Plasmonically Cloaked and Metamaterial Neutron Scintillators

PI: Eric Burgett – Idaho State University

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Collaborators: Christopher Summers – Georgia Institute of Technology, Mohamad Al-Sheikhly – University of Maryland

ABSTRACT

This research project will pursue advanced measurement techniques utilizing cutting edge Plasmonic cloaked and metamaterial neutron scintillators. The goal of the project is to measure the fission neutron spectrum, fission neutron yield, and time dependence of the neutron yield as a function of incident fission neutron energy. These innovative ideas bring game changing technology to the table, which is applicable to nuclear data, national security and the DOE. The project is centered around cutting edge advances in plasmonic cloaking, metamaterials and custom growth techniques to produce neutron scintillators who are intrinsically gamma blind. This new team will develop new measurement systems to address the nuclear data needs for the FCR&D program and will work in conjunction with the nuclear data working group and other NEUP funded projects such as the elastic/inelastic measurement team and the fission Time Projection Chamber to develop the next generation of neutron detectors. This proposal addresses many of the pitfalls of other scintillator systems that had been proposed previously. The project will focus initially on proven planar configurations for growth of these scintillators. This will continue to produce useful results within the first three months of the project start. Within one year, the project will have an innovative fluidized bed ALD reactor system. The fluidized bed ALD reactor is being designed to coat three dimensional nanoparticles with various scintillator materials which are optimized in the first year. These coatings also include plasmonic cloaking devices. This research program aims to solve two separate needs, the production of a highly efficient thermal and fast neutron scintillator without the use of 3He, and two, the light collection problem in nanoparticle based large volume scintillators. This innovative method should result in several ground breaking advances for not only neutron detector research but also phosphor and nanotechnology fields. The end goal is to produce a 4 pi neutron detector for the measurement of neutron yield, neutron spectrum and time dependence of neutron emission from fission. This 4 pi detector array aims to collect high precision neutron data in support of several DOE mission and Nuclear Data needs.