

Planetary Science at APL Takes Off

Harold A. Weaver Jr. and Andrew F. Cheng

This issue of the Technical Digest is dedicated to planetary science at APL. Planetary science is about the formation and the evolution of the many worlds in our solar system and how they work. By exploring the solar system, we learn more about our own planet Earth, its past, and its future. APL is a relative newcomer to planetary science, as the first APL planetary science mission was NEAR (Near Earth Asteroid Rendezvous), which started in 1993. NEAR was the first NASA planetary mission to be implemented outside a NASA center, and it became the first mission to orbit and then land on an asteroid. Since the NEAR mission, APL has become an established NASA partner in planetary exploration. There are now two NASA planetary missions being implemented by APL: the MESSENGER (MErcury Surface, Space ENvironment, GEochemistry, and Ranging) mission to Mercury and the New Horizons mission to Pluto and the Kuiper Belt.

But this issue of the Digest is not about APL missions; it is about recent research highlights and accomplishments of APL planetary scientists in the Planetary Exploration Group. Since its formation in January 2004, the Planetary Exploration Group has grown substantially and now includes 23 Ph.D. scientists working on problems that span the solar system—from the inner planets to the outer planets and the Kuiper Belt as well as asteroids and comets. Some highlights of APL planetary science research are presented in the six articles that follow this brief introduction.

Research at APL on the “small bodies” of the solar system (asteroids, comets, Centaurs, and Kuiper Belt objects, in order of increasing heliocentric distance)

traces its genesis back to the critical role played by APL on NASA’s NEAR mission, and small bodies research continues to be a mainstay of the Laboratory’s planetary

science activities. Owing partly to their small physical size, small bodies contain some of the most primitive material in the solar system, whose study provides a window to our past when the Earth and other planets were just forming.

Earth's nearest neighbors in the solar system are mostly asteroids. In her article, Debra Buczkowski explains how lineaments, which are long, linear surface features, can be used to probe the physical structure, density, and cratering history of asteroids. Andy Rivkin discusses attempts to discover and characterize a special class of asteroids, the so-called Near Earth Objects (NEO), which have escaped the main asteroid belt and could potentially strike the Earth. "Know thy enemy" is certainly an apt description for much NEO research, and APL expects to play a leading role in protecting Mother Earth!

Comets formed relatively far from the Sun and were able to retain highly volatile ices in addition to rocky material and organics. But how does a comet's composition vary with its formation site, which could be anywhere from Jupiter's to Pluto's orbit, and possibly beyond? And does a comet's composition vary with "age," i.e., with the number of passages the comet makes through the inner solar system? Neil Dello Russo and colleagues explain how to address these questions with high-resolution IR spectroscopy, which can be used to identify and characterize the molecules that sublime directly from the surfaces of cometary nuclei.

The icy satellites of the outer planets are another focal point of planetary research at APL, and Saturn's moon Titan is one of the most intriguing. Ralph Lorenz discusses how data from the Cassini spacecraft, which is currently orbiting Saturn, are unveiling some of Titan's

mysteries, revealing hydrocarbon lakes and rivers on its cryogenic surface beneath a thick, predominantly N₂ atmosphere.

"Follow the water" is the mantra of the missions currently investigating Mars, and no one is doing that better than Scott Murchie and his CRISM team. Their article explains how their powerful imaging spectrograph on the Mars Reconnaissance Orbiter is mapping the mineralogy over the entire surface of Mars, in addition to scouting out the best landing sites for the recently launched Phoenix lander and future Mars landed missions.

APL scientists also perform laboratory investigations in support of the remote observations of planetary objects described above. Nancy Chabot and several colleagues describe how important it is to tie the data collected by remote observations to ground truth obtained by studying laboratory samples or by simulating planetary processes in a laboratory setting. The samples range from analogs of planetary materials created in the laboratory, to meteorites found during Antarctic expeditions, to material collected from hot springs and craters all over the Earth.

The last article in this issue differs from the others, as Ralph McNutt discusses what is required of NASA, our nation, and the world to make the next big strides in the scientific exploration of the solar system. Ralph outlines the basic principles that govern space exploration, both robotic and manned, that remain valid today.

Enthusiasm for planetary exploration comes through loud and clear in each and every one of these articles, and we are delighted to be able to present them to you. We hope that they will inspire you as they have inspired us. So please read and enjoy!

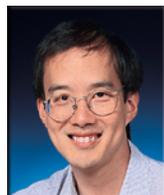
The Authors

Harold (Hal) A. Weaver Jr. has been pursuing space-borne, rocket-borne, air-borne, and ground-based investigations in planetary science since 1978. For his doctoral degree in physics from The Johns Hopkins University in 1982, he performed the first systematic investigation of cometary UV emissions. In 1985–1986, he and colleagues directly detected water in comets during IR observations of Comet Halley. For this work Dr. Weaver was awarded the NASA Medal for Exceptional Scientific Achievement in 1988. Since 1990, he has led many investigations of comets using the Hubble Space Telescope and the Far Ultraviolet Spectroscopic Explorer. He joined APL in May 2002 and is now serving as the Project Scientist for the New Horizons Pluto/Kuiper Belt mission.



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Andrew F. Cheng received an A.B. in physics from Princeton University in 1971 and a Ph.D. in physics from Columbia University in 1977. He joined APL in 1983. Dr. Cheng's research interests include the physics of asteroids and the magnetospheres of the outer planets. He was the Project Scientist for the NEAR mission, an interdisciplinary scientist for the Galileo mission, a co-investigator for the MIMI instrument on the Cassini mission, the Orbiter LIDAR scientist for the MUSES-C mission, and the Principal Investigator of the LORRI instrument on the New Horizons mission. Dr. Cheng has served both as an associate editor of the *Journal of Geophysical Research* and *Geophysical Research Letters* and as editor (for Solar-Planetary Relations) of *EOS: Transactions of the American Geophysical Union*. For further information related to the subject of this article, contact Dr. Weaver. His e-mail address is hal.weaver@jhuapl.edu.



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