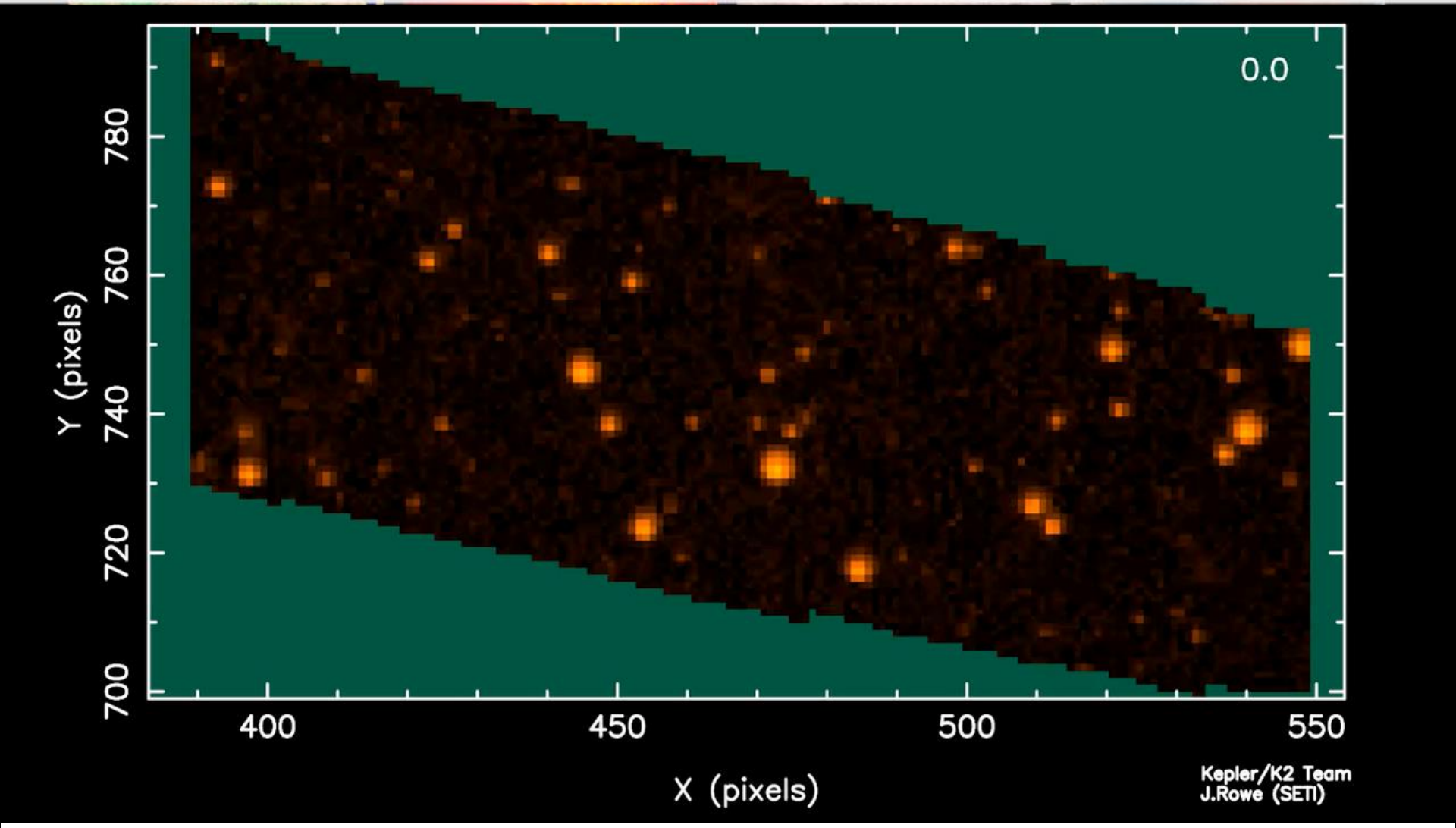
Astrophysics Subcommittee Meeting July 21+22, 2015 Summary Report

Scott Gaudi
(Astrophysics Subcommittee Chair)

NAC Astrophysics Subcommittee Membership

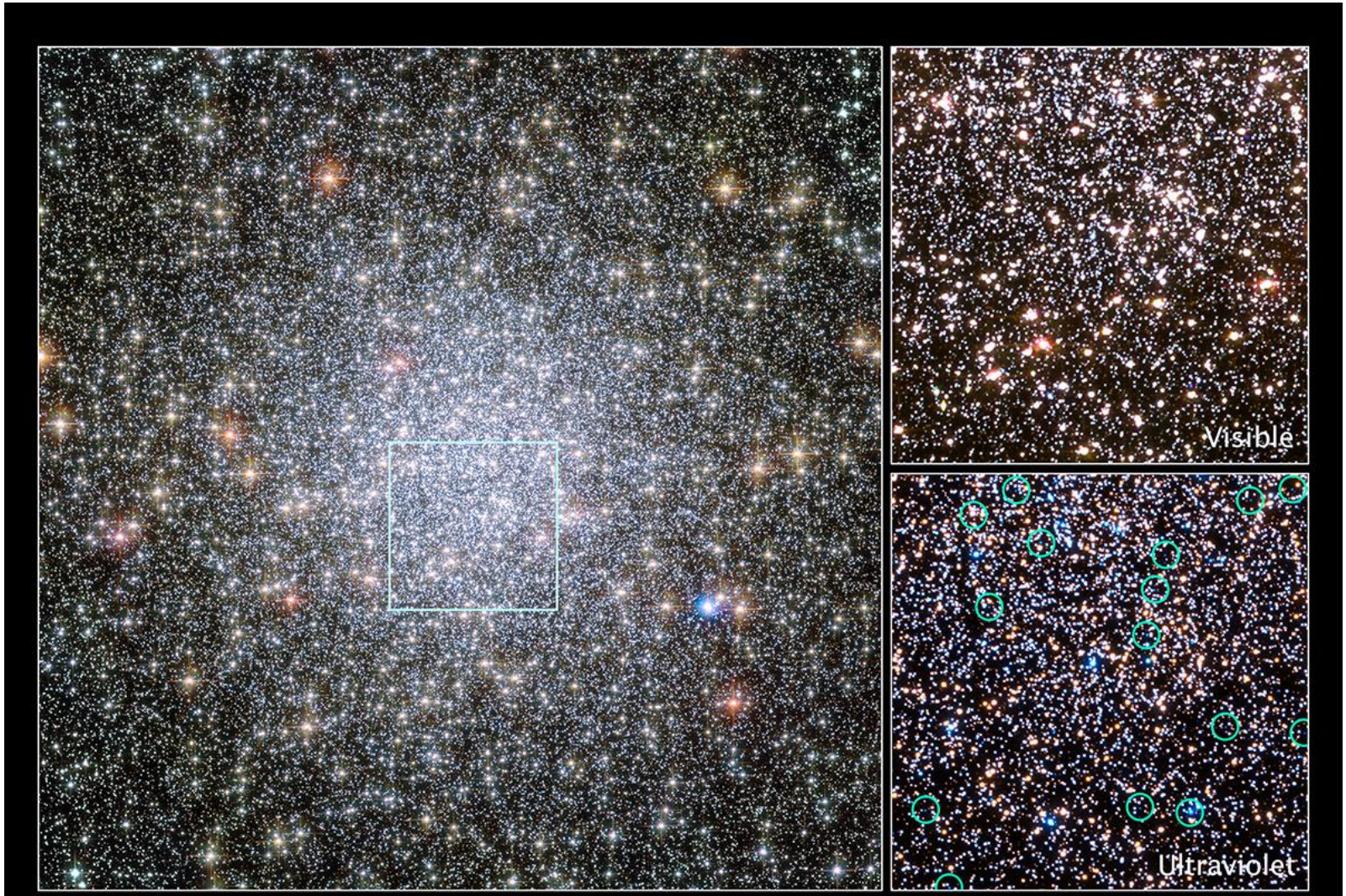
- Scott Gaudi (Chair) — The Ohio State University
- Hashima Hasan (Exec. Secretary) — NASA Headquarters
- Natalie Batalha — NASA Ames Research Center
- Marshall Bautz — Massachusetts Institute of Technology
- Jamie Bock (PhysPAG EC Chair) — California Institute of Technology
- Alan Boss (ExoPAG EC Chair) — Carnegie Institution
- Patricia Boyd — NASA Goddard Space Flight Center
- Joel Bregman (Deputy Chair) — University of Michigan
- Neil J. Cornish — Montana State University
- Giovanni Fazio — Harvard-Smithsonian CfA
- Fiona Harrison — California Institute of Technology
- Jason Kalirai — Space Telescope Science Institute
- Chryssa Kouveliotou — NASA Marshall Space Flight Center
- Paul A. Scowen — Arizona State University
- Kenneth Sembach (COPAG EC Chair) — Space Telescope Science Institute
- Rachel Sommerville — Rutgers University
- Yun Wang — California Institute of Technology

Kepler/K2 Campaign 3 Observes Neptune



Movie available at: http://www.nasa.gov/feature/kepler/ames/kepler-observes-neptune-dance-with-its-moons

Hubble Captures Stellar Exodus in Action

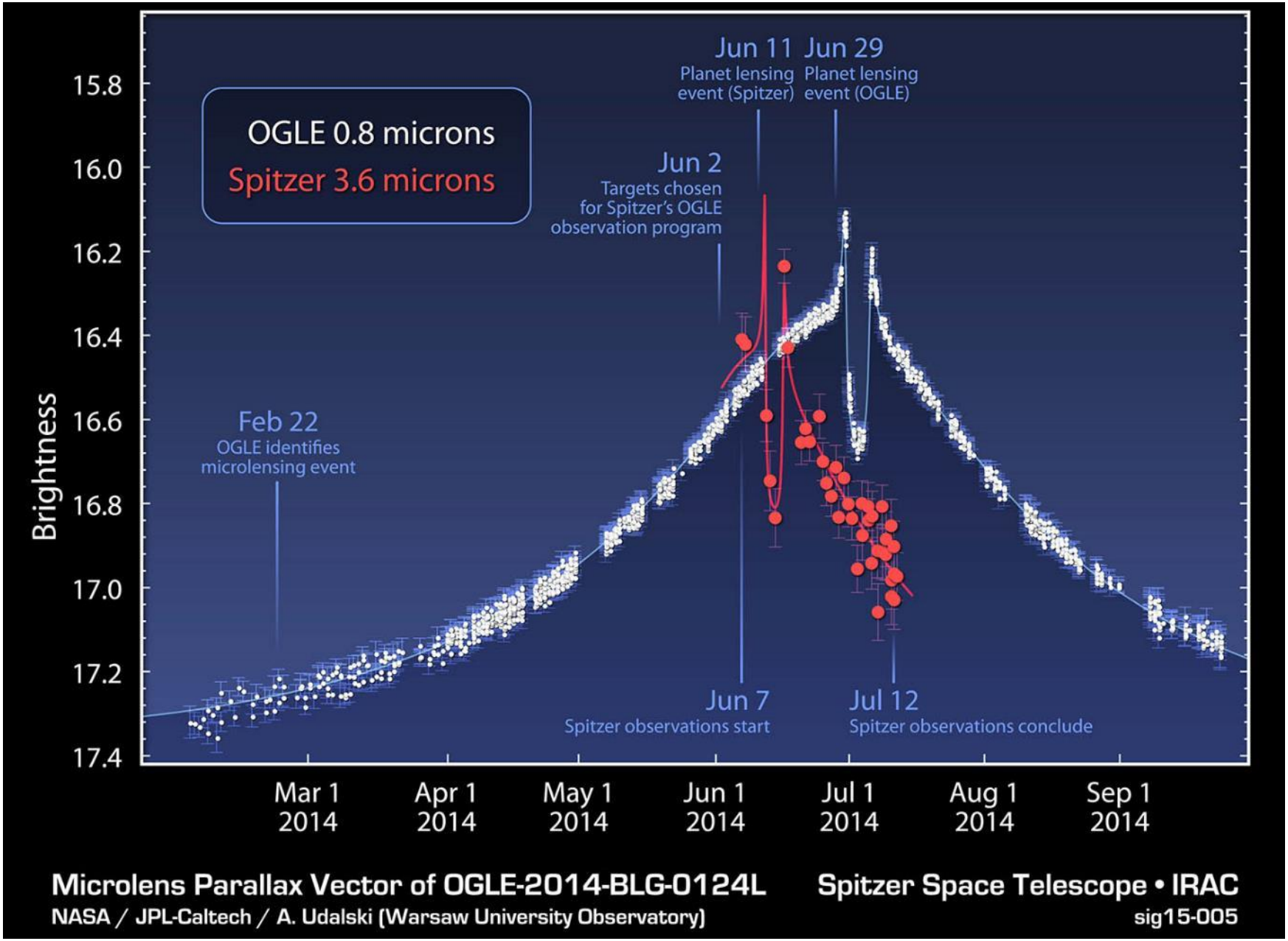


Globular Cluster 47 Tucanae
Hubble Space Telescope ▪ ACS/WFC ▪ WFC3/UVIS

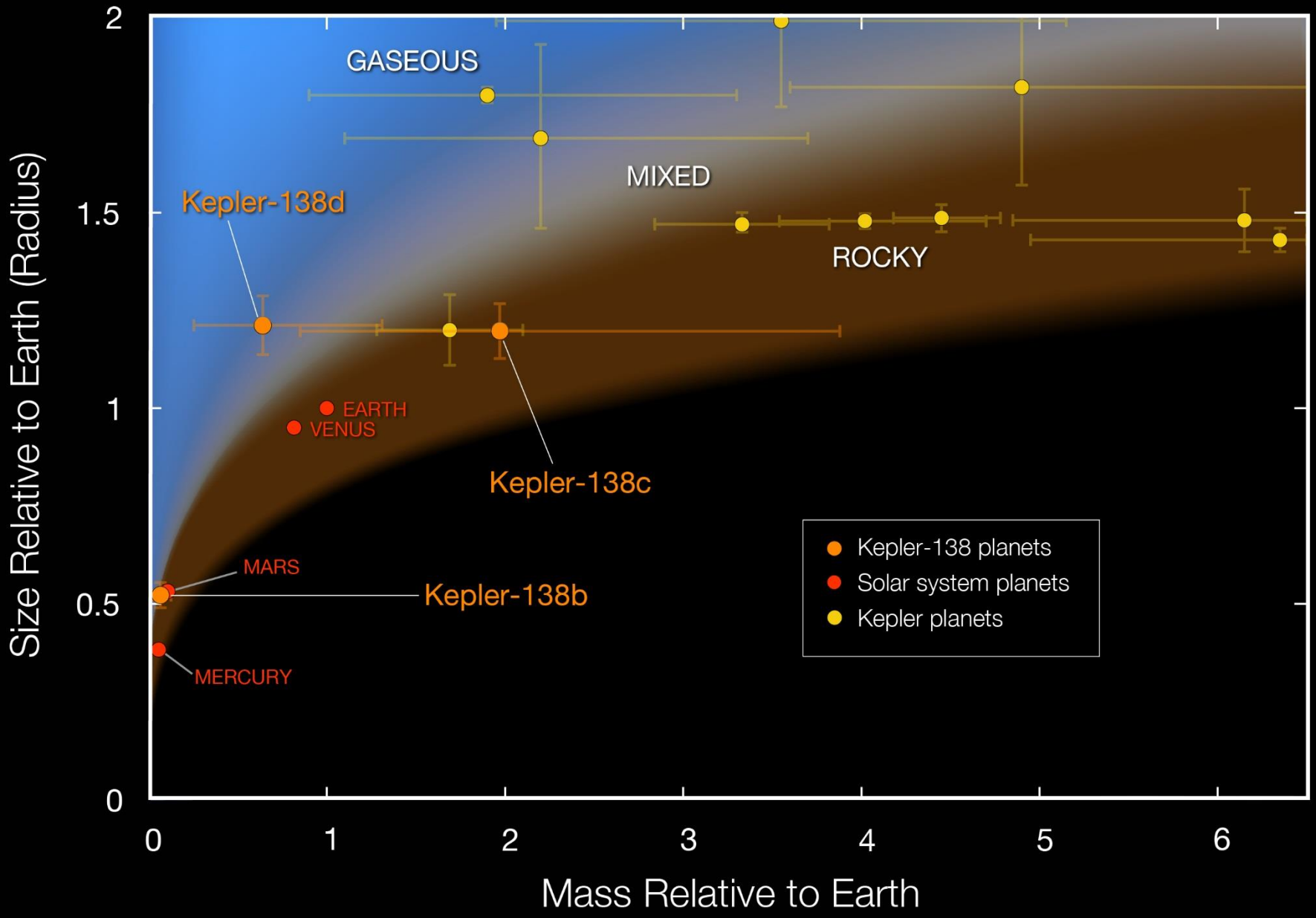
NASA and ESA

STScI-PRC15-16a

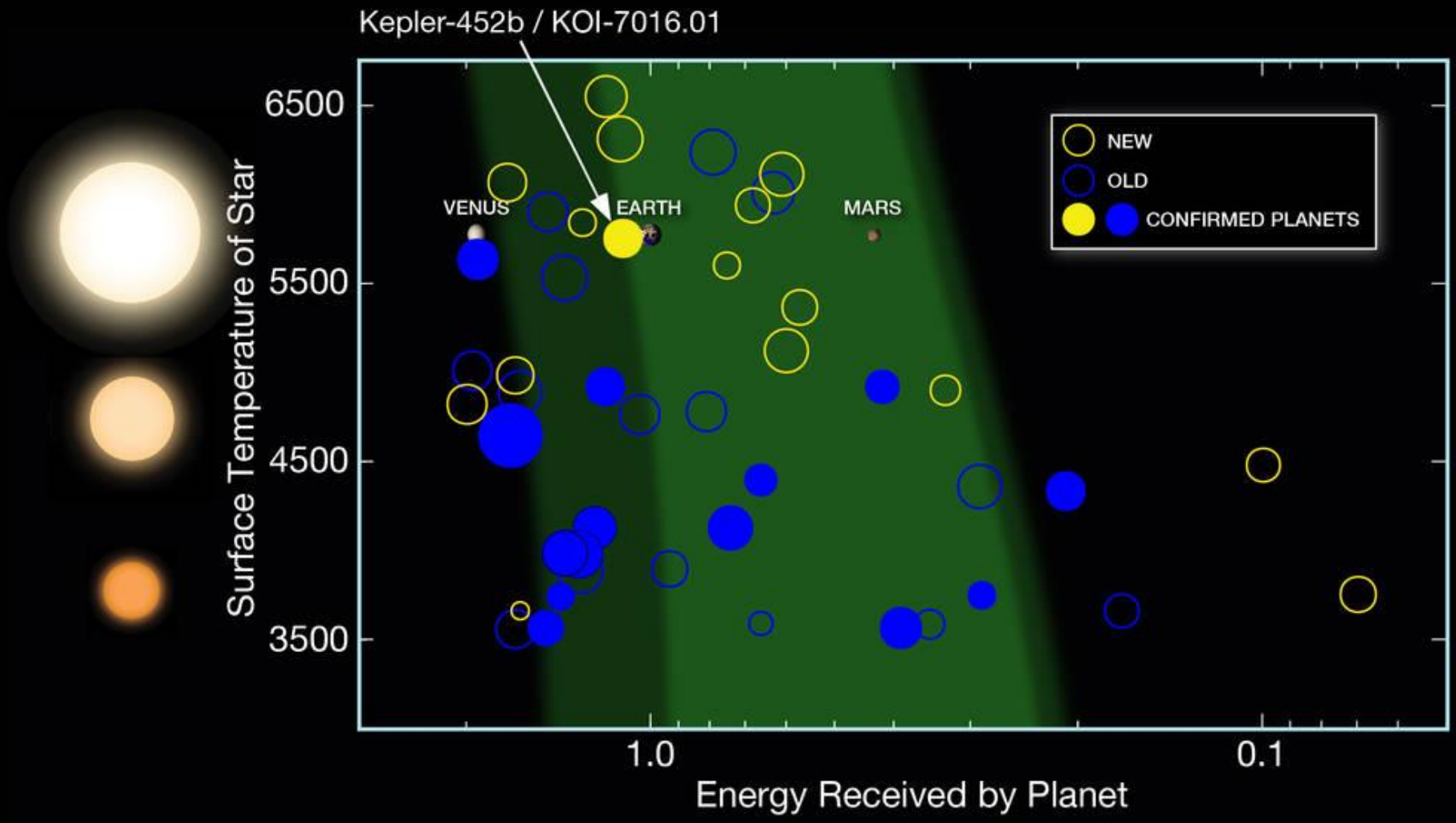
Spitzer Spots Planet Deep Within Our Galaxy



Mass and Radius of Kepler-138 Planets

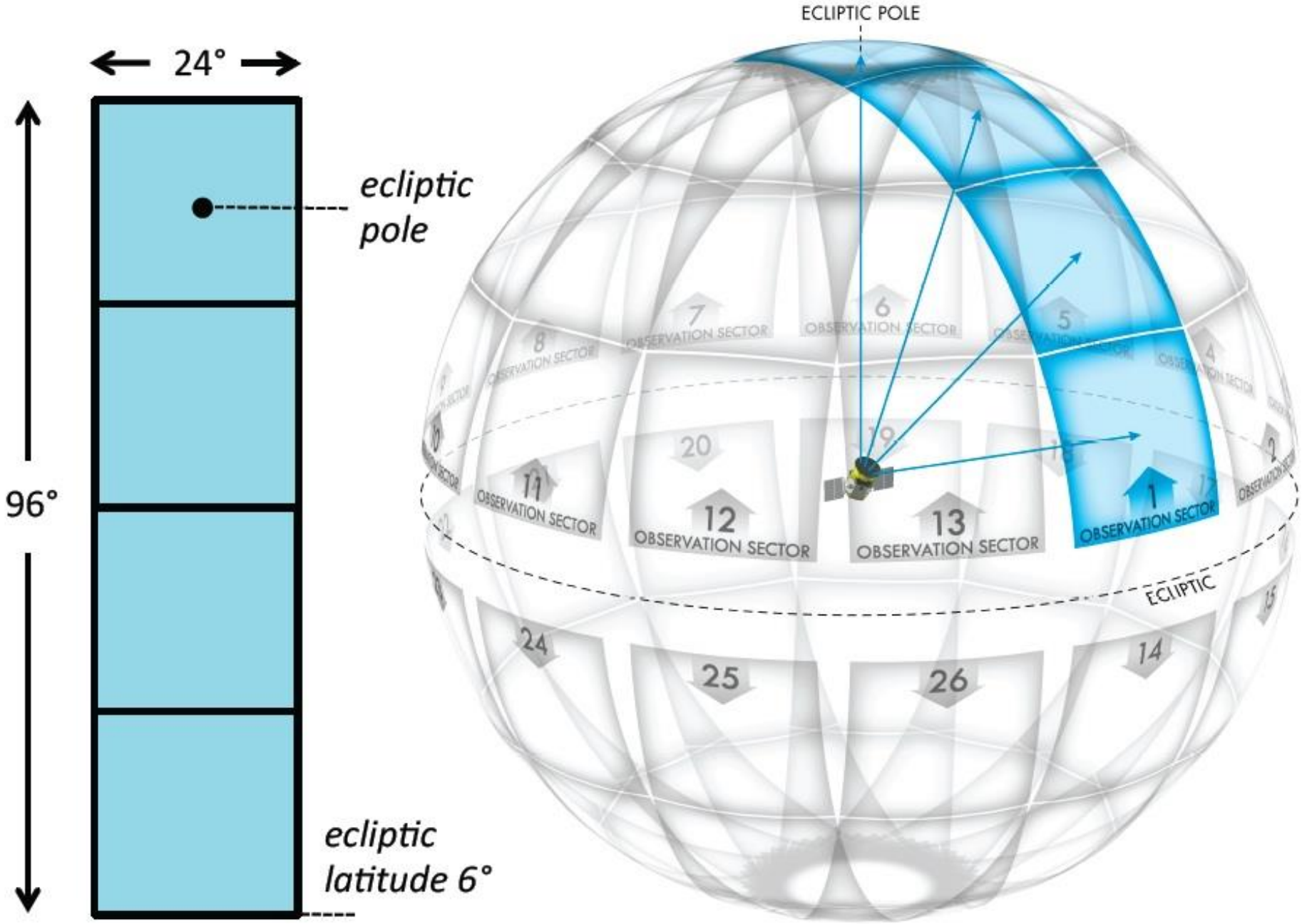


Twelve New Small Kepler Candidates in the Habitable Zone



Presentations.

- Transiting Exoplanet Survey Satellite
  - All-sky survey, brightest targets for JWST
  - George Ricker (MIT), TESS PI
  - On track to launch in August 2017
- Gravitational Observatory Advisory Team Update
  - Robin Stebbins (GSFC)
- Summary of Inclusive Astronomy Meeting
  - Keivan Stassun (Vanderbilt)


24°
96°
ecliptic pole
ecliptic latitude 6°
ECLIPTIC POLE
ECLIPTIC
1 OBSERVATION SECTOR
2 OBSERVATION SECTOR
4 OBSERVATION SECTOR
5 OBSERVATION SECTOR
6 OBSERVATION SECTOR
7 OBSERVATION SECTOR
8 OBSERVATION SECTOR
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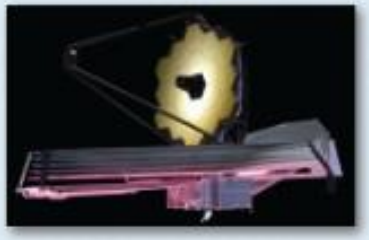
26

Legacy of TESS



- TESS's launch planned for 2017
- TESS will find 1000 planets smaller than Neptune transiting nearby stars
- TESS will provide a map to the easiest-to-observe exoplanet atmospheres
- TESS will identify several habitable zone planets orbiting stars sufficently bright for JWST and future ELT study of their atmospheres

Ricker et al. 2014
(astro-ph 1406.0151)

ESA's Gravitational Observatory Advisory Team (GOAT)

Terms of Reference:

•"To evaluate and recommend on possible scientific and technical approaches for a gravitational wave observatory envisaged for a planned launch date in 2034."

GOAT has made significant progress on several topics.

•Laser interferometry is the only detection technology shown to be viable.

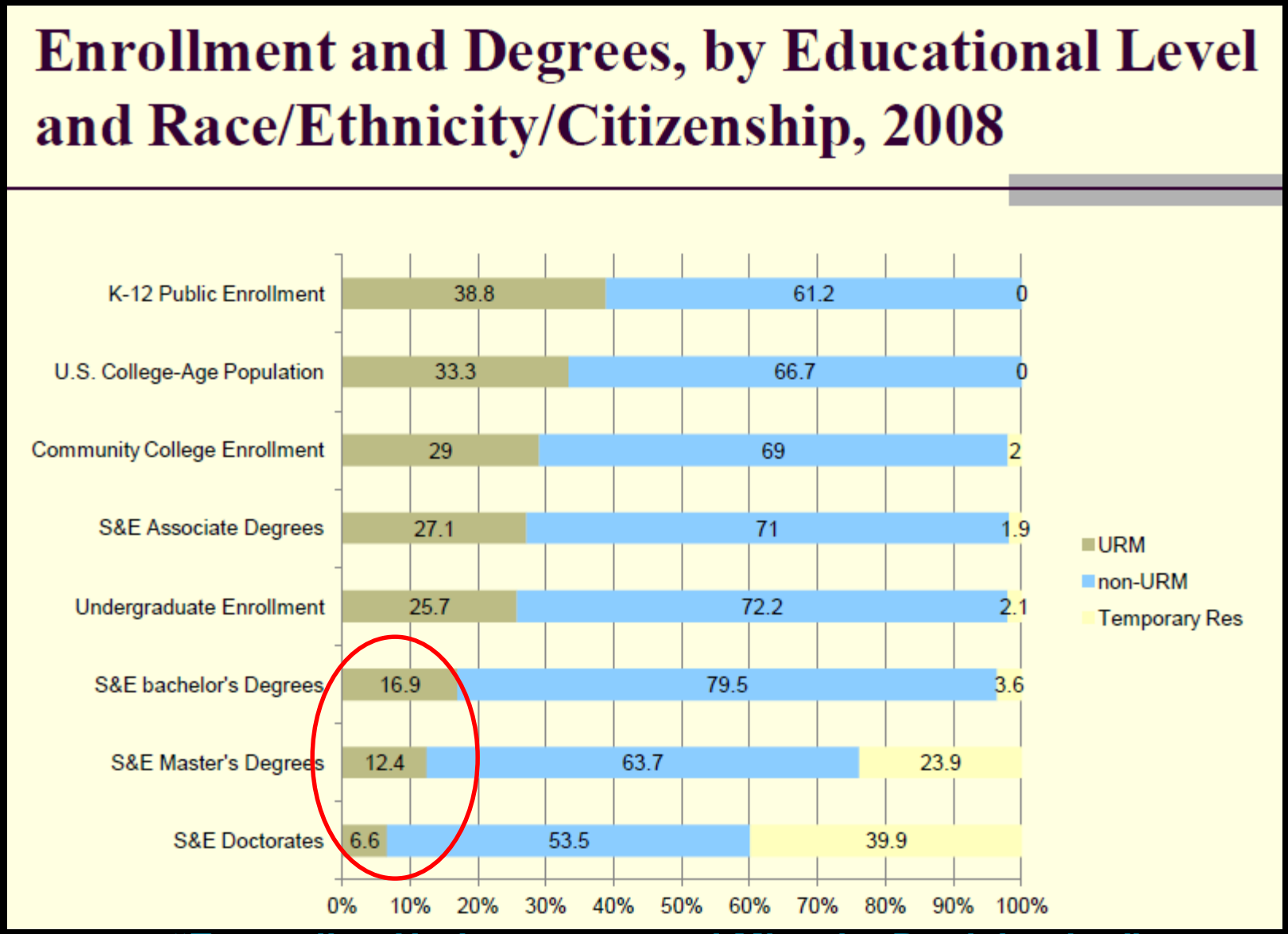
•Science trade-offs have been investigated.

•Technology recommendations enable ESA and the member states to start investments as early as the end of the year.

•No fundamental technical obstacles found, in either technology or data analysis.

•A preliminary schedule has been developed, but remains under study.

Astrophysics Diversity Statistics



"Expanding Underrepresented Minority Participation"
National Academies (2011)

Agency programs focused on underrepresented minorities and workforce at graduate/postdoc levels

Partnerships in Astronomy & Astrophysics Research and Education (PAARE)

PROGRAM SOLICITATION
NSF 13-566

REPLACES DOCUMENT(S):
NSF 08-562

National Science Foundation

Directorate for Mathematical & Physical Sciences
Division of Astronomical Sciences

Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):

August 27, 2013

August 21, 2015

Third Friday in August, Every Other Year Thereafter

Synopsis of Program:

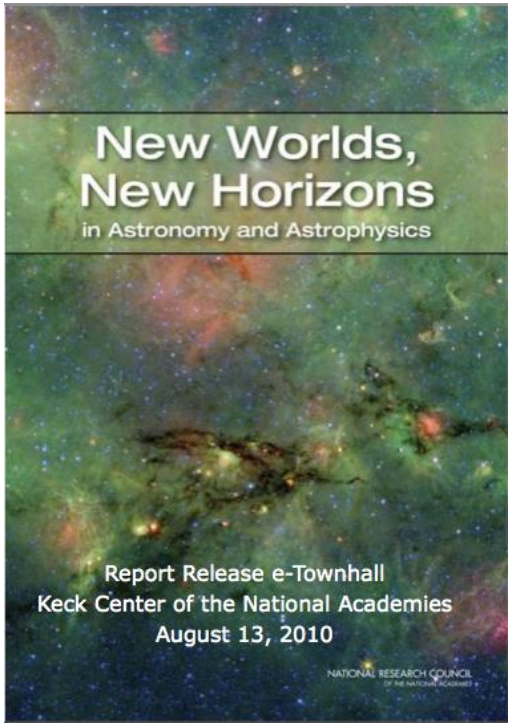
The objective of PAARE is to enhance diversity in astronomy and astrophysics research and education by stimulating the development of formal, long-term, collaborative research and education partnerships among minority-serving institutions and partners at research institutions, including academic institutions, private observatories, and NSF Division of Astronomical Sciences (AST)-supported facilities.

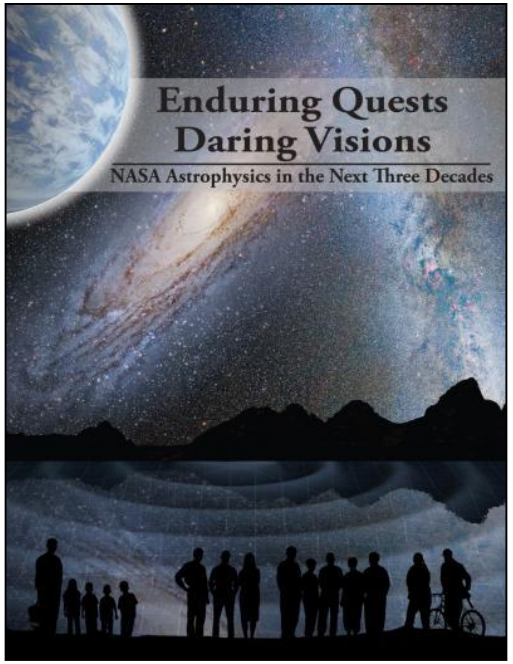
GPRAMA.

- GPRAMA: 2010 Government Performance and Results Modernization Act (GPRAMA)
- Measure progress made toward each of the APD science goals during the year in question:
  - Demonstrate progress in probing the origin and destiny of the Universe, including the nature of black holes, dark energy, dark matter, and gravity.
  - Demonstrate planned progress in exploring the origin and evolution of the galaxies, stars, and planets that make up the Universe.
  - Demonstrate planned progress in discovering and studying planets around other stars and exploring whether they could harbor life.
- APS concludes that the progress made toward each of the science goals is GREEN:
  - Expectations for the research program fully met or exceeded in the context of resources invested.

Hertz's Charge to the PAGs.

"I am charging the Astrophysics PAGs to solicit community input for the purpose of commenting on the small set [of large mission concepts to study], including adding or subtracting large mission concepts."





Detailed Charge, Part 1.

1. Each PAG, under the leadership of its Executive Committee, shall broadly solicit the astronomy and astrophysics community for input to the report in an open and inclusive manner.
   - To accomplish this, each PAG is empowered to envision and use its own process.
2. Each PAG will consider what set of mission concepts should be studied to advance astrophysics as a whole; there is no desire for mission concepts to be identified as "belonging" to a specific Program or PAG.
   - Each PAG shall keep the number of large mission concepts in the set as small as possible.
   - Each PAG is specifically charged to consider modifications and subtractions from the small set, and not just additions.
3. Each PAG shall produce a report, where it shall comment on all large mission concepts in its small set of large missions, including those in the initial small set and those added or subtracted.
   - The PAGs may choose to work together and submit coordinated or joint reports.
   - Where there is existing analysis to support it, PAGs are encouraged to comment on the cost range anticipated large mission concepts (>$1B? Maximum?)

Detailed Charge, Part 2.

4. **Each PAG may choose to have a face-to-face meeting or workshop I in developing its report; said meeting may be scheduled in proximity to an existing community meeting or conference.**
5. **Although there is no page limit for the report, each PAG shall strive to be succinct.**
6. **Each PAG shall submit its report in writing no later than two weeks prior to the Fall 2015 meeting of the NAC Astrophysics Subcommittee (meeting schedule not yet known).**

Constraints.

- **Missions are to follow JWST and WFIRST.**
- **NASA's plans for realizing a space-based GW observatory is focused on partnering with ESA's L3 (LISA)**
  - **Study participation.**
  - **Technology development.**
- **CMB Polarization Surveyor is a probe-class mission.**
- **Basically: assume 2010 Decadal Priorities as a constraint.**

What is *not* in our charge.

1. Detailed science goals or requirements.
2. Detailed architectures or technology requirements.
3. Advocacy or Advice (rather: “Analysis”)
4. Prioritization of the suggested missions.
5. “Ownership” of any mission concept by any individual PAGs
6. Don’t attempt to prepopulate the STDTs (Note: these are likely to be competitively selected).

Charge of the STDTs.

- **Define science objectives and a strawman payload concept.**
- **Identify technology development requirements**
- **Develop a design reference mission.**
- **Conduct a cost assessment, with the possibility of iteration.**
- **Goal:** ***to maximize the potential of all of these missions.***

Initial list of missions.

Taken from NASA Roadmap (Surveyors) and Decadal Survey (HabEx)

- Far IR Surveyor
- Habitable-Exoplanet Imaging Mission
- UV/Optical/IR Surveyor
- X-ray Surveyor

Far-IR Surveyor

- **Wavelength coverage: 25-500 μm in 6-8 log-spaced bands with R~500**
- **Monolithic telescope – diameter ~ 5 m.**
- **Telescope actively cooled to < 4 K, instruments cooled to <100 mK.**
- **Field of View = 1 deg at 500 μm**
- **Mission: 5 years + at Earth-Sun L2**
- **High-resolution (heterodyne) spectroscopy also compelling, possibly for warm phase.**

Habitable-Exoplanet Imaging Mission

- **Likely <~8m, monolithic or segmented primary**
- **Optimized for exoplanet direct imaging.**
- **ExoEarth detection and characterization:**
  - **Needs ~10^{-10} contrast**
  - **Coronagraph and/or starshade**
  - **Camera**
    - **Optical and near-IR wavelength sensitivity for planet characterization**
    - **IFU, R>70 spectrum of 30 mag exoplanet**
    - **1" FOV**
- **Potential for an instrument for spectroscopic characterization of transiting planets.**
- **UV-capable telescope/instrument suite would constrain the high-energy radiation environment of planets, and enable a broad range of compelling COR science.**
- **L2 orbit or Earth-trailing**

Large UVOIR Surveyor

- ~8-16m
  - likely segmented, obscured primary.
- Cosmic origins science
  - HST-like wavelength sensitivity (FUV to Near-IR)
  - Suite of imagers/spectrographs
- **ExoEarth detection and characterization:**
  - **Needs ~10^{-10} contrast**
  - **Coronagraph (likely), perhaps with a starshade**
  - **Camera**
    - **Optical and near-IR for planet characterization.**
    - **IFU, R>70 spectrum of 30 mag exoplanet**
    - **1" FOV**
- **L2 Orbit**

X-ray Surveyor

- Effective area ~3 m^2
- Sub-arcsecond angular resolution
- High-resolution spectroscopy (R ~ few x 10^3) over broad band via micro-calorimeter & grating spectrometer instrumentats
- FOV $\gtrsim$ 5'
- Energy range ~0.1-10 keV

Timeline for STDTs.

- 2015:
  - Identify a small set of candidate large missions to study
  - PAG reports due by October 2015 APS meeting.
- 2016-2019:
  - Initiate studies.
  - Conduct studies.
  - Identify technology requirements
  - Deliver results to decadal survey.

Timeline/Meetings for Hertz Charge (completed).

- *January 2014: Initial discussion at ExoPAG 9.
- March 2014: APS approves SIG #1.
- June 2014: Brainstorming session at ExoPAG 10.
- January 2015: Brainstorming session at ExoPAG 11, Paul's charge.
- February 2015: First dedicated SIG #1 Meeting, brainstorming & consensus building.
- March 10 COPAG Virtual Town Hall
- March 19, 2015: Joint PAG EC meeting.
- April 11-14 2015, Am. Phys. Soc. (Baltimore) - PhysPAG
  - SIGs and PCOS mini-symposium
- June 2, 2015: ExoPAG Virtual Meeting
- June 3-5, 201: Far-IR Workshop (Caltech) – COPAG
- June 13-14, 2015: ExoPAG #12 (Chicago) - ExoPAG
  - Half to full day to be spent on charge (2nd day)
- June 25-26, 2015: UV/Vis SIG Meeting, Greenbelt, MD – COPAG
- July 1, 2015: panel discussion during the HEAD meeting (Chicago) – PhysPAG
- July 3, 2015: joint PAG EC Chair telecon.
- July 13, 2015: joint PAG EC Chair telecon with Paul Hertz
- July 14, 2015 – ExoPAG Virtual Meeting

Timeline/Meetings for Hertz Charge (future).

- August 2015 – COPAG Virtual Town Hall
- August 7, Joint PAG Splinter Session at IAU, 1-5pm
- August 18, 2015 – ExoPAG Virtual Meeting
- August 31, 2015 – AIAA Space 2015 Joint PAG Presentation
- July-September 2015: writing, circulating, finalizing report(s?).
- October 2015: Deliver report to Hertz (two weeks before the APS)

COPAG Response to Hertz Charge

Process

Means for community input

- **Cosmic Origins Website**

  http://cor.gsfc.nasa.gov/copag/rfi/

- **AAS meeting**
  - Cosmic Origins UV-Vis and FIR sessions (Jan 4)
  - ExoPAG/COPAG Joint Meeting (Jan 4)
  - Joint PAG Session (Jan 7)
  - NASA Town Hall Meeting (Jan 7)
- **Cross-PAG telecon and joint meetings**
- **Virtual Town Hall (March 10)**
- **White papers**

  Posted at above COR URL, SIG2 webpages

- **SIG meetings**

COPAG

- COPAG
- Decadal Survey Planning Activities
- Submit White Paper to COPAG
- COPAG Request for Community Input on Future Large Missions to be studied by NASA
- Upcoming COPAG Meetings
- SIGs and SAGs
- Contact the COPAG

Links

- Sign up for COR News and Announcements
- Paul Hertz message, Jan 2015
- Paul Hertz Charge to the PAGs for 2020 Decadal Planning
- Paul Hertz AAS PAG Plenary Presentation, Jan 2015
- AURA Study of Future Space-Based Telescopes
- Newsletters
- NASA Astrophysics Program Offices
- Multimedia Library
- Request for Information

COPAG Analysis: Large Mission Studies, Decadal Survey 2020

COPAG Requests Community Input

To submit your white paper, email it to the COPAG at **COPAG_Contact@bigbang.gsfc.nasa.gov**

- **COPAG Call for White Papers**: Large Astrophysics Missions to Be Studied by NASA Prior to the 2020 Decadal Survey [PDF]

Web Meetings

- Tuesday, March 10, 2015 03:00 - 04:00 EDT
  - **COPAG Virtual Town Hall** Presentation [PDF]
- Early Summer 2015 - COPAG Virtual Town Hall to discuss White Paper responses, date TBD
- August 2015 - COPAG Virtual Town Hall to discuss report to Paul Hertz, date TBD

Face-to-face Meetings

- Joint PAG EC meeting, STSci, March 19, 2015, 9:00 A.M.–4:00 P.M.
  - Presentations [PDF]
- Far-IR meeting, Pasadena, CA, June 3–5, 2015 **http://conference.ipac.caltech.edu/firsurveyor**
- **ExoPAG Meeting**, Chicago, IL, June 13–14, 2015
- **UV/Vis SIG Meeting**, June 25–26, 2015, Greenbelt, MD
- **PhysPAG Community Meeting** at HEAD meeting, Chicago, IL, June 29–July 1, 2015
- Joint PAG Splinter Session at IAU, as August 7, 1-5pm, room TBD

Presentations to PhysPAG

- Far-IR Surveyor Concept [PDF]

White Paper Responses from the Community

- COPAG Merged White Papers, May 18, 2015 [PDF]
- 2012 Request for Information (RFI2012) - **Responses**
  - Mapping Turbulent Energy Dissipation through Shocked Molecular Hydrogen in the Universe [PDF] - P. Appleton
  - Are Flagships the Best Way to Advance Astrophysics? [PDF] - D. Ardila

Program News

11 May 2015
UV/Vis Community Workshop, 25–26 June, 2015, Greenbelt, MD » [Details]

11 May 2015
Far-Infrared Community Workshop, 3–5 June 2015, Pasadena, CA » [Details]

Project News

Hubble News
24 Jun 2015
Hubble Sees a 'Behemoth' Bleeding Atmosphere Around a Warm Neptune-Sized Exoplanet » Details

Spitzer News
5 May 2015
Astronomers Set a New Galaxy Distance Record » Details

Herschel News
17 Jun 2013
Herschel Decommissioned » Details

ExoPAG's Response to Paul's Large Mission Charge.

- Talks, brainstorming, and discussion at ExoPAGs 9, 10, 11, 12, one stand-alone meeting, and one virtual meeting.
- NASA Astrophysics Roadmap.
- Solicited (and unsolicited) input from a several dozen members of the community.
- COPAG White Papers

Exoplanet Exploration: ExoPAG Input into the 2020 Decadal Survey and Large Mission Studies

ExoPAG Input into the 2020 Decadal Survey and Large Mission Studies

Virtual Meetings | Face-to-Face Meetings | Science Division Documents | Supporting Documents | Links

Paul Hertz (NASA Astrophysics Division Director) has charged the three Astrophysics Program Analysis Groups (PAGs) with reviewing a small set of candidate large mission concepts, and suggesting addition, subtraction, and other useful summary. The results of this review will be reported at the NASA Advisory Council Subcommittee meeting in October in the form of a report. This page provides information on the charge and the ExoPAG's plans for responding to this charge and creating this report.

The ExoPAG will respond to this charge in the context of its Science Interest Group #1 activities, as described in the following charter:

SIG #1: **Toward a Near-Term Exoplanet Community Plan**.

The ExoPAG is soliciting input from the community through three primary methods:

- Direct input to the SIG #1 chair Scott Gaudi: **gaudi.1@osu.edu**.
- **Virtual Meetings**
- **Face-to-Face Meetings**

The COPAG is also soliciting white papers and are happy to receive white papers from the ExoPAG community: **http://cor.gsfc.nasa.gov/copag/rfi/**

PhysPAG Response to Charge

Community discussion and input sought at face-to-face meetings:

- **X-ray-, Gamma- & Cosmic-SIG, PhysPAG & Joint PAG meetings at AAS, January**
- **IP-SIG discussions at Minneapolis CMB Pol. Workshop, January**
- **Gamma-SIG at 'Future Space-Based Gamma Observatories', February**
- **Joint PAG executives meeting, March**
- **Cosmic-, Gravitational-Wave- & Gamma-SIG meetings; PCOS & Gamma Mini-symposia at APS, April**
- **Gamma-, X-ray-SIG & various panels, this meeting**

and in many, many telecons

Reference Material.

- http://cor.gsfc.nasa.gov/copag/rfi/
- https://exep.jpl.nasa.gov/exopag/decadal/
- http://pcos.gsfc.nasa.gov/physpag/

Cross-PAGs Topics of Discussion.

- **Joint PAG Reports?**
  - **Joint summary.**
  - **Joint table.**
- **Should we add any missions?**
- **Should we subtract/merge any missions?**
- **The Astrophysics Division's goal is to identify a set of missions that 'advances astrophysics as a whole". Are there major gaps not addressed by this set of missions?**
- **How should we organize the STDTs for these missions?**
- **Paul Hertz has asked the PAGs for 'other useful commentary' about the set of missions for put forward for study. What commentary would you include?**
- **What do we say about probes?**