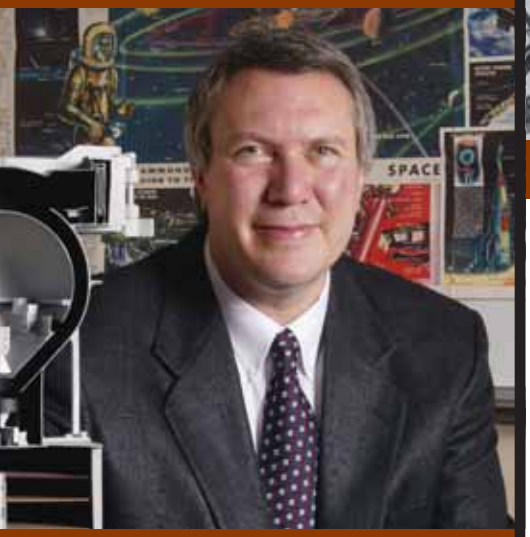
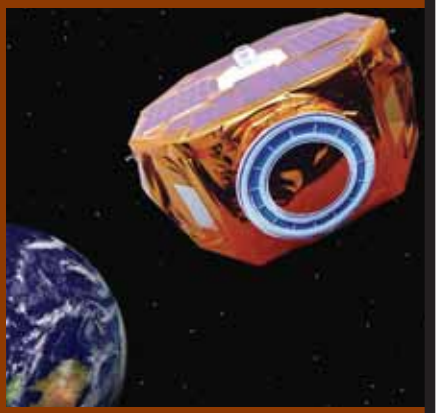
SAE100 Future look

In celebration of SAE's Centennial in 2005, industry executives discuss the future of mobility technology.

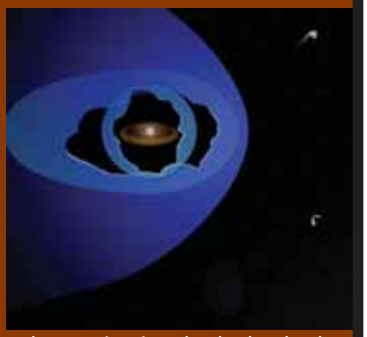


Exploring the boundaries of our solar system

*by **Dr. David J. McComas**, Senior Executive Director, Space Science and Engineering Division, Southwest Research Institute; Principal Investigator, Interstellar Boundary Explorer (IBEX) Mission; and Chairman, NASA's Solar Probe Science and Technology Definition Team*



The IBEX spacecraft. (Courtesy of Orbital Sciences)



The termination shock, the shock front surrounding the sun at an estimated distance of about 100 astronomical units.

In addition to helping enable **NASA**'s new vision of taking humans back to the moon and paving the way to Mars and beyond, two robotic space science missions are preparing to explore the outermost and innermost edges of our solar system.

Serious challenges face human exploration, such as the significant radiation hazards from galactic cosmic rays that originate outside our solar system and from solar energetic particles that originate in the sun's corona. The vast majority of cosmic rays are shielded by the complex interactions between the million-mph ionized gas that flows out from our sun—the solar wind—and the ionized and neutral gases outside our solar system in interstellar space. NASA's recently selected Interstellar Boundary Explorer (IBEX) mission (www.ibex.swri.edu) will take the first images of this distant region, exploring the interstellar boundaries at the edge of our solar system roughly 10 billion mi away. These unique observations will provide critical information to improve our understanding of how this shielding really works and make a first step toward pioneering the galactic frontier.

To study the boundary region separating our solar system from interstellar space, researchers currently use data from Voyagers 1 and 2, gathered as the spacecraft left the solar system, and from Ulysses, making 3-D observations of the solar wind in a unique solar polar orbit. While making heroic measurements at great distances, the Voyager spacecraft were instrumented for planetary flyby observations and have limited capabilities for evaluating this distant region of space. Some observations from Voyager 1 suggest that it has already reached the closest interstellar boundary while others strongly disagree, leading to conflicting interpretations about the location and attributes of this boundary. Measurements of the outer heliosphere gathered by the Voyagers are extremely valuable but are ultimately pinpricks in the vastness of the solar system.

In contrast, IBEX will use recently developed energetic neutral atom imaging techniques to produce the first global images of the region, giving researchers a deep understanding and the first views of our sun's interaction with the galaxy. Hopefully still complemented with local measurements from the Voyagers and the solar-wind baseline from Ulysses, IBEX's neutral-atom images will provide a quantum leap forward in researchers' understanding of the outer heliosphere.

To qualify the mission for NASA's Small Explorer program, the IBEX team is developing a small, lightweight spacecraft that will be launched in May 2008 from a Pegasus rocket dropped from an airplane. Pegasus rockets are commonly used to place spacecraft into low-Earth orbits but, for this mission, an additional rocket will be stacked on top of the Pegasus for the first time. This unique "rocket on rocket" method will launch IBEX into a highly elliptical orbit, reaching two-thirds of the way to the moon at significantly reduced launch costs.

Relatively closer to home, space scientists are also preparing to robotically explore the inner frontier of our solar system, down in the sun's corona. The Solar Probe mission, presently under detailed study by NASA, will fly to within four solar radii of the sun's surface. This exciting mission requires the spacecraft to swing by Jupiter and use the planet's immense gravitational field to fall in toward the sun. At closest approach, the Solar Probe spacecraft is shielded from the equivalent heat of thousands of suns using a pointy, conical heat shield made of carbon-carbon. Solar Probe will directly measure the region where some of the most dangerous energetic particles are accelerated, allowing scientists to understand these processes for the first time.

Researchers at **Southwest Research Institute** are leading the development of IBEX and the definition team for Solar Probe. These groundbreaking programs will revolutionize mankind's understanding of the outer and inner boundaries of our solar system in the near term and help enable humans to explore far-off destinations throughout the 21st century. AE