Colton Graham, University of Michigan
Title: Characterization of Boron Loaded Liquid Scintillators

Abstract

The detection and measurement of gammas, fast neutrons, and thermal neutrons is an important component of nuclear security as these signals can be used to identify fissile materials. EJ309 is a liquid scintillator which is sensitive to fast neutron recoils and gamma interactions. Additionally, it is capable of discriminating between these events through pulse shape discrimination. EJ309B is a variant of this scintillator loaded with natural boron, thereby introducing thermal neutron capture capabilities. The potential applications of this detector include triple pulse shape discriminating neutron and gamma measurements and capture gated spectroscopy of fast neutrons. The boron loading is available in 3 different concentrations: 1.5% by weight, 2.5% by weight, and 5% by weight. However, the differences in light output and capture efficiency between these variants has not been well studied in the literature. We present preliminary work in measuring these differences, including measuring the PMT response to a single photoelectron to calibrate the detectors and looking into the potential for triple pulse shape discrimination by optimizing digitization parameters. Future work on this project includes determining the quenching parameters for light output using a time of flight measurement with Cf-252, implementing machine learning capabilities to more accurately distinguish capture events, and measuring neutron capture efficiency using a Cf-252 source and a DT neutron generator.