ExoPAG 9:
Introduction and Motivation

ExoPAG 9 Meeting
Washington, DC
January 4+5, 2014

Scott Gaudi
(ExoPAG EC Chair)

EC Membership.

- Current EC members (as of April 2013).

Nick Cowan	Northwestern
Jonathan Fortney	U.C. Santa Cruz
Scott Gaudi (*Chair)*	Ohio State
Tom Greene	NASA Ames
Lisa Kaltenegger	MPIA
Dave Latham	SAO
Amy Lo	Northrop Grumman
Peter Plavchan	Caltech/NexSci
Aki Roberge	NASA Goddard
Gene Serabyn	JPL
Remi Soummer	Space Telescope Sci. Inst.
Doug Hudgins (*Ex officio)*	NASA Headquarters
James Kasting (*Ex officio)*	Penn State
Wes Traub (*Ex officio)*	JPL

Charter.

In June 2009, NASA formed the *Exoplanet Exploration Program Analysis Group* (ExoPAG), responsible for soliciting and coordinating community input into the development and execution of NASA's Exoplanet Exploration Program (ExEP). The ExoPAG serves as a community-based, interdisciplinary forum for analysis in support of activity prioritization and for future exploration.

- Articulate the key scientific drivers for exoplanet research.
- Evaluate the expected capabilities of potential ExEP missions for achieving the science goals of the program.
- Evaluate ExEP goals, objectives, investigations, and required measurements **on the basis of the widest possible community outreach**.
- Articulate focus areas for needed mission technologies.
- Identify related activities that enhance the ExEP mission portfolio such as ground-based observing, theory and modeling programs, and community engagement.

ExoPAG Direction.

Over the past ~2 years, ExoPAG activities have been (more or less) focused on the following general goals:

- Gathering input from the wide cross-section of the exoplanet community on the future of exoplanet research.
- Considering novel ways in which NASA can address exoplanet research in the short term, including ground-based research *in support* of current or future missions.
- *Maintaining progress* toward eventual goal of a flagship direct imaging mission.

Methods & Activities.

- Solicit community input through ExoPAG meetings.
- Identify questions and inquiry areas.
- If needed, form Study Analysis Groups (SAGs) to address these questions in depth.
  - Chaired by EC members (generally), but comprised of community members.
- Deliver conclusions and community input to NASA through the Astrophysics Subcommittee (APS) of the NASA Advisory Council (NAC).
  - Includes final reports from SAGs.

Immediate questions.

- What do we need to properly characterize exoplanets (of all types)?
- What are the requirements to support NASA's goals and current and future missions?
  - Observational, technological, theoretical.
  - Including ground-based research, and in particular radial velocity requirements.
- What are the science requirements for small- to medium-scale direct imaging missions?
- Others?

ExoPAG Meta-goal:

Develop a holistic, broad, unified, and coherent exoplanet plan for the next 5-10 years, with community consensus, focusing on areas where NASA can contribute.

Completed SAGs.

SAG1: Debris Disks & Exozodiacal Dust - Aki Roberge

- Report completed; paper published in PASP, 2012, 124, 799-808

SAG2: Potential for Exoplanet Science Measurements from Solar System Probes - Dave Bennett and Dan Coulter

- Completed, no report. Topic explored in detail at Kavli Institute workshop, Santa Barbara CA, May 2010

SAG5: Exoplanet Flagship Requirements and Characteristics- Charley Noecker, Tom Greene

- Final report complete, approved by APS.

Current SAGs, Part 1.

SAG4: Planetary Measurements Needed for Exoplanet Characterization - Lisa Kaltenegger

- Draft report completed.

SAG8: Requirements and Limits of Future Precision Radial Velocity Measurements - Dave Latham, Peter Plavchan

- Presentations at ExoPAG 6, 7 and 8
- Report started.

SAG-9: Exoplanet Probe to Medium Scale Direct-Imaging Mission Requirements and Characteristics - Rémi Soummer

- Presentations at ExoPAG 8 and 9.

Current SAGs, Part 2.

SAG10: Characterizing the Atmospheres of Transiting Planets with JWST and Beyond - Nick Cowan

- What is the full diversity of planet properties needed to characterize exoplanets?
- Which measurements are needed?
- Will JWST be able to characterize habitable planets?
- Which critical measurements will be too expensive orinaccessible to JWST)?

SAG11: Preparing for the WFIRST Microlensing Survey – Jennifer Yee

- Identify both mission critical and mission enhancing programs,
- Identify immediate science to come out of each program, as well as the program's direct impact on the WFIRST mission,
- For each proposed program, quantify the improved scientific return for the WFIRST mission,
- Emphasize programs that can be executed using existing (NASA) resources.

ExoPAG 6, 7, 8.

- Since June 2012:
  - ExoPAG 6: October 13-14, 2012, Reno, NV
  - ExoPAG 7: January 5+6, Long Beach, CA
  - ExoPAG 8: October 5+6, Denver, CO
- Primary topics/questions addressed:
  - What is the landscape of current and future missions?
  - What are the radial velocity requirements to support NASA's goals and current and future missions?
  - What do we need to characterize exoplanets and their host stars?
  - Update on the progress toward a high-contrast imager in space.
  - What do we need to do to prepare for WFIRST-AFTA exoplanet surveys?
  - What do we need to do to ensure a robust measurement of η_{Earth}?
- (most) Talks available online:

http://exep.jpl.nasa.gov/exopag/exopag6/agenda/

http://exep.jpl.nasa.gov/exopag/exopag7/agenda/

http://exep.jpl.nasa.gov/exopag/exopag8/agenda/

What we've learned.

- Need to figure out overlap of RV surveys and ground-based direct imaging surveys with potential future direct imaging (space) missions.
- The frequency of habitable planets is not one number; need to specify distribution functions and/or agree upon a fiducial definition for a habitable planet.
- Continued investment in extracting science from Kepler is both worthwhile and critical.
- Need to determine the requirements to characterize exoplanets; need to figure out whether or not JWST can characterize habitable planets.
- Need to identify the future roles of astrometry and interferometry.

Recent and Upcoming Developments.

1. WFIRST-AFTA blessed for future study, with coronagraph baselined, coronagraph architectures selected.
2. Science and Technology Definition Teams convened.
3. Kepler reaches end of its primary mission; future: primary mission closeout + K2.
4. Gaia, JWST, TESS are imminent.
5. Mid-decadal Review.

Goals of ExoPAG 9.

- Continue work on previous questions.
  - SAG reports.
- New missions: TESS, CHEOPS.
- Address new questions:
  - What is the potential of JWST to characterize exoplanets?
- Joint ExoPAG/COPAG Meeting.
- Toward a broad, unified, and coherent exoplanet plan.

We want your input!

Welcome, and thanks for coming.