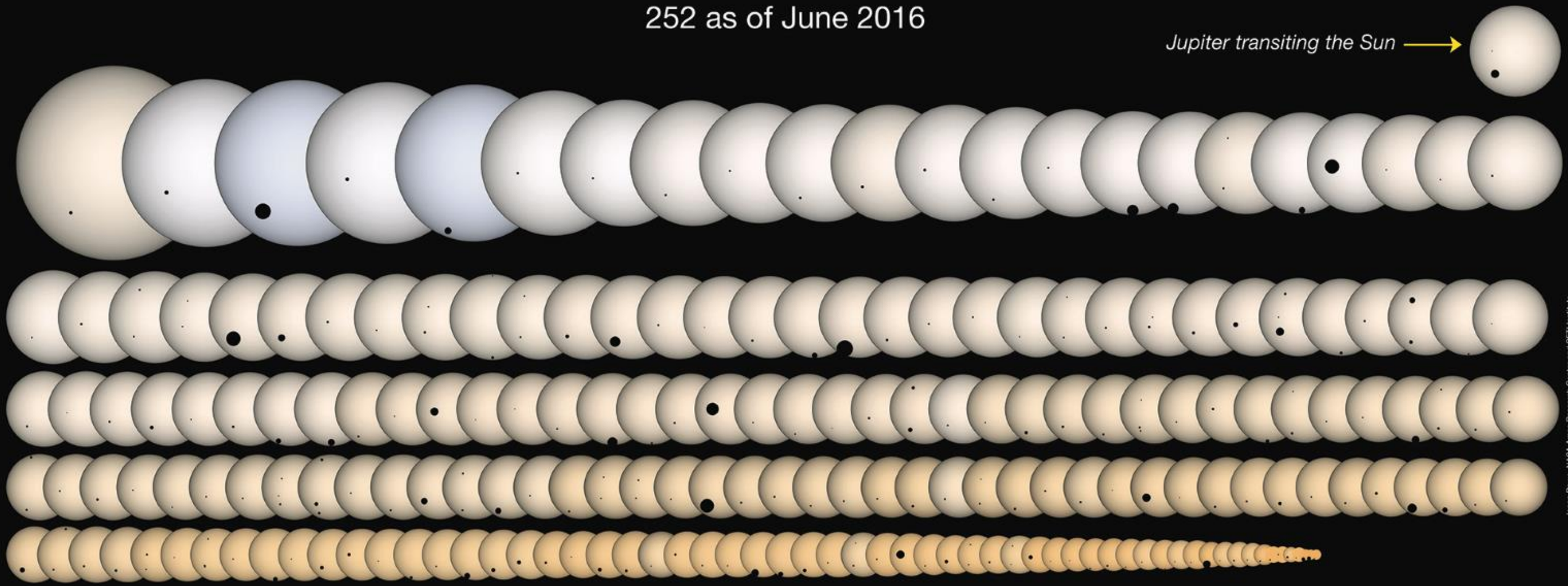


National Aeronautics and Space Administration

K2'S PLANET CANDIDATES

252 as of June 2016

Jupiter transiting the Sun →



STAR COLORS

A F G K M

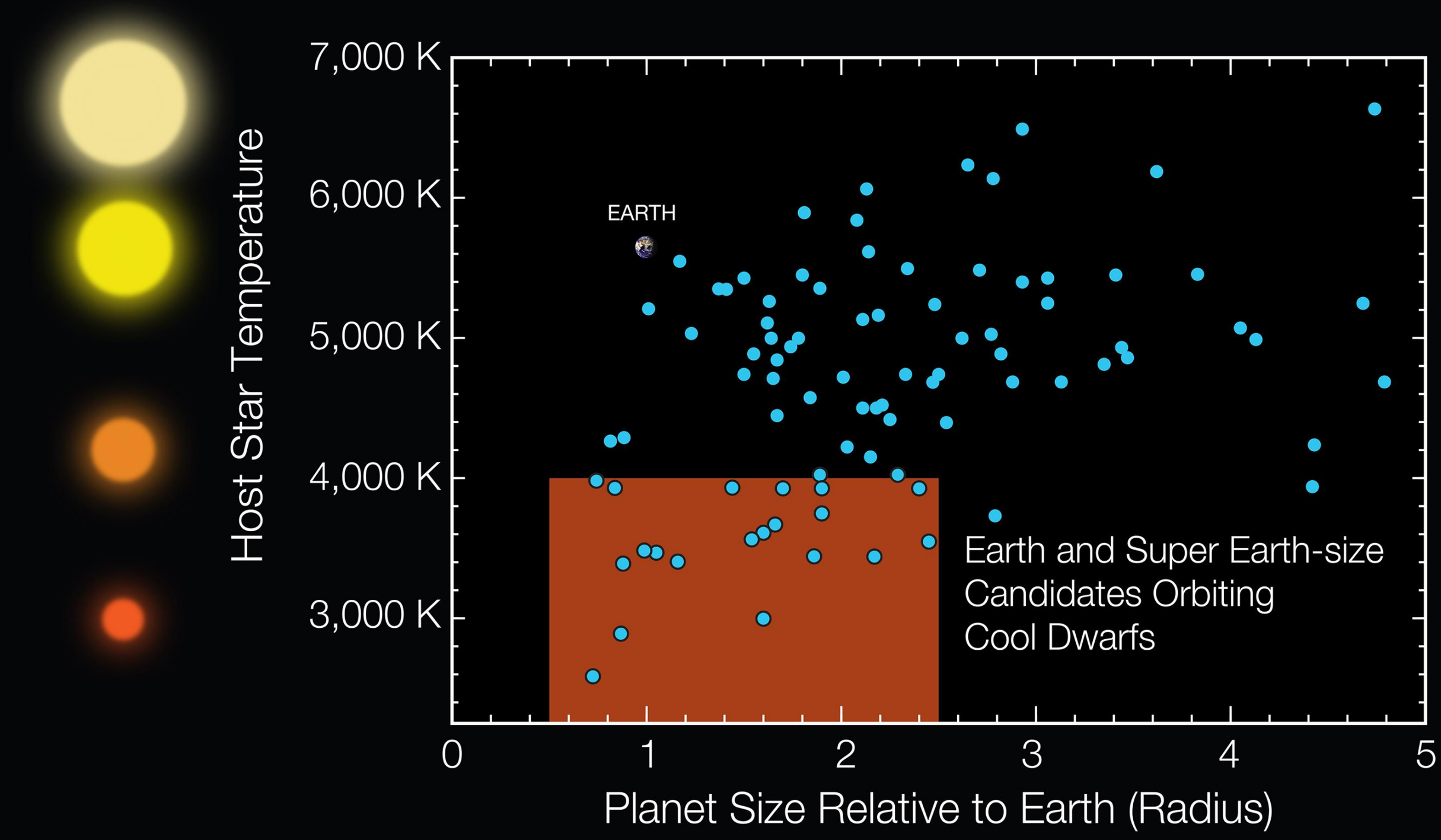
NASA's K2 mission has discovered 252 planet candidates orbiting other suns since beginning full operations in June 2014. The K2 mission uses the the Kepler space telescope to conduct a series of sequential observing campaigns of fields distributed around the ecliptic. In these campaigns, K2 finds planets that transit their star, which means that there is a slight dimming of starlight when the planet crosses the face of its star. In this diagram, the planetary systems are ordered by decreasing diameter of the host star. The star's color represents its temperature as shown in the lower scale, and the letters (A, F, G, K, M) designate star types. The simulated stellar disks and the planet silhouettes are shown on the same scale as that of our Sun and Jupiter shown in the upper right. Look carefully: some systems have multiple planets. New exoplanets are discovered every few months as more data is collected and analyzed. A higher resolution version of this graphic is available at: http://www.nasa.gov/mission_pages/kepler/multimedia.

www.nasa.gov

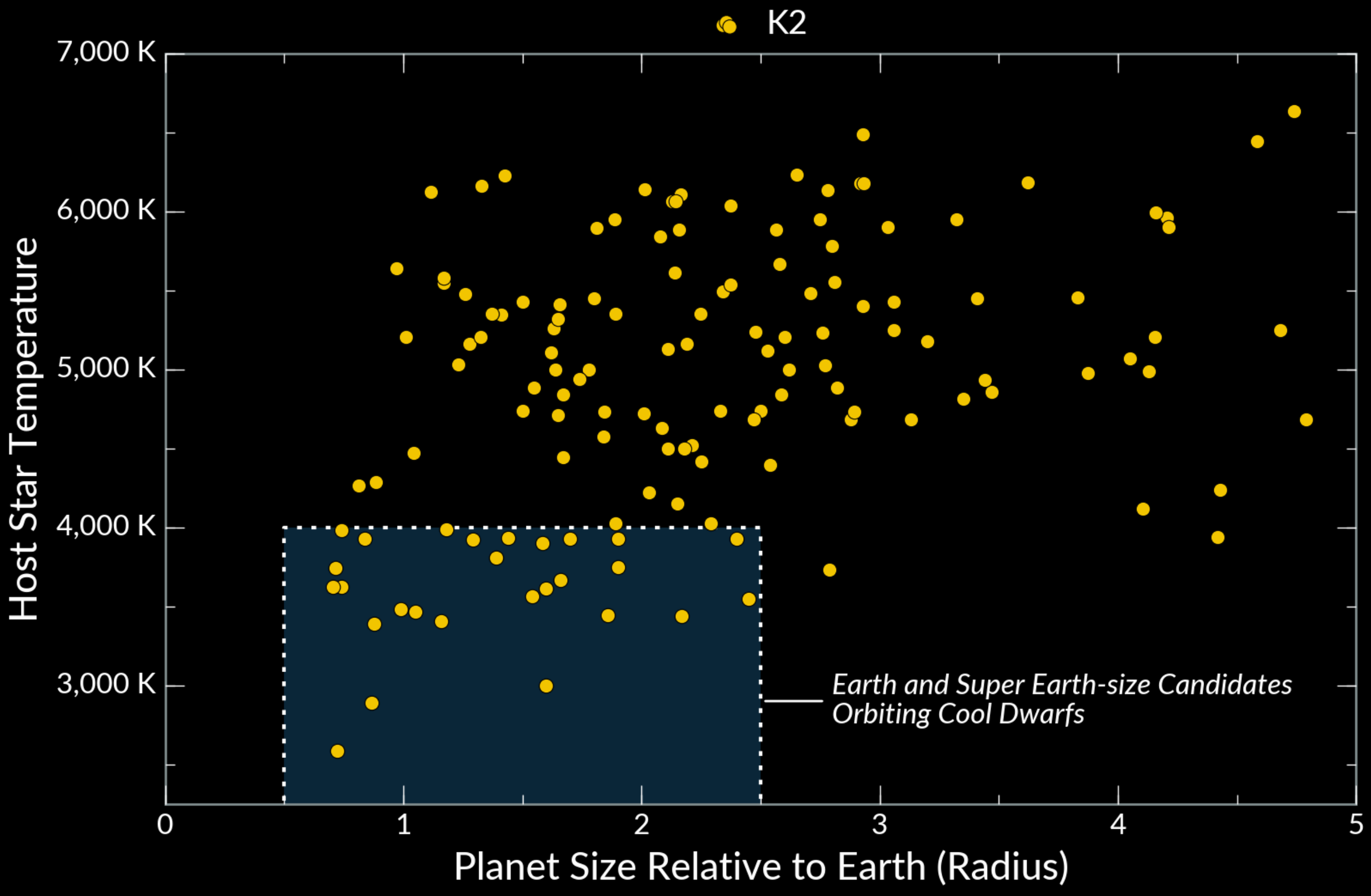
Jason Rowe, NASA Ames Research Center and SETI Institute

NASA's K2 Planet Candidates for Atmospheric Characterization (Ks < 11)

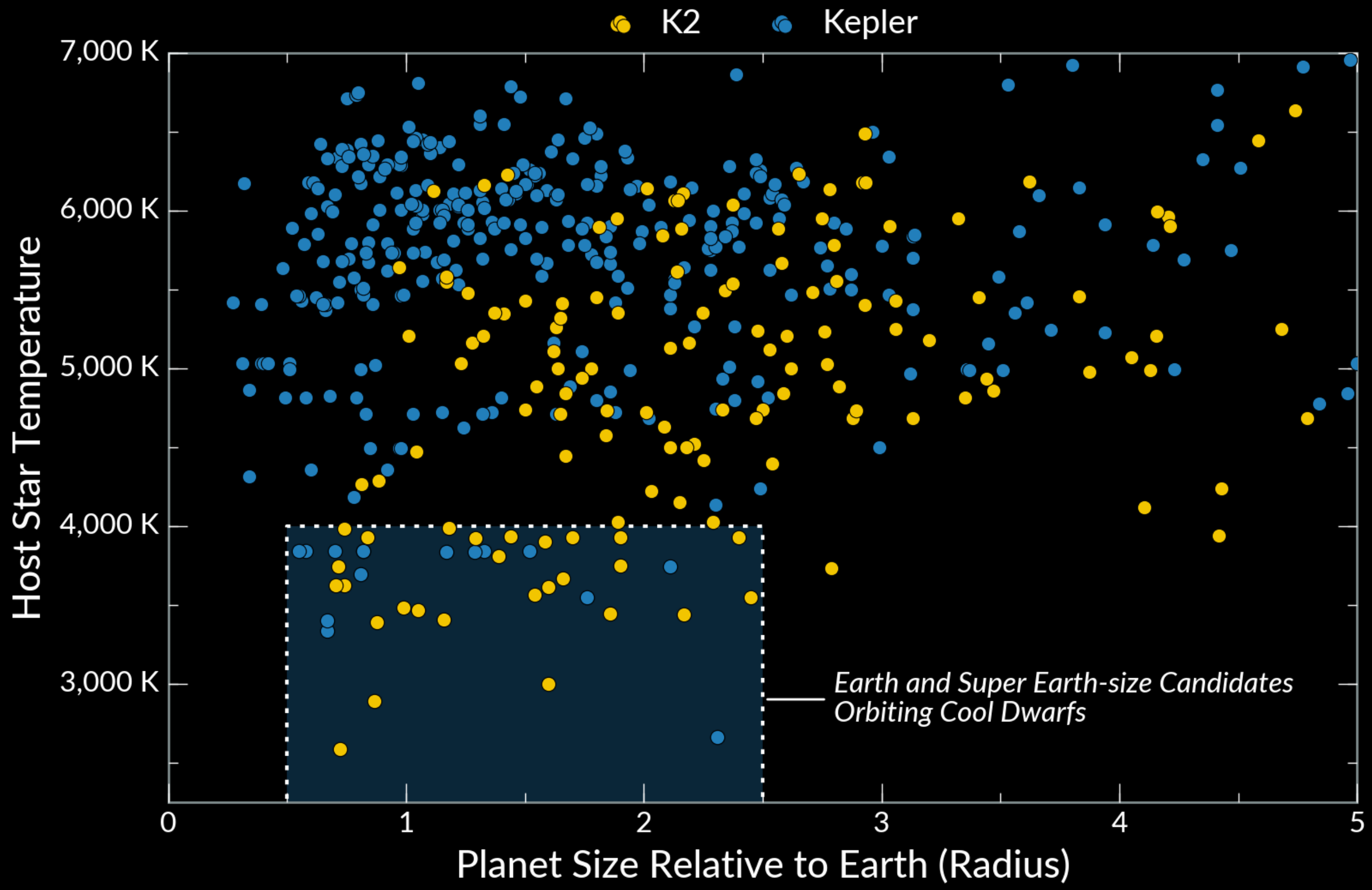
As of June 1, 2016



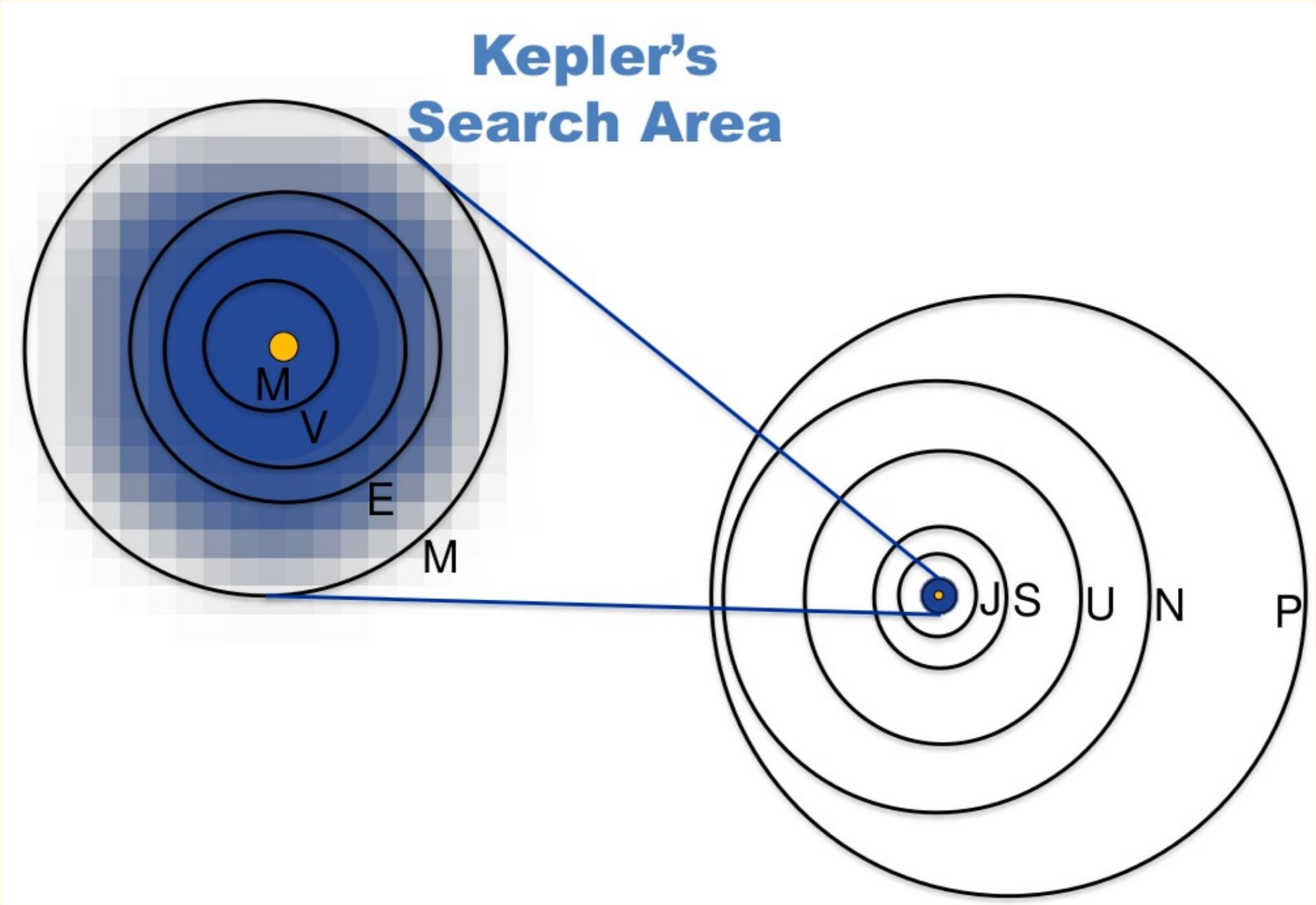
Planet Candidates for Atmospheric Characterization (Ks < 11)



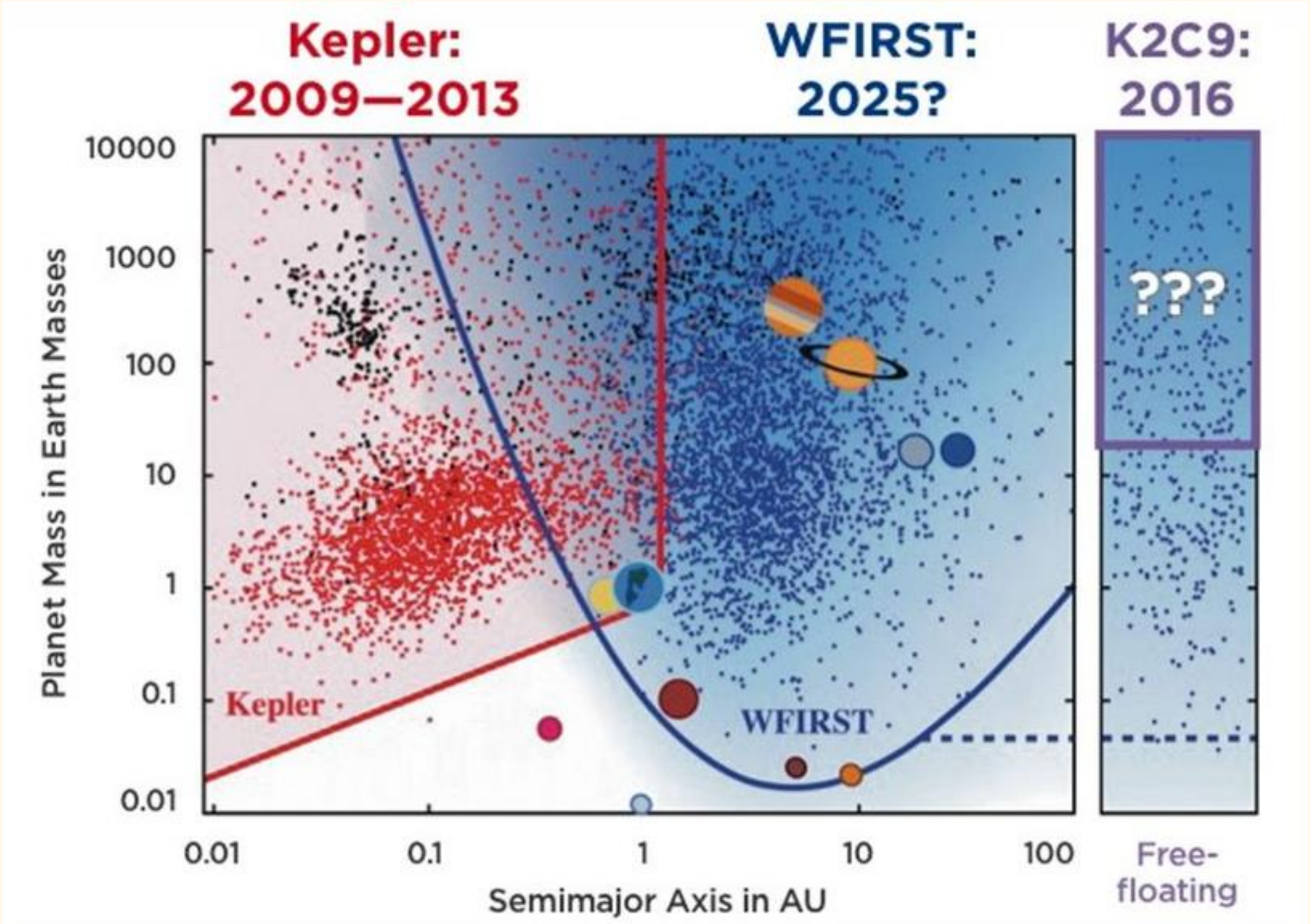
Planet Candidates for Atmospheric Characterization (Ks < 11)



Completing the Exoplanet Census

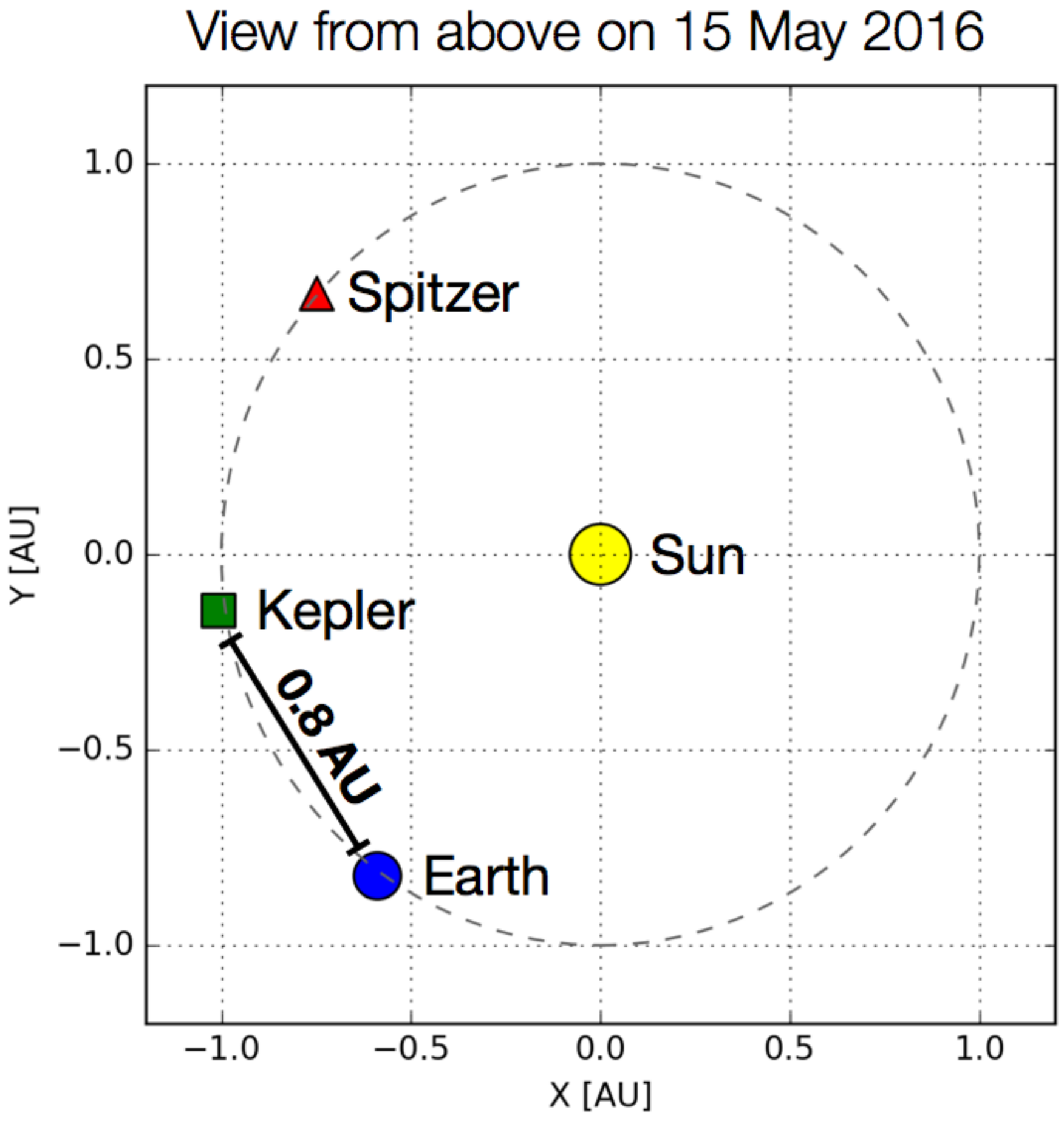


Completing the Exoplanet Census

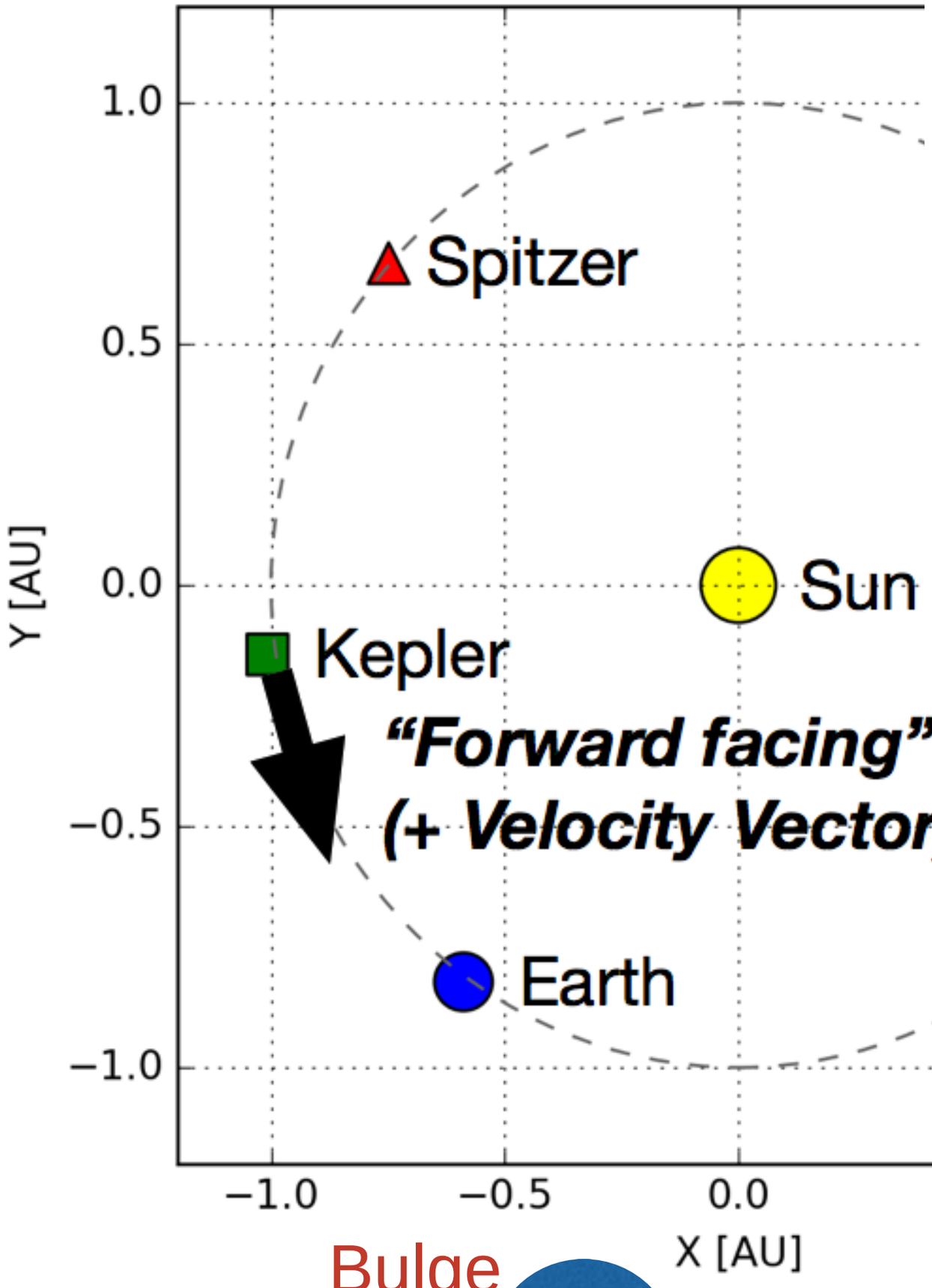


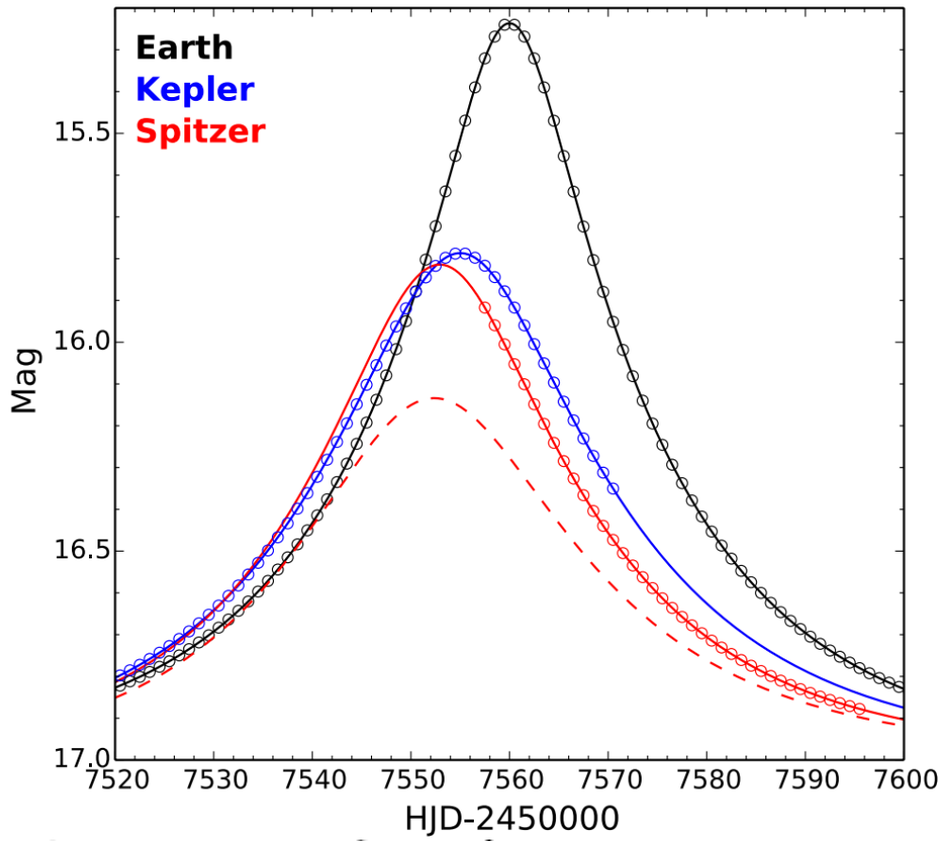
Adapted from Spergel et al. 2015

Using Starlight to Find Wandering Worlds


View from above on 15 May 2016
Spitzer
Sun
Kepler
0.8 AU
Earth
1.0
0.5
0.0
−0.5
−1.0
Y [AU]
−1.0
−0.5
0.0
0.5
1.0
X [AU]

View from above on 15 May 2016



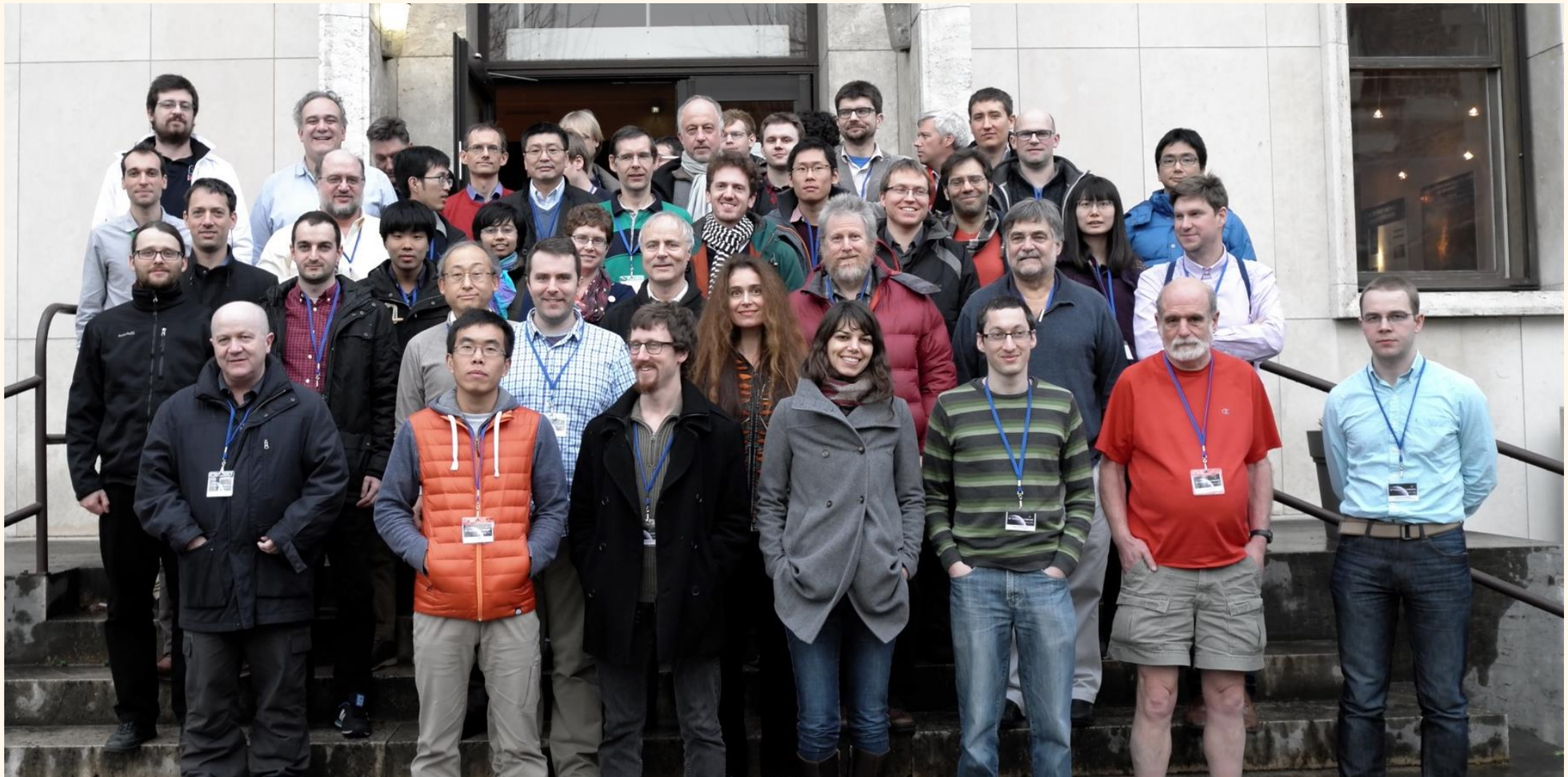


Microlensing Science Team

- We recognized the need for a single, cohesive unit with a charge to represent and serve the best interests of the microlensing scientific community
- Two essential tasks
  - Facilitating simultaneous ground-based data collection and analyses of those ground-based data
  - Development and execution of methods that ensure accurate, under-sampled, crowded field photometry
- We aimed to provide an environment that enabled new talent to get involved with microlensing

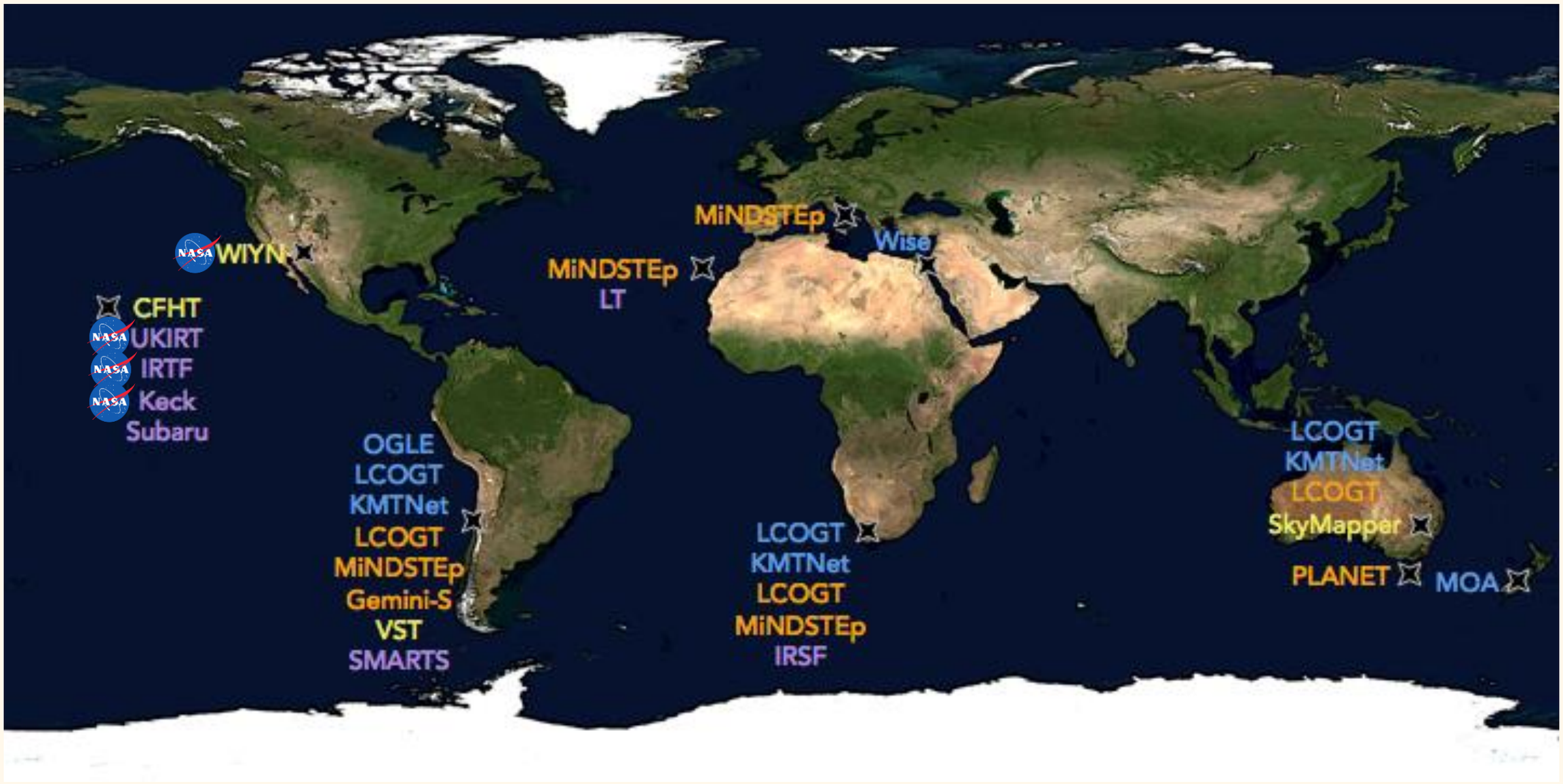
Microlensing Science Team

- Achievements so far include
  - Wrote a white paper (arXiv: 1512.09142)
  - Set up an open mailing list and wiki
  - Secured telescope resources during C9 on every continent (except Antarctica!)
  - With NExScI, developed real-time events database and telescope calendar
  - Selected targets and pixels for downlink
  - Started identifying and analyzing events using newly developed photometry techniques

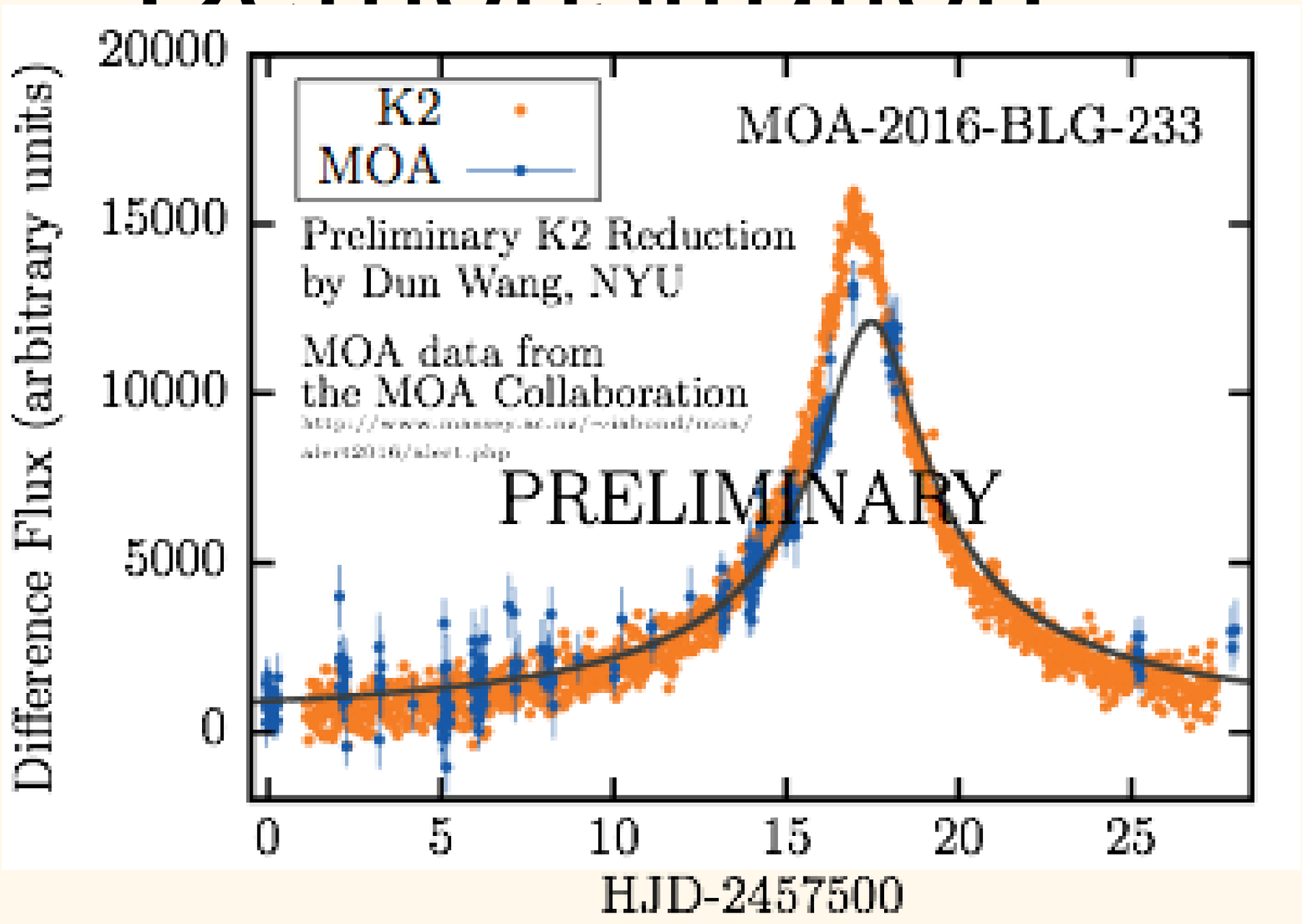


K2 Microlensing Experiment

Obtaining sufficient telescope resources was a key component to a successful campaign and our #1 risk



Early Demonstration



Role as a Pathfinder

- Flexibility from the K2 team at NASA and Ball enabled a brand new science experiment using existing capabilities
  - Changing the spacecraft pointing direction
  - Reducing the target selection lead time to a few weeks
  - Instant access to the raw data, enabling rapid follow-up
- The unique capabilities offered by a space mission can unite and grow a community

Role as a Pathfinder

- A pathfinder for future missions
  - For WFIRST: K2 C9 is growing expertise within the current microlensing community, and also growing that community with additional skills and talent
  - C9 is showing that the community is able to extract high-value, time-sensitive information from raw spacecraft data with minimal mission support
    - we wrote one 600-line software package to parse the data
    - to enable time-critical science, should providing instant access to data become the default for future missions?

KEPLER & K2 SciConIV:
Legacy & Scion

2017 **JUNE 19-23**

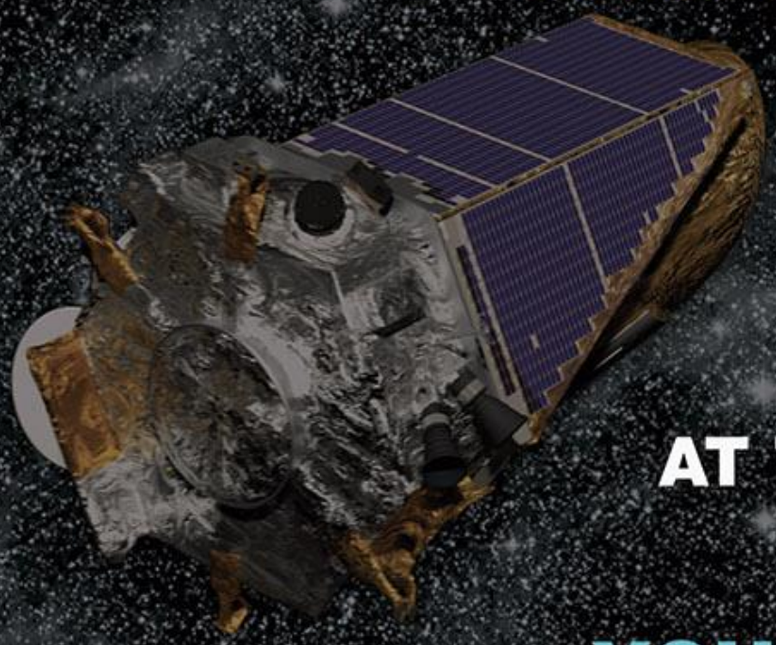
NASA Ames
Research Center
Moffett Field, CA

NASA'S KEPLER/K2 MISSIONS

KEPLER MODEL GIVEAWAY!!

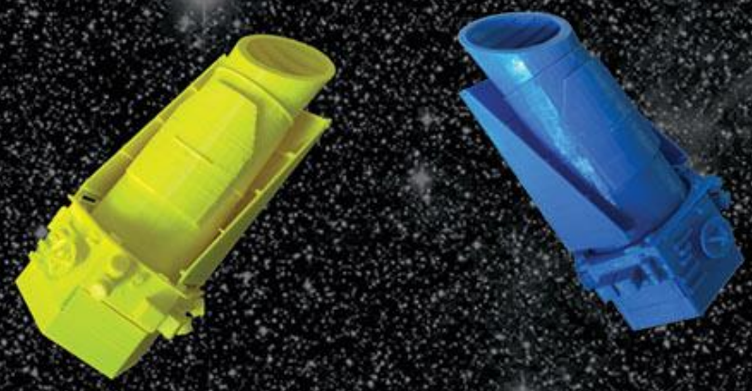
Win a 3d-printed KEPLER!!

(1/33 scale)

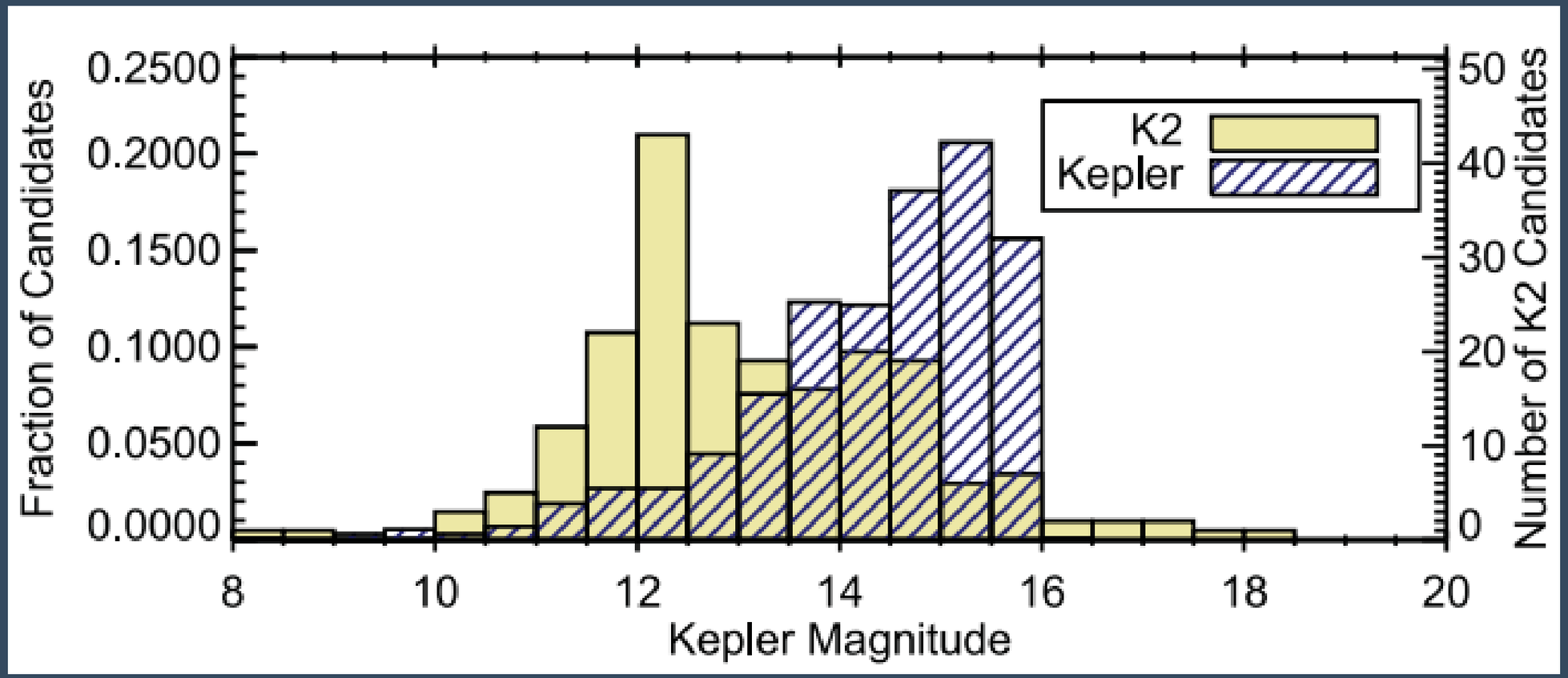


DRAWING AT 6:00 PM
WEDNESDAY, JUNE 15
AT THE KEPLER/K2 BOOTH (#106)

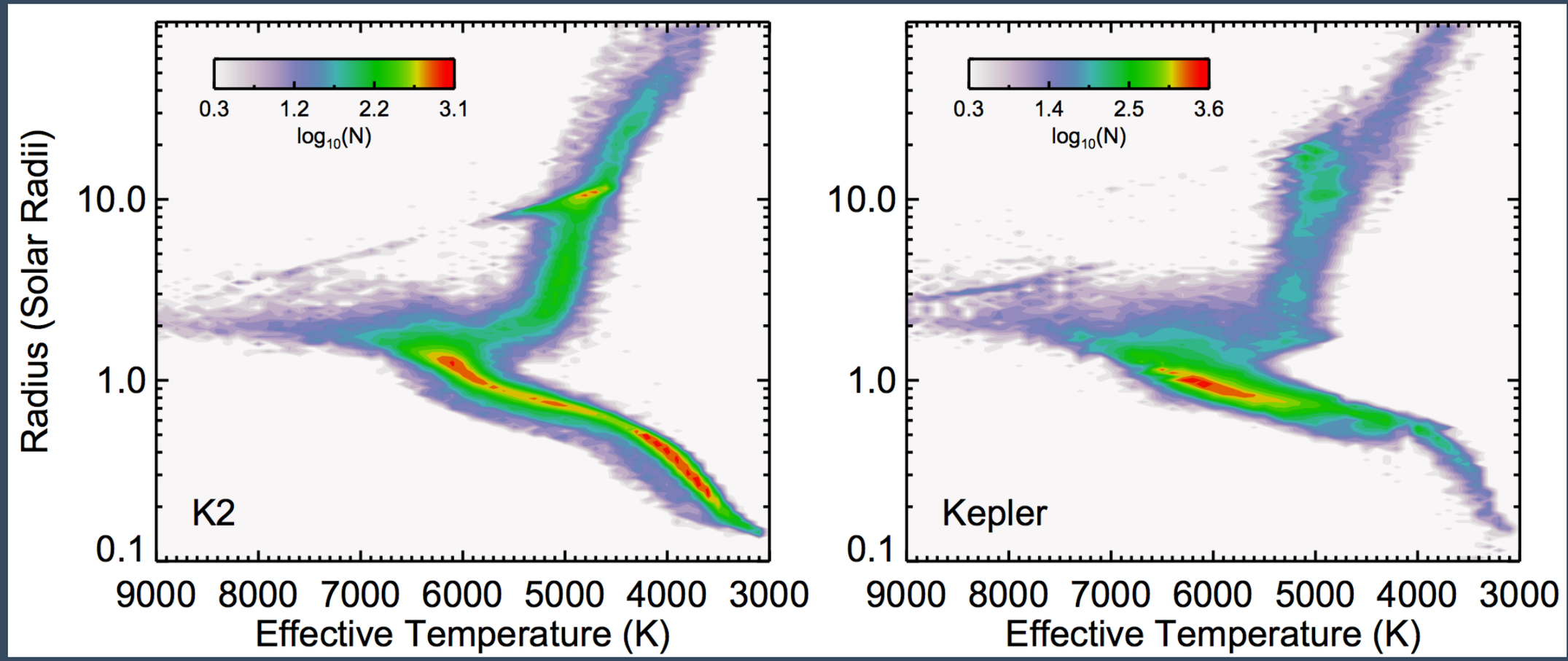
YOU MUST BE PRESENT TO WIN



Backup



Huber et al. 2016



Vanderburg et al. 2015

National Aeronautics and Space Administration

NASA

HYADES
Nearest
Open Star Cluster

M67
Nearest Old
Open Star Cluster

CAMPAIGN 4

CAMPAIGN 5

PLEIADES
Nearby Open Star Cluster
(Seven Sisters)

M44
Nearby Open Star Cluster
(Beehive Cluster)

COMA BERENICES
Galaxy Cluster

RUPRECHT 147
Oldest Nearby Star Cluster

CAMPAIGN 6

CAMPAIGN 7

QATAR-2b
Transiting Exoplanets

PLUTO
Largest Dwarf Planet

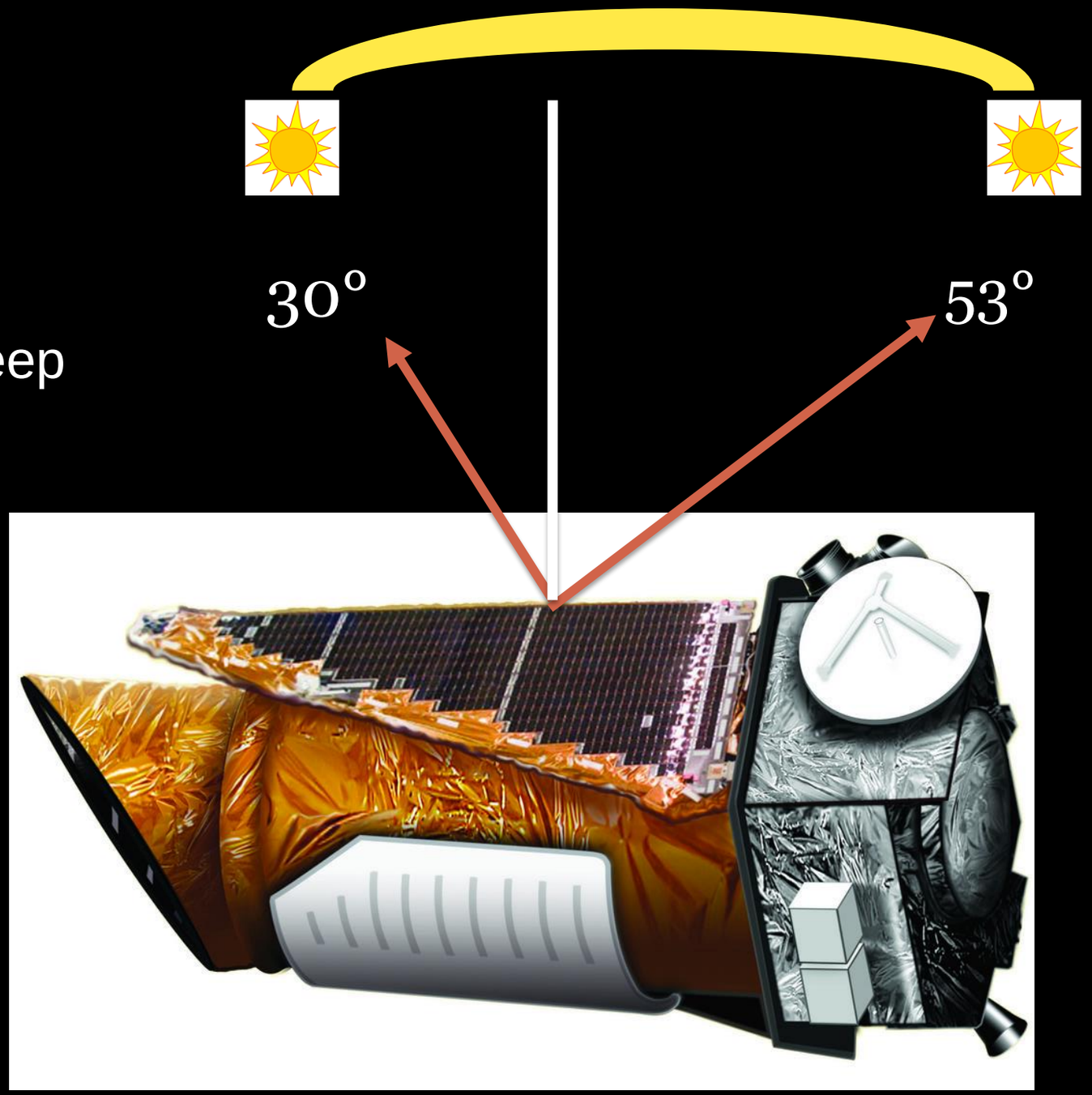
www.nasa.gov

As of May 2016

Balancing Solar Pressure

Spacecraft must keep solar panel pointed at the sun.

Limits time it can stare at a single field to 80-90 days (depending on the spacecraft orbital phase)



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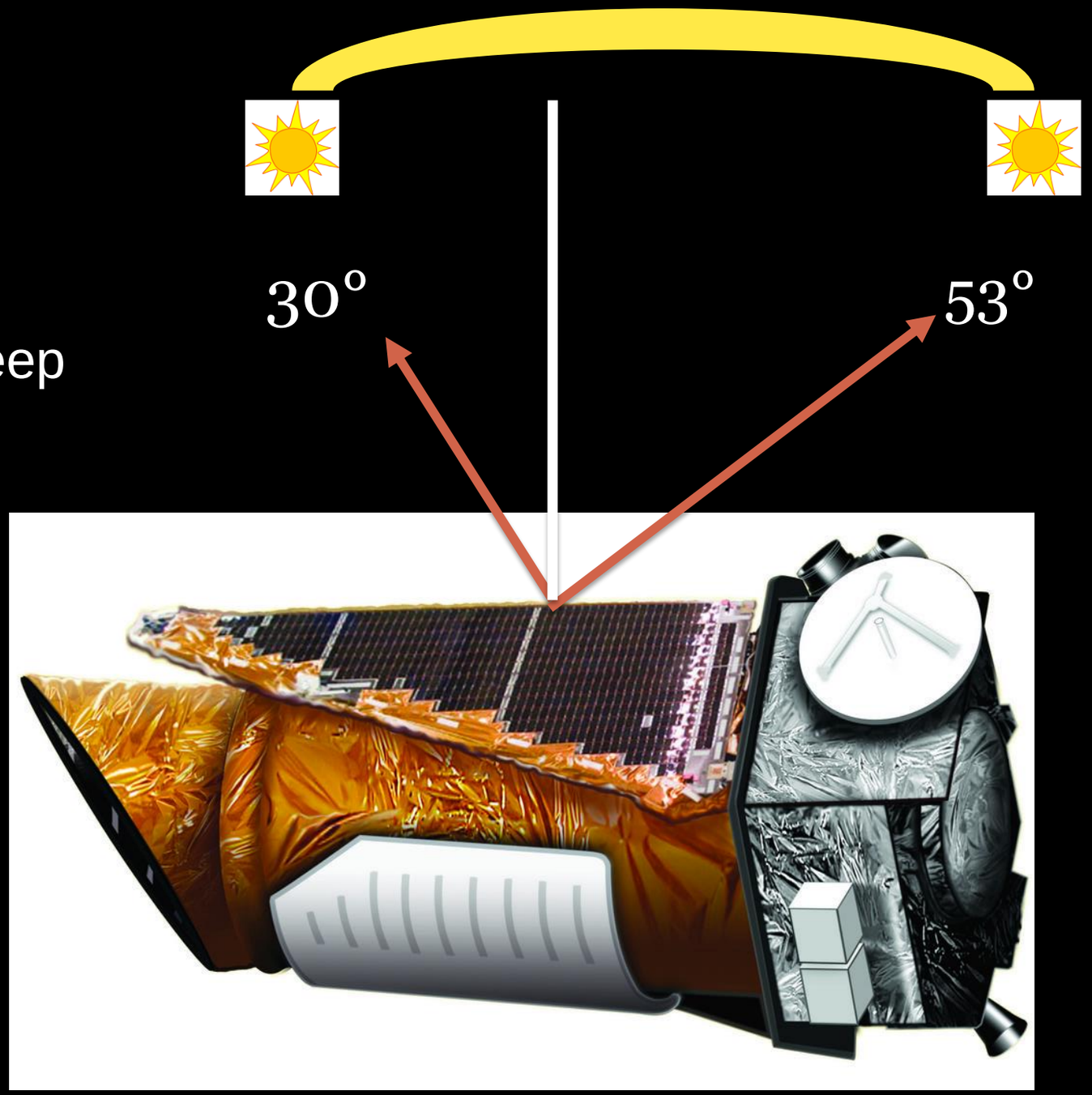

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