Diabologic: FRIB
by Frank Dolinar

> **December 11, 2008:** Press Release**:** The Department of Energy announced that Michigan State University in East Lansing, Michigan has been selected to design and establish the Facility for Rare Isotope Beams (FRIB), a cutting-edge research facility to advance understanding of rare nuclear isotopes and the evolution of the cosmos. The new facility—expected to take about a decade to design and build, and to cost an estimated $550 million—will provide research opportunities for an international community of approximately 1000 university and laboratory scientists, postdoctoral associates, and graduate students. Facts about FRIB
> **Quoted from the article at: http://www.sc.doe.gov/np/program/FRIB.html**

It's mid-December in Michigan and the weather outside is frightful, though for many people the weather is better than the chill that has descended on the country's economy.

Locally, however, we got some good news, which is partly economic.

On December 11, the US Department of Energy [http://www.energy.gov] announced that it had selected Michigan State University to design and build the Facility for Rare Isotope Beams (FRIB). This will be a world-class physics laboratory to operate in conjunction with Michigan State's well known National Superconducting Cyclotron Laboratory (NSCL) [http://www.nscl.msu.edu].

The DOE press release may be read at: http://www.energy.gov/news/6794.htm

The FRIB is expected to bring approximately $550 million to the mid-Michigan economy over the next few years for construction and startup, including approximately 400 new tech jobs. Over the next 20 years, the FRIB may generate nearly a billion dollars more for the Michigan economy in revenues from research grants and R&D spinoffs.

Isotopes are variants of a chemical element, such as carbon, that contain differing numbers of neutrons in the atom's nucleus. All isotopes of an element must contain the same number of protons in the nucleus, because the number of protons determines the element. Carbon has three naturally occurring isotopes: carbon-12, with six protons and six neutrons, is 99% of the carbon on Earth; carbon-13, with seven neutrons makes up 1%; and carbon-14 (aka "radiocarbon") with eight neutrons is found in trace amounts. Because of the additional neutrons, these isotopes of carbon have different mass numbers, which indicate the total number of nucleons (protons and neutrons) in the atom's nucleus. The presence of carbon-14 in organic materials – and its known rate of decay into nitrogen-14 – makes possible the radiocarbon dating of archeological, geological, and hydrogeological samples.

Carbon-14 is a "rare isotope" of carbon, whose radioactive properties make it useful.

Rare isotopes are atoms with an atypically large number of neutrons in the nucleus, which makes the isotope radioactive. Therefore, the study of rare isotopes is nuclear physics and chemistry. Such isotopes are produced in stars and exhibit unusual, often short-lived, and potentially valuable properties.

Imagine being able to create rare isotopes of almost any naturally occurring element.

A high-intensity heavy-ion linear accelerator will be the basic tool of the new facility. [See an image of the proposed FRIB design at: http://news.msu.edu/media/photo/2008/12/bd79a94b-d887-450f-b859-6a1ee3f492fd.jpg]

This linear accelerator will provide unique technical capabilities – such as the ability to stop and then re-accelerate beams of isotopes from fragments obtained after the initial beam impacts on and goes through a thin foil target. This technique makes it easier to separate isotopes from one another. More information on stopped and reaccelerated beams is available on the Experimenters section of the NSCL Web site [http://www.nscl.msu.edu/exp/sr].

FRIB will provide intense beams of rare isotopes and, in so doing, allow researchers the opportunity to address fundamental questions of nuclear structure and nuclear astrophysics. According to Eugene Henry, Acting Associate Director of the Office for Nuclear Physics of the DOE, "This capability will allow physicists to study the nuclear reactions that power stars and stellar explosions, explore the structure of the nuclei of atoms and the forces that bind them together, test current theories about the fundamental nature of matter, and play a role in developing new nuclear medicines and techniques."

This is serious, world-class physics. For the next couple of decades, FRIB will keep Michigan State on the map of the world's premier physics research institutions.

The FRIB acronym may take some getting used to, but the research is hardly fribolous.