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GRANDSim: a novel Geant 4 based simulation software for HPGe detectors in use at CTBTO monitoring stations

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As part of the CTBTO verification regime, the radionuclide component of the International Monitoring System (IMS) is based on 80 particulate stations and 40 noble gas systems. Daily gamma spectral data are transmitted to the International Data Centre (IDC) in Vienna for automatic processing and interactive analysis.

Data analysis aims at monitoring a list of CTBT relevant radionuclides. These consists of 42 fission products and 41 activation products in aerosols as well as 4 isotopes of radioxenon. The results are made available to authorized users of State signatories through secured access mechanisms, for national implementation of CTBT related measures.

The IDC developed a novel Geant 4 based Monte Carlo simulation software for HPGe detectors in use at IMS particulate stations. The software, dubbed GRANDSim (Geant 4 based RAdioNuclide Detector Simulation software), covers both coaxial and planar detectors, measurement geometries and shielding configuration of the three technologies operated at IMS particulate stations.

The software simulates efficiency calibration, isotopic response function and coincidence summing correction factors for natural and anthropogenic radionuclides of interest. The physical model is automatically optimized by constraining simulation results against experimental calibration for non-summing energies.

Simulated entities are used as support parameters in the automatic processing of daily spectra from IMS for:
- Improving the quality of efficiency calibration (by including coincidence summing corrections).
- Enhancing the nuclide identification results (by including summation peaks) which reduces the workload on analysts in interactive mode.
- Ensuring reliable activity concentration results by including required coincidence summing corrections when applicable.

In addition, GRANDSim simulates gamma spectra for mixtures of radionuclides with any activity concentrations.

The contribution aims at presenting the key features of GRANDSim.

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