

A Tradition of Discovery

HRL Laboratories, LLC, which will host this year's AIP Corporate Associates meeting, is a newly minted name for what was long known as Hughes Research Laboratories, a venerable institution now marking its 50th anniversary.

During its half-century of existence, researchers there have expanded the frontiers of science and technology in such diverse areas as electronics, lasers and optoelectronics, semiconductor processing, space satellites, display technology, and ion-beam technology, among others. In May 1960, in perhaps the lab's most famous accomplishment, Hughes researcher Theodore Harold Maiman demonstrated the first workable laser, which used a synthetic ruby crystal. The device became the cornerstone of Hughes' multibillion-dollar laser rangefinder business and opened the explosive worldwide growth of lasers, optoelectronics, and fiber optics.

"Last year, we made significant technical advances in high-power solid-state lasers, micromachined inertial sensors, high-speed analog-to-digital converters, and many other areas," says HRL president Art Chester. "And Hughes recently launched the first commercial xenon ion propulsion system for satellites, developed at HRL (see cover story, *The Industrial Physicist*, 6/98, pp. 24-26)."

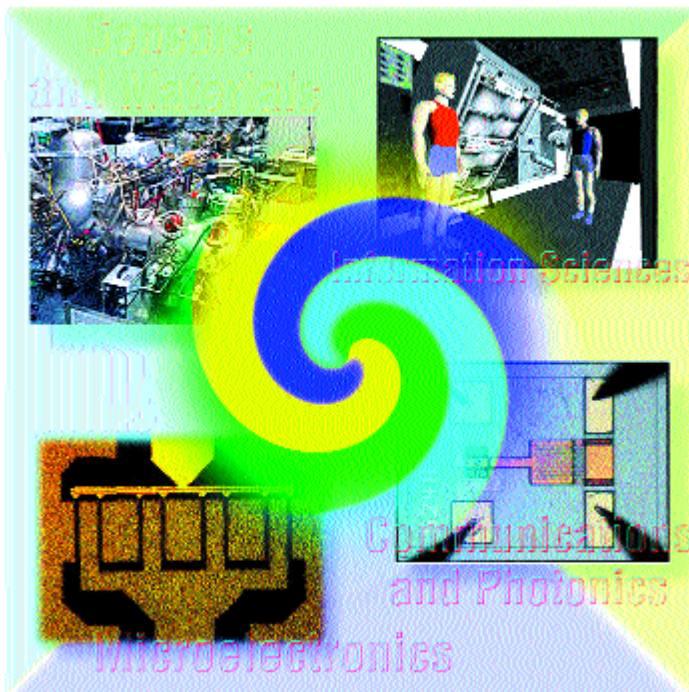
HRL Laboratories acquired its name on Dec. 17, 1997, following a series of complex business transactions by Hughes, Raytheon Co., and General Motors Corp. The research company, located in Malibu, California, is now owned by Hughes Electronics Corp. and Raytheon.

HRL's roots date back to 1948, when Hughes Air Craft Co. spun off

Hughes Research and Development as a separate entity. It became an AIP Corporate Associate in 1952. Initially, the new compa-

ny's mission was to upgrade the early microwave systems through work on traveling wave tube transmitters, ultralow-noise microwave maser receivers, and improved radar display devices. It was from these efforts that the first workable laser emerged. From 1959 through 1997, as Hughes Research Laboratories, the facility continued to serve as Hughes' research arm.

"Today, HRL faces an entirely new venue and environment," says Dick Reynolds, HRL's vice president and technical director. Because of its joint ownership by Hughes and Raytheon and extensive research ties to General Motors and the Department of Defense, HRL has "four significant owners or customers—and that is a management challenge," Reynolds adds. "We hope to learn from our AIP Corporate Associates colleagues how they manage these 'multiple-director' structures."



Connecting with Communications

Wireless and Space Communications is the theme for the 1998 meeting of the American Institute of Physics Corporate Associates, Oct. 25 to Oct. 27, hosted by HRL Laboratories, LLC (Malibu, CA).

Two days of sessions will follow a Sunday evening reception. Speakers on Monday will address the opportunities and challenges posed by wireless and space communications as the Information Skyway becomes a growing part of peoples' lives. Day one will conclude with a tour at HRL and a reception and banquet.

On Tuesday, a panel discussion will highlight policy issues, including privacy, frequency and orbit-slot allocations, and the effect of wireless communications on radio astronomy. The meeting will conclude with the annual "Frontiers of Physics" session, which this year features talks on the Mars Sojourner mission, the moon as a mirror for global change, quantum teleportation, and sonoluminescence.

Additional meeting information and registration materials are available on the AIP Web site (www.aip.org/aip/corporate/1998/98mtg.htm).

Four labs in one

The long-standing Hughes commitment to excellence continues among the 350 employees of HRL Laboratories, which consists of four technical laboratories intensely focused on a wide array of research and development projects.

At HRL's **Communications and Photonics Laboratory**, for example, researchers have a CLUE (compensated laser ultrasonic evaluation) for industry to improve the nondestructive inspection of weld joints, metals, and composites. CLUE, essentially an optical version of sonar, uses one laser to "ping" the part and a second to decipher the response. Thus, only beams of light are needed to reveal such information as defects within a material, temperature, and metallurgy. Elsewhere within the lab, researchers are developing the first fully functional, optically controlled, phased-array antenna; a new generation of integrated circuits


containing both electronic and optical devices; lightweight, highly coherent fiber-laser sources for sensors; and enhanced, high-power, solid-state industrial lasers for cutting, welding, and drilling.

The **Information Sciences Laboratory's** work in advanced information technology includes cutting-edge software—for signal and image processing, human-centered systems, networking, multimedia computing, and investment management—and digital-processing hardware for embedded real-time systems. One current project is the development of the Aware Network, which maintains constant vigilance and awareness of all activity on the network, almost like a neighborhood watch program. When it detects an intruder or other security breach, the network steps in to defend itself. The Aware Network also learns from past invasions and adapts to new threats. Another effort, focused on neural-network technology, has resulted in novel algorithms for pattern recognition and the development of the advanced optical and electronic hardware needed to implement them efficiently.

At the **Microelectronics Laboratory**, HRL researchers carry on a half-century of improvements in microwave systems. Today, the emphasis is on developing and applying advanced microwave/millimeter-wave devices and integrated circuits. One key project seeks to develop and produce high-performance devices based on indium phosphide (InP) and other advanced semiconductors for satellite, missile, and radar applications. To capitalize on the rapid advances in InP technology, HRL has established a pilot line to produce high-performance digital and microwave/millimeter-wave devices and integrated circuits. Device-materials scientists at HRL are constantly striving to improve the quality and state-of-the-art manufacturing processes of advanced microelectronics-device structures.

HRL's fourth internal lab, **Sensors and Materials**, pursues innovative sensors, advanced materials and structures, novel materials-related processes, exploratory devices, and modeling. Its researchers have

exploited the quantum tunneling effect between metals to design microelectromechanical sensors that can sense an applied force with extreme sensitivity and 10^6 orders of magnitude of dynamic range. In addition, some teams are pursuing advanced solid-electrolyte lithium ion batteries, which promise high energy density and light weight

for satellite and automotive use, and electro-optical sensor materials, such as mercury cadmium telluride. 

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