

## At Research Center, A Matter of Light Intensified

By James Schultz

**H**uman eyes are easily drawn to a brightening sky at dawn, a reddening sunset or the cold luminescence of a full moon. Sight comes because the human retina perceives the constant splash of the light-energy-carrying particles known as photons. Normally those photons radiate out widely, in different directions and at different wavelengths. Make light march in lockstep, however, and a unique kind of phenomenon occurs: light amplification by stimulated emission of radiation. Thus it is that a device known as the laser produces concentrated, intensely focused light energy.

Lasers are as versatile as they are powerful, used in everything from surgery to telecommunications to manufacturing. Medical lasers can pierce the human eye without damaging vision, and industrial lasers can slice through thick metal. Lasers are used in the production of microelectronics and in the collection and analysis of scientific data. By reading the depressions and protrusions on the surface of a compact disc, lasers produce sharp images and crystal-clear sound. Lasers may one day even power interplanetary spaceships.

Lasers will soon add another accomplishment to the long list of innovation. A new breed of laser derived from basic research in nuclear physics at Thomas Jefferson National Accelerator Facility, or Jefferson Laboratory, could revolutionize the way goods such as textiles, computer components, solar-power equipment, auto parts and airplanes are designed and manufactured.

The Laboratory's "free electron" laser, or FEL, makes use of individual electrons stripped from a source material. The electrons are injected into a linear arm of a racetrack-like oval, where they are steered and accelerated. By the time the electrons reach a device known as a "wiggler," they are highly energized. Inside the wiggler, the electrons move up and down; a portion produce photons that are subsequently released as laser light.

Because FEL light can change the surface properties of textiles, the manufacturing industry could eliminate some of the environmentally hazardous, wet-chemical treatments now used during production. The FEL also has the potential to substantially reduce the cost of solar-energy panels by boosting their light-gathering capacity. A host of other FEL applications are possible, including dramatic improvements to the quality and costs of food packaging, food wrap, air and water filters and cer-

tain kinds of medical supplies. An FEL could "micromachine" such parts as fuel injectors and ink-jet printer heads, boost metals' resistance to corrosion and produce a stainless-steel finish on the surface of low-grade steels.

"I have deliberately focused the University's attention on areas that I feel have the most promise," says Old Dominion President James Koch. "I feel the FEL is one of those. I really think this laser will make a commercial difference in the marketplace."

### Future Solutions Today

The FEL is one of the keystone technologies connected with the development of the Applied Research Center (ARC), an \$18 million, seven-story, 122,000-square-foot research complex adjacent to the grounds of Jefferson Lab. ARC design and construction costs were underwritten by the city of Newport News, with financial support for research programs, faculty salaries and equipment purchases coming from the state of Virginia. Major equipment donations have been made to the Center by Xerox Corp. and Eastman Kodak Co.

Old Dominion is one of four university tenants at ARC, which concentrates faculty expertise on solving technological problems of interest to industry. Within the facility, Old Dominion has established a dozen laboratories that specialize in various aspects of FEL-connected materials processing, as well as in the development of miniature optical sensors and diagnostic apparatus relating to manufacturing and manufacturing quality control. The University is working on projects commissioned by or involving such companies or corporations as Eastman Kodak, Xerox, Solarex, Mitsubishi Chemicals, Siemens and Motorola.

"Our aim is to have a strong economic impact in the high-tech arena," says Mool Gupta, Applied Research Center director for Old Dominion. "That includes microelectronics, optoelectronics, materials science and engineering. We're applying University-based expertise to help industry solve problems and to develop applications they may not even be aware of."

Gupta says that the University's Research Center participation is particularly beneficial for students, since early and repeated interaction with industry is excellent preparation for future employment. In addition, faculty will be able to pursue important, challenging projects that could benefit the whole of

society. Industrial projects also provide an ongoing source of financial support to Old Dominion, as well as the potential for development of Center-derived intellectual property — which, in turn, could lead to whole new industries and many new jobs.

The ARC is the hoped-for impetus to another ambitious project: a planned research park that designers believe may create more than 4,000 new jobs and attract investments of at least \$160 million in property and equipment in the first years of the coming century. Meantime, high-tech businesses are being recruited to fill the roughly 20 percent of ARC's square footage not already occupied by the quartet of universities or Jefferson Laboratory personnel. As the research park matures, more firms are expected to set up shop in or near the Research Center.

"There was an era when one person could work in a lab, alone," Gupta points out. "Now the complexity is so great that you need a multidisciplinary team. Those who have succeeded, both in terms of funding and in terms of product

development, have put together a strong team."

### Working Together

While each of the four state universities housed in the ARC — joining Old Dominion are the College of William and Mary and Christopher Newport and Norfolk State Universities — will conduct individual research ventures, there will be several collective areas of focus. In particular, the universities will support the Common Materials Laboratory, a general-purpose facility that will study the specific effects of the FEL on a variety of materials. The Laboratory will house equipment — donated by such Fortune 500 contributors as IBM and DuPont and, in the public sector, NASA, Jefferson Lab and the universities themselves — that will be used communally by all four institutions.

Another shared research area set aside within the Research Center will be known as the Common Laser Laboratory. Here, a number of conventional and low-power lasers will be made available for research and training. A key advantage of

university cooperation within ARC is the instruction of students and technicians in the use of current and advanced lasers. Those trained in the Laser Laboratory could go on to positions with existing or new FEL-related companies in the ARC research park, or elect to continue their studies at Jefferson Lab itself.

University-based scientific and technological support for the Jefferson Lab's FEL Program seems guaranteed to intensify and expand. Eventually, other FELs could be built near the site of the original prototype, attracting primary businesses and their suppliers. A relatively large pool of university-trained ARC specialists and technicians will eventually be available to area firms for expansion of product lines and enlargement of the local labor force.

"We wrote a brochure a few years ago. In it we said that Old Dominion was not built with ivory towers in mind," says University Provost Jo Ann Gora. "I think that summarizes our attitude toward applied research. That's why our partnership in the FEL project and with ARC is so important to us."

**Mool Gupta, director of Old Dominion's Applied Research Center, with the Laboratory's "free electron" laser.**

