Contribution ID : **72** Type : **Poster**

Simultaneous, Dual-Isotope Measurement Approaches for Tritium and Radiocarbon by Ultra-Low-Background Proportional Counting

Wednesday, 28 September 2016 12:01 (0:01)

Content

Tritium and radiocarbon can be used as environmental tracers; by measuring both isotopes simultaneously, one can study how each isotope moves through a system relative to the other. Pacific Northwest National Laboratory (PNNL) has developed an ultra-low-background measurement capability which, when combined with their Shallow Underground Laboratory, provides enhanced capability to measure low-activity sources of tritium and radiocarbon simultaneously. Tritium levels have been steadily decreasing since atmospheric nuclear weapon testing in the 1960's and are now nearly back to pre-nuclear test levels (~2-8 TU in rainwater). This makes a direct dual-isotope measurement difficult without additional chemistry to first concentrate the tritium in a sample.

Both tritium and radiocarbon can be collected in the form of methane from an environment of interest. This leads naturally to proportional counting as a direct measurement approach since methane samples can be loaded straight into a proportional counter with little or no sample chemistry required to increase concentrations or to separate isotopes for individual measurements.

There are detector specific characteristics that need to be known in order to simultaneously quantify the amount of tritium and radiocarbon present in a given sample. The detector background must be measured at the same pressure as the actual sample. Also, single-isotope standards must be measured in the same detector (also at the same pressure as the actual sample) in order to provide efficiency curves for each isotope individually. The latter is essential when quantifying the simultaneous measurement of tritium and radiocarbon since the beta end-point energies overlap (tritium beta end-point energy is 18.6 keV and radiocarbon beta end-point energy at 156.5 keV). In order to successfully decouple the two spectra, single-isotope measurements of each isotope individually are necessary.

Previous work has been performed at PNNL using modeling to decouple the tritium and radiocarbon spectra but the uncertainty in such models is high due to the complicated decay structure of radiocarbon. New work is in progress using single-isotope standards to directly measure the efficiency curves for both tritium and radiocarbon in an ultra-low-background proportional counter. This will allow for more accurate quantification of low-level tritium activities on top of a radiocarbon background.

We will present results of the single-isotope measurements used to decouple the simultaneous, dual-isotope measurement of a single methane sample. With this new information, we can identify sensitivity levels for the dual-isotope measurement in PNNL's Shallow Underground Laboratory.

About the Presenter

Emily K. Mace is a Senior Research Scientist at the Department of Energy's Pacific Northwest National Laboratory (PNNL). She received her Masters in Physics from Purdue University in 2006. Ms. Mace has a background in radiation detector development and characterization. She has participated in growing the ultra-low-background capabilities of PNNL including characterization of the ultra-low-background proportional counters and the ultra-low-background counting system in PNNL's Shallow Underground Laboratory. In the Shallow Underground Laboratory, Emily measures samples in the ultra-low-background counting system for applications of environmental science and treaty verification. Emily has also worked in safeguards to develop a UF6 unattended cylinder verification station (UCVS) for non-destructive assay of UF6 cylinders to verify U-235 mass using full volume measurement techniques. Emily has participated in field campaigns using the UF6 technology in deployments at both foreign and domestic enrichment facilities.

Primary author(s) : MACE, Emily (Pacific Northwest National Laboratory)

Co-author(s) : Dr. AALSETH, Craig (Pacific Northwest National Laboratory); ALEXANDER, Thomas (Pacific Northwest National Laboratory); Dr. BACK, Henning (Pacific Northwest National Laboratory); HOPPE, Eric (Pacific Northwest National Laboratory); Dr. KEILLOR, Martin (Pacific Northwest National Laboratory); Dr. MORAN, James (Pacific Northwest National Laboratory); OVERMAN, Cory (Pacific Northwest National Laboratory); PANISKO, Mark (Pacific Northwest National Laboratory); Dr. SEIFERT, Allen (Pacific Northwest National Laboratory)

Presenter(s) : MACE, Emily (Pacific Northwest National Laboratory)

Session Classification : Radiometrics

Track Classification : Radiometrics