

Big Five at Centennial Display

Visitors to the centennial meeting of the American Physical Society (APS) in Atlanta last March found the past, present, and future of industrial physics celebrated in an exhibit of visual and intellectual power. The salute to industrial physics and physicists, sponsored by the Forum on Industrial and Applied Physics (FIAP), featured displays by five companies that are world-renowned as innovators—IBM Corp., Bell Laboratories, Ford Motor Co., General Electric Co., and Delphi Automotive Systems.

Using a time line that spanned the last 125 years, Lucent Technologies' Bell Laboratories presented a sweeping view of the impact of physical-sciences research on communication technology and the communications industry. The display graphically depicted the major milestones in electronics and photonics that underlie the communications revolution—including the transistor, integrated circuits, microprocessors, semiconductor lasers, and optical fibers and other light-wave components.

The time line traced the fundamental advances in solid-state physics, materials science, and quantum optics that enabled these breakthroughs, and related these fields, in turn, to their conceptual roots in electromagnetism and quantum theory. The tight interplay between science and technology illustrated in the exhibit has served as a hallmark of the communications industry for decades.

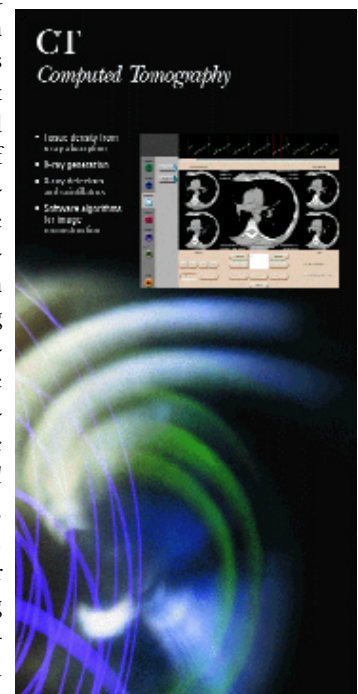
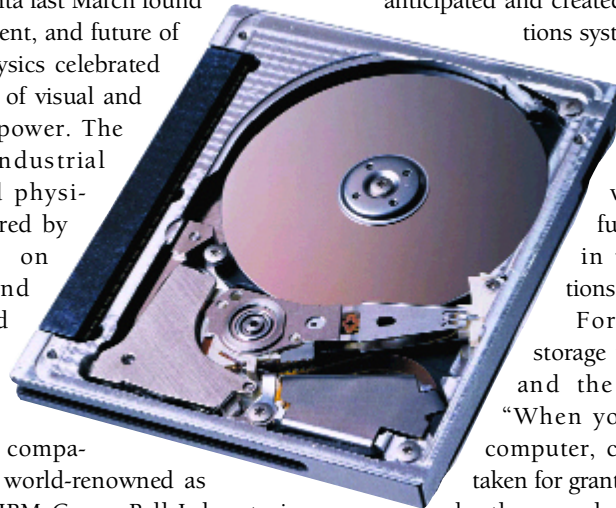
Although most of the time line featured important examples of R&D and product development by Bell Laboratories scientists, some entries focused on other companies or universities. Overall, the display covered three eras: the electron and electromagnetism; quantum mechanics and solid-state physics; and photonics. The result was a

march through time with the men and women whose discoveries and inventions anticipated and created the communications systems of today, and a glimpse of current research at Bell Laboratories, which may lead to future innovations in the communications industry.

For IBM, magnetic storage was the message, and the message read, "When you turn on your computer, certain things are taken for granted: Your data will be there, and you can run your programs, check out the Internet, or retrieve data from a network server. None of these activities would be possible without a magnetic hard-disk drive."

IBM invented the magnetic hard-disk drive and brought it to market in 1957, and its exhibit emphasized the future of these indispensable computer elements. In developing giant magnetoresistance (GMR) sensors (see *The Industrial Physicist*, 6/99, pp. 22–24) for recording heads—which read and write data

on disks—IBM has harnessed the fundamental quantum nature of electrons to create a critical new capability to read data stored at



FIAP FLOURISHES

Exhibit visitors found an introduction highlighting FIAP's rapid growth and accomplishments. Since its creation in November 1994, FIAP has grown to more than 5,000 members and become the largest of the APS forums. FIAP represents the interests of industrial and applied physicists within APS, and through its energetic leadership and active participation, the Forum has emerged as a strong asset to the Society across a swath of policy issues and professional activities. The Forum works diligently to make "hidden physicists," those employed under titles other than physicist, more visible to management and their co-workers.

FIAP's officers and executive-committee members arrange invited talks, focused sessions, and tutorials at APS meetings and sponsor or co-sponsor special events, such as the networking breakfast for women in industry held at the March APS meeting. The Forum maintains a speakers' list of industrial physicists (www.aps.org/FIAP) and plans to create an online directory of consultants. It also publishes a newsletter twice a year and initiates the Forum department of *The Industrial Physicist*. For further information on FIAP, please contact the chair, Galen B. Fisher (galen.b.fisher@delphiauto.com).

very high densities.

By 2004, IBM expects to achieve an areal density of 40 Gb/in.², which is up from 6 Gb/in.² today. Beyond 40 Gb/in.², superparamagnetism becomes an important issue because this phenomenon—in which the magnetic-orientation energy for small written bits is

equal to the surrounding thermal energy—could reduce bit stability. GMR sensors, as well as new disk materials, structures, and writing techniques, are believed to hold the key to surmounting the problem.

Patients seldom think of physics when seeing a physician, but the physical sciences underpin much of today's high-tech medicine. General Electric, where William D. Coolidge invented the modern X-ray tube in 1913, emphasized this in a display that featured the physics behind the imaging devices developed by GE Medical Systems.

Computed-tomography (CT) scans, for example, show the density of tissue, which is derived by determining the absorption of X-rays. CT technology depends on the generation of X-rays, X-ray detectors and scintillators, and software algorithms. Ultrasound machines, which record the propagation of sound waves in tissue, utilize piezoelectric transducer arrays and beam-forming, as well as Doppler flow measurement.

Nuclear magnetic resonance serves as the basis of magnetic resonance imaging. MRI machines incorporate radio-frequency electronics and coils, magnet and gradient coil design, and cryogenics. The emerging benefits of digital X-ray machines depend on large-area amorphous silicon detector arrays, analog electronics, scintillator materials, and, of course, X-ray generation. As the GE exhibit made eminently clear, physics serves the world's physicians well.

Ford exhibited Synergy 2010, its concept car used as a test-bed to explore the scientific

frontiers of the family auto a decade from now (see *The Industrial Physicist*, 8/99, p. 25). Synergy 2010 is Ford's initial step in developing cars that will get up to 80 mpg while retaining the performance, driving range, and features that customers want and expect. Among its advanced technology features, Ford's concept car boasts a rear-mounted 1.0-L compression-ignition, direct-injection engine with more than 43% peak efficiency; an engine-powered generator; and permanent magnetic motors with 90% efficiency in all four wheels. It also has flywheel energy storage with a composite rotor (95% one-way efficiency), regenerative braking, aluminum unibody construction that is one-third lighter than today's models, and a reduction of 40% in aerodynamic drag. Synergy 2010's tires have a low rolling-resistance coefficient (0.0055) and the ability to run when they are flat.

One key finding of Ford's look into the future: A lot of research lies ahead to ensure the affordability

and durability of tomorrow's autos, and the ability to manufacture them.

Delphi Automotive, once General Motor's high-tech component-and-systems arm and now an independent company, offered a look at futuristic collision-avoidance systems developed by the Delphi Delco Electronics Systems Division.

Videos showed test versions of the crash-avoidance devices at work. These devices include front, back, and side radar; advanced traction control; adaptive cruise control, which maintains a constant distance between one vehicle and the one directly ahead; and an angular-rate sensor, which adjusts the forward-looking radar to keep it focused on the vehicle ahead during turns and on curves. An

on-site microscope enabled visitors to look at the tiny angular-rate sensor, and thus provided some display visitors with their first view of a microelectromechanical systems (MEMS) machine.

New technologies for making more integrated vehicles with safer interiors, smarter sensors, better fuel economy, lower exhaust emissions, and mobile communications also attracted attention. But the exhibit's most popular items were the free puzzles, which if manipulated

correctly, spelled out Delphi. Those brain-teasers disappeared rapidly each day. □

