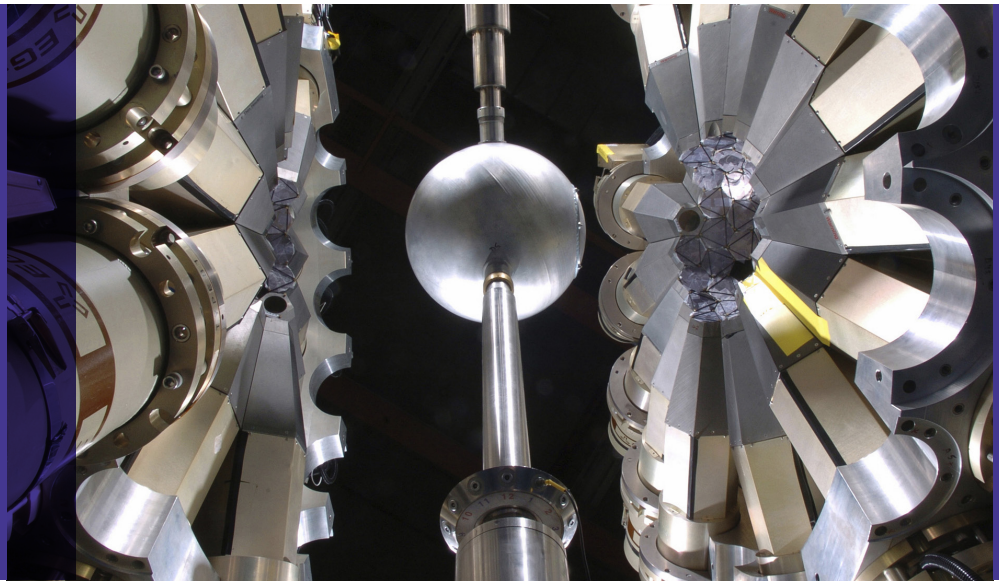
Argonne NATIONAL LABORATORY

ARGONNE TANDEM LINAC ACCELERATOR SYSTEM (ATLAS)

The prime national facility for nuclear structure research



The mission of ATLAS, a U.S. Department of Energy user facility at Argonne, is to enable high-quality user and staff research, especially for probing the properties of atomic nuclei through use of the accelerator and research equipment in a safe and efficient manner. In support of this, ATLAS staff perform research and development of accelerator science, applications of nuclear science and techniques required to accomplish scientific goals.

ATLAS is a leading facility for nuclear-structure research in the nation and the world's first superconducting linear accelerator for ions. Any stable ion can be accelerated in ATLAS and delivered to one of its six target stations. Plans are for two more stations to come online in 12 to 18 months.

ATLAS provides a wide range of beams for nuclear reaction and structure research to a large community of users from the U.S. and abroad. About 20 percent of available beam time is used to generate secondary radioactive beams. These beams are used mostly to study nuclear reactions of astrophysical interest and investigate the structures of atomic nuclei.

RESEARCH PROGRAMS

ATLAS research programs focus on key questions that are central to our understanding of matter and to learning about the astrophysical processes that generate energy and produce elements in stars. Specific issues being addressed are (1) the quantum structure of nuclei, (2) nuclear shapes, (3) decay of exotic systems, (4) masses of exotic nuclei, (5) fundamental interactions, (6) nuclear reactions of astrophysical importance, (7) properties of the heaviest nuclei, and (8) accelerator mass spectrometry, a process used for dating materials.

USER COMMUNITY

ATLAS provides beams and experimental instruments for a large international community of scientists—around 300 to 400 researchers per year. Interested scientists can submit a proposal to the Program Advisory Committee (www.anl.gov/atlas/ proposals). Beam time is then allocated based on the committee's recommendations.

INSTRUMENTS

Gammasphere

Gammasphere (shown in image above) is the world's most powerful spectrometer for nuclear-structure research and is especially good at collecting gamma-ray data following the fusion of heavy ions.

In such studies, beams of ions from ATLAS are directed at a target (usually a thin metal film). Nuclei from the beam fuse with those in the target, producing highly excited, heavier nuclei. The Gammasphere detects gamma rays—high-energy photons—emitted from the excited nuclei as they spin and cool. Research performed using Gammasphere has centered on studying nuclei that are unstable.

U.S. DEPARTMENT OF ENERGY Argonne National Laboratory is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC.

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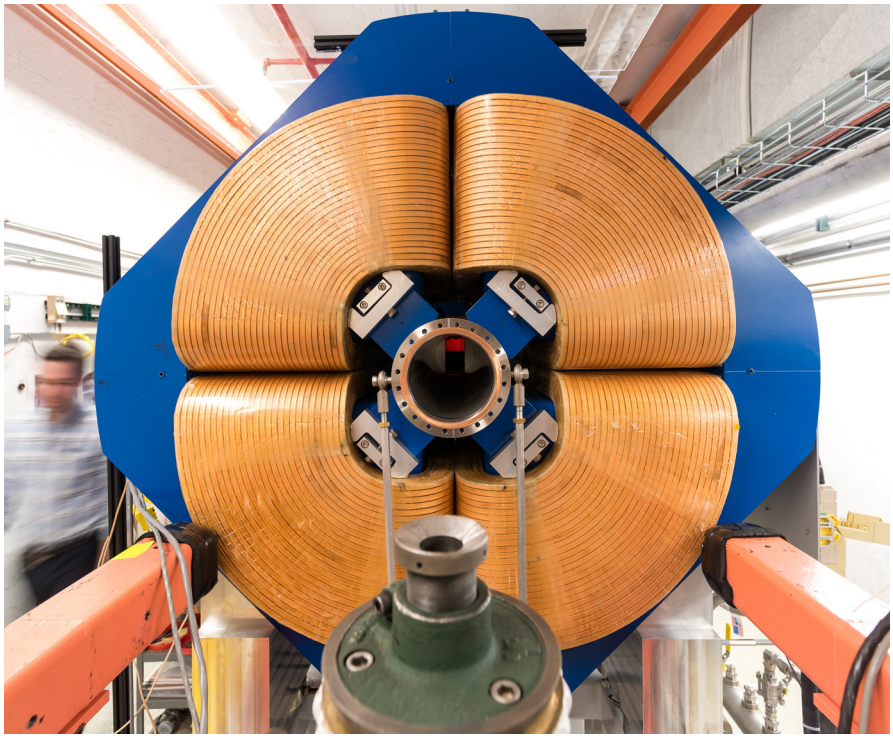

Fragment Mass Analyzer (FMA)

The FMA is used to separate nuclear-reaction products from the primary heavy-ion beam. Its magnetic and electric fields guide the desired reaction products, focusing them onto detectors, so scientists can perform a wide variety of experiments, including particle identification. Proton radioactivity in heavier nuclei was discovered at the FMA. In addition, beta radioactivity of various isotopes has been studied as well as exotic modes of alpha and proton decay. Studies of microsecond isomers have been performed on rare-earth nuclei.

Californium Rare Isotope Breeder Upgrade (CARIBU)

This facility provides for the acceleration of neutron-rich fission fragments of californium so that scientists can study neutron-rich nuclei. These nuclei can be studied in an area with a low background using a stopped beam or can be accelerated and delivered to any of the target stations. CARIBU is especially useful for studying the astrophysical processes that are responsible for producing most of the heavy elements in the universe.

Helical Orbit Spectrometer (HELIOS)

HELIOS provides greatly improved resolution in the study of charged-particle transfer reactions, those where individual protons or neutrons are added to a nucleus. It achieves this with compact detectors and electronics, as well as simple particle identification techniques. It is well suited to experiments that probe the structure of exotic nuclei of high interest to researchers.

Argonne Gas-Filled Analyzer (AGFA)

The AGFA is a state-of-the-art gas-filled separator developed in collaboration with a number of research institutions. Since becoming operational at ATLAS in early 2017, it has been used in conjunction with Gammasphere to study nuclei and by itself to study super-heavy nuclei, isomers in heavy elements, and fast proton and alpha emitters, including heavy nuclei. Together with a gas catcher, AGFA will be used to prepare beams of exotic radioactive ions for mass measurements, to study the interactions between matter and electromagnetic radiation in trapped atoms, and to study heavy neutron-rich nuclei that are important in supernovae.

Argonne In-flight Radioactive Ion Separator (RAISOR)

Available to ATLAS users since the fall of 2018, RAISOR enhances the quality of secondary beams by separating out specific ions. This process improves the transmission and selection of short-lived radioactive ions produced when a stable ion beam interacts with a specialized target. The resulting suite of such ions is now much larger and more intense than previously available and allows deeper probing into ion properties and structures. RAISOR provides access to a suite of short-lived radioactive ions at ATLAS.

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