Accelerator Test Facility (ATF)

Purpose:
Carry out R&D on Advanced Accelerator Physics and study the interactions of high power electromagnetic radiation and high brightness electron beams.

Sponsor: *U.S. Department of Energy Office of Science, Offices of High Energy Physics and Basic Energy Sciences*

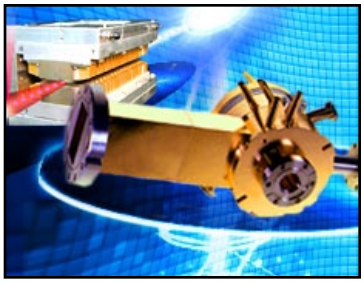
Features:
- *High-brightness photoinjector electron gun*
- *A 70 MeV linac*
- *High power lasers synchronized to the electron beam to a picosecond level*
- *Four beam lines*
- *A sophisticated computer control system.*

Facility Users:
National Laboratories: *ANL, BNL, LANL, FNAL, SLAC*
International: *BINP, KEK, CERN, Oxford U.,Tokyo Metropolitan, National Tsinghua U., Technion*
Industries: *QEL Inc., Vista Control Systems, Omega-P Inc., STI Optronics, TR Research Inc.*
Universities: *Catholic U., U. of Colorado, Columbia, Darmouth, MIT, Montclare State U., U. of New Mexico, UCLA, U. of Pittsburgh, Princeton, UCSB, Stanford, U. Stony Brook, Waseda U., Yale, Northwestern*

Web Address:
www.bnl.gov/atf/default.html

ATF serves graduate students, industries and laboratories from around the world

ATF users, from universities, national laboratories, and industry, are carrying out R&D on advanced accelerator physics, developing new radiation sources, and related subjects. From another point of view, the ATF serves as a laboratory for studying the interactions of high-power electromagnetic radiation and high-brightness electron beams, including laser acceleration of electrons and Free-Electron Lasers. Other work includes developing electron beams with extremely high brightness, photo-injectors, electron beam and radiation diagnostics, and computer controls.



ATF's Gun IV and tapered undulator from STELLA experiment

ATF Electron Beam

The ATF provides a very-high brightness electron beam in four beam lines, synchronized with high-power lasers. The electrons are produced by a photoinjector, whose photocathode is illuminated by a frequency quadrupled Nd:YAG laser. Two S-band (2856 MHz) linac sections accelerate the electrons. The beam can be manipulated in the transport line to match it into one of the experimental locations in the experimental hall. There are more than 40 quadrupoles along 4 transport lines to match the beam to the particular experiments. More than 50 high-resolution profile monitors measure the beam's distributions.

ATF Laser Systems

Many experimental programs at ATF study the interactions of the picoseconds-long electron and laser beams. The ATF has two lasers, both with unique properties: A Nd:YAG laser and a CO2 laser. The Nd:YAG laser (abbreviated as YAG) is the source of illumination for the ATF's photoinjector and also operates an electro-optic switch in the CO2 laser. The YAG light also can be delivered to the experiment hall for experiments. This laser has an exceptionally high stability and a great versatility in generating variable length pulse-trains with adjustable amplitude. The CO2 laser is used for various experiments, including laser acceleration of electrons, Harmonic Generation FEL (there the CO2 laser is used as the subharmonic seed), and Compton backscattering experiments. While a few GW of available laser power is enough for the initial proof-of-principle experiments that are scheduled at the ATF for more advanced experiments a much more powerful laser would be needed. For instance, the laser accelerator schemes described here are potentially scalable to 100 MeV. To reach this milestone, a 200 GW CO2 laser at least will be required. Therefore, the ATF is constructing a modified CO2 laser system approaching the terawatt power level.

11/04