



Canadian Association
of Physicists

Association canadienne
des physiciens et physiciennes

Contribution ID: 2559 Type: **Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)**

Development of multi-detector systems for radiation measurements at Simon Fraser University

Tuesday, 4 June 2019 11:30 (15 minutes)

Gamma ray spectroscopy in the Nuclear Science Laboratory (NSL) at Simon Fraser University (SFU) is used for nuclear structure studies, neutron activation analysis, and environmental radioactivity monitoring. The current detection system is the Germanium detector for Elemental Analysis and Radioactivity Studies (GEARS), and consists of a single high purity germanium (HPGe) detector which is housed in a lead box for passive shielding. Sensitivity is limited especially at low energies due to background radiation and Compton scattering. The detection capabilities of the NSL can be improved through the use of Compton suppression and time coincidence measurements. The time coincidence method allows for the possibility of gamma-gamma, beta-gamma, and alpha-gamma measurements that will help distinguish between events of interest, and background radiation or events caused by contaminant induced reactions. However a multi-detector system is required to take advantage of this method.

The 8-pi spectrometer, recently acquired by SFU from the ISAC-I facility at TRIUMF, is a set of 20 HPGe detectors equipped with BGO Compton suppressors arranged in a spherical array. The 8-pi is being rebuilt to its original design of a high multiplicity spectrometer to be used in fission studies. All photomultiplier tubes and 18 out of 25 HPGe are currently operational. HPGe detectors operate at liquid nitrogen (LN2) temperatures and the required cooling system is being expanded from GEARS to support the 8-Pi. Implementation of the data acquisition (DAQ) system poses a greater challenge as it requires 332 channels for the BGO photomultipliers plus 20 channels for the HPGe detectors in order to operate the full array. A DAQ based on the TIG-10 and VF-48 digitizers is under development.

In the interim, a subset of six 8-Pi Compton Suppressed Spectrometers (CSS) will be arranged in a cubic array for the purpose of time coincidence measurements. A frame has been designed and will be constructed by the SFU machine shop. The HPGe detectors will be cooled using the LN2 cooling system intended for the full 8-pi array. The High Voltage distribution for the CSS shield photomultipliers built for the 8-pi will be used. Additionally NIM/CAMAC-based DAQ can be adapted from the existing GEARS system to allow operation of six CSS for the cube. Progress towards completion of this array will be presented and discussed.

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Session Classification: T2-10 Nuclear Instrumentation (DNP) | Instrumentation nucléaire (DPN)

Track Classification: Nuclear Physics / Physique nucléaire (DNP-DPN)