Measurement of $^{16}O(\gamma,\alpha)^{12}C$ with a bubble chamber and a bremsstrahlung beam at Jefferson Lab Injector

Riad Suleiman

Jefferson Lab

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The carbon-helium fusion reaction is considered to be the key reaction in the helium burning of stars because it determines not only the carbon and oxygen abundances in stars and, ultimately, in the universe, but also the nucleosynthesis of all heavier elements.

At Jefferson Lab, we plan to obtain the rate for this reaction by measuring the inverse process, i.e., the photo-disintegration of oxygen into helium and carbon. This measurement would be based on a novel bubble-chamber technique, which makes use of the fact that a super-heated liquid (Nitrous Oxide) is sensitive to recoiling helium and carbon nuclei produced by photo-disintegration of the oxygen nuclei in the liquid.

This experiment will be staged in the exact place of the completed PEPPo experiment and will re-use the same beamline. The experiment will measure the $^{16}O(\gamma,\alpha)^{12}C$ reaction with bremsstrahlung photons at 7 different electron beam kinetic energies ranging from 7.9 MeV to 8.5 MeV. These energies are higher than what has been achieved in the Injector, thus the need to increase the cryo-unit gradient. The uncertainty on the beam energy is the dominant systematic error. To reduce the absolute energy error, we plan to install a new dipole with improved field homogeneity.

Better knowledge of the beam properties in the Injector is required for this experiment than has been ever needed before. Requirements on energy stability, beam intensity, and beam diagnostics will be discussed.