The Exoplanet Exploration Program Analysis Group (ExoPAG)

PhysPAG Meeting
August 14, 2012
Scott Gaudi
(Incoming ExoPAG Chair)
Objective.

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.
Past Activities

• Chaired by Jim Kasting up until June 2012.
• The ExoPAG has had 5 meetings and one joint CoPAG/ExoPAG since January 2010
  - These meetings have been well attended, with about 70–80 people at the winter meetings and 50–60 in the summer
• The primary topic of discussion has been planning for a future flagship-class direct imaging mission
  - Technology development for the New Worlds program was the highest medium-class priority listed in the NWNH report.
  - Joint meetings/discussions with COPAG about a large optical/UV space telescope.
New Membership

- As of June 2012: new chair and a few new members.

Scott Gaudi (*Chair*)
Aki Roberge
Tom Greene
Charley Noecker
Lisa Kaltenegger
Alycia Weinberger
Dave Latham
Peter Plavchan
Remi Soummer
Jonathan Fortney
Wes Traub (*Ex officio*)
Doug Hudgins (*Ex officio*)
James Kasting (*Ex officio*)

Ohio State
NASA Goddard
NASA Ames
JPL
MPIA
Carnegie Institute
Harvard Smithsonian
Caltech/NexSci
U.C. Santa Cruz
JPL
Headquarters
Penn State
New Direction.

• In response to exoplanet community input, and new budget realities, the ExoPAG will revise its focus.

• Future ExoPAG activities will aim to:
  – Expand the inclusiveness of NASA’s Exoplanet Exploration Program to the wider exoplanet community, beyond the past focus on future flagship missions in space.
  – Consider novel ways in which NASA can address exoplanet research in the short term.
Science of Exoplanets.

- Finding and characterizing a ‘pale blue dot’ remains a long-term goal.
- But there are many other exoplanet science questions that can and should be addressed in the interim.
- May bear directly on our understanding of these worlds.
Before 1995...
1995: A Planetary Companion to 51 Peg

(Mayor & Queloz 1995)
Strange New Worlds.
General Inquiry Areas

- Physics of Planet Formation and Evolution.

- Physics of Planetary Atmospheres and Interiors.

- Physics, Frequency, and Evolution of Habitability.
Demographics

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<tr>
<th>Current</th>
<th>Future</th>
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<tr>
<td>RV Surveys</td>
<td>Ultra-Precise</td>
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<td></td>
<td>RV Surveys?</td>
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<tr>
<td>Ground-based µlensing</td>
<td>GAIA</td>
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<td>Kepler</td>
<td>Precision astrometry?</td>
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<td>WFIRST</td>
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Characteristics

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<tr>
<th>Current</th>
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<tr>
<td>Ground-based Transit Surveys</td>
<td>NGELTs</td>
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<td>Ground-based Follow-Up</td>
<td>JWST</td>
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<td>Spitzer</td>
<td>ECHO/FINESSE</td>
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<td>HST</td>
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Demographics + Characteristics

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<thead>
<tr>
<th>Current</th>
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<tr>
<td>Ground-Based Direct Imaging</td>
<td>PLATO/TESS</td>
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<td>EXCEDE</td>
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<td>Direct Imaging Mission</td>
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# Habitable Planets

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<th>High Mass ★s</th>
<th>Low Mass ★s</th>
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<td>Frequency</td>
<td>Habitability</td>
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<tr>
<td><strong>Current</strong></td>
<td><strong>Kepler</strong></td>
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<tr>
<td><strong>Future</strong></td>
<td><strong>RV? WFIRST?</strong></td>
<td><strong>RV? Astrometry? Direct Imaging Mission?</strong></td>
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“Pale Blue Dot”

“Small Black Shadow”
A Short Term Strategy

• So what can be done to advance these exoplanet science goals in the next ~10–15 years, given constraints?

• Constraints
  • JWST
  • No new large starts until JWST is launched.
  • Explorer program going forward.

• Given these, how do we make progress on:
  • Demographics
  • Characterization
  • Nearby habitable planets
Demographics & Characterization

- **Demographics:**
  - Need to understand what’s out there!
    - Kepler
    - Euclid
    - WFIRST – detector development.

- **Characterization**
  - Need to understand the stars themselves.
    - Disks, ages, distances, abundances, etc.
  - RV not yet tapped out
    - Outer planets
    - Pushing to <10 cm/s – technology development
  - Near-IR RV
  - Ground based (NGELTs)?
    - Direct imaging
    - Characterization
  - Characterization mission
Habitable Planets

• Nearby habitable planets
  • Remains the ultimate goal
  • But a flagship mission is a ways off

• Make progress where we can!
  • Now: MEarth/near-IR RV
  • Soon: TESS/PLATO? + JWST promising

• Be prepared
  • Technology development
  • What can be accomplished with a probe class mission?
Future of the ExoPAG

- Develop a short term strategy w/ community involvement.
- Study analysis groups (SAGs):
  - Exozodiacal Dust – Roberge et al. (arXiv:1204.0025)
  - Exoplanet Characterization – Kaltenegger
  - Flagship mission requirements – Noecker, Greene
    - -> “Probe” class mission science goals
  - Precision RV: requirements, resources. – Latham, Plavchan
- Next Meeting: October 13+14, Reno, NV
  - Coincides with the 44th DPS meeting.
- How can we work with PhysPAG and COPAG to maximize our science?