Abstract for Poster

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Metal-loaded Liquid Scintillators for Neutrino Experiments

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After the first direct observation of neutrino flavor transformations at the Sudbury Neutrino Observatory, future planned neutrino experiments are focusing on the understanding of the neutrino oscillation mechanism by determining key neutrino parameters, such as the mass differences and mass hierarchy, the mixing angles, and the possibility of CP violation. Organic liquid scintillators (LS) have been the detection medium of choice for neutrinos since the early discovery experiment of Reines and Cowan. For the delayed neutron-capture signal following antineutrino capture, the advantages of adding a metallic element to the LS (to form M-LS) are significant. Chemically, there are challenges to adding inorganic salts of metal directly to the LS. Key aspects of the metal-loaded LS for neutrino detection are (a) long-term chemical stability, (b) high optical transparency, (c) high photon production by the LS, and (d) ultra-low impurity content, mainly of natural radioactive contaminants, such as U, Th, Ra, and Rn. The BNL Neutrino & Nuclear Chemistry group has a long history of neutrino research since Ray Davis's pioneering Homestake experiment. The group has developed new chemical techniques of loading metals, such as In, Yb, Gd, Nd, and currently Li and other low-Z elements, in organic liquid scintillator that can be used for low-energy solar neutrino, reactor antineutrino, terrestrial antineutrino or double-beta decay experiments. Metals at different concentrations in a series of liquid scintillators have been studied systematically at BNL. We have successfully prepared many metal-doped scintillators, with long attenuation lengths (10-15 m) and high light yields. These have been stable for long period of time since synthesis (>2 years for Gd-LS and Nd-LS, and >3 years for In-LS), a crucial characteristic in experiments that are planned to run for at least 3 years. Our chemical-doping technologies and the performance of different organometallic liquid scintillators for different experiments will be presented.

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