EPRAT

ExoPlanetary Roadmap Advisory Team

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And the ExoPlanet Roadmap Avisory Team (EPRAT)

And special thanks to
Malcom Fridlund
ESA

Your EPRAT Team

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Rudolf Dvorak, Institute for Astronomy, University of Vienna, Austria
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Heike Rauer, German Aerospace Center (DLR), Germany
Franck Selsis, Laboratoire d'Astrophysique de Bordeaux (LAB), France
Giovanna Tinetti, University College London, UK
Stephane Udry, Université de Genevé, Switzerland
Anja C. Andersen, Dark-Cosmology Center, Copenhagen, Dk (Expert)

Malcolm Fridlund, (Secretary), ESA

Team has diverse expertise spanning full range of exoplanet studies:

Radial Velocity Searches: Hatzes, Udry

Transit Searches: Tinetti, Rauer

Direct Imaging: Boccaletti (coronography), Quirrenbach (interferometry)

Astrometry: (Quirrenbach)

Planet Formation: Morbidelli

Atmospheres: Rauer, Selesis, Tinetti

Dynamical Studies: Dvorak

Debris Disks/Dust: Anderson

Why an EPRAT?

EPRAT is to advise ESA on the best scientific and technological roadmap to pursue in order to address the characterization of terrestrial exo-planets (up to the possible detection of biomarkers)

Task #1: Consult the Community

- The Advisory Team will consult with the broad community.
- Input has been solicited via an open “Call for White Papers” by ESA Summer of 2008 (25 responses).
- The Advisory Team is evaluating the papers received and will take due account of them in the preparation of the final report.

Task #2: Report its findings

- This report is expected to cover the intermediate and long-term scientific goals for the field of exo-planet research.
- Report will include:
  - survey of existing and planned facilities, both ground- and space-based;
  - and the scientific goals likely to be achieved with these facilities.
- The team will identify:
  - future facilities and relevant technologies needed at these facilities to achieve the goals.
  - Intermediate milestones that must be met before the longer-term goals can be considered feasible.

Task #3: ESA Studies

- ESA will take the opportunity to study concepts not hitherto investigated for feasibility
- Such topics include:
  - Completely new concepts
  - Topics not studied in a European context
  - Collaborative concepts previously not investigated
- Studies will be initially be internal to ESA:
  - Science advise culled from EPRAT and invited experts.
  - Technical expertise from Science Robotic Exoploration/Payloads and Advanced concepts
  - Possible use of concurrent design facility

Internal Studies

- External Occulters – Space
  - Orbital dynamics may be difficult
- THESIS - space
  - 1.4 m telescope in L2 feeding 2 MIR spectrometers
  - Spectroscopic characterisation of Earth-like planets orbiting M-dwarfs

Rauer and Selsis preparing reports to help in internal studies

Initial timeline

- Summer 2008:ESA issues Call for White Papers (Deadline 30 July 2008 (12:00 CEST))
- August 2008 - January 2010:EPRAT prepares a draft roadmap, ESA carries out relevant internal technical studies & evaluations
- **Feb 2010**:Open workshop (ESTEC) at which EPRAT presents draft roadmap report to community and solicit feedback
- Summer 2010:Final roadmap report is presented to ESA and to the scientific community.

Workshop: End of Feb 2010

- Workshop will consist of
  - Brief (expect participants to have read draft) description of each segment of draft report
  - Open discussions about each segment
  - Opportunity for community to directly interact and provide new input
- Final report released (electronically) June 2010 in time for CV2015/2 call for letter-of-intent

My own thoughts on a successful roadmap

Drafting a roadmap implies we are taking a trip and all successful trips have a check list:

1. Enough money to make the trip
2. Good preparation to ensure success
3. A good road map (EPRAT‘s job)
4. A suitable vehicle for the expected road conditions
5. Milestones to be sure you are on the right path
6. Some idea as to what you will do when you get there
7. Enough drivers to make the trip

1. Enough money for the trip – expect the worse

• We are entering sobering budget times, particularly in the U.S.

• Europe or the U.S. cannot “go it alone”, we need each other

• We may not be able to depend on our “traditional” partners

In future the new big players in the game may well be China and India ➔ explore collaborations early on

2. Plan well to ensure success

• If you plan a 2B Euro “fishing expedition” you need to convince the public you *will* catch fish

• Don’t promise something you will not deliver, otherwise you may kill the field for at least a generation

• Extensive observational (ground and space) and theoretical work should give us a target list of known systems (e.g. superearth in the habitable zone).

• A Darwin-like mission should be one to study terrestrial planets in the habitable zone, not find them.

3. Make sure your vehicle can make the trip

Currently there are at least several proposed techniques for Direct Imaging:

- Nulling Interferometry
- Coronography
- Occulters

We are still not sure which has the best chance of success

White Paper from EADS: ”ESA has focused on nulling interferometry in recent years. An industrial trade between interferometry, coronography and occulters can not be made on insight but require testbeds….”

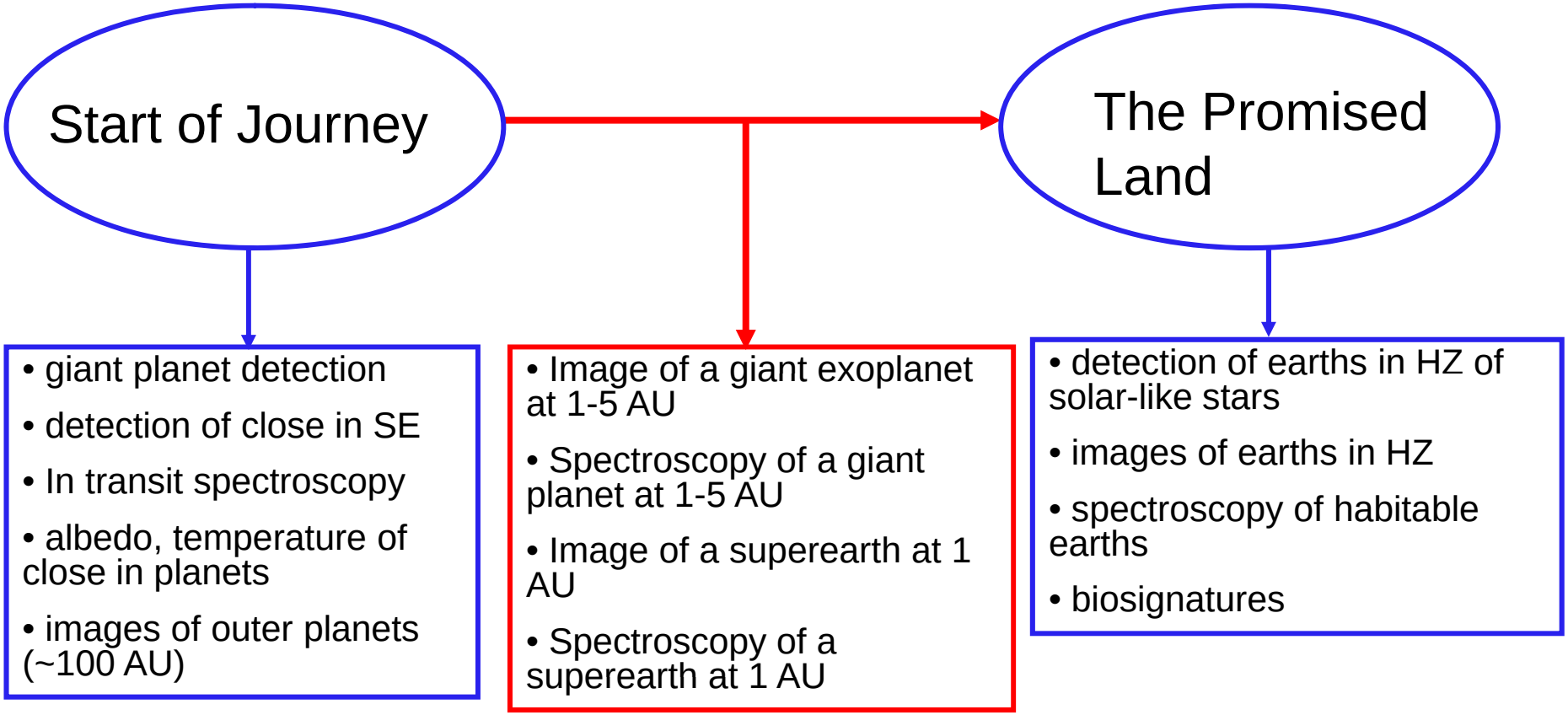
4. Have a good road map, but make it flexible

Even the best roadmaps are outdated in 5-10 years, particularly in a fast moving field like exoplanets

We should be able to adapt rapidly if our roadmap is outdated (e.g. a route we were counting on is closed, or a new superhighway has been built)

- Abandon “pet” technologies if they prove unfeasible
- Exploit new technologies as they become available
- Adapt strategies to new observational, experimental, and theoretical results

5. Milestones to be sure you are on the right path



6. An idea of what to do when you get there.

„There‘s the Grand Canyon, ok kids, back in the car.“

NASA shortened the Apollo program in part from lack of support from the geological community.

- A vibrant community of talented scientists, both theorists, observers, experimentalists (laboratory studies), and planetary scientists to interpret your results: build a diverse community now

- A politically savy and well-organized community to lobby the governments and funding agencies.

- Speak with one voice

7. Make sure you have enough drivers

"… the torch has been passed to a new generation.."

Inaugural address, John F. Kennedy

- You need to keep the torch lit. Keep this an exciting and vibrant field with a pool of talented young scientists

- Don't plan an "eggs in one basket" where the scientific result is 20 years in the future, you will lose the best and the brightest.

Examples of successful Roadmaps from NASA

Technology: The Apollo Moon program

Science: The Voyager Program.

Extensive ground-based preparation for this program

Avoid going “back to the past”

A suggestion for President's Obama next State of the Union Address

"First, I believe that this planet should commit itself to achieving the goal, before the next decade is out, of detecting a Earth-like planet in the habitable zone of another star and its possible biosignatures. No science project in this period will be more impressive to mankind, or more important for understanding the formation of life on our planet. We propose to accelerate the development of the appropriate technology to achieve this goal. We do this not because it is easy, but because it is difficult"

My own recommendations[1]

In the ERA of the ELT devote one VLT to Radial Velocity/Spectral measurements of Exoplanets :

- Better coordination between ESO and ESA for ground-based observations of exoplanets

- New ESO OPC panel devoted to Exoplanets/Planetary Science

[1]These opinions represent those of the speaker and do not reflect those of the EPRAT