Accelerator Test Facility

Destination for doing research in advanced accelerators, radiation sources

Purpose:
To serve the DOE accelerator R&D and stewardship missions by providing laser and electron beams for user research

Operating Costs:
$3 million per year

Sponsor:
U.S. Department of Energy, Offices of High-Energy Physics and Basic Energy Science

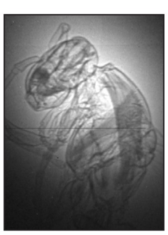
Status:
Proposal-driven, peer-reviewed user facility with free beam access to qualified researchers

Users:
National and international scientific centers, national laboratories, universities and businesses

ATF Users Demography
U.S.: 65 percent
Europe: 20 percent
Asia: 15 percent

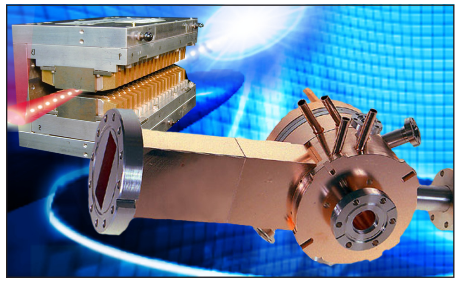
Features:
- High-brightness 80 MeV electron linear accelerator
- Three experimental beamlines
- Picosecond CO_2 laser synchronized to the electron beam

Visit ATF website:
www.bnl.gov/atf to get more information and learn how to submit your research proposal



Phase-contrast x-ray picosecond snapshot of a wasp by means of inverse Compton scattering

The Brookhaven Accelerator Test Facility (ATF) pioneered the concept of a user facility for studying complex properties of modern particle accelerators and new methods of accelerating electrons and ions. The ATF successfully serves this mission, now for more than two decades.



BNL photocathode gun (front) and the first monoenergetic laser accelerator (rear), both introduced by ATF

Unique Capabilities

The ATF's high-power, picosecond (10^{-12} sec. pulse length), carbon dioxide, infrared laser (λ=10μm) is unique in the world. Synchronized to electron bunches from a state-of-the-art 80 Mega-electron-volt (MeV) linear accelerator, this laser allows the ATF users to explore long-wavelength scaling of strong-field physical processes leading to new approaches for particle acceleration and high-brightness x-ray generation.

Historical Achievements

Over the last two decades, the ATF has become the destination for hundreds of users from different institutions worldwide, both academic and private. They are coming to the ATF to conduct their ground-breaking research experiments in:
- Accelerator beam physics
- Particle sources and beam instrumentation
- Novel acceleration techniques
- Novel radiation sources

Research carried out at the ATF was critical to the advent of X-ray Free Electron Lasers (FEL). This included first demonstrations of very high-brightness electron beams from a photocathode RF gun, self-amplified spontaneous emission in visible wavelength and a seeded high gain harmonic generation. These ATF developments laid the foundation for the Linac Coherent Light Source (LCLS) and other leading worldwide FEL projects.

The first-ever staged laser accelerator achieved a narrow energy spread at the ATF, in what was then a novelty for laser accelerators.

Compton scattering between colliding CO_2 laser and electron beams resulted in strong bursts of x-rays that shed light on processes in the early Universe and simultaneously allow ultra-fast, high-contrast tomography.

A focused laser converted a supersonic hydrogen gas jet into a monoenergetic MeV proton beam with studies in progress towards medical application of such beams.

Bright Future

A next-generation sub-picosecond 100-TW CO_2 laser based on chirped pulse amplification in isotopic gas mixtures is under construction. Future plans also include the electron energy upgrade to 300 MeV and adding new spacious experimental halls.

The ATF upgrade will enable new scientific missions that complement cutting-edge projects conducted or planned with the most powerful solid-state lasers worldwide.

New opportunities for the ATF users will range from generating multi-MeV proton beams of cancer therapy quality to the detailed study of plasma "bubbles" carrying high-charge electron bunches into compact, energy-frontier accelerators. Another new direction will be the development of next-generation, laser- and plasma-based, compact light sources with spectral coverage from gamma-rays to terahertz radiation.

(03-14)