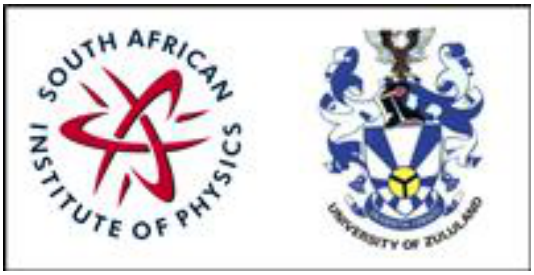

Contribution ID: **520** Type: **Oral Presentation**

Determination of U-235 in the context of interference with Ra-226 for the study of the disequilibrium in the U-238 decay series

Friday, 12 July 2013 09:20 (20 minutes)

Abstract content
   (Max 300 words)

In a gamma-ray spectrum from the uranium decay series the most intense peaks are from the decay of Pb-214 and Bi-214. These isotopes follow the gaseous Rn-222, the daughter of Ra-226 in the uranium decay series. It is relatively easy to compensate for the radon problem so that these peaks are a direct measure of the Ra-226 content of the samples. Because of the constant ratio between U-235 and U-238, the 185.72 keV peak from U-235 can be used as a measure of the uranium content. In order to do this it must be de-convoluted from the 185.25 keV peak from Ra-226. In this study, an IAEA uranium standard, known to be in equilibrium has been analysed by gamma-ray spectroscopy at iThemba LABS, Gauteng, using a new Broad Energy, HPGe detector (BEGE by Canberra Electronics) with the sample in a Marinelli beaker geometry. Spectral data were collected using spectrum analysis software in the Genie2000 system. The actual positions of the Ra-226 and U-235 peaks are known. Although these two lines are separated by only 0.5 keV, it is possible to obtain reliable values for the two peak intensities by using this modern detector and with appropriate data manipulation strategies. The FWHM of the detector and its variation with energy were therefore determined experimentally to reduce the free parameters in the fit; a least squares fit of a sum of the two Gaussians superimposed on a second degree polynomial background was then performed on the U-235/Ra-226 186KeV peak convolution using the MIGRAD minimizer in ROOT (an object oriented C++ data analysis platform developed at CERN). The varying parameters in the fit were the magnitudes (representing the intensities of the two peaks) of the two Gaussians and the background parameters. A numerical method for determining the intensity of U-235 and hence its concentration in an environmental sample, independent of Ra-226/Rn-222 equilibrium state has been established and the Chi squared surface has been studied to determine the errors in the important intensity parameters and to compare these values with the case where the FWHM is also a free parameter.

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Session Classification: NPRP

Track Classification: Track B - Nuclear, Particle and Radiation Physics