Contribution ID: **90** Type: **Poster**

Compact Gamma Spectrometer

Tuesday, 23 July 2019 18:45 (15 minutes)

Implemented at nuclear facilities, ultra-high-resolution microcalorimeter gamma spectroscopy offers important capabilities for advanced nuclear fuel cycle safeguards. Our goal is to reduce the performance gap between nondestructive and destructive isotopic analysis methods. The improved energy resolution of microcalorimeters can reduce uncertainty in nondestructive isotopic composition measurements of plutonium and other complex nuclear materials. Advancements in large array fabrication, multiplexed readout, electrically-cooled cryostats, signal processing, and data analysis have enabled us to develop an instrument architecture capable of count rates comparable to germanium detectors but with 5-10 times better energy resolution. We are now building a compact gamma spectrometer using a High Precision Devices Model 102 cryostat and Cryomech PT403 pulse tube cryocooler. Larger systems requiring three-phase electrical power and cooling water are unsuitable for installation at many analytical laboratories. This compact air-cooled cryostat system requires only single-phase electrical power similar to a large window air conditioner, and enables many new opportunities for testing and deployment. With 256 pixels and high-bandwidth microwave frequency-division multiplexing, total count rates of over 5000 per second are expected. We will present the design of the compact gamma spectrometer, initial results, and plans for testing in nuclear facilities.

Student (Ph.D., M.Sc. or B.Sc.)

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Less than 5 years of experience since completion of Ph.D

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Session Classification: Poster session

Track Classification: Technology transfer, outreach, and dissemination