SCINTILLA - Scintillation Detectors and new Technologies for Nuclear Security

Hermann Friedrich[2], Sebastian Chmel[2], Wolfgang Rosenstock[2], Guillaume Sannie[1], Stéphane Normand[1], Paolo Peerani[3], Hamid Tagziria[3], Raffaella De Vita[4], Erica Fanchini[4], Gabriele Firpo[5], Enrico Botta[5], András Kovács[6], László Lakosi[6], Christian Baumhauer[7], Maud Equios[7], Grégoire Petrossian[8], Romain Fossé[8], Geraint Dermody[9], Grant Crossingham[9]

[1]*guillaume.sannie@cea.fr*
[1]Commissariat à l'énergie atomique et aux énergies alternatives (CEA), Saclay, France
[2]Fraunhofer-Institut für Naturwissenschaftlich - Technische Trendanalysen (INT), Euskirchen, Germany
[3]European Commission, Joint Research Centre, ITU, Nuclear Security Unit, Ispra, Italy
[4]Istituto Nazionale di Fisica Nucleare, Sezione di Genova, Genova, Italy
[5]Ansaldo Nucleare S.P.A, Genova, Italy
[6]Hungarian Academy of Sciences, Centre for Energy Research, Budapest, Hungary
[7]ARTTIC, Paris, France
[8]SAPHYMO, Massy, France
[9]Symetrica Security Ltd, Southampton, United Kingdom

According to the European Union, CBRNE and, in particular, radioactive sources and nuclear material represent a difficult to assess but serious threat to the world in general and to Europe in particular. The difficulty in detecting shielded or masked radioactive sources or nuclear material offers opportunities of malignancy to terrorists, criminal organizations and rogue states. The prevention of illicit trafficking of such material requires the availability of appropriate detection systems.

In the frame of the Seventh Framework Programme (FP7) the project SCINTILLA (Scintillation Detectors and new Technologies for Nuclear Security) aims at building an innovative and comprehensive toolbox of devices and best-of-breed technologies for the enhanced detection and identification of difficult to detect radioactive sources and nuclear material. The three year project started in January 2012 and is headed by CEA as project leader. Nine partners from Germany, France, Italy Hungary and the United Kingdom are working on the development of reliable and cost effective radiological and nuclear detection systems, especially on the finding of a reliable replacement for Helium-3, which is the major detection material for today's Radiation Portal Monitors devices (RMPs) for neutron detection and has become hardly available in the European Union.

SCINTILLA is innovating in two technology areas that offer complementary capabilities for the detection and identification of neutron and gamma radiation addressing different usage contexts like relocatable portal monitors for containers, vehicles, persons or luggage on one hand and portable respectively miniature devices for police and customs in airports or first responders for bomb detection on the other hand. These technology areas are scintillator-based technologies (organic and inorganic scintillation material) and CZT (Cadmium Zink Telluride) technologies complemented by advanced image processing technologies.

The investigations and developments cover in particular:

- Organic Plastic Scintillators using Pulse Shape Discrimination (PSD). New algorithms are developed which significantly improve both time response and gamma rejection level.
- Improvement of Gadolinium-lined Plastic Scintillators by using of Monte Carlo simulations to optimize the detector geometry in view of dealing with multiplicity counting.
- Modular ^{6}LiZnS(Ag)-coated Scintillators for neutron detection.

- A networkable, stabilized, de-convolution enhanced NaI gamma spectrometric detector system. Research activities also cover the spectrometry using PVT.
- A CZT Gamma camera, integrating new MicroGami technology, with a new concept of CZT gamma-ray detector based on innovative 2N electrode structure.
- Miniature CZT semiconductors for gamma spectrometry with focus on new electronics with enough computation capabilities to enable online spectrum in-situ analysis.

During the project test-bed services are provided in order to evaluate the performance of the developed detection systems to give support service to the technology subsystem developers. Also annual technology benchmarks, which are also open to third party developments, support the comparison of technologies and selection of the technologies for the SCINTILLA Toolbox.

The first annual technology benchmark was held in Ispra, Italy at the Joint Research Centre (JRC) facilities from 4th to 8th of February, 2013. The measurements were performed in a laboratory which was originally build for the ITRAP+10 project and is explicitly dedicated to testing of equipment for detection of radioactive and nuclear materials.

The following prototypes or components of instruments belonging to the RPM and SPRM family were benchmarked (in brackets: project partner responsible for development):

- Gd-lined plastic scintillator (INFN/Ansaldo)
- LiZnS neutron detector (Symetrica)
- NaI(Tl) gamma spectrometer composed by two 3”x3” crystals (Symetrica)
- PVT spectrometer – 2 sizes: 6 and 20 litres (Symetrica)
- Plastic scintillator with PSD – 2 prototypes: with a set of 3 and 4 detectors (SAPHYMO and CEA).

As reference standard for developing the benchmark procedures the ANSI and IEC standards were chosen: RPM standards (Radiation Portal Monitors) when dealing with alarm capabilities and SRPM standards (Spectrometric Radiation Portal Monitors) when dealing with spectroscopic and identification features. The benchmarking concentrated on radiometric properties only. The main parts of the tests were the response to gamma and neutron radiation, the influence of gamma radiation to neutron response, categorization and identification of radionuclides, and masking of Special Nuclear Material sources by medical isotopes.

Furthermore SCINTILLA aims at setting up a sustainable Partnership Network which is expected to last beyond the end of the project. The aim of this network is to optimize the project outcome during and beyond the project life span and should establish a worldwide community of technology providers, experts and users on the topic of detection technologies. The SCINTILLA Partnership Network is expected to grow throughout the project life, its growth being related to the SCINTILLA project major events like benchmark campaigns and workshops. Different membership offerings will be proposed, depending on the profile and level of interest of the member so through the SCINTILLA Partnership Network third parties will be able to benefit from a range of sustainable services.