



National Science Foundation  
and the  
National Aeronautics and Space Administration



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DEC 19 2006

Dear Dr. Illingworth:

This letter is to request that the Astronomy and Astrophysics Advisory Committee (AAAC) establish an Exo-Planet Task Force (ExoPTF) as a subcommittee to advise NSF and NASA on the future of the ground-based and space-based search for and study of exo-planets, planetary systems, Earth-like planets and habitable environments around other stars.

### **Background and Purpose**

In the past 10 years more than 200 planets have been detected in orbit around nearby stars. During this time, the study of exo-planets and systems has blossomed into a mainstream activity that engages hundreds of astronomers in the U.S. and around the world, and many community teams have successfully competed for federal support to carry out exo-planet research. Progress in the technologies of precision radial velocity measurement has reinvigorated the classical Doppler shift technique, which is steadily improving capability to find smaller planets close to or in the habitable zone. Transit detections are providing increasingly valuable constraints from both ground and space programs. Gravitational micro-lensing is beginning to probe an Earth-mass planet population. Imagery of pre-planetary and planetary debris disk arcs and rings is becoming available to confront theoretical models for planet formation and evolution. The recent and continuing dramatic successes of exo-planet programs strongly validate the search for Earth-like, habitable planets in orbit around nearby stars.

The study of exo-systems is very challenging and remains strongly limited by the scale and performance of the available tools. Nonetheless, impressive efforts are underway from the ground through existing and new federal, private and international facilities. These include dedicated telescopes and ongoing experiments, as well as traditional telescopes accessed through the normal proposal process, some with specialized instruments. Promising approaches under development include extremely large telescopes, extreme adaptive optics with new coronagraphic methods, millimetric and submillimetric imaging with the Atacama Large Millimeter Array (ALMA), and optical interferometry over long baselines. As exo-planet science addresses increasingly difficult questions, scientists are led to more advanced instrument concepts, with higher costs and longer lead times.

Moreover, while much exo-planet research continues to be carried out on the ground, space platforms will offer a unique advantage for the most sensitive measurements, and NASA has responded to this opportunity. In 1995, the NASA report *Roadmap for Exploration of Neighboring Planetary Systems* (a.k.a. "the Townes report"; <http://origins.jpl.nasa.gov/library/exnps/>) described a program to detect Earth-like planets orbiting the nearest stars and to characterize the atmospheres of the brightest of

these planets. NASA endorsed and responded to this opportunity with the broadly based Origins Theme and Program. More recently, the NASA Navigator Program was established with the prime objective of advanced telescope searches for exo-solar planets and habitable environments. In 2004 the search for exo-planets was featured in the President's Vision for U.S. Space Exploration, and the search is a central element of NASA's Astrophysics Plan. This basic approach to research in exoplanetology has found support in the last two National Research Council Decadal Surveys and has been revalidated and endorsed in three community-prepared Origins Roadmaps. The Kepler transit survey telescope, now in an advanced stage of development, will return measurements of the statistical frequency of Earth-sized planets. Technology development and engineering demonstrations in the Navigator Program have produced mission-enabling technology advances in precision metrology, interferometric nulling, and coronagraphy. The Space Interferometry Mission (SIM-PlanetQuest) is in Phase B (formulation), and the Terrestrial Planet Finder Coronagraph (TPF-C) and Interferometer (TPF-I) missions are in pre-formulation study.

In view of the rapid recent progress, the high scientific and public interest, and the probable large cost, it is timely and appropriate to reassess the national strategy in this area. The task force study will be conveniently timed for consideration by the next Astronomy and Astrophysics decade review.

### **Charge to the Task Force**

The ExoPTF is asked to recommend a 15-year strategy to detect and characterize exo-planets and planetary systems, and their formation and evolution, including specifically the identification of nearby candidate Earth-like planets and study of their habitability. The strategy may include planning and preparation for facilities and missions beyond the 15-year horizon. Since future funding levels are uncertain, and project costs are difficult to establish at an early stage, it is important to develop an efficient and adaptable plan. To the extent possible, the recommendations should accommodate a range of funding levels representing conservative and aggressive programs. The ExoPTF will work in cooperation with agency efforts to advance the justification, specification and optimization of planet finding and characterizing opportunities.

The ExoPTF is asked to address the following specific areas:

1. The key scientific questions and issues, in the context of recent developments in exo-planet science and planet formation;
2. Measurement techniques, their enabling technologies and their implications for future survey and measurement directions and priorities;
3. Specific types of experiments (e.g., radial velocity measurements, transit searches, microlensing, adaptive optics, coronagraphy) with respect to their expected scientific return and contributions;
4. The potential and complementary science return from measurements at different wavelengths;
5. The role of theoretical investigations in defining needed capabilities, constraining measurement requirements, and interpreting results in terms of the overarching scientific questions;
6. Major decision points in the exo-planet study process;
7. Identification of key technologies relevant to the scientific goals of the program;
8. Important steps in the development of instrumentation, R&D, and other work required in preparation for or in support of, these and related experiments and missions;
9. The complementary ground-based and space-based research opportunities, coordination between funding agencies and possible synergistic advances;
10. Opportunities for cooperation, coordination or synergy with international programs.

The ExoPTF is not constituted to review individual proposals to determine their technical feasibility or likelihood of meeting performance goals. However, in recognition of the difficult technological challenges associated ultimately with the direct detection of Earth-like planets, the ExoPTF must address carefully a measured program of technology development that can lead to optimal and affordable facilities and missions.

### **Composition of the Panel and Community Input**

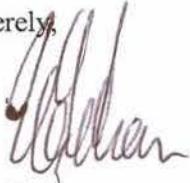
The challenge of finding other habitable planets and searching for life will draw on many fields of science and technology. The Task Force should engage these issues with a broad representation of experience and expertise. Early in its activity, the ExoPTF should solicit white papers from the community, in addition to arranging for invited briefings by groups and individuals active in exo-system research.

### **Reporting**

The ExoPTF Chair is responsible for preparing the final report in consultation with all ExoPTF members. In accordance with Federal Advisory Committee Act (FACA) rules, this report will be discussed independently at the first meeting of the AAAC following completion of the report, before formal presentation to the agencies. We request that the ExoPTF prepare their report for submission to the AAAC with a target date of October 1, 2007.

We thank you for your efforts and wish you success in this important endeavor.

Sincerely,



Tony F. Chan  
Assistant Director, Directorate for  
Mathematical and Physical Sciences  
National Science Foundation



Richard J. Howard  
Acting Director, Astrophysics Division  
Science Mission Directorate  
National Aeronautics and Space Administration

cc: G. W. Van Citters, NSF-AST

P. Hertz, NASA-Science Mission Directorate  
M. H. Salamon, NASA-Astrophysics Division