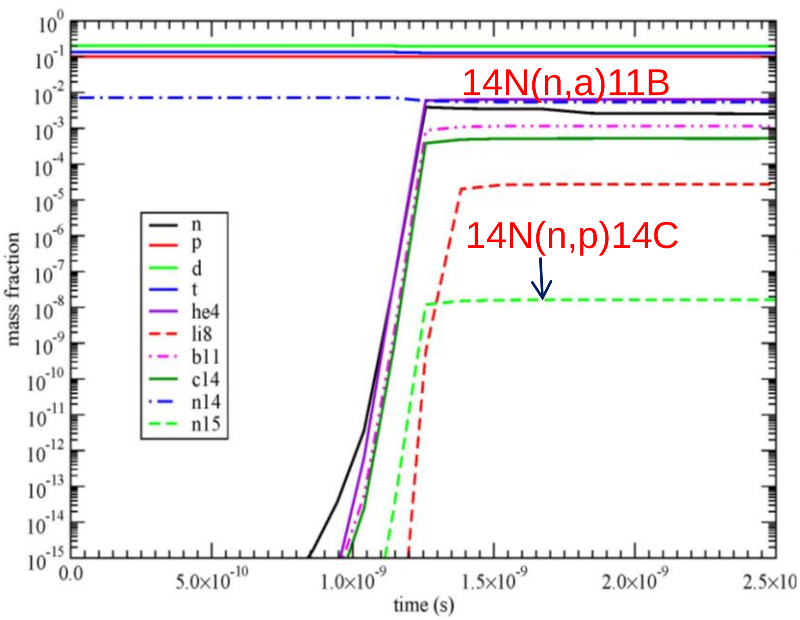
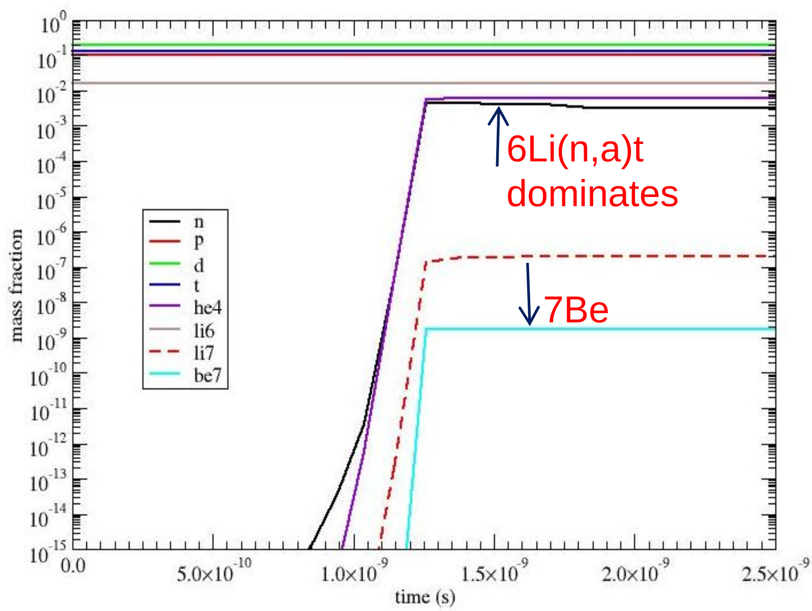
Joint Institute for Nuclear Astrophysics

# Charged Particle Reaction Predictions for NIF

To use NIF for astrophysical studies requires a detailed knowledge of density and temperature environment. Charged particle reactions can be used to probe how these quantities change during an ignition. To do this the capsule must be doped with a known amount of a light isotope, with a known proton capture cross section. In order to collect and count the residual nucleus, it must have a suitable half life. Using in turn the doping nuclei: $^{6}$Li, $^{10}$B and $^{14}$N, network calculations were performed which simulated the reactions occurring during a NIF D-T ignition. Since nuclei in the NIF environment do not have a Maxwell-Boltzmann velocity distribution, reaction rates were obtained by folding the cross sections with the D-T neutron yield spectrum. It was found that in all three cases the (n,α) channel dominates over the (p,γ) channel, significantly decreasing the production of the signature, charged particle reaction. However it was also found that when the capsule was doped with $^{14}$N, a significant quantity of $^{14}$C was synthesized, through the (n,p) channel. When combined with AMS techniques, this could serve as a probe of the reproducibility of the ignitions.




***Figs. 1 & 2*** – Results of network calculations simulating reactions occurring during a NID D-T ignition. In Fig.1 the simulation has been performed with a $^{14}$N-doped capsule. In Fig.2 the simulation assumes a $^{6}$Li-doped capsule. In both networks, the (n,α) channel dominates, and the signature isotope (either $^{15}$O or $^{7}$Be) is orders of magnitude smaller.

**Contact:**
Mary Beard
University of Notre Dame
University of Notre Dame
mbeard@nd.edu

**Researchers:**
M.Beard (ND)
M.Wiescher (ND)