

Argonne scientists reach milestone in accelerator upgrade project

January 6 2009

Scientists at the U.S. Department of Energy's (DOE) Argonne National Laboratory have successfully stopped and then reaccelerated a stable ion through a newly constructed charge-breeder, bringing the CALifornium Rare Isotope Breeder Upgrade (CARIBU) Project closer to completion.

"We have this elegant balancing act we play," senior accelerator physicist Richard Pardo said. "If we go too slowly, the ions are reflected back and if we go too fast they go right through."

Beams of stable isotopes from elements across the entire periodic table have been used at ATLAS for research in nuclear physics for many years.

But as more protons or neutrons are added, the nuclei eventually become 'particle unstable,' emitting excess protons or neutrons. Neutrons, unlike protons and electrons, have no charge and therefore many more can be added to nuclei before this limit is reached.

The CARIBU project will extend the reach of ATLAS to include potentially hundreds of previously unstudied isotopes.

CARIBU will use Californium 252 to create neutron-rich heavy fission fragments at a rate of more than 1 billion per second. These fragments are thermalized in helium gas into a low-energy beam of singly-charged ions.

The charge-breeder, an electron Cyclotron Resonance (ECR) ion source, takes these beams, stops them in the plasma and strips them to higher charged states for reacceleration in the Argonne Tandem Linac Accelerator System (ATLAS).

"There are only a handful of charge-breeder ion sources in operation throughout the world and only one other has been used to deliver beams to an accelerator," senior scientific associate Richard Vondrasek said. "Our is the first to accomplish this goal in the United States."

The Cf 252 fission process creates hundreds of neutron-rich isotopes, but only one is used for any particular experiment. Argonne scientists stop these fragments in helium gas, cool them and form them into a precise beam of ions that can be processed by magnetic fields to select only the particular isotope of interest and move it to the charge-breeder.

Once the fragments enter the charge breeder, stripped of additional electrons and given the desired charge state, they are formed into a steady beam for acceleration through the main accelerator.

So far, scientists have only used stable ions through the charge breeder, but they should be ready to use the Cf 252 fragments in the next few months. CARIBU is set to be operational by the latter half of 2009.

Source: Argonne National Laboratory

Citation: Argonne scientists reach milestone in accelerator upgrade project (2009, January 6) retrieved 10 April 2024 from <https://phys.org/news/2009-01-argonne-scientists-milestone.html>

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