INNOVATION at National User Facilities

From studying matter at the fundamental level to developing practical applications for new materials, experiments at the National User Facilities illuminate the potential technologies for our future.

Center for Functional Nanomaterials

All That Glitters Is Not Gold

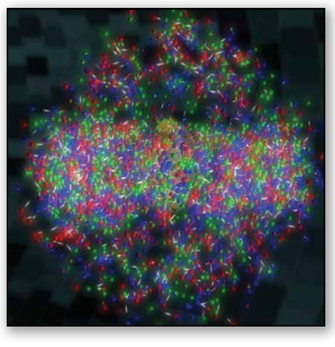
Semiconductor quantum dots are tiny crystals that can fluoresce or glow when excited, and have potential for use in a wide range of fields. By adding gold nanoparticles into the mix, CFN scientists have shown how to boost the intensity of light emitted from quantum dots by up to 20 times. The researchers used short strands of synthetic DNA as a "glue" to link the nano-particles and the quantum dots. This precision technique advances methods for modifying the optical properties of quantum dots and can lead to improved solar-energy devices, light-controlled electronics, and biosensors.

Particle Physics and Astrophysics at SLAC

Accelerator Research

Home to a two-mile-long linear accelerator which has been operating since 1968, SLAC is at the forefront of improving accelerator performance and developing new technology for accelerating particles more efficiently, to higher energies and in much less space. Once used exclusively for physics, linear accelerators are now widespread in medicine and industry, where they help treat cancer, harden materials and process silicon chips.

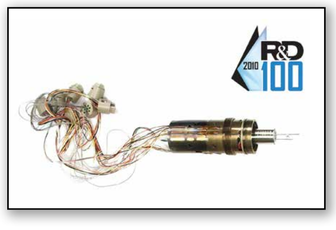
Relativistic Heavy Ion Collider



Quark-Gluon Plasma

Heavy ion collisions at RHIC have produced a liquid of strongly interacting quarks and gluons. With a temperature 250,000 times hotter than the center of the Sun, this quark-gluon plasma has given scientists a surprising idea of what the universe was like just after the Big Bang some 14 billion years ago – a nearly perfect liquid with practically no viscosity.

National Center for Electron Microscopy



Tools for Atomic Scale Imaging

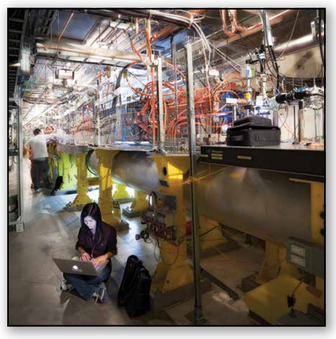
NCEM continues to develop innovative tools for microscopy research, including the Transmission Electron Aberration-corrected Microscope (TEAM). The stage for the TEAM instrument received an R&D100 award for its revolutionary design that uses piezoelectric actuators. Other breakthrough technologies include a high-brightness electron sources and supersensitive electron detectors.

Center for Advanced Microstructures and Devices

Microfabrication

CAMD is the nations premier location for synchrotron-based microfabrication. Working jointly with the our academic and industrial users, we develop, prototype and manufacture ultra-precision polymer and metal microstructures, including micro-gears, switches, microreactors and diagnostic labs-on-a-chip.

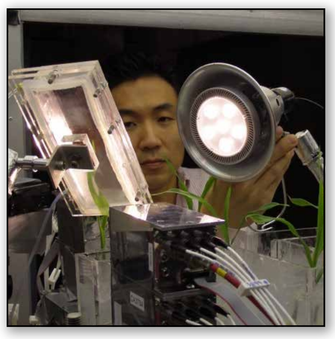
Facility for Advanced Accelerator Experimental Tests



Dielectric Wakefield Acceleration

Materials such as silica and diamond can also be used to accelerate subatomic particles 10 to 100 times better than today's accelerator technologies. When two well-spaced bunches of particles pass through the structure, the first loses energy and the second gains it due to the interaction with the dielectric material. FACET provides the peak fields needed to test this technology.

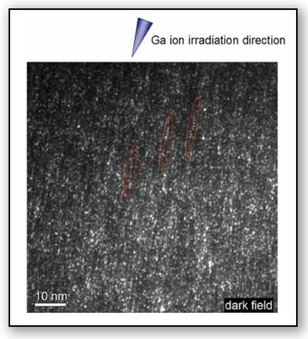
Thomas Jefferson National Accelerator Facility



Imaging Photosynthesis

Researchers at the Thomas Jefferson National Accelerator Facility, in collaboration with scientists at Duke University and Triangle Universities Nuclear Laboratory, are developing PhytoPET, a detector system that can follow the process of photosynthesis in live plants using positron emission tomography (PET). The system uses a carbon-11 radiotracer, a form of the element that emits positrons, to study the transport of carbon within the plant in 3 dimensions. PhytoPET is expected to be used in research in biofuel development, carbon sequestration in biomass, and optimization of plant productivity.

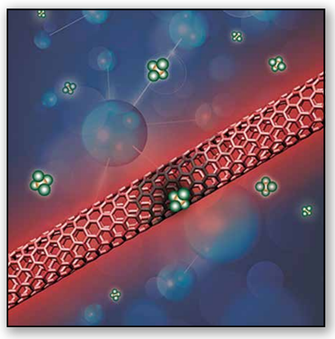
Advanced Test Reactor National Scientific User Facility



Science of New Materials

Metallic glasses (MGs) are a class of structural materials that can be used in harsh environments such as nuclear reactors. MGs are strong, have high corrosion resistance, and can be applied as spray coatings. Recent research in these materials at ATR provides new understanding of phase transitions within metallic glasses and their method of application to material surfaces.

The Center for Integrated Nanotechnologies



Nanotube "Glow Sticks" Transform Surface Science

Many physical and chemical processes necessary for biology and chemistry occur at the interface of water and solid surfaces. Using high-speed microscopic imaging, a team of CINT Users and Staff has found that semiconducting carbon nanotubes — light emitting cylinders of pure carbon — can both detect and track the motion of individual molecules as they bombard the surface at the water interface. The team's work may lead to practical, nanotube-based, single-molecule detectors in aqueous biological and chemical environments.

Brookhaven Tandem Van de Graaff Accelerator

Testing Electronics for Space Applications

Cosmic rays can adversely affect the operation of electronics on a spacecraft. At TANDEM testing of onboard electronics is used to determine the sensitivity of these devices to cosmic radiation. The Single Event Upset Test Facility, developed at TANDEM in collaboration with NASA, NRL, NSL, and USASDC, is making significant contributions to the US space program.

NATIONAL USER FACILITY ORGANIZATION