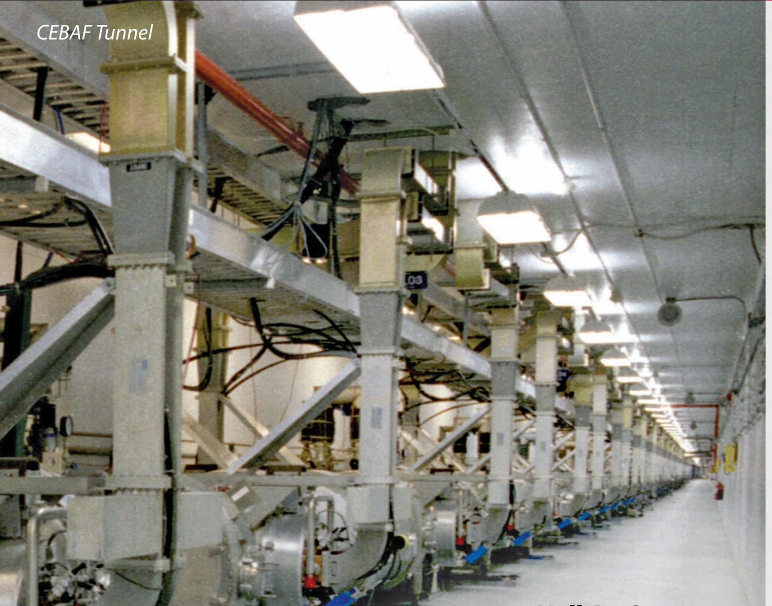
EXPERIMENTAL HALL UPGRADES



CEBAF Tunnel

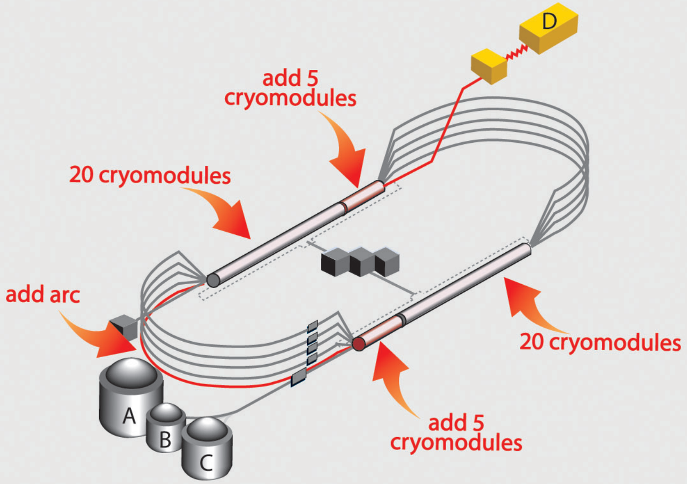
Hall A - Continue use of the existing two High Resolution Spectrometers and standalone detection systems, and use the available floor space for special set-up experiments.

Hall B - Upgrade the existing CLAS detector with new magnets and detectors to capture the more forward-focused reaction products at the higher-incident beam energy. Since scattering probabilities decrease at higher energies, the upgraded CLAS also will feature operation at increased luminosity.

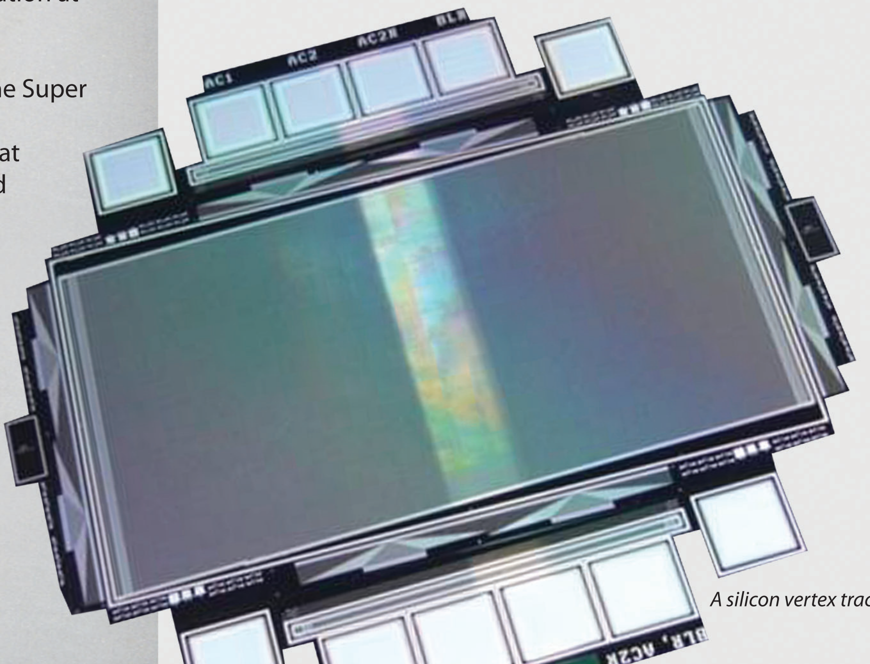
Hall C - Install a new spectrometer system called the Super High Momentum Spectrometer, or SHMS, enabling measurements of particles scattered, or produced, at up to full-beam momentum. The SHMS will be used together with the existing High Momentum Spectrometer (HMS).

Hall D - Construct a new experimental hall to house the GlueX experimental equipment to search for exotic mesons or hybrids. Also to be constructed are an extension of the accelerator tunnel to house a new beam transport line and a dedicated magnet to tag photons created in beam-target interactions, as well as a counting house, cryogenics plant and service buildings.

BUILDING ON SUCCESS



Though originally designed to deliver a 4 GeV beam, CEBAF is now capable of producing an electron beam of about 6 GeV, exceeding design specifications by 50 percent. This success has made it possible to complete a relatively simple and inexpensive upgrade of CEBAF. In addition to carrying a 12 GeV electron beam to a new experimental facility (Hall D), the upgrade will make it possible to deliver beam at energies up to 11 GeV to Jefferson Lab's existing three experimental halls (Halls A, B and C), which will house improved beamlines and detectors.



A silicon vertex tracker

A magnet coil

WANT TO KNOW MORE?

Learn more about Jefferson Lab by visiting:
www.jlab.org.

E-mail: jlabinfo@jlab.org

Thomas Jefferson National Accelerator Facility
12000 Jefferson Avenue
Newport News, VA 23606
(757) 269-7100

Jefferson Lab

Thomas Jefferson National Accelerator Facility is managed by Jefferson Science Associates, LLC, for the U.S. Department of Energy's Office of Science

Detector Components

THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY

12 GeV UPGRADE

12 GeV UPGRADE

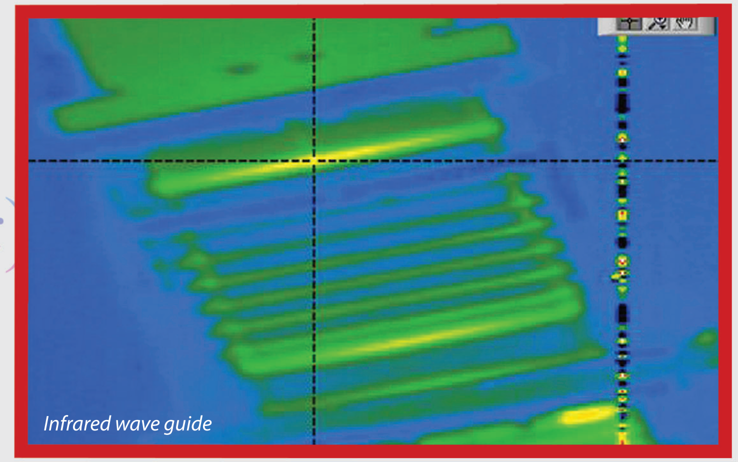
Physicists at Jefferson Lab are trying to find answers to some of nature's most perplexing questions about the universe by exploring the nucleus of the atom. Their goal is to answer such questions as: "What is the universe made of?" and "What holds everyday matter together?"

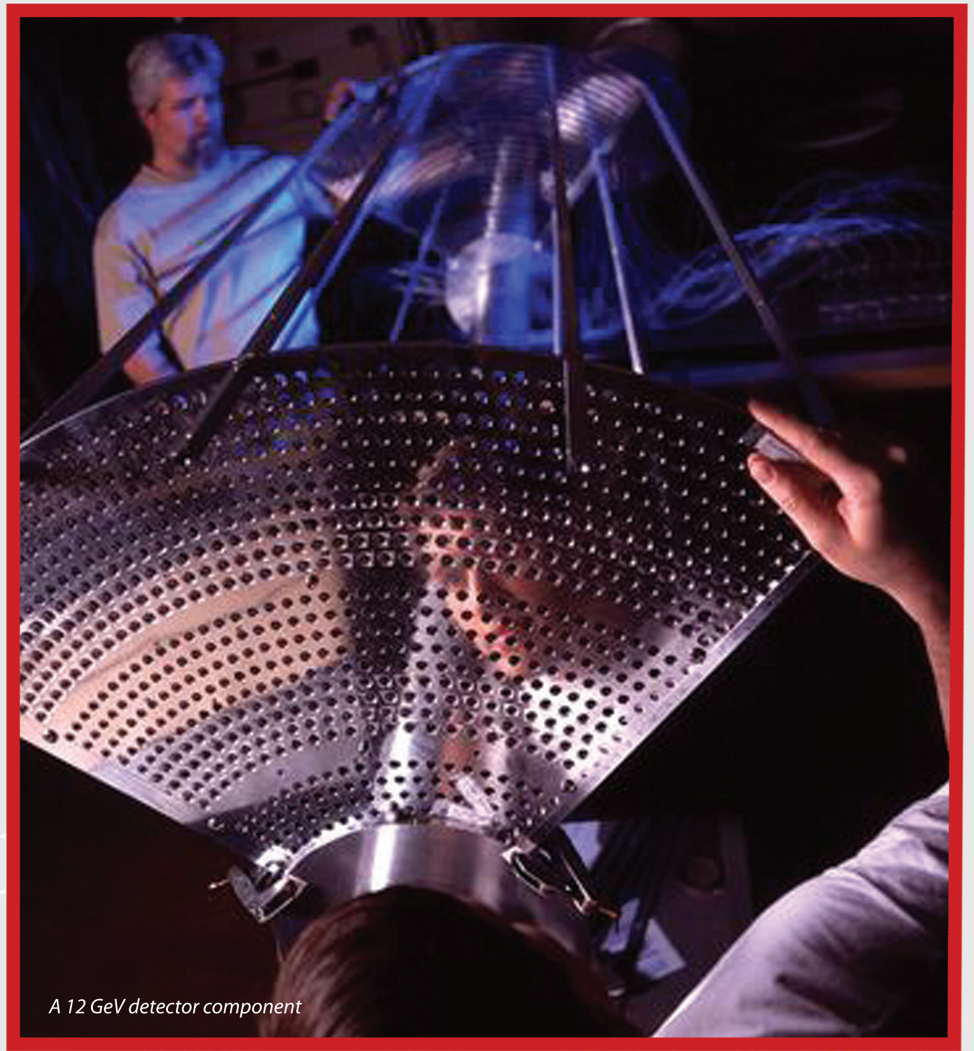
In their search for answers, physicists smash electrons into atoms using Jefferson Lab's Continuous Electron Beam Accelerator Facility, or CEBAF. The accelerator provides physicists with an unprecedented ability to study the basic building blocks of the visible universe: the nucleus of the atom, and its protons, neutrons, quarks and gluons.

To expand the opportunity for discovery for this type of research, Jefferson Lab is upgrading its facility by doubling the energy of its accelerator's electron beam from 6 billion electron volts (GeV) to 12 GeV, constructing a new experimental hall and upgrading its existing experimental halls.

The 12 GeV Upgrade will allow Jefferson Lab to employ new methods for studying the basic properties of the building blocks of the universe, how they are formed, how they interact and the forces that mediate these interactions. Through experiments aimed at revealing these and other secrets of matter, physicists will use the upgraded CEBAF to contribute to Jefferson Lab's mission of expanding our knowledge of nuclear and particle physics well beyond its current level.

The upgrade will impact four main areas:


Infrared wave guide


A 12 GeV detector component

QUARK CONFINEMENT

With the 12 GeV Upgrade, physicists plan to address one of the great mysteries of modern physics - the mechanism that "confines" quarks to exist only together with other quarks and never alone. According to a fundamental theory of physics, the force that binds quarks together - the strong force - is so powerful that quarks cannot exist in isolation. Quarks exist in pairs (in particles called mesons) and in triplets (in particles called baryons: protons and neutrons are baryons). But other quark combinations are theoretically possible.

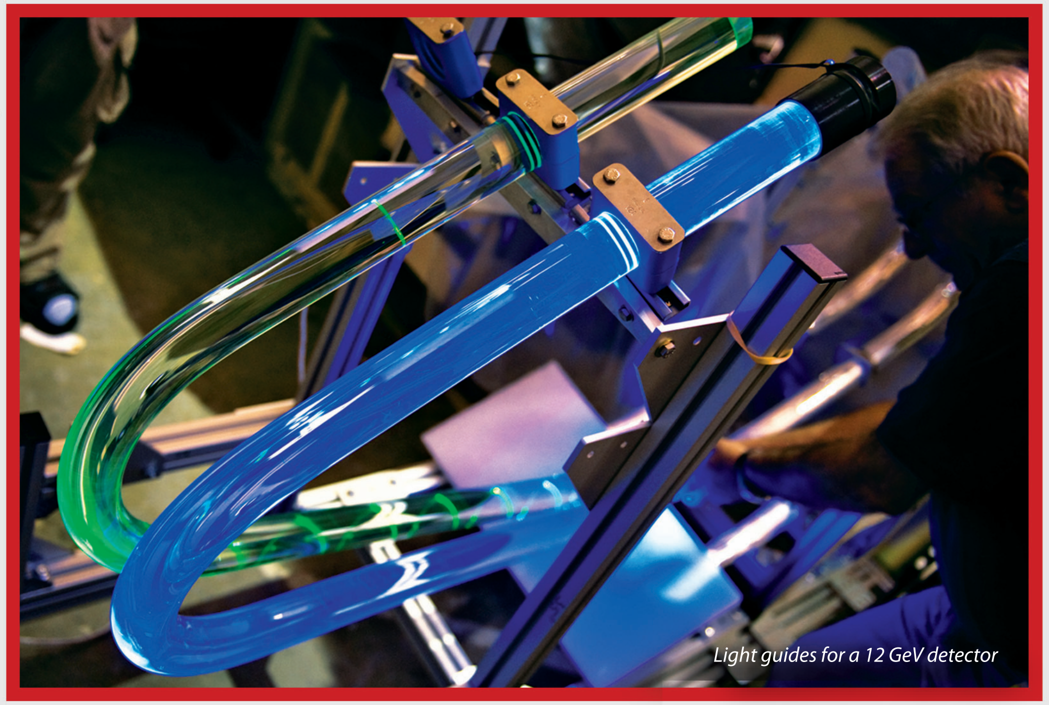
The new experimental hall, Hall D, will be used to produce exotic or hybrid mesons and to study their properties. These exotic mesons consist of a quark and anti-quark held together by gluons, but unlike conventional mesons, the gluons are excited. The gluons are the carriers of the strong force (the "glue") that binds the quark and anti-quark together. Although predicted by theory, there is only tentative experimental evidence for these exotic mesons. Jefferson Lab aims to produce many of them and study their properties in detail to fully understand the strong force and how it confines quarks.

THE FUNDAMENTAL STRUCTURE OF PROTONS AND NEUTRONS

Through its combination of luminosity and energy, the 12 GeV Upgrade can make profound contributions to the study of the fundamental structure of protons and neutrons (collectively called nucleons). The upgrade will enable scientists to map in detail the combined space and momentum distribution of the three "valence" quarks - the quarks that define the quantum numbers of nucleons. This, for the first time, will provide a three-dimensional snapshot of the inner structure of the particles that make up the nucleus of the atom.

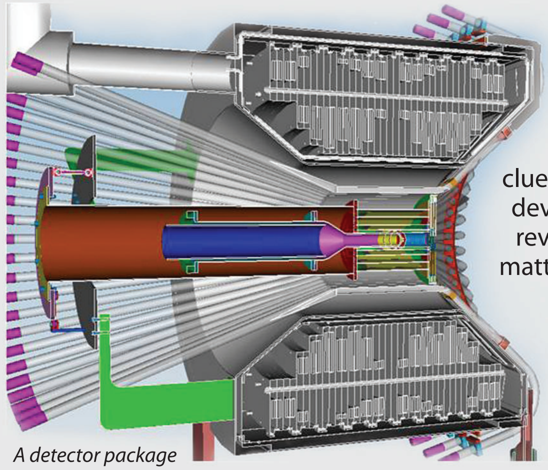
THE PHYSICS OF NUCLEI

How protons and neutrons bind together to form the nucleus is another puzzle physicists want to solve. One idea is that when nucleons are close together, the strong force binding quarks together inside a nucleon can "leak out" to bind the nucleons together. Another idea is that protons and neutrons swap quarks, and this exchange provides the force that binds nucleons together. The upgrade will allow scientists to study new aspects of how nucleons interact.


Light guides for a 12 GeV detector

TESTS OF THE STANDARD MODEL

Finally, an upgraded CEBAF will allow physicists to study the limits of the "Standard Model," a theory that describes the fundamental particles and their interactions. So far, tests of this model have mostly confirmed its validity. The upgrade will open new opportunities for probing the model's limits. If the Standard Model predictions are confirmed, we will have extended our knowledge of its range of applicability and its accuracy. If we discover that it fails, we will have the first important clues necessary to develop a new or revised theory of matter that will be even more accurate and inclusive and provide deeper insights into the nature of the world we live in.


A detector package