

## **ICNT and JINA-CEE Program on r-process nucleosynthesis: connecting FRIB with the Cosmos**

About 60 astronomers, astrophysicists, nuclear theorists and nuclear experimentalists attended a broad program on r-process nucleosynthesis held at FRIB from May 31 to June 17, 2016. This program was funded by the International Collaborations in Nuclear Theory (ICNT) and the Joint Institute for Nuclear Astrophysics - Center for the Evolution of the Elements (JINA-CEE). The meeting had several highlights.

- 1) The historic observation of gravitational waves from black hole mergers. Over the next few years LIGO should measure the rate of neutron star – neutron star and neutron star – black hole mergers. These events are promising r-process sites.
- 2) Possible observations of Kilonovae – infrared glows from the decay of new r-process elements. These observations are part of an intense search, expected during the next five years, for electromagnetic counterparts to gravitational wave events.
- 3) Observation of r-process enhanced stars in the ultra-faint dwarf galaxy Reticulum 2 suggest that a single nucleosynthesis event produced much more r-process material than expected for a core collapse supernova. This is consistent with the expected large yield of a neutron star merger, or perhaps a rare energetic kind of supernova.
- 4) The yields of r-process elements are very sensitive to unknown nuclear physics including masses, beta decay half-lives, neutron capture cross sections and other reactions of heavy neutron rich nuclei.
- 5) Nuclear experiments, in the coming years at radioactive beam facilities throughout the world, will measure many nuclear properties that should significantly reduce these nuclear physics uncertainties. Among facilities worldwide, FRIB with its large primary beam power, will likely play an important role in studying the most neutron rich nuclei.
- 6) Astrophysical simulations of supernovae and neutron star mergers are making rapid progress identifying promising r-process sites, suggesting possible r-process conditions, and enumerating some astrophysical uncertainties.
- 7) The apparent importance of dwarf galaxy mergers for galactic chemical evolution suggests that understanding r-process nucleosynthesis will have important implications for cosmology.
- 8) Nuclear fission could play a significant role in the r-process. Therefore, it is important to improve nuclear theory descriptions of both the rate and fragment distributions for the fission of very neutron rich heavy nuclei.

Talks have been posted on line at

<https://indico.fnal.gov/internalPage.py?pagelId=4&confId=11273>

Results from the workshop will be published as a review article “r-process nucleosynthesis: connecting rare-isotope beam facilities with the cosmos” for Journal of Physics G.

Organizers:

Charles Horowitz (Indiana)

Brian Metzger (Columbia)

Gail McLaughlin (NCSU)

Rebecca Surman (Notre Dame)

Hendrik Schatz (MSU)