The Tipping Point: Avoiding Catastrophe for a New Generation of Planetary, Solar and Space Physicists in an Era of Unparalleled Discovery

Our society is witnessing an expansive era of discovery in our exploration of the cosmos. Robotic explorers have given us a detailed knowledge of Earth's space environment and its interaction with the Sun, including the threat of space weather to the satellite technologies on which we are becoming increasingly dependent. For example, NASA's Solar Dynamics Observatory, STEREO, and IRIS missions have given researchers views of the Sun's surface and atmosphere with unprecedented resolution, giving new insights into the causes and effects of solar eruptions. The recent THEMIS and Van Allen Probes missions have helped answer questions about how geomagnetic storms, which can damage satellites, proceed and how the radiation belts are formed and evolve. The Curiosity rover is assessing whether Mars had an environment capable of supporting life. Cassini is completing its study of Saturn, its magnetosphere, moons, and ring system. Orbiting spacecraft have revealed the crevice-riven ice crust of Europa, the water-rich geysers of Enceladus, the ancient surface of Mercury, and the hydrocarbon lakes of smog-shrouded Titan. A pair of spacecraft have provided stunning detail about the Moon's interior, helping to constrain models of the formation of the Earth-Moon pair. Robotic probes have mapped the heliosphere—the part of the galaxy dominated by the Sun's influence, and we are now reaching beyond our solar system as the Voyager spacecraft move into the uncharted realm of galactic space. A spacecraft has discovered nearly a thousand planets orbiting other stars – many in multiple planet systems – allowing direct study of other solar systems vastly different from our own.

New missions hold promise to sustain this remarkable pace of discovery. A solar probe will fly within 10 solar radii of the Sun, which will be humankind's first visit to a star. A spacecraft will orbit an asteroid and return a pristine sample to Earth, while another will be the first to visit the dwarf planet Ceres. A constellation of four spacecraft in Earth orbit will investigate magnetic reconnection, a process involving the often explosive release of energy stored in cosmic magnetic fields that is important for understanding space weather and the sources of harmful radiation. An orbiter will study the Martian atmosphere to better understand the nature of climate change on that planet. Missions to Pluto and Jupiter's polar regions are en route.

We stand thus on the verge of unparalleled discovery in space and planetary science. At the same time, however, we face an imminent threat to the nation's future leadership in these areas: the loss of the next generation of scientists. Many scientists—particularly our youngest investigators including students—rely on relatively small research grants to support their research outside the budgets of NASA missions. These funding opportunities are disappearing, and without this critical funding, many scientists in solar, space, and planetary sciences are being forced to leave the field. This trend will only get worse, which will cripple our ability to carry out important research in many areas, and will impair our ability to gain the fullest return from our impressive array of missions.

In scientific research as in many endeavors, innovation and discovery go hand in hand. New discoveries require innovation, and innovations lead to discovery. Our country has led in both areas throughout the space age, but many foreign countries such as India, China and S. Korea are

now rapidly gaining ground. The US cannot afford to lose a new generation of solar, space and planetary scientists.

The trend in research funding opportunities in recent years is alarming and has already begun to squeeze out a generation of scientists. From 2006 to 2010, there was a 50% decrease in the number of non-mission related research grants in Heliophysics at NASA, and this lower level has been sustained since 2010. Similarly since 2003, there has been a 45% reduction in the number of research grants awarded per year in Planetary Science at NASA. Success rates for solar, space,and planetary science proposals at both NASA and NSF have fallen from typical values of 30 - 40% in 2006 to 10 - 20% now, and will be lower still this coming year. *If this contraction is sustained, we face the potential loss of half the researchers in the field within just five to ten years.*

It is critical that our nation maintains its leadership and competitiveness in solar, space and planetary science. *We ask that you help avoid the catastrophic situation facing the new generation of solar, space and planetary scientists in the United States by providing increased funding to support small research grants from NASA and NSF in solar, space and planetary sciences in the 2015 budget and beyond*. The consequences of a loss of a generation of scientists in these fields will undermine the current era of scientific discovery, positioning other countries to take the leadership role in these important areas and to reap their scientific and technological benefits.

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