SETTING THE PACE

SRF technology is critical to research in high-energy physics, nuclear physics, nuclear astrophysics, life sciences and materials science. Without SRF technology and systems, the particle beams needed for these specialized areas of research would be unattainable or prohibitively expensive.

Cavity cleaning

Jefferson Lab uses superconducting radiofrequency (SRF) cavities to accelerate electrons in the beam used to conduct experiments. Fields built up inside the cavities give the electrons additional energy. After passing through several cavities, the electrons in the beam reach very high speeds, traveling almost as fast as light. In this process, the electrons gain additional mass. An electron travelling through CEBAF can become nearly 9,000 times more massive than an ordinary electron.

Jefferson Lab's cavities are made of niobium, a special material that becomes superconducting at extremely cold temperatures. The cavities are operated at a temperature of about -456 °F or 2 kelvin (K).

A cavity made of a non-superconducting metal, such as copper, requires a lot more power to operate than one made of a superconducting metal, such as niobium. Copper cavities lose much of their energy to heat. The amount of energy lost to heat in a niobium cavity is about 100,000 times smaller than in a copper cavity.

Because of its superconducting qualities, CEBAF requires an average of 20 megawatts of power to operate. If CEBAF were not superconducting, it would require 60 megawatts, enough power for about 48,000 homes.

ABOUT JEFFERSON LAB

Thomas Jefferson National Accelerator Facility is a world-leading nuclear physics research laboratory. Funded by the U.S. Department of Energy, Jefferson Lab's mission is to expand our knowledge of the universe by studying sub-atomic particles known as quarks and gluons.

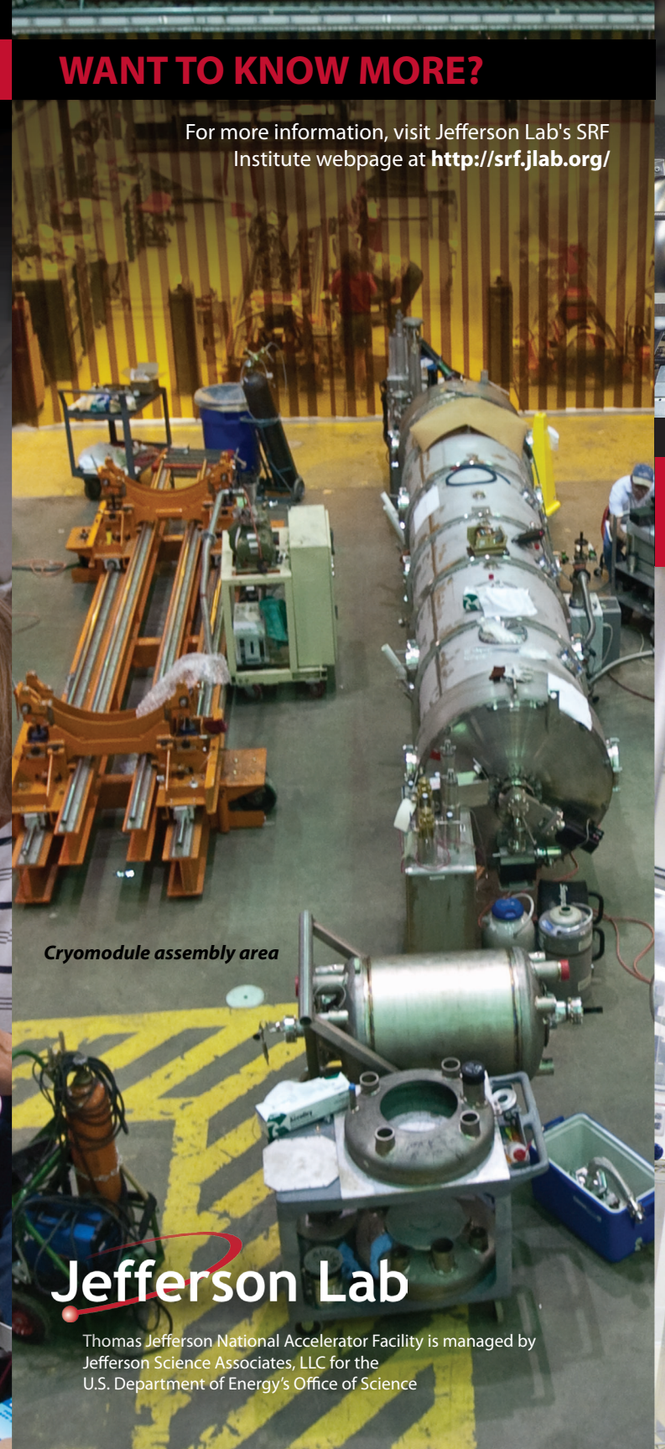
Making this research possible is the laboratory's Continuous Electron Beam Accelerator Facility. CEBAF acts like a giant microscope, allowing physicists to "see" things a million times smaller than an atom. CEBAF does this by propelling a continuous beam of electrons into targets located in the lab's three experimental halls.

CEBAF's remarkable electron-accelerating ability is due to its superconducting radiofrequency technology, or SRF.

Component testing

WANT TO KNOW MORE?

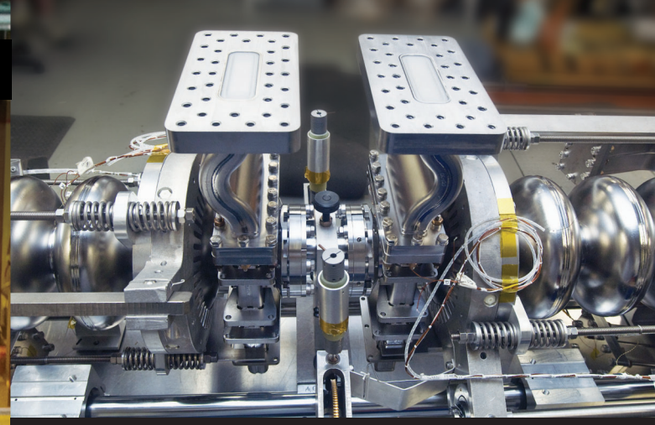
For more information, visit Jefferson Lab's SRF Institute webpage at **http://srf.jlab.org/**



Cryomodule assembly area

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

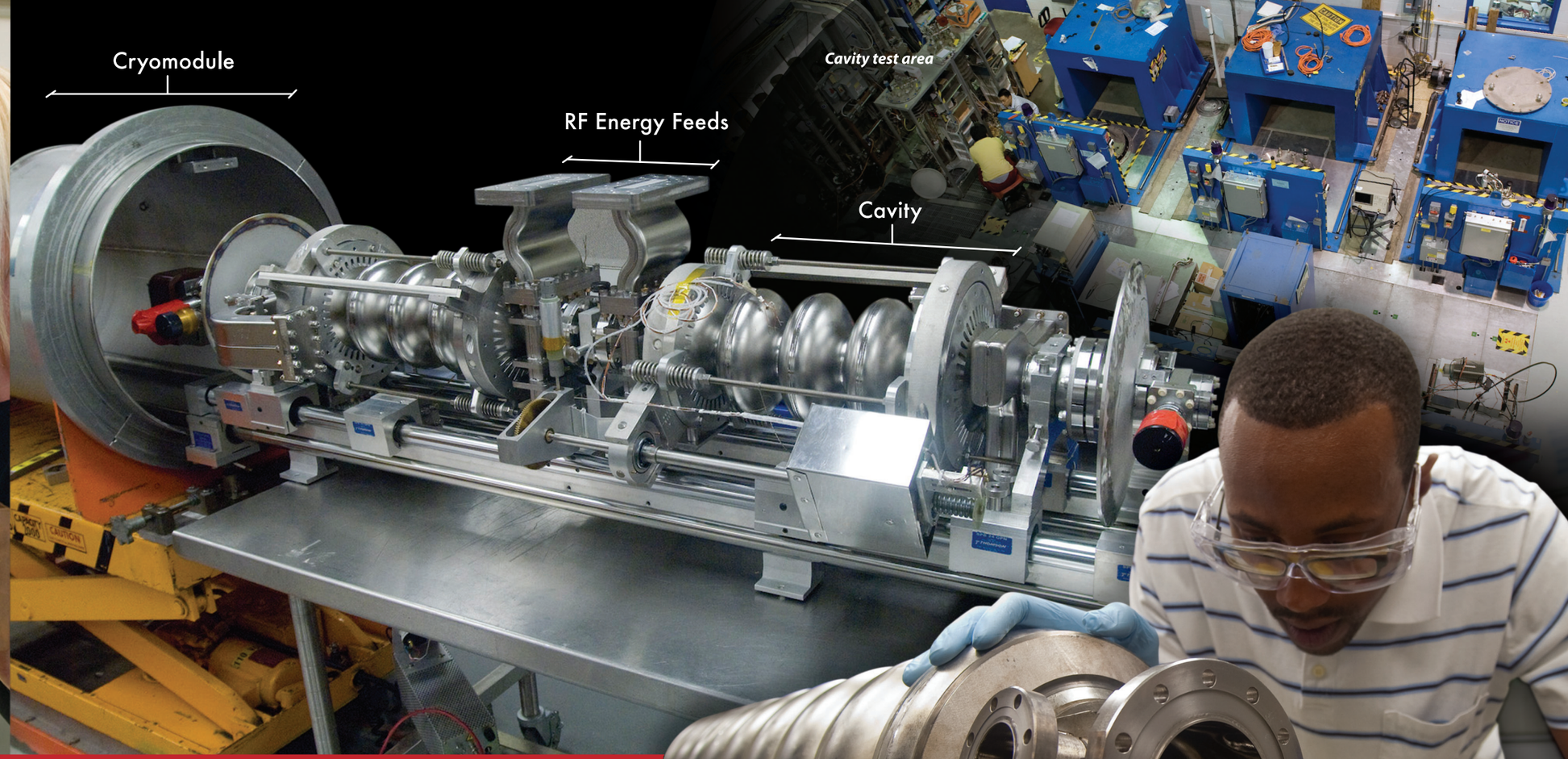


THOMAS JEFFERSON NATIONAL ACCELERATOR FACILITY

SUPERCONDUCTING RADIO FREQUENCY TECHNOLOGY

JLab clean room

SRF R & D



SRF AT JEFFERSON LAB

Jefferson Lab is a world leader in SRF technologies, studying and advancing the materials used in superconducting cavities as it strives to improve the performance of SRF cavities and make possible future particle accelerators. Jefferson Lab is one of the few laboratories in the world where cavities are designed, fabricated, processed and tested.

Making a cavity is a complex and delicate process. Once a cavity has been formed and assembled, the interior surface is cleaned using strong chemicals. Cleaning is critical, because even the smallest particulate can degrade a cavity's performance. Once cleaned, a cavity is tested before being installed in special containers called cryomodules.

Cryomodules are nearly self-contained sections of the accelerator. They hold the cavities in precise alignment; contain the super cold liquid helium that cools the cavities to -456 °F; and keep cavity interiors clean and in almost perfect vacuum.

The staff at Jefferson Lab built all the cryomodules in CEBAF and in the laboratory's Free-Electron Laser. Staff members also built 23 cryomodules for the Spallation Neutron Source at Oak Ridge National Lab in Tennessee. Jefferson Lab continues to provide SRF expertise to labs in the U.S. and abroad.

In all, more cryomodules and different cryomodule designs have been constructed at Jefferson Lab than any other place in the world.

Inspecting a cavity