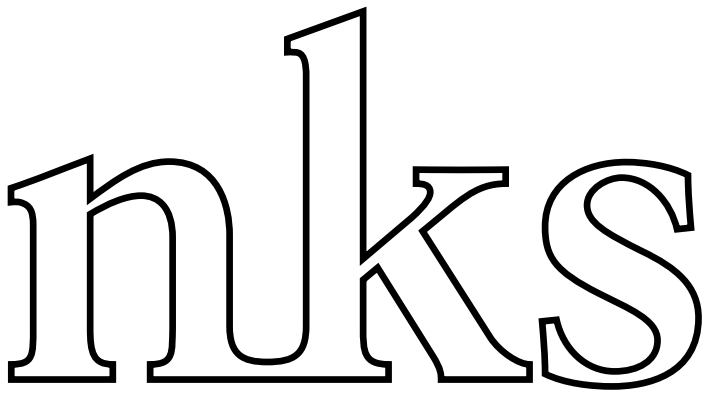
# GammaSem2010

A Nordic seminar for users of gamma spectrometry

Book of abstracts




Kjeller, 28-29 September 2010

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# True Coincidences and a Decent Currie

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This lecture will cover developments I led and worked for during a couple of years at the beginning of this century at the Provisional Technical Secretariat (PTS) for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in Vienna.

In laboratory-based environmental gamma spectroscopy we normally work with weak samples that require a close detector – sample arrangement. That also makes true coincidence summation a visible problem for many nuclides. There are a lot of schemes and programs to deal with this, but the lecture will focus on the one we developed in-house that is based on a two-step Monte-Carlo process where both decay and radiation transport are simulated.

Time permitting, I will also dwell on Currie detection criteria in gamma spectroscopy. Currie's classical paper from 1968 deals with single-channel analyzers and it is not straight-forward to apply it to spectroscopic data. At CTBTO with its political environment we had to define this as rigorously as we possibly could and we also had to understand the effects of erroneously detecting peaks at conventional risks as high as 5 % across a full 8192 channel spectrum.

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# Expert System SHAMAN and Comparison of its Coincidence Correction to KORSUM

Jarmo Ala-Heikkilä, Pertti Aarnio
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SHAMAN is an expert system for radionuclide identification. It has been developed at Aalto University (formerly Helsinki University of Technology, TKK) since 1987. SHAMAN needs a gamma-ray spectrum analysis tool as its preprocessor, typically SAMPO or UniSAMPO that have also been developed by the same research group. SHAMAN is used world-wide mainly in airborne radioactivity measurement networks.

SHAMAN has been designed to replace the human expert in gamma-ray spectrum interpretation as far as possible. It uses a comprehensive nuclide library (3,600 nuclides, 80,000 gamma-ray and X-ray lines) and conservative inference rules. The aim of SHAMAN is to find the most probable nuclide composition that explains the spectrum peaks. In particular with air filter spectra, the automated results of UniSAMPO-SHAMAN are very close to the goal.

SHAMAN features background subtraction, coincidence summing correction, and self-absorption correction. Additionally, it can estimate the sizes of sum peaks and escape peaks. The output reports of SHAMAN are fully tailorable and the analysis procedures can be scripted to enable a non-interactive analysis. SHAMAN also supports a publicly available SQL database schema called LINSSI that is separately presented at this seminar.

Coincidence summing is important in close geometries, typically used in environmental monitoring, and for complex decay schemes. In SHAMAN, the method of Andreev *et al.* [IET 25 (1972)] for coincidence correction has been implemented. Decay schemes for 120 important nuclides have been extracted from ENSDF. Total efficiency that is needed in the calculation in addition to peak efficiency can be input to SHAMAN, but if it is not available, SHAMAN can estimate total efficiency from peak efficiency.

SHAMAN's coincidence correction calculation was compared to KORSUM implemented by K. Debertin *et al.* [NIM 158 (1979)]. A set of 25 nuclides and their 291 gamma-ray lines was used in the comparison. Identical decay schemes and calibrations were used as input to reveal essential differences, if any, in the results.

It was found that coincidence correction factors calculated by SHAMAN and KORSUM were within 1 % of each other for 89 % of the gamma-ray lines. All but 4 of 291 values were within 3 % of each other, i.e., within typical uncertainties from other sources. The 4 differing cases were explained with inaccuracy in efficiency extrapolation, a metastable state, and a gamma line matching problem. It can be concluded that the coincidence correction calculation in SHAMAN is consistent with that in KORSUM. The differences in results are due to differences in input. The calculation is especially sensitive to the decay scheme details.

Acknowledgement:
The KORSUM results were kindly provided to us by Weihua Zhang (Radiation Protection Bureau, Health Canada).

Further reading:

P.A. Aarnio *et al.*, "Analysis Pipeline for Air Filter Gamma-Ray Spectra from the CTBT Verification Network". J. Radioanal. Nucl. Chem. 263 (2005).

P.A. Aarnio *et al.*, "Performance of UniSampo-Shaman with Gamma-Ray Spectra Containing Known Traces of Fission Products". J. Radioanal. Nucl. Chem. 276 (2008).

J.J Ala-Heikkila, "Analysis Methods for Airborne Radioactivity". Doctoral Dissertation, Helsinki University of Technology, TKK Dissertations 129, Espoo 2008; available at http://lib.tkk.fi/Diss/2008/isbn9789512294404/

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# Cascade Summing Corrections with Genie-2000

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Several nuclides emit two or more gammas within a timeframe much to short for a germanium detector to resolve them. If more than one hit the detector the energy from both will be registered. This can lead to either summing out, to few pulses in the photo peak, or summing in to many pulses. Both cases lead to a wrong determination of the activity.

Canberra's gamma spectroscopy software Genie-2000 contains a method for correcting for cascade summing. The method has recently been extended to lower energy to be able to better correct for x-ray summing. In addition the need for performing peak-to-total calibrations have been eliminated. These new features will be presented together with a review of the Canberra Cascade Summing Correction method.

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# A summary from the ALMERA workshop on coincidence summing and geometry correction in gamma ray spectrometry

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During the 6th ALMERA coordination meeting in November 2009, the ALMERA participants requested the IAEA to organize workshop to discuss coincidence summing and geometry correction in gamma ray spectrometry. The workshop took place in the IAEA's Laboratories in Seibersdorf (Austria), from 19 to 23 July 2010.

The workshop was addressed to experienced scientists in gamma spectrometry and represented a possibility for the ALMERA members to work on practical exercises, and to refresh and update their knowledge and skills in coincidence summing and geometry correction in gamma ray spectrometry. It also created an opportunity for the ALMERA scientists to initiate collaboration with other laboratories.

The following topics were addressed during the workshop:

1. True coincidence summing correction: Theory
2. True coincidence summing correction: Experimental
3. Geometry correction: Theory
4. Geometry correction: Experimental
5. Self absorption corrections: Theory
6. Self absorption corrections: Experimental
7. Decision threshold and detection limit

This presentation gives a short summary of the workshop.

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# Geological mapping using airborne gamma ray spectrometry

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At the Geological Survey of Norway (NGU), we use airborne gamma ray spectrometry (AGRS) for geological mapping. Till date, we used a 256 channel Exploranium GR820 gamma ray spectrometer with sodium iodide detector packs with a total crystal volume of 20.9 l (16.7 l downward and 4.2 l upward detector). A full spectrum of energy from 0.2 MeV to 3 MeV is recorded in channels 0 to 254 and the total counts for energies above 3 MeV is recorded in channel 255 as cosmic radiation. From this year on, the spectrometer is upgraded by Radiation Solutions Inc. to a RSX-5 which has possibility to operate it in 1024 channels. General interest of geological mapping is to map naturally occurring radioelements K-40, U-238 and Th-232, however it can also be used for nuclear fallout mapping and for searching of radioactive objects. At NGU, we use AGRS for mapping of natural radioelement and manmade Cs falldown. Our equipment is a part of the National Nuclear Accident Preparedness Organization.

We performed helicopter-borne geophysical surveys in the autumn, 2008 and summer, 2009 for natural radioelement mapping around Kongsberg area in south of Norway. Collected data was processed for corrections due to radiations from cosmic, aircraft and radon in addition of other general corrections of AGRS. The Radon correction was performed with the help of upward detector measurements. It is learnt that there was different seasonal variation of airborne radon present in the area which affects especially U measurements. Therefore different calibration coefficients for airborne radon were calculated for two seasons and applied separately to the dataset collected in the different season. Working out the amount of airborne radon in different season helped in leveling the concentration of U for whole area of the survey.

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# Mobile gamma ray spectrometry and the efficiency of real-time data processing in describing the natural background signal and highlighting anthropogenic nuclides

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Mobile gamma ray spectrometry is a rapid and efficient way of mapping spatially distributed fallout during and after a nuclear accident and locating lost or hidden isolated sources of radiation. In 1999 the Geological Survey of Norway developed a mobile measuring system called "GammaLog" that is now a key element in emergency mobile mapping in Norway, operated by the Geological Survey of Norway, Norwegian Radiation Protection Authority and Norwegian Air Force. GammaLog can be deployed by car/van, helicopter and aeroplane. In Norway the airborne platforms are likely to be the most effective in the majority of emergency situations.

GammaLog depends on a large NaI detector and spectrometer system with the option for an additional complementary HpGe instrument operating at a lower measuring frequency. Given the considerable spatial variation in background natural signal in Norway it is essential to divide the observed gamma ray spectra into natural and anthropogenic components in real time. This gives the operators the ability to (1) differentiate between natural and man-made nuclides (2) avoid entering hazardous areas, (3) dynamically adjust surveying strategy, (4) identify and report contamination while surveying, (5) make a first order assessment of radiation doses at ground level.

The presentation will focus on the method employed by GammaLog to isolate the anthropogenic signal. First, a method founded on conventional window stripping is used to produce a model natural gamma spectrum, assuming it is the sum of signals from naturally occuring uranium and thorium daughters (including airborne radon), potassium-40 and cosmic radiation. The difference between this and the observed spectrum is assumed to relate to anthropogenic sources. This difference spectrum can be displayed in a number of ways to highlight local and weak anthropogenic sources as well as feint distributed fallout.

Given that the measuring cycle for the NaI instrument is 1 second, real time processing must be kept simple to leave computer processing capacity free for other tasks. We will show this approach performs using examples of real field measurements acquired at exercises carried out over the last 12 years. We will show situations where the processing technique works well, explain why, and where it fails and show how we guard against misinterpretation of data in these situations.

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# Uncertainties in mobile gamma spectrometry

Helle Karina Aage
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Calibration of mobile equipment for measurement of gamma radiation differs in many ways from calibration of laboratory equipment with the same general purpose. Factors as source geometry, standardised measurement procedures and the importance of low level background that in a laboratory measurement situation is given the utmost attention and are of critical importance for laboratory certification take on an altogether different importance in mobile gamma spectrometry.

In mobile gamma spectrometry used for emergency purposes, i.e. purposes where radiation from natural radionuclides is considered part of the background, there is neither a low level background level, nor a constant background level. For these systems, background means not only background from soil, roads etc. but also contributions from radioactive gases in the air. Radon daughters, that are not only considered a health risk, are by far the larger contribution to background variations during a series of measurements. And they move with the wind, out of the measurement area and into the measurement area and possibly precipitates. A simple dose rate measurement on the same physical position outdoors may vary by a factor of two during a thunderclasp of heavy rains.
In mobile gamma spectrometry used for emergency purposes, also there is no physical source definition and no standard measurement geometry exists. The distance from the detector to the source is in principle unknown and measurements may be made primarily in order just to find the source, e.g. orpaned source. The source may also be an area source with radionuclides smeared out in uneven distribution on a ground surface of unknown area size. Calculations and estimations of point source strengths and radionuclide contamination concentrations on surfaces represent two quite different types of procedures.

A nuclear fallout is in principle an area source for which large and theoretical calculation procedures does exist. In praxis, the area of land - seen from e.g. an altitude of 300 feet with a field of view of 500 meters around the measurement equipment - is not just one area but consists of many smaller areas. Some areas may be farmland, some forest, cities, motorways, etc.

Deposited radionuclides may be washed or blown off a contaminated smaller area very fast. In other areas, grass and plants may assimilate some of the radionuclides. At the bottom of mountains the radionuclides may well accumulate and create pools of radiation – hot spots.

When the source is defined, the relative position of the measurement equipment must be defined, too. For airborne surveys consecutive 1-sec-measurements may be distributed several hundred meters apart in the horizontal direction and also differ in the vertical distances between aircraft and ground level.

"What has been measured, how much and where?" becomes questions that lessen the importance of e.g. minimum detection levels in contrast to the importance of the personnel performing the measurements being skilled to evaluate the data materiel taking into account the appropriate influences from terrain, weather conditions, water bodies a.o. on the day the measurements were made.

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# Aspects affecting low-background measurements

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Gamma measurement of low activity environmental samples is a demanding task. In some cases the activity of the sample may be at the same level as background. In the case of anthropogenic nuclides measurement is some what easier since the prominent gamma peaks are not present in the background. The situation is much different when the interest lies in the normally occurring radioactive materials (NORMs). Small quantities of natural radioactivities in the background can disturb measurements significantly. Thus it is important know which factors contribute to the total background which ultimately determines the detection limits. Before measures of background reduction can be taken factors and their contribution effecting to total background must be understood.

A series of background measurements were conducted in order to determine contribution of different components in background. Also different measurement setups were tested in order to determine optimum setup. Constant background measurement time of 2880 minutes (48h) to allow exact comparison of measurements. The detector used in the measurements was an Ortec HPGe installed inside an ultra-low background lead castle. Lead bricks on the floor were used to reduce the radiation from the floor, plastic disks were used to slow down atmospheric neutrons together with a borated steel plate, nitrogen flush was used to reduce radon induced background inside the lead castle, measurement room radon level was monitored continuously.

The results of these measurements will be discussed in the presentation.

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# LINSSI - Relational Database for Gamma-Ray Spectrometry

Pertti Aarnio, Jarmo Ala-Heikkilä
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LINSSI is a relational SQL database for gamma-ray spectrometry, including extensions for alpha and beta-gamma coincidence spectrometry. Its general features also allow further easy extensions to other fields of radiation measurement and analysis. LINSSI is designed to cover the whole production chain from sample preparation to final analysis results. Static or mobile sampling and measurement with multiple sample types are supported. In addition, each sample can be split or combined any number of times. A sample may be measured multiple times and each measurement multiply analyzed as well. With LINSSI, measurement setups with detectors, shields, attenuators and source geometries can be defined. Full control of calibrations, their histories and tracing of each calibration point back to its corresponding analysis and calibration measurement are also available. LINSSI supports multiple facilities including, but not limited to, laboratories, sampling stations, in-situ sampling and measurement, mobile equipment with real time GPS tracking, etc. In addition, transport and tracking of samples between and inside facilities can be controlled. Tables are also available for formal inter-facility document exchange.

A traditional solution for data management in gamma-ray spectrum analysis has been a file based system where each spectrum with its associated information and analysis results is stored in a set of files. In addition, paper copies have been filed as legally binding documents. When the number of files in this kind of system grows, searching specific data from them becomes quite complicated unless some order is imposed. This can be obtained with relational database system consisting of the definition of database tables, database scripts and standard spectrometry software. The database definition [1] is rigid but extendable. The scripts [2], on the other hand, are flexible and easy to write when new needs arise.

LINSSI also provides support for an automated analysis pipeline, where spectra received by email are automatically analyzed and stored in the database. STUK, for instance, has set up an analysis pipeline for Comprehensive Nuclear-Test-Ban Treaty air-filter spectra. That pipeline, using Shaman analysis software, which is separately presented at this seminar, operates continuously and has analyzed hundreds of thousands of spectra and stored the results in LINSSI.

LINSSI has been developed as a common effort of Aalto University School of Science and Technology (former Helsinki University of Technology (TKK)), Finnish Radiation and Nuclear Safety Authority (STUK) and the Radiation Protection Bureau of Health Canada (HC). A LINSSI demonstration, database specifications, and and user scripts are available at http://linssi.hut.fi/.

[1] Pertti Aarnio, Jarmo Ala-Heikkilä, et al., LINSSI - SQL Database for Gamma-Ray Spectrometry, Part 1: Database, Version 2.2, Report TKK-F-A-861, 2010
[2] Pertti Aarnio, Jarmo Ala-Heikkilä, et al. LINSSI - SQL Database for Gamma-Ray Spectrometry, Part 2: Scripts and Interfaces, Version 2.2, Report TKK-F-A-861, 2010

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# Hand-held gamma spectrometry for assessing radon risk from building aggregates

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Radon levels in dwellings are associated with increased incidence of lung cancer, and building materials can be a significant contributor to indoor Radon concentrations. To ensure compliance with recommended Radon levels, NGU and Statens strålevern have embarked on a study to assess radon risk from building aggregates. The study includes the investigation of methods of measuring radon potential from aggregates at production sites, including the use of hand-held gamma ray spectrometry. Such gamma ray measurements can be sensitive to the effects of background radiation from airborne radon and the surrounding environment, and we investigate the use of lead and plastic shielding configurations to correct for these effects.

An overview of NGU's role in the study will be presented, with emphasis on gamma ray measurement techniques.

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# International co-operation on the analysis of gamma spectra for malevolent radiological situations: NKS-MALRAD and testing the international use of the US TRIAGE system

Sigurður Emil Pálsson[1] and Mark Dowdall[2]
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The MALRAD activity was intended to provide an exercise activity with respect to gamma ray spectrometric response to malevolent situations involving radioactive sources. Such situations can often be characterised by high activity sources in difficult contexts where the response is by necessity conducted with less than optimal instrumentation. Seven scenarios were developed based on previous incidents where possible and gamma spectral data (both HPGe and low resolution) and other information was disseminated to participants who were given one week to respond to each scenario with as much information as possible. In total 14 individual laboratories responded. The majority of laboratories were in a position to satisfactorily identify sources where single sources were used in situations with no complicating factors. For those scenarios involving heavy shielding some difficulties were encountered due to distortion of the spectrum from that which would normally be viewed as characteristic for the isotope in question. Special nuclear materials such as reprocessed enriched uranium and weapons grade plutonium provided different challenges and there were indications in the responses from participants of unfamiliarity with these materials.

The U.S. Department of Energy / National Nuclear Security Administration (NNSA) has been providing an analytical service, TRIAGE, for many years within the US, whereby measurement data and additional information can be submitted and an evaluation is provided promptly, typically within an hour. This service is now available internationally through the IAEA or via direct contacts with the NNSA. The Icelandic Radiation Safety Authority (IRSA) and NNSA decided to conduct an exercise using the NKS-B MalRad scenarios and data for testing international use of the TRIAGE system. IRSA provided the information and data to TRIAGE on each of the 7 scenarios as had been done in the MalRad exercise, here however only one scenario was submitted at each time. The TRIAGE performed well, giving promptly as accurate results as could be expected by the given data.

The 7 scenarios will be presented and what type of difficulties the participants seemed to have analysing them. The MALRAD activity showed how it was possible to generate data corresponding to realistic situations using Monte Carlo methods, data which would in some cases have been difficult to obtain via measurements. The exercise also gave the participants an opportunity to practice receiving and evaluating outside data, which can be important during an emergency. The MALRAD test data created can be used for subsequent training and exercises, as was demonstrated with the IRSA-NNSA exercise.

The activity is described in the NKS report NKS-207, M. Dowdall *et al*: Proficiency Test in the Analysis of Gamma Spectra for Malevolent Radiological Situations (MALRAD) and a paper has been accepted for publication by Applied Radiation and Isotopes.

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# Gamma spectrometric measurement of nuclear materials

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Characterization of nuclear material is important in many applications, such as nuclear safeguards and illicit trafficking. Nuclear material includes e.g. plutonium, uranium and U-233. Basic characterization of nuclear materials can be done using e.g. high resolution gamma spectrometry. Such a measurement will give the isotopic composition and the age of the material. Implementation and development of methods has been done at FOI. A method for measuring U-233 (age and U-232 content) was developed. Furthermore, a method for assessing the uncertainty in uranium isotopic measurements using gamma spectrometry was developed and evaluated.

The presentation will give the fundamental basis for these kind of measurements as well as the results from the methods developed at FOI.

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# Analysis of samples containing a mixture of biological, chemical and radiological agents ("mixed samples")

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The Norwegian Defence Research Establishment (FFI) has developed and implemented a set of procedures and routines in house for handling and analysis of "CBR mixed samples".

Efficient response and national preparedness against biological, chemical and radiological (CBR) threat agents is dependent on reliable detection and identification methods of any sample to be analysed. The analysis of several CBR agents simultaneously and/or immediately in sequence is more challenging compared to analyses of a sample solely containing one agent. NATO has recognized this challenge and has taken effort to strengthen the alliance's competence on handling samples containing a mixture of CBR agents (mixed samples) by organizing exercises among the participating nations of the NATO SIBCRA Subgroup (Sampling and Identification of Biological, Chemical and Radiological Agents). These exercises were initiated in 2007.

Handling such mixed samples involves complex problems. Mixed samples require strict safety procedures. Analysis techniques used for one type of agent might destroy other types of agents. Screening for radioactivity is no-destructive and can therefore be done at an early stage in the process, but before a more thorough analysis is performed, the samples should be treated to avoid contamination of equipment and risk to personnel from chemical and biological agents.

The FFI has participated in two NATO laboratory exercises. The procedures followed and the results from these exercises will be presented.

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# Verification of fissile materials

Naeem Ul Hasan Syed and Tonje Sekse
Norwegian Radiation Protection Authority

The verification technologies are important in authenticating the presence of the fissile materials using non-destructive assay. The International Atomic Energy Agency (IAEA) has developed methods and technologies as a part of their safeguards procedures, employed for the verification of declared fissile material content. However, the methods and procedures for the verification of nuclear weapons (mainly consisted of weapon grade plutonium (WGPu)) are not well developed.

In order to develop the nuclear warheads verification methods, the concept of information barrier is normally employed. Information barrier (IB) is a combination of hardware, software, and procedures that protects all sensitive information but provides a small set of non-sensitive information, required by the monitoring authority. The Norwegian Study Group on Nonproliferation and Disarmament (NorNed) and the Atomic Weapons Establishment (AWE) are working jointly on an Information Barrier (IB) project. The basic purpose of the project is to implement the non-Nuclear Proliferation Treaty (NPT) article VI, which concerns the nuclear disarmament under strict and effective international control.

The NordNed and AWE started its work in designing and building a prototype IB. The gamma-spectroscopy method was used to detect and verify the presence of $^{60}$Co in a sample. In another prototype, the groups have identified the abundance ratio between two $^{60}$Co and $^{22}$Na sources by measuring the peaks at 1.17 MeV for $^{60}$Co and 1.2 MeV for $^{22}$Na. The relative count rates of these peaks were used to deduce the relative abundance of Co and Na in the sample. The goal of these prototype IBs is to detect radiometric signatures from a surrogate radioactive source and give a yes/no response to a declared standard.

In order to extend the idea for the identification and verification of plutonium isotopes, the picture becomes more complicated. The weapon grade plutonium (WgPu) is characterized by the presence of a large amount of $^{239}$Pu (ca. 93%) and lesser amounts of $^{240}$Pu (ca. 6%). The gamma-ray energy spectrum of these isotopes shows various superimposed gamma –rays from 59 keV to 900 keV. So, the simple analysis as in the Co and Na verification would not be applicable here.

The process of verification of the weapon grade fissile material is simplified by searching predefined attributes. The following are the important attributes for the verification of WGPu: 1) the presence of $^{239}$Pu, 2) the isotopic ratio between $^{239}$Pu and $^{240}$Pu, 3) the age of the plutonium, characterized by relative amount of $^{241}$Am, 4) the minimum mass threshold of $^{239}$Pu isotope, and 5) the presence of metallic plutonium. Therefore, a detailed spectroscopic analysis of plutonium isotopes is required. Additionally, one needs to model the count rates of characteristic peaks for variable isotopic composition and variable shielding conditions. These goals are very challenging keeping in mind the restricted access to plutonium isotopes.

The safeguards inspectors of the IAEA have, during inspections, the possibility to measure the entire spectrum. This is normally done with non-irradiated fuel, both uranium and mixed oxide (MOX) fuel. Such nuclear materials are declared under safeguards from a State to the IAEA. The

enrichment, isotopic content etc. in this material is known, and then verified by the IAEA through gamma-ray spectrum.

Weapon grade plutonium and uranium has not been declared under safeguards. These materials come under the military control in the Nuclear Weapon States (NWS). Therefore, characteristics of these materials that may be helpful for authenticating their presence at a site, are unknown.

In the present talk the developments in establishing a method of WGPu verification will be discussed.

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# Pu Lx spectroscopy in the presence of other radioisotopes

Per Roos and Sven Nielsen
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Technical University of Denmark – DTU

Analysis of actinides, primarily Pu isotopes and Am-241, may be done using a low-enery HPGe-detector using gamma-lines and/or Lx-lines. In many applications the actinide isotopes are ocurring together with other radioisotopes creating potential interferences by their emission of gamma-rays, characteristic X-rays and even through beta and conversion electron emission. The presentation gives some examples of interferences in analysis of actinide-containing material with different composition.

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# Report on GammaWiki as a source of information on gamma spectrometry

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***Background:***
Following the GammaSem seminar in 2009 and the establishment of various working groups, the Icelandic Radiation Safety Authority offered to set up wiki based web, the GammaWiki, and an associated web forum, GammaForum. The idea was that the GammaForum could be used as a discussion forum for individual groups as needed and the GammaWiki could be used by the group to publish material, whether still in draft or final versions.

***Advantages of a wiki-approach for compiling information:***
The system uses a database to store the contents of the web site and the system takes care of much of the administration a system manager would have to do in a "manual" system. The users only need to input material according to some simple rules (see below), the system does the rest. Some key features:

- Familiar interface (like Wikipedia)
- It is easy to input text (can be copied from other sources), nice appearance is controlled by a few formatting commands.
- Tables can easily be imported from web, PDF or Excel
- PDF files can be referred to as well as images.
- It is very easy and fast to get a list of all pages containing a given search term (like in Wikipedia)
- If a page gets long it is automatically gets a list of contents

The value of a wiki-based system increases as more material comes in, especially the search and the web linking. The problem with "hand coded" web sites (without a search function) on the other hand is that as more material gets in, finding it and navigating through the web can become tiresome.

The GammaWiki can be found at https://www.gr.is/wiki/GammaWiki/ and simple instructions for inputting material and editing (for those who have editing rights) at https://www.gr.is/wiki/GammaWiki/index.php/Editing_GammaWiki

***Results and conclusions:***
No use seems to have been made of GammaForum. At time of writing (early September 2010) the working groups have not published their material on the GammaWiki. Favourable comments have however been received concerning the concept and material that was published and more will be added before the seminar as it becomes available.

The use (including input of material and editing) will be demonstrated at the seminar and the question will be raised if GammaWiki, with input from others, should be continued.

**GammaSem seminar,**
**28-29 September 2010**
**Lillestrøm Centre of Expertise Conference Centre, Kjeller, Norway**

# GammaSem 2010: Working Group on true coincidence summation corrections

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***Background:***

At the GammaSem seminar in 2009, several key issues in gamma spectrometry were identified for follow up, among them true coincidence summation corrections (TCC), and working groups were established. No plan for the working group on TCC was set up at the seminar, but the group agreed on the following during spring 2010:

Primary goal of the TCC GammaSem working group:

1. Describe when TCC is needed.
2. How large error is produced if TCC is not used.
3. Produce guidelines on how to use TCC (for users of the major softwares Genie and GammaVision)

How to achieve this?

1. Write a short "guidance" on when TCC is needed → labs already using TCC.
2. Test the TCC calibration procedure presented by IRSA on GammaSem 2009 → labs using GammaVision.
3. Test TCC calibration for Genie → labs using Genie.
4. Intercomparison test, with and without TCC → all labs in TCC working group.

***Results and conclusions:***

Information on use of TCC was compiled, but there has been little or no response from the working group participants during the year that has passed. It is believed that most of the group members signed up because they wanted to learn more about TCC and eventually implement TCC in their own laboratories. Also, there were no funding made available for this work, and the group therefore agreed that the work should be accomplished only by e-mail communication. This has led to the fact that almost nothing has been done in the TCC working group.

This presentation will therefore mainly focus on pros and cons with the working group concept, and some ideas and suggestions for future work will be made.

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# GammaSem 2010: Working Group on uncertainties and detection limits

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***Background:***
The working group regarding uncertainties and detection limits was set-up in the last GammaSem meeting 2009 to find a platform where Nordic and Baltic laboratories could enhance the understanding of the uncertainty assessment of gamma ray spectrometry, and to improve the consistency in the use of detection limits aimed to make certainty statement of the analysis. Our first step was to elaborate and submit a questionnaire in order to obtain a diagnosis of how we operate on a day-to-day level regarding uncertainty analysis and detection limits. The questionnaire was basically divided into three categories of questions; *i.)* the extent to which software is used in the various steps of the gamma ray assessment, *ii.)* the uncertainty budgeting and the steps in the gamma spectrometry being considered; *iii.)* the use of detection limits that characterize the detectability of gamma rays of the detection set-up (detection limit) and the gamma ray assessment (critical limit).

***Results and conclusions:***
So far 9 laboratories participation in the GammaSem have responded. The outcome has been qualitatively assessed by the working group leaders. The results show that most laboratories have automatised the whole assessment chain from pulse acquisition to statement of activity, but that some laboratories still use in-house algorithms as a complement. The sources of uncertainty being considered can be ranged in order of decreasing fraction of use; counting statistics are considered by virtually all, about half of the responders consider the uncertainty in the efficiency and measuring normal, a third consider density and true coincidence correction. More than half the responders do not use the GUM formalism to evaluate the uncertainty in their gamma ray assessment. Another laboratory report an intention to use this algorithms. The alternative approach in stead of GUM varies between the responders; some have merged Type A and Type B but intent to make a distinction between, someone has not made any distinction or even considered such a distinction have been employed in the uncertainty budget. Regarding the use of detection limits, 7 of 9 reported the use of detection levels for *a priori* characterization of gamma detection sensitivity. The expressions vary and some of them are directly adopted from the gamma software used. Only 2 of 9 reported use of critical limit for *a posteriori* characterization of a gamma spectrometry assessment.

***Conclusion:***
From the response of the questionnaire it is obvious that we must work out a way to encourage the laboratories to complete their uncertainty budgeting and take all the steps in the assessment into consideration. We also need to increase the understanding of how the uncertainties are analytically evaluated. Even more concern should be taken to make the operators of the laboratories understand the principles behind the use of detection limits. This applies especially to the use of critical limit, which is central to all laboratories somehow connected to exemption measurements commissioned by industry or authorities