Development of Platforms at NIF to measure (n,2n) Cross Sections

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The incredibly large neutron flux generated by a DT-fusion capsule fielded at NIF can be used to induce neutron capture reactions in materials added to the inner surface of the capsule shell in order to measure nuclear reaction rates in a plasma environment. The advantage of using NIF over traditional neutron facilities is that much less material is required, which lowers the overall radioactivity of the target material for reactions on unstable isotopes. The short burn time of a NIF shot also opens the possibility of reactions on excited nuclear states with lifetimes longer than the NIF burn. In cases where there is an insufficient quantity of target material, or the radioactivity of a traditional accelerator target is too large to handle safely, performing neutron activation at NIF may be the only viable path to measuring nuclear reaction rates on unstable nuclei when the data is unknown. In the absence of this data, nuclear reaction rates rely on models, which may have very large uncertainties. In an effort to begin measuring neutron activation rates on rare earth nuclei, two sets of NIF capsules were doped. The first set contained 91Y, 171Tm, and 152Eu, and were shot without DT fuel in an effort to determine if rare earth isotopes would fractionate from one another as they condensed out of the plasma onto the debris collectors. The second set contained 89Y, 169Tm, and 152Eu for an initial measurement of the 89Y(n,2n)88Y cross section using a cryo-layered DT capsule fill. Future efforts will focus on measuring unknown quantities such as 88Y(n,2n)87Y. Results from the fractionation shots and initial results from the layered shot will be presented.