Liquid-Lithium Charge Stripper

Innovative Solution Boosts Accelerator Performance

The Facility for Rare Isotope Beams (FRIB), a U.S. Department of Energy Office of Science (DOE-SC) user facility operated by Michigan State University, has demonstrated a liquid-lithium charge stripper to accelerate unprecedentedly high-power heavy-ion beams.

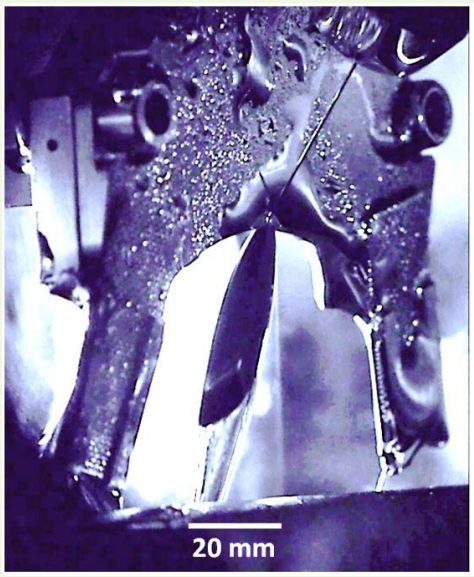
High-power heavy-ion beam facilities like FRIB are needed to enable fundamental nuclear science discoveries. In such accelerators, charge strippers play an essential role in effectively accelerating the beams. However, the conventional carbon stripper is the bottleneck, limiting beam power. FRIB stably formed a liquid lithium film in its accelerator beamline to make an effective heavy-ion stripper. Together with the success of an earlier experiment at DOE's Argonne National Laboratory, it was shown for the first time the liquid-lithium charge stripper can significantly increase the accelerator power beyond the present limit.

Superior Heat Remover, Impervious to Radiation Damage

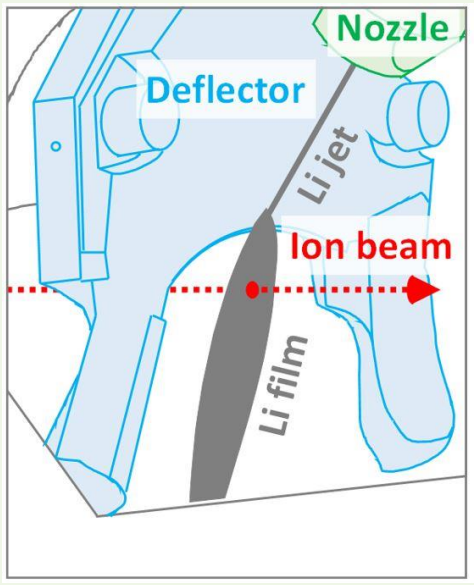
FRIB accelerates heavy-ion beams at beam power up to 400 kW into a target to create rare isotopes for scientific research. A charge stripper plays an essential role. It strips electrons from the beam to accelerate it more efficiently. FRIB's beam is so powerful that a conventional carbon-foil stripper is not feasible. It would suffer severe thermal and radiation damages, limiting its lifetime and beam power. To overcome this, FRIB developed and demonstrated a state-of-the-art liquid-lithium charge stripper. Since it is self-replenishing, it is a superior heat remover and cannot be damaged by radiation.

Liquid-Lithium Charge Stripper's Dual Advantage

Two alternative designs were considered when designing FRIB's charge stripper. Even the best-performing carbon-foil charge stripper would only last for six hours at FRIB. Another type of self-replenishing charge stripper is a gas stripper. While this can last indefinitely, the beam's charge state after the gas charge stripper is significantly lower than after a solid or a liquid charge stripper. A liquid-lithium charge stripper can produce as high a charge state as a solid charge stripper and last indefinitely. This new technology will help FRIB accelerate heavy-ion beams up to 400 kW, and open new possibilities in various other high-power accelerator developments.



Above is a photograph of the liquid-lithium film formed in the FRIB beamline chamber. The extremely smooth surface of the lithium film appeared as a mirror.



Above is a corresponding illustration with labels for clarity.

For more information

Visit frib.msu.edu/lithiumchargestripper

Learn more at frib.msu.edu

Michigan State University operates the Facility for Rare Isotope Beams as a user facility for the U.S. Department of Energy Office of Science (DOE-SC), supporting the mission of the DOE-SC Office of Nuclear Physics.