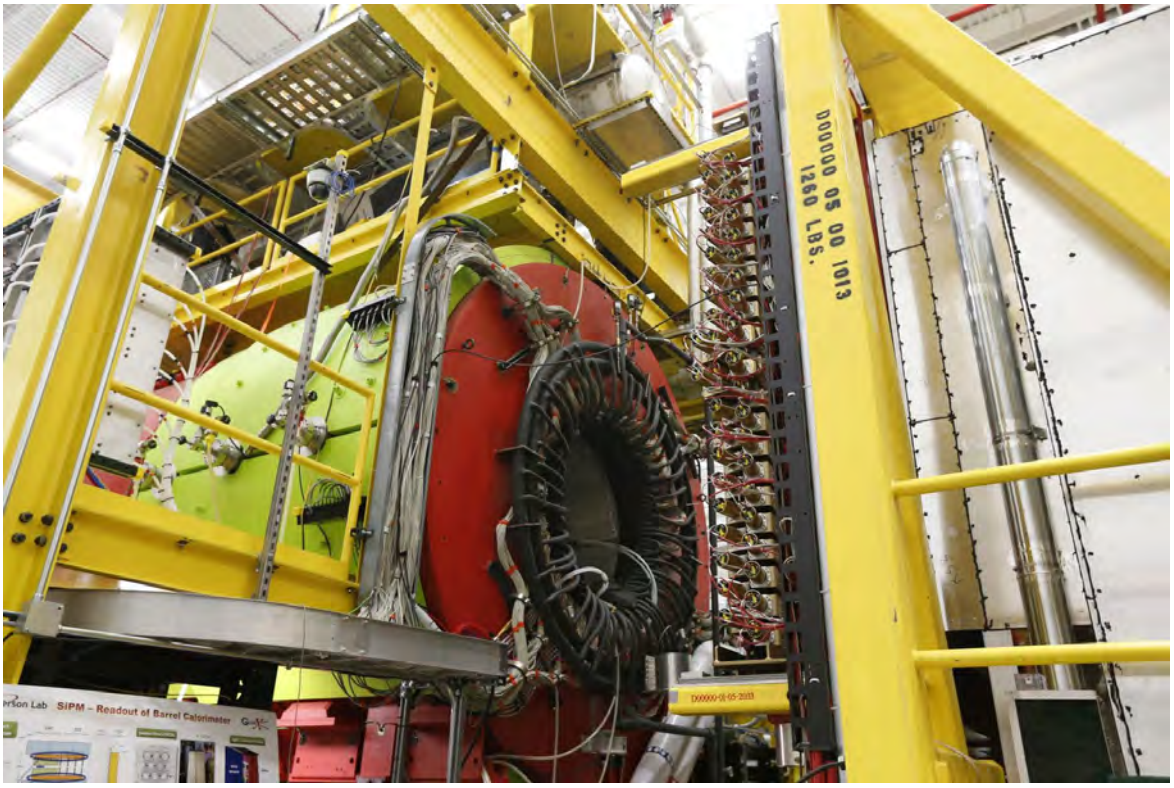
http://www.richmond.com/opinion/their-opinion/guest-columnists/paul-dabbar-and-stuart-henderson-deconstructing-the-atom-in-newport/article_30e62ae1-3ca7-5805-a0bf-bc55d32e843a.html

JEFFERSON LAB

Paul Dabbar and Stuart Henderson: Deconstructing the atom, in Newport News

Paul Dabbar and Stuart Henderson May 5, 2018



This is the GlueX detector systems at the Thomas Jefferson National Accelerator Facility. Electrons or protons are accelerated to collide with other particles inside the detector, enabling physicists to collect data.

2015, ALEXA WELCH EDLUND/TIMES-DISPATCH

By Paul Dabbar and Stuart Henderson

In 1945, Dr. Vannevar Bush produced a report, “Science — The Endless Frontier,” that would chart a roadmap for basic scientific research and technological innovation in the post-war era.
That report advised then-President Truman on the importance of fostering a national approach and infrastructure that encouraged basic scientific exploration, founded in the faith that scientific discovery eventually leads to technological innovation that drives the health and well-being of the nation’s citizens.

This remarkable report serves as the cornerstone of today’s modern system of federally funded research carried out at the nation’s 17 Department of Energy National Laboratories and throughout the university system.

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> We hope to glean answers to a host of profound questions. Why is no quark ever found alone? What does the interior of a proton or neutron 'look' like?

On May 2, nearly 75 years later, the newest scientific instrument aimed at studying the basic building blocks of matter and the forces that bind them together in the atom's nucleus was dedicated at Jefferson Lab, in Newport News.

This scientific facility, called the 12 GeV Continuous Electron Beam Accelerator Facility (CEBAF), will open a new era of nuclear physics research, allowing scientists to "see" objects a million times smaller than an atom. It will keep the U.S. at the forefront of science and innovation in critical fields, such as physics and supercomputing.

The story of science is largely the story of humankind's ability to look at and make sense of the microscopic world — from the first microscopes used to see that living things were composed of cells, to modern instruments that take snapshots of materials at the scale of individual atoms.

With CEBAF, scientists from around the world are shining this powerful electron microscope on individual protons, neutrons, and atomic nuclei to see and understand the remarkable quantum world of quarks and gluons that make (and are confined within) protons, neutrons, and other subatomic matter — and that comprises all the visible matter on Earth and in the universe.

We hope to glean answers to a host of profound questions.

Why is no quark ever found alone? What does the interior of a proton or neutron "look" like, and can we capture a 3-D image of the the constituent pieces?

How does the force that holds protons and neutrons together in the nucleus arise from the strongest known force in the universe — the force between two quarks?

One may ask why a nation should bother to fund this sort of basic scientific research, given all of the other pressing, near-term needs that our country faces. The answer to this question was provided by Vannevar Bush's report in 1945, and it continues to be answered in the Department of Energy's National Laboratory system.

Basic fundamental research in nuclear physics over the past 50 years has led to particle accelerators that treat cancer, nuclear medicine to diagnose and treat disease, and the development of technologies that enable semiconductor manufacturing.

The discovery and development of radioisotopes finds applications as diverse as pipeline inspections, nuclear medicine, and smoke detectors. Nuclear propulsion powers our Navy, and nuclear power provides 20 percent of the nation's electricity.

At Jefferson Lab, detector technologies for nuclear physics have been licensed to a local company that manufactures molecular breast cancer imaging cameras, now in use in hundreds of hospitals.

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These applications neatly illustrate the observation once made by President Ronald Reagan: "The remarkable thing is that although basic research does not begin with a particular practical goal, when you look at the results over the years, it ends up being one of the most practical things government does."

Perhaps more important than these byproducts of basic research is the role that the pursuit of grand scientific questions has in attracting the smartest minds from around the planet to our nation's universities.

Scientists trained in nuclear physics go on not only to work in fields directly related to the developments mentioned above, but they are also essential members of the workforce who go on to propel technology and innovation forward in direct and tangible ways, to the benefit of our nation's economy and society.

For instance, more than 40 percent of the world's Nobel Prizes in physics have been associated with the Department of Energy's 17 National Labs, as have more than 25 percent of the Nobel prizes in chemistry. The facility that was dedicated last week opens another proud chapter in the legacy of outstanding science being carried out at the national labs.

Basic scientific research and discovery, and investments in the nation's scientific infrastructure that powers those discoveries— such as Jefferson Lab's 12 GeV CEBAF — rely on sustained and reliable funding.

Reagan also said, "We cannot know where scientific research will lead. The consequences and spin-offs are unknown and unknowable until they happen. In research, as Albert Einstein once said, 'imagination is more important than knowledge."

For as we study the forces that bind the universe together, we also come closer together as a nation, in sustained effort, in shared imagination, and in scientific aspiration. For through Jefferson Lab's 12 GeV CEBAF, we're opening a new era of nuclear physics discovery, not only for this nation, but also for the world.
We're putting energy back on the frontier of science and innovation. And, most of all, we're creating a stronger, a better, and a brighter nation.

Paul Dabbar is the Department of Energy's under secretary for science.

Stuart Henderson is the director of the Thomas Jefferson National Accelerator Facility (Jefferson Lab), which is located in Newport News.