Nuclear Seminar

Nuclear astrophysics with gamma-ray beams

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Room 124 Nieuwland Science Hall

The determination of thermonuclear reaction rates of relevance to stellar environments suffers from our present inability to perform experiments at luminosities that can reach the minute cross section regimes required. While slow improvements in ion source and charged particle accelerator technology have been able to alleviate the problem to some extent, current experiments are usually dominated by cosmic ray and beam induced backgrounds. This makes future experiments very expensive as new facilities need to go deep underground to take advantage of overhead shielding.

In this talk I will discuss an alternate scheme for performing these challenging measurements. The idea is to piggyback ride on communities that are currently improving their technology at a much higher rate than we are in classical nuclear astrophysics: lasers and electrons.

Electron accelerators have a huge variety of applications, making them attractive to high energy, material science, nuclear, atomic and many other subfields of physics. This simple fact makes facilities such as ASTA at Fermilab and ELI-NP in Europe efficient and competitive in the long term. In addition, technologies of intense lasers are rapidly improving.

Gamma-ray beams can be produced as bremsstrahlung radiation by using electron beams, or by inverse Compton scattering of laser light on fast electrons. However, photodisintegration of nuclei with gamma rays requires new target technologies, some of which I will discuss as well. Ultimately, nuclear astrophysics using gamma ray beams also shows a very bright and intense future.