

No Small Matter

By James Schultz

Seldom seen, difficult to capture and tamed only with effort, a strange menagerie of subatomic particles swarms among us in ceaseless flux. All that we know of reality — our bodies, the ground under our feet, the stars over our heads, the air we breathe, the food we eat — is quite literally made from the constituents of the sub-microscopic realm. We are familiar with some of its inhabitants: the protons and neutrons that comprise the atomic nucleus, and the electron, carrier of the force known as electromagnetism.

Beyond this familiar trio, physicists have identified a set of fundamental building blocks known as quarks. The word “quark” was coined by Irish writer James Joyce in his 1939 novel *Finnegans Wake*, by the late 1960s it had been appropriated by physics to describe six kinds of basic particles believed to assemble in various combinations to form several hundred kinds of more complex particles. For a number of Old Dominion physicists, the mysterious ways and habits of quarks have made for a life’s work — work that recently has acquired a welcome boost from the maturation of a one-of-a-kind nuclear physics research center.

Old Dominion has been one of the key participants in the development of the Thomas Jefferson National Accelerator Facility, or Jefferson Laboratory, located in the southeastern Virginia city of Newport News. The Laboratory is home to the world’s first large-scale, superconducting electron accelerator, a complex assembly of high-tech hardware and

electronics stretching through an underground tunnel almost a mile in circumference.

“Jefferson Laboratory is located nearby. It’s not in Blacksburg or Minneapolis,” says Old Dominion President James Koch. “It’s a natural thing for us to look for comparative advantage in our own neighborhood. Jefferson Lab provides us with a superb opportunity to capitalize on our assets.”

From the Beginning

Old Dominion’s involvement with the Laboratory dates back to the facility’s creation in 1976. The Laboratory was envisioned by physicists as a sort of ultra microscope, capable of peering deep into the heart of atomic nuclei to answer emerging questions about the nature and role of quarks in matter’s basic structure. Thus it was that a consortium of universities that included Old Dominion — a group formally known as the Southeastern Universities Research Association or SURA, now numbering 41 members and charged with the daily operation of the facility — made a proposal in the early 1980s for construction of a center for nuclear physics research.

In 1983, SURA’s proposal was chosen by the Department of Energy after competition with the Massachusetts Institute of Technology, the University of Illinois, Argonne National Laboratory and the National Bureau of Standards. A year later, 200 acres in Newport News had been selected as the site for the new

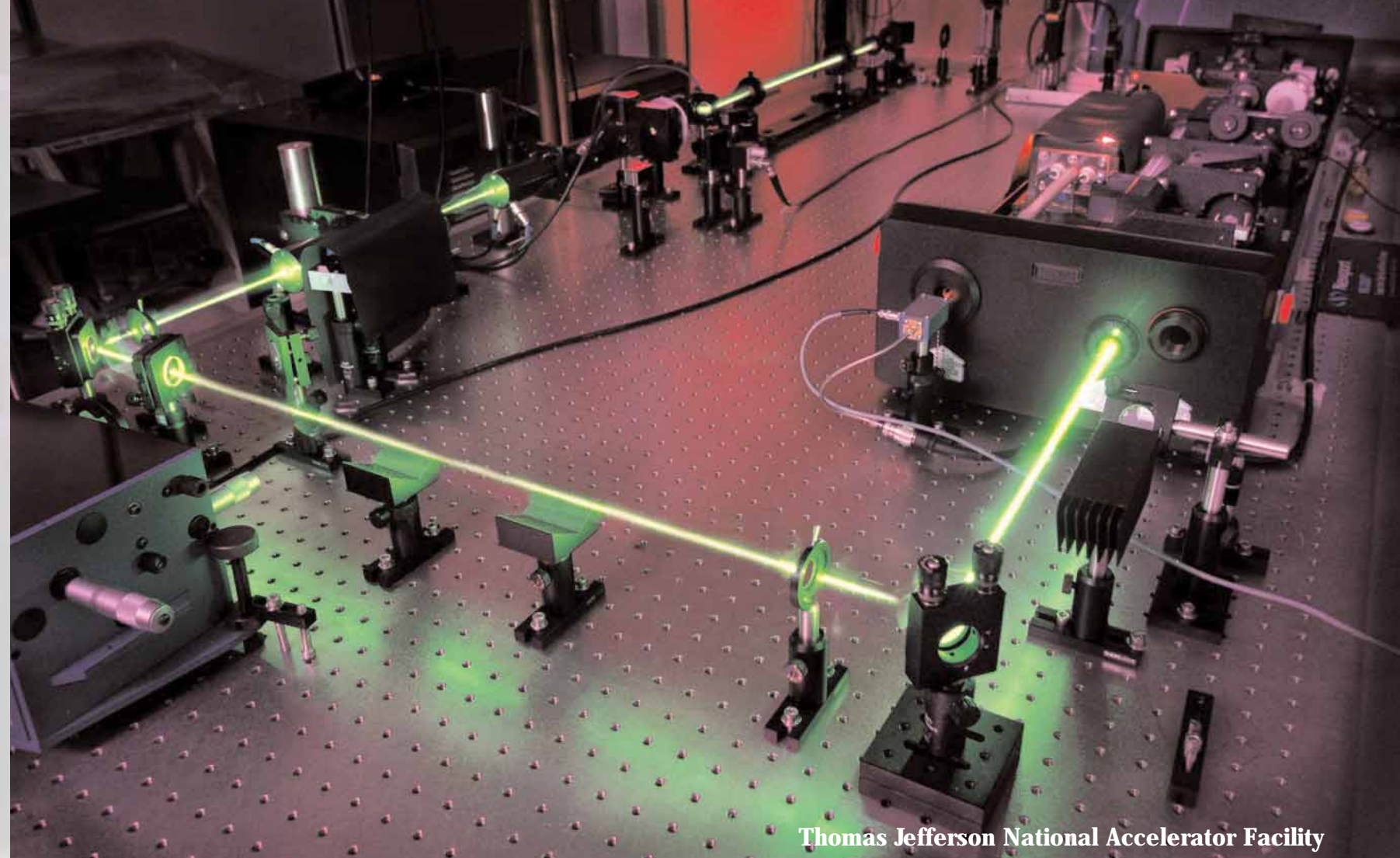
Laboratory, and initial federal funding had been received for research, development and design. Ten years would pass before researchers would conduct their first physics experiments.

Today, however, basic and applied research are booming at the \$600 million facility, as hundreds of scientists around the country and the world journey to Newport News to join the Laboratory’s permanent staff of 500. Experiments that previously took decades or years, or weren’t possible at all, are being done in months at the facility. And spinoffs from the Lab’s unique accelerator and particle-detection equipment are finding their way into the private sector.

“Physics is often described as the queen of the sciences. Every other science seems to start with it or depend on it,” says University President Koch. “Good applications nearly always stand on the shoulders of strong basic science. We certainly couldn’t have had these numbers of spinoffs without Jefferson Laboratory’s basic-research strengths.”

Moving to the Top

Eleven of Old Dominion’s regular, full-time physics faculty members (the University’s contingent of six theorists and five experimentalists is one of the largest at the Lab, which hosts faculty from other state and national universities) split their time



Thomas Jefferson National Accelerator Facility

between Old Dominion and the Laboratory. In addition, two scientists employed full time at the Lab are known as Jefferson Laboratory Professors, official members of the University faculty with responsibilities for and oversight of graduate physics students. Old Dominion researchers are also influential members of the Jefferson Lab Theory Group.

One recent study ranking physics groups placed Old Dominion’s in the top quarter nationally. The results come as no surprise to Physics Chair James Cox. “The quality of our [physics] group is as good, or better than any group in the world,” he contends. “You have to be competitive on the world stage. I think we’ve stepped onto the world stage in a big way.”

At the Laboratory, students and faculty alike have the opportunity to work with state-of-the-art equipment

unlike almost any other. The Jefferson accelerator is a research tool designed not to smash atoms but to dissect them. Experimenters accelerate hair-thin beams of electrons to collide with small targets, while house-sized arrays of electronic data-gathering equipment track, measure and record the resultant, telltale debris. The electron beam can be split for use by three simultaneous experiments in circular, domed end stations known as Halls A, B and C. By studying the speed, direction and energy of scattered particles, scientists will learn more about how the nucleus is put together.

In pursuit of the Laboratory’s basic nuclear physics mandate, a number of new technologies have been and continue to be developed with the potential for industrial application. These include the creation of a “free electron” laser; a number of

accelerator-related technologies; advanced control-system software; and next-generation medical diagnostic systems based on Jefferson’s sophisticated particle-detection and data-acquisition systems.

In 1998 Laboratory technology transfer continued its expansion with the move of 200 staff members to the Applied Research Center, a new \$18 million, seven-story, 122,000-square-foot complex adjacent to Laboratory grounds. Old Dominion is a primary tenant in that complex, which is aiming to attract applied-physics-related industry and new-business development to southeastern Virginia in the first decade of the coming century.

“Jefferson Lab has already been an important investment for the University,” Cox says. “The bulk of the payoff still lies ahead. It’s something I see continuing for years, decades even.”