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Feasibility of Nuclear Plasma Interaction studies with the Activation Techniques

Electron-mediated nuclear plasma interactions (NPIs), such as Nuclear Excitation by Electron Capture (NEEC) or Transition (NEET), may have significant impact on nuclear cross sections in High Energy Density Plasmas (HEDPs). These HEDP environments are found in the cosmos where nucleosynthesis takes place. Attempts have failed so far in measuring the NEEC process [1], while NEET has recently been observed experimentally [2]. NEEC, NPIs have not been observed due to the narrowness of nuclear transitions ($\sim 1\text{eV}$). The NPIs may occur on highly excited nuclear states in the quasi-continuum which is populated in nuclear reactions prior to their decay by spontaneous γ -ray emission. Direct observation of NPIs are hindered by the lack of a clear signature of the effect in HEDP environments. Hence, a new signature [3] for NPIs on highly excited nuclei will be tested by investigating isomeric to ground state feeding from the quasi-continuum region. An experiment was performed using the reactions $^{197}\text{Au}(^{13}\text{C}, ^{12}\text{C})^{198}\text{Au}$ and $^{197}\text{Au}(^{13}\text{C}, ^{12}\text{C}2n)^{196}\text{Au}$ at Lawrence Berkeley National Laboratory in inverse kinematics with a ^{197}Au beam of 8.5 MeV/u energy. The activated foils were counted at the low-background counting facility of Lawrence Livermore National Laboratory. I will discuss several measurements with different target configurations to investigate the feasibility of NPI studies.

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