

Nucleonica Newsletter

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ISSUE 1

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Greetings from the managing director



Dear Users,

Welcome to the first Nucleonica Newsletter! It is now almost 1 year since Nucleonica GmbH was launched as a spin-off company through a license agreement with the European Commission's Joint Research Centre (JRC). It has been an exciting experience so far.

I am joined in this new endeavor by my colleague Raymond Dreher who is a physicist and expert programmer. Both of us worked previously at the JRC's Institute of Transuranium Elements (ITU) in Karlsruhe. Before I founded Nucleonica, I was involved in many areas of nuclear science including advanced nuclear fuel cycles, non-proliferation and laser induced nuclear reactions.

The new company's close collaborators include Gerda Pfennig, one of the original authors of the Karlsruhe Nuclide Chart, who continues to provide expertise on nuclear data. She will be assisted in this by Dr. Zsolt Sóti from ITU. Dr. Hans Wiese provides additional support for fuel cycle analyses.

Our main products are the Nucleonica nuclear science portal and the Karlsruhe Nuclide Chart, both of which are under continuous development. In addition, we organize international training courses in nuclear science based on the Nucleonica applications.

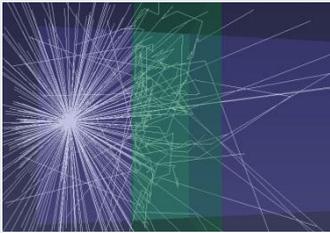
We're working hard to make your work easier. So, in this first Newsletter, we will inform you on the progress made so far and what we're planning for 2012. In particular, the latest developments in the Nucleonica web portal are described with emphasis on new and improved applications and features. Early in 2012, a new 8th edition of the Karlsruhe Nuclide Chart will be released containing information on many new isotopes and updated nuclear data. In addition to the brochure with fold-out Chart and Wall-chart, we are planning a new Auditorium Chart. A brief review of the ITRAC-3 and the NuTRoNS-2 training courses, which took place in Karlsruhe and Monaco in 2011, is also given. I hope you will find our newsletter helpful and informative.

Finally, we would like to thank all our customers for their support this year,

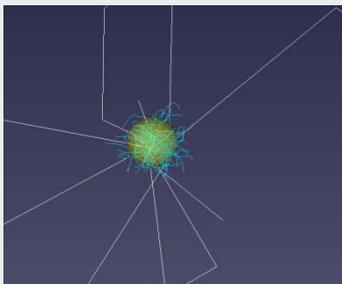
very best wishes for 2012

Dr. Joseph Magill

Further information on this new Nucleonica application can be found on our wiki page at the Virtual Cloud Chamber



Multiple scattering: low energy photons (energy 100 keV) are attenuated with a thick (15 cm) water shield. This combination of low energies and thick shields give rise to multiple scattering of the radiation

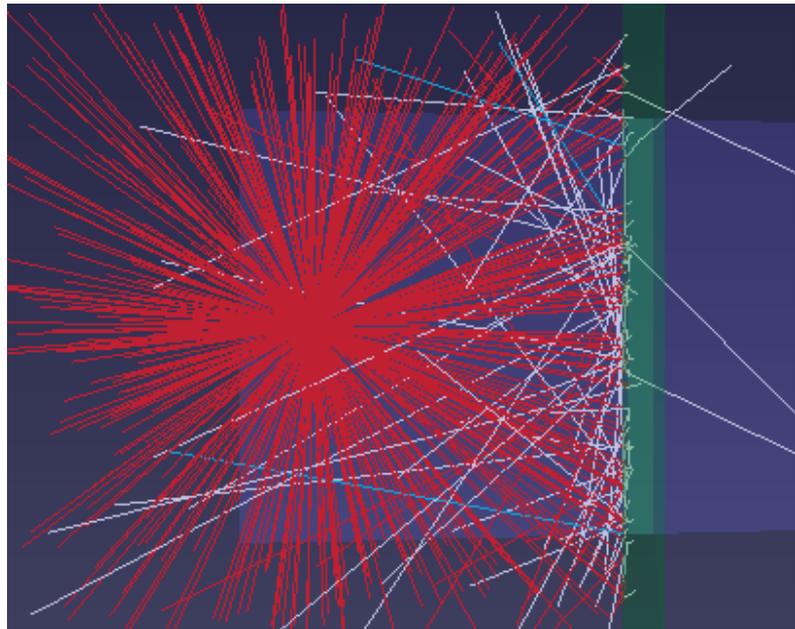


Selective Internal Radio-Therapy (SIRT)
For the simulation electrons are selected and the energy is set to 2.28 MeV (2280 keV). The simulation media selected in water (since that is very similar to tissue). The source diameter is set to 1 cm - this highlights a volume of tissue corresponding to the range of the beta particles.

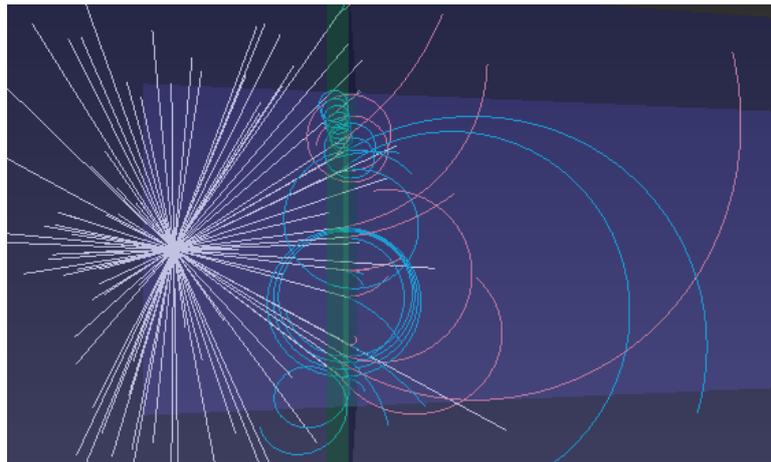
What's New in Nucleonica?

1. Particle Interaction with Matter - Simulation (PIMS)

This new module allows the visualization of photons, electrons, positrons, alpha particles, protons and neutrons in their interaction with matter. The new application is based on the GEANT4 Monte Carlo "engine". In this first released version, the interaction of photons, electrons and positrons with a large variety of materials can be simulated. The output files contain the full 3D information on the particles trajectories. The information is stored in VRML (Virtual Reality Markup Language) format and viewed in the web browser. Currently visualization is performed with Cortona 3D.



The red particles (3 MeV positrons) from the radioactive source are blocked by a lead shield (green). When the positrons collide with the shield, they combine with electrons (blue) to create gamma radiation (white). Only a few gamma photons pass through the shield material.



Nucleonica's virtual cloud chamber: Electron-positron pairs are created through the interaction of 10 MeV gamma photons incident on lead. By "switching off" the electron and positron energy loss mechanisms, the charged particles are seen to spiral in the applied magnetic field. Information on the energies of the electrons and positrons can be obtained from the diameter of the trajectory in the magnetic field. The output files contain the full 3D information on the particle trajectories.

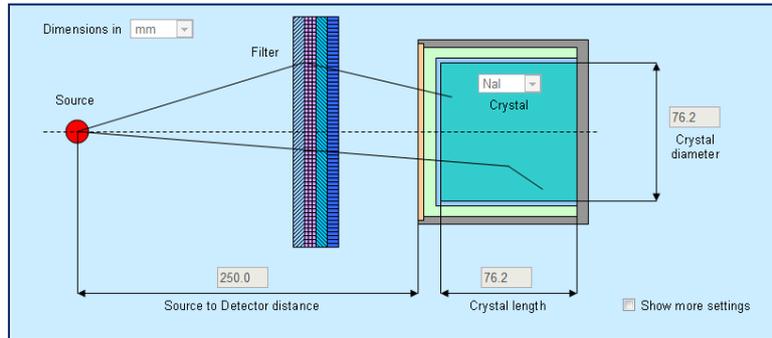
A 66-page colour brochure describing all the applications and features in Nucleonica is available. Hard copies can be requested by email. Alternatively, the pdf can be downloaded from our website: [Download pdf](#)

More information on the Nucleonica wiki at [Gamma Spectrum Generator](#)

More information on the Nucleonica wiki at [Cambio File Converter](#)

2. Gamma Spectrum Generator (GSG) and GSG Pro

- A major change in the detector database for the Gamma Spectrum Generator has been made to allow the inclusion of the detector response characterization data for distances greater than 0 cm. The previous database had only detector profiles at 0 cm, which were also used for all other source-to-detector distances. The new database includes the detector response shapes at 0 cm, 1 cm, 5 cm and 25 cm. The GSG makes use of these data to perform the response shape interpolation for other distances in the 0-25 cm interval. For distances higher than 25 cm the profiles at 25 cm are used.



- From the GSG, and GSG Pro applications, it is now possible to download the calculated spectrum in the standard IAEA.spe format. This IAEA.spe spectrum can then be used and visualized in other Nucleonica applications (e.g. Cambio, WESPA).

- The Gamma Spectrum Generator Pro has now been released for all users. With this Pro version, it is now possible to simulate the natural background radiation and to account for bremsstrahlung for example from beta emitters.

3. Cambio File Converter

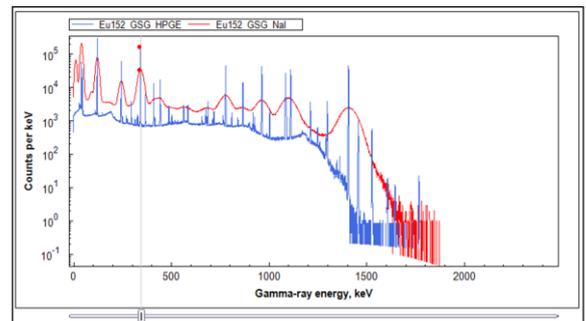
The Cambio file converter now supports the fully featured webGraph (see webGraph below). In addition, user generated gamma libraries can now be used in the analysis of spectra. Cambio has been updated to automatically read data from several new formats that have come into use in the past year. These include data from the following specific detector systems and format types in general use:

Specific Detector Systems:

Thermo Scientific "Mobile ARIS",
Smiths Detection "RadSeeker",
Raytheon "ASP-L",
FLIR "Raider",
ORTEC "MicroDetective",
PGT/Berkeley Nucleonics "SAM Eagle+",
ICx "Identifinder U",
FLIR "radHUNTER"

Formats Types in General Use:

"Energy, Data" list,
Draft Revision 1 to the N42.42 ANSI Standard, HPRDS, ICx SPC and N42 (updated),
GADRAS PCF (updated)



4. Nucleonica wiki upgraded

The "engine" used in the Nucleonica wiki is based on the MediaWiki from Wikipedia. To date the MediaWiki version 1.7.1 has been used. Due to a number of problems encountered especially with the use of different browsers, we have decided to update to the most recent version of the MediaWiki 1.17.0.

More information on the Nucleonica wiki at [Decay Engine for Large Nuclide Sets](#)

The Nucleonica wiki now runs with this latest version. The earlier problems encountered with different browsers (Internet Explorer, Firefox, Chrome, etc.) have now been resolved. The end user will see much improved performance in the use of the Search box. Not only are all areas of the wiki searched by default (previously this was not the case), but the Search results are structured in a more coherent way. Enjoy using this powerful search tool!

5. Decay Engine for Large Nuclide Sets

For larger numbers of nuclides it is not very efficient to use the Decay Engine. For this reason, a new module - Decay Engine for Large Nuclide Sets - was developed to handle large numbers of nuclides, typically hundreds to thousands of nuclides. The new module is based on the very fast decay engine in webKORIGEN.

6. webKORIGEN

- Up to 20 nuclides can now be saved as a mixture with a single mouse click. The mixture is then available in the Nuclide Mixture module under the name webKORIGEN nuclides.

The screenshot shows the webKORIGEN interface with a table of nuclides and a summary table. A red circle highlights the 'Save as Mixture' button and the text '...of up to 20 selected Nuclides'.

Plot	Z	Nuclides	Results	Plot	Z	Elements	Results	Plots	Totals	Nuclides	Elements	Results
<input checked="" type="checkbox"/>	55	Cs137	1.095e+17	<input type="checkbox"/>	55	Cesium	1.402e+17	<input checked="" type="checkbox"/>	Actinides+Progenies:	93	19	1.130e+17
<input checked="" type="checkbox"/>	56	Ba137m	1.036e+17	<input type="checkbox"/>	94	Plutonium	1.054e+17	<input type="checkbox"/>	Actinides:	61	11	1.130e+17
<input checked="" type="checkbox"/>	94	Pu241	9.939e+16	<input type="checkbox"/>	56	Barium	1.036e+17	<input type="checkbox"/>	Transuraniums:	38	7	1.130e+17
<input checked="" type="checkbox"/>	39	Y90	7.120e+16	<input type="checkbox"/>	39	Yttrium	7.120e+16	<input type="checkbox"/>	Minor Actinides:	21	3	7.577e+15
<input checked="" type="checkbox"/>	38	Sr90	7.118e+16	<input type="checkbox"/>	38	Strontium	7.118e+16	<input type="checkbox"/>	Radon:	3	1	4.832e+10
<input checked="" type="checkbox"/>	55	Cs134	3.069e+16	<input type="checkbox"/>	61	Promethium	2.914e+16	<input checked="" type="checkbox"/>	Fission Products:	605	43	4.669e+17
<input checked="" type="checkbox"/>	61	Pm147	2.914e+16	<input type="checkbox"/>	63	Europium	1.211e+16	<input type="checkbox"/>	Lanthanides:	106	12	4.959e+16
<input checked="" type="checkbox"/>	63	Eu154	9.624e+15	<input type="checkbox"/>	44	Ruthenium	9.475e+15	<input type="checkbox"/>	Rare Earths:	146	14	1.303e+17

More information on the Nucleonica wiki at [webKORIGEN](#)

- It is possible to export the webKORIGEN output into an Excel spreadsheet. In a typical calculation around 800 nuclides are produced mainly through the fission process. The list of nuclides together with their masses, activities, etc. can be downloaded to Excel or CSV files. Alternative cross section libraries are now available. In addition to the standard libraries, the following two additional libraries are available: PWR UOX 4.0% U235 60MWd/kgHM, PWR UOX high burn-up (ORNL).

7. Decay Engine

A date calculator has now been introduced into the Decay Engine. This is very useful for calculating the activity of standards, which are certified on a specified date. Say you have a standard of Pb-210 from 1.12.1990. It is now possible to enter the date on the certificate and directly calculate the activity today or at any other date. Alternatively, if you have measured the activity of say a radwaste sample a few months ago, it is now straightforward to obtain the activity today. Universal time (UTC) is used for date and time conversions.

More information on the Nucleonica wiki at [Decay Engine](#)

The screenshot shows the Decay Engine interface for Pb-210. A red circle highlights the date input fields.

Pb210
22.17 y

Decay engine
82 Lead

Current Chart: Karlsruhe

Element: Pb Mass: 210 Mixture selector

Decay Engine Options

Quantity: Becquerel 1e6

Time: Years 2.38E+01

Starting Final (or now if empty)

Date: 1.9.1987 12:00:00 02.07.2011 07:00:39 (Universal time, UTC)

More information on the Nucleonica wiki at [Gamma Library](#)

More information on the Nucleonica wiki at [webGraph](#)

More information on the Nucleonica wiki at [Dosimetry & Shielding](#)

8. Gamma Library

The new Nucleonica Gamma Library module has been released for general use. The library creation module can be used to create nuclide libraries using the latest internationally evaluated nuclear data. In addition to text formats, some proprietary formats (e.g. GammaVision) are also supported. Such libraries are required for example for radionuclide identification programs such as the WESPA (web spectrum analyzer) module in Nucleonica. Libraries can be created using a range of commercial software, but usually the data (which includes nuclide, energies, emission probabilities, $T_{1/2}$, etc.) has to be entered by hand. Also the underlying databases may not be up to date with the most recent nuclear data. Using the Gamma Library creation module in Nucleonica for this purpose makes life easier.

9. webGraph

The user interface has been substantially improved. webGraph now offers a choice of 5 types of graphs: Simple Graph, Log/Log Graph, webGraph Logo, Multiple Independent Curves and User Defined. The curve styles (colour, line style, symbol, etc.) can be edited independently within the general graph settings in the Option tab.

10. Physical Constants

The physical constants have been updated to reflect the new CODATA 2010 recommended fundamental physical constants.

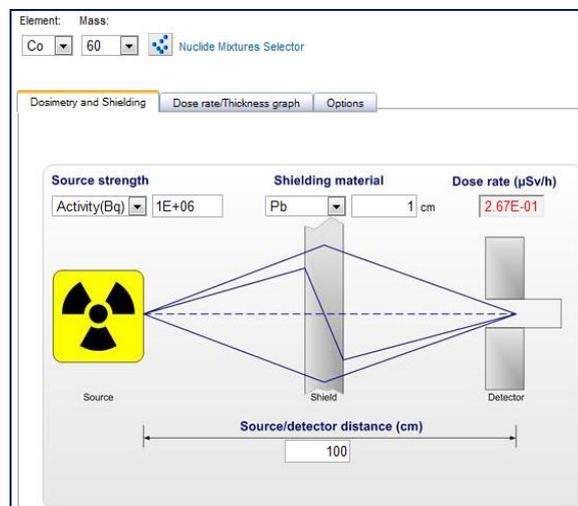
2010
2006 CODATA RECOMMENDED VALUES OF THE FUNDAMENTAL
CONSTANTS OF PHYSICS AND CHEMISTRY NIST SP 959 (Aug/2006) UPDATE
VALUES FROM: P. J. Mohr, B. N. Taylor, and D. B. Newell, *Rev. Mod. Phys.* **80**, 633-636 (2008), and *J. Phys. Chem. Ref. Data* **37**, 1187 (2008). The number in parentheses is the one-sigma (1σ) uncertainty in the last two digits of the given value. POBS

Quantity	Symbol	Numerical value	Unit
speed of light in vacuum	c, c_0	299 792 458 (exact)	m s^{-1}
magnetic constant	μ_0	$4\pi \times 10^{-7}$ (exact)	N A^{-2}
electric constant $1/\mu_0 c^2$	ϵ_0	$8.854 187 817 \dots \times 10^{-12}$	F m^{-1}
Newtonian constant of gravitation	G	$6.674 08(67) \times 10^{-11}$	$\text{m}^3 \text{kg}^{-1} \text{s}^{-2}$
Planck constant	h	$6.626 068 96(46) \times 10^{-34}$	J s
$h/2\pi$	\hbar	$1.054 571 817(47) \times 10^{-34}$	J s
elementary charge	e	$1.602 176 487(40) \times 10^{-19}$	C
fine-structure constant $e^2/4\pi\epsilon_0\hbar c$	α	$7.297 352 5697(50) \times 10^{-3}$	
inverse fine-structure constant	α^{-1}	137.035 999 071(94)	
Rydberg constant $\alpha^2 m_e c/2h$	R_∞	10 973 731.568 525(73)	m^{-1}
Bohr radius $a/4\pi R_\infty$	a_0	$0.529 177 208 50(28) \times 10^{-10}$	m
Bohr magneton $eh/2m_e$	μ_B	$9.27 400 945(23) \times 10^{-26}$	J T^{-1}

Handwritten notes in red: 384(80) next to G , 957(17) next to h , 724(47) next to \hbar , 565(35) next to e , 074(94) next to α^{-1} , 29(55) next to R_∞ , 1092(17) next to a_0 , 68(20) next to μ_B .

11. Dosimetry & Shielding

In addition to the gamma dose rate in $\mu\text{Sv/h}$, the exposure rate ($\mu\text{Gy/h}$) in air is also computed and displayed.



Further information on the Karlsruhe Nuclide Chart can be found on the [Nucleonica website](#)

Some versions of the Karlsruhe Nuclide Chart...



The Karlsruhe Nuclide Chart Fold-out Chart



The Karlsruhe Nuclide Chart Wallchart

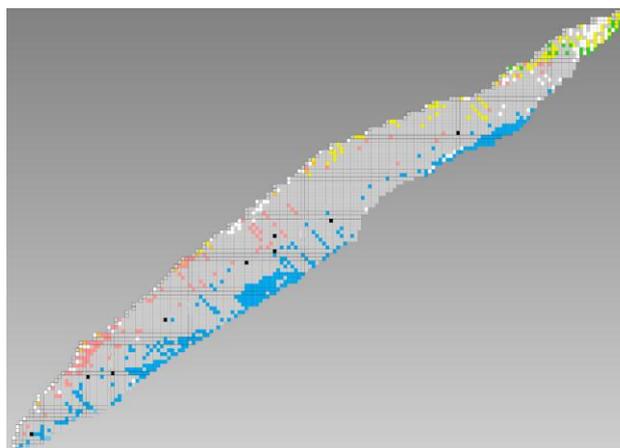
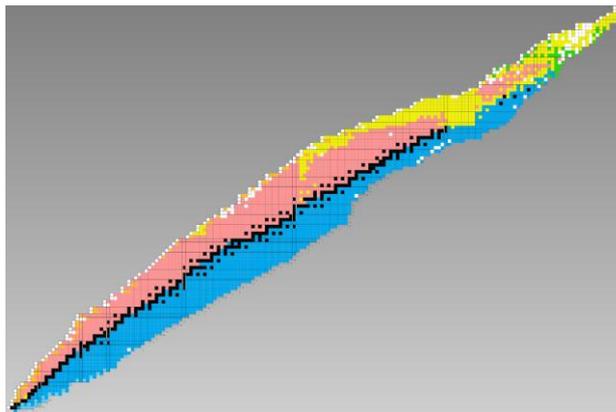


The new 8th Edition 2012 of the Karlsruhe Nuclide Chart –“Carpet” version is [now available](#).

Digital Print PVC: Polyester-Banner B1 with anti-slip laminate, Dimensions: 100 x 650cm, ca. 2mm thick. As an option your company's logo can be included on the carpet. If you are interested in obtaining this product for your organization please contact: info@nucleonica.com

Karlsruhe Nuclide Chart

The Nucleonica Team is currently in the final phases of the preparation of the new 8th Edition of the Karlsruhe Nuclide Chart (the previous 7th Edition was published in 2006). The new 8th edition contains experimental data on 3847 ground states and isomers. This data comprises of half-lives, branching ratios and decay modes, and energies of the emitted radiations. In addition, most recent values of the atomic weights, isotopic abundances and cross sections are included together with the thermal fission yields for both ²³⁵U and ²³⁹Pu. New element names copernicium (symbol Cn, element 112), and provisionally flerovium (Fl, element 114) and livermorium (Lv, element 116) have been introduced. As indicated in the "difference" Chart below, the new 8th edition contains information on the element 117 together with 194 new ground and isomeric states. New and updated experimental data on more than 471 ground and isomeric states are presented.



The new 8th Edition (2012) of the Karlsruhe Nuclide Chart. The top figure shows the full chart. In the lower chart, the coloured boxes indicate new and updated nuclides.

The new nuclide clusters observed in the various parts of the “difference” Chart are a reflection of new machine developments and improvements at major nuclear centres such as the Joint Institute for Nuclear Research, Dubna, Russia; GSI Helmholtzzentrum for Heavy Ion Research, Darmstadt, Germany; Lawrence Berkeley National Laboratory, Berkeley, USA; Nishina Centre for Accelerator Based Science, RIKEN, Wako, Japan.

In addition to the fold-out and wall-Charts, a new auditorium Chart is planned for 2012 together with a new electronic version. An article on the Karlsruhe Nuclide Chart has been published in the international magazine lab&more. To read the articles, please click on the links below:

[The Treasure Island of the Universe](#) (in English)

[Schatzinsel des Universums](#) (in German)

The full training course proceedings are available [online](#)

Training Courses 2012!

Participating in a Nucleonica training course is the most effective way of learning to use Nucleonica.

Are you interested?

Please contact us at: info@nucleonica.com

Information on future training courses will also be posted on the Nucleonica web site at [Nucleonica Training Courses](#).

Training Courses on behalf of ITU

ITRAC-3: EC/JRC Nuclear Science Training Course - 3rd International Training Course on Illicit Trafficking and Radiological Consequences with Nucleonica, Karlsruhe, 11-13 May 2011

NuTRoNS-2: Joint EC-IAEA Nuclear Science Training Course with Nucleonica NuTRoNS-2: Nucleonica Training on Nuclear Science, 14 - 16 Nov. 2011 at the IAEA Marine Environment Laboratories in Monaco

These courses were devoted specifically to the use of Nucleonica applications within the fields of Illicit Trafficking and Radiological Consequences and Environmental Radioactivity. The courses were aimed at persons who provide technical support (measurements, interpreting results, drawing conclusions, making recommendations) for the actions in response to illicit trafficking incidents and radiological events. The participants included physicists, radio-chemists, health physicists, technical experts from national law enforcement agencies and regulatory authorities.

Guest speakers included Dr. Andrey Berlizov from the IAEA's Safeguards department and Dr. George Lasche from Sandia Laboratories. ITU speakers included Drs. Z. Soti, K. Mayer, M. Wallenius, J. Galy, J. Zsigrai, and E. Hrneck. From the Nucleonica team speakers were J. Magill and R. Dreher. Participants from Switzerland, Turkey, Macedonia, Azerbaijan, Latvia, Romania, Netherlands and Belgium took part in the courses. The course organizers acknowledge the financial assistance from the JRC's Enlargement and Integration Action (E&IA).

Highlights of the training courses were sessions on the Fukushima reactor accident and Nucleonica's newest application: the Virtual Cloud Chamber.

BfS-Nucleonica training course in Berlin

This one-day training course for staff at the Federal Office of Radiation Protection (BfS) was held in Berlin on 3rd Nov. 2011. The special focus in this course was on the use of the "standalone" version of Nucleonica. A highlight of the course was on the analysis of gamma spectra using the Cambio and WESPA modules.



Participants at the ITRAC-3 training course in Karlsruhe May 2011



Participants at the NuTRoNS-2 training course in Monaco november 2011

For further information, see [Nucleonica Premium Access](#)

Thank you!

Nucleonica GmbH would like to thank the ITU Director Prof. Thomas Fanghaenel and Messrs. Olivier Eulaerts and Huseyin Kebapci from the Technology Transfer Unit of the JRC in Brussels for their tremendous help and support in establishing this new spin-off company.

The Nucleonica Team would also like to thank the following organisations for supporting us through contracts and license agreements in this first year of operation. Our first customer was the Federal Office for Radiation Protection (BfS) in Germany. We were also awarded a contract to develop a CBRN Glossary wiki along the lines of the Nucleonica wiki-based glossary. This Glossary was also designed especially for use with smart phones. Our first institutional license agreements were signed with Paul Scherrer Institute (PSI) in Switzerland, ARPANSA in Australia, and SCK-CEN in Belgium. These were followed later with license agreements with WAK and KIT in Germany, ENSI in Switzerland, and the Technical University of Munich. Recent license agreements have been signed with SANDIA laboratories, IAEA, CERN and FZ-Juelich.



Impressum

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The Nucleonica Newsletter is prepared by Nucleonica GmbH, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany

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Nucleonica GmbH is a spin-off from the JRC's Institute for Transuranium Elements

