Nucleonica Newsletter

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2016 in Review

Dear Nucleonica Users,

In 2016, we continued with our mission to build the most innovative technical resource for knowledge creation & competence preservation for the worldwide nuclear science community. Our vision is to provide scientists, engineers and technical personnel in the field the best software solutions and, in addition, create a sustainable home for the nuclear science community on the web.

Nucleonica Online Applications
During the past year, we have again extensively upgraded and re-written a wide range of applications. In particular the following new applications have been created: Photon Dose Rate Constants, Radiological Converter, and Dosimetry & Shielding, H*(10). Pages 2-4 describe these new developments in more detail.

Nucleonica Dedicated Training Courses
In the area of training, 2016 has been a busy year for the Nucleonica team. In May there was a 2-day training course in CERN. This was followed by 3 training courses at the WAK / KIT in Karlsruhe and a course at JEN mbH on the Fz-Juelich site. In November, a training course was held at the BfS premises in Berlin with emphasis on nuclear security and nuclear material identification. For more information see pages 11-13.
If you would like to book a dedicated training course for your organisation 2017, please make sure to register your interest as soon as possible. To enquire about Nucleonica training courses, please send an email to info@nucleonica.com.

Karlsruhe Nuclide Chart
We continue to provide updates to the Karlsruhe Nuclide Chart through a collaboration with the EC's DG Joint Research Centre. The new element names recently accepted by IUPAC have been included in the Karlsruhe Nuclide Chart Online. To order copies of the most recent version of the Chart, please place your order here. More information can be found on page 10.

We Welcome your Feedback
Finally, thanks to all our partners and users for the many suggestions and proposals which we received during 2016. Many of these have been discussed in our Forum and where possible the relevant application has been updated. A particular example here was the request to update the Dosimetry & Shielding and related applications to include the internationally standarised ambient dose equivalent H*(10).

On the following pages, this Newsletter informs you in more detail about the above developments. Hopefully you find this of interest.

Finally, thanks for your continued support and best wishes for 2017.

Sincerely yours,

Joseph Magill
Managing Director

What's New in Nucleonica (2016)

1. Photon Dose Rate Constants++

The new Photon Dose Rate Constants++ application in Nucleonica allows the user to calculate the internationally accepted Ambient Dose Equivalent Rate Constants, Air Kerma Rate Constants, and Exposure Rate Constants for approximately 1500 gamma and x-ray emitting radionuclides. These quantities are useful for estimating the dose rates from point sources where attenuation and scattering in the source and in air are negligible. From the dose rate constants, the ambient dose rates H*(10), air kerma rates K_{air}, and exposure rates X can then be obtained.
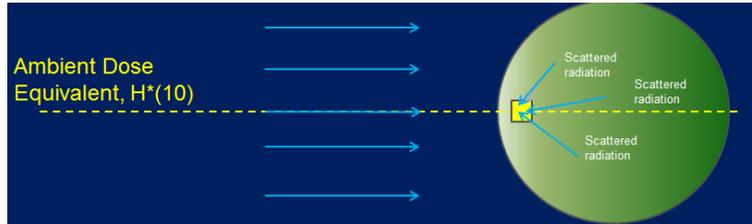
In contrast to previously defined dose rates, the ambient dose rate H*(10) accounts for absorption and scattering in the human body by simulating the body through a phantom (the ICRU sphere of 30 cm diameter made of tissue equivalent material).

For the calculation of the dose rate constants, some nuclides are considered to be in equilibrium with daughter products. This is the case when a single radioactive decay chain in which radionuclides are present in their naturally occurring proportions, and in which no daughter nuclide has a half-life either longer than 10 days or longer than that of the parent nuclide, shall be considered as a single radionuclide.

Additional features of the application are that 1. the underlying dataset used in the calculations can be selected from a list of international nuclear datafiles (JEFF3.1, ENDF/B-VII.1, etc.) and viewed in the results grid; and 2. the threshold energy used in the calculations can be set by the user to investigate the effect of this on the calculation results.

2. Radiological Converter

The Radiological Converter is a further development of Nucleonica's Mass Activity Converter++ with the following new features:

* The list of conversion quantities now covers a) air kerma rates Kair; b) exposure rates X; and c) ambient dose equivalent rates H*(10) for approximately 1500 gamma and x-ray emitting radionuclides (depending on the database used).

* The threshold energy used in the calculations for dose quantities can be set by the user to investigate the effect of low energy photons on the dose calculations.

* Account is taken of short-lived daughter nuclides when a parent nuclide is selected indicated with a * e.g. Cs137*.

* The underlying dataset used in the calculations can be selected from a list of international nuclear datafiles (JEFF3.1, ENDF/B-VII.1, 8th TORI)

More information on the
[Radiological Converter](#)

Radiological Converter showing the new dose quantities. A key feature is the inclusion of short-lived daughters in the calculations as indicated by an asterisk * before the physical quantities and following the nuclide name e.g. Cs137*.
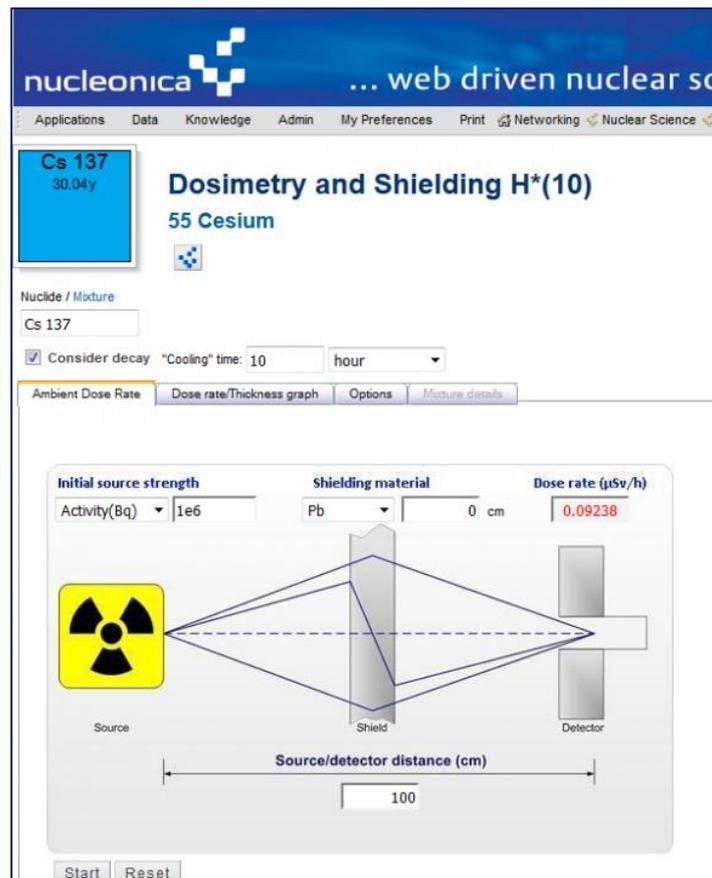
3. Dosimetry & Shielding H*(10)

The new Dosimetry & Shielding H*(10) is a further development of Nucleonica's Dosimetry & Shielding++ with the following new features:

* The list of calculated quantities now covers a) air kerma rates Kair; b) exposure rates X; and c) ambient dose equivalent rates H*(10) for approximately 1500 gamma and x-ray emitting radionuclides (depending on the database used).

* The threshold energy used in the calculations for dose quantities can be set by the user to investigate the effect of low energy photons on the dose calculations.

* Account is taken of short-lived daughter nuclides when a parent nuclide is selected indicated with a * e.g. Cs137*.

* The underlying dataset used in the calculations can be selected from a list of international nuclear datafiles (JEFF3.1, ENDF/B-VII.1, 8th TORI)

More information on the

Dosimetry & Shielding H*(10)

The Dosimetry & Shielding H*(10) application with the new dose quantities. A key feature is the inclusion of short-lived daughters in the calculations as indicated by an asterisk * before the physical quantities and following the nuclide name e.g. Cs137*.

4. Derived Data with new dose quantities

The Derived Data application in the Nucleonica Nuclide Datasheets++ has been updated to include the new dose quantities. The Derived Data now include:

* The list of derived data now includes covers a) air kerma rates Kair; b) exposure rates X; and c) ambient dose equivalent rates H*(10) for approximately 1500 gamma and x-ray emitting radionuclides (depending on the database used).

* The threshold energy used in the calculations for dose quantities can be set (in the Options) by the user to investigate the effect of low energy

photons on the dose calculations.

* The results are for single nuclides only. In this application, no account is taken of short-lived daughters. To obtain the results including short-lived daughters the user should use the Photon Dose Rate Constants application.

* The underlying dataset used in the calculations can be selected from a list of international nuclear datafiles (JEFF3.1, ENDF/B-VII.1, 8th TORI)

More information on the

[Derived Data](#)

Derived Data showing the new dose quantities.

5. Apache Subversion SVN for Nucleonica Source Control Management

Due to the ever increasing scale and range of the applications, Nucleonica software developers are now using Subversion SVN to maintain current and historical versions of files such as source code, web pages, and documentation. Apache Subversion (often abbreviated SVN, after its command name svn) is a software versioning and revision control system distributed as free software under the Apache License (Wikipedia).

More information on the [Subversion SVN](#)

The SVN server (VisualSVN standard version) has now been installed and is running on a Nucleonica server. This can be addressed with any SVN clients such as the Tortoise SVN client.
(https://tortoisesvn.net/index.en.html)

With the Tortoise client installed locally on the development computers, the Nucleonica programmers can address the repository with the appropriate URL to have the latest source code and keep the repository updated.

6. Natural Radioactivity

Nucleonica's Natural Radioactivity Applet has been rewritten as a standard Nucleonica application to replace the Java applet version. The application is an educational tool to provide information on the radioactivity of everyday materials.

More information on the Natural Radioactivity application

The new application, Natural Radioactivity, has the following new and updated features:

– The application is no longer a Java applet and it is therefore not necessary to install the Java runtime environment.

– the application runs directly is most modern browsers, in particular Chrome, Firefox, Internet Explorer, Safari etc.

– The application consists of a number of images of everyday materials, locations, etc. On placing the mouse over the image, information on the radioactivity and dose rate are given qualitatively in a central panel. Additionally, an acoustic signal is given corresponding to the level of the radioactivity (low, medium, high).

– Clicking on an image will lead to further information shown in a pop-up window.

– The wiki page gives further information together with relevant references to the information shown.

7. Decay Tree features & improvements

The Decay Tree feature in Nucleonica's Decay Engine++ allows users to see and investigate all possible linear decay chains resulting from the decay of a radioactive nuclide or nuclide mixture. This feature is very useful when the decay process is relatively complex. It is particularly useful when fission products, resulting from spontaneous fission, are involved in the decay.

The Decay Tree information contains the following new features:

– The example above shows the results for the decay of Cf-254. The summary information shows the number of nodes (800), number of nuclides (329) and the number of linear chains (212) considered in the decay calculation

– A particular daughter of interest (e.g. Cs-137 resulting from spontaneous fission) can be selected from the "Highlight a nuclide" drop-down menu. Of course any other daughter product can be selected from this menu.

– Additional information can be shown by clicking the radio buttons "Show expanded nodes", "Show all".
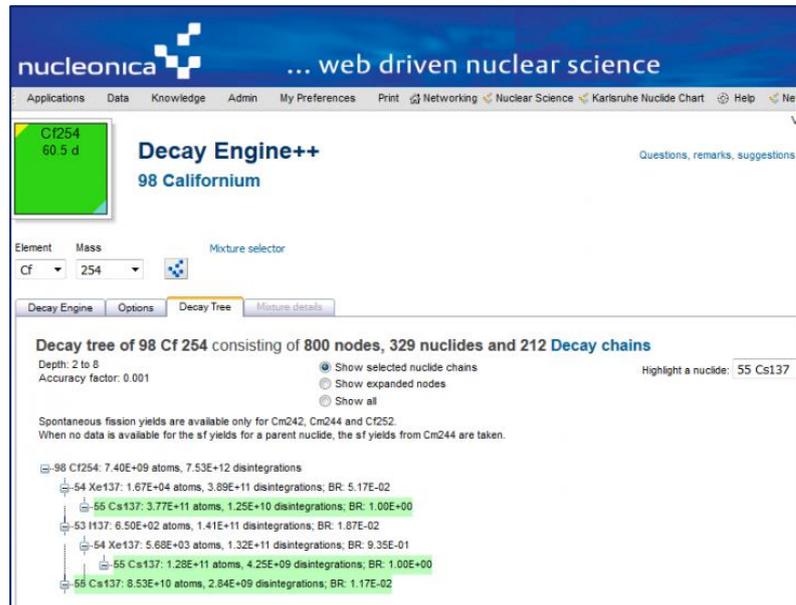
8. Decay Engine for Large Nuclide Sets, DELNuS++

Nucleonica's Decay Engine for Large Nuclide Sets, DELNuS++, has been further updated. The application is particularly suitable for performing decay calculations with large numbers of nuclides (nuclide sets). It is also useful for investigating the radioactive decay of nuclides which undergo spontaneous fission (sf). The new application has the following new and updated features:

– Nuclide inventories can now be created and edited directly within the application. This allows users to easily create inventories containing one or more nuclides for test purposes.

– In the inventory creation process, single nuclides as well as previously created nuclide mixtures can be added to the new inventory.

– The allowed file formats has now been considerably extended to make the upload procedure more user friendly.

– Allowed file formats: The decimal separator may be the comma or the point. If the comma is used as field separator, numerical values with a decimal comma must be quoted with double quote characters e.g. "3,14"

– the new version of DELNuS++ has been tested on Firefox, Chrome and Edge browsers.

9. Mass Activity Converter++

Nucleonica's Mass Activity Converter has undergone a major revision. The new Mass Activity Converter++ has the following new and improved features:

– The nuclide icon box at the top left of the page is based on a client side javascript function which creates the nuclide icon. The information contained in the nuclide box is loaded for all nuclides together with the

application. Previously the nuclide image was created on the server and sent to the client when the application was loaded or a new nuclide selected.

– The nuclide selector box is now a single drop-down menu. On entering the first letter of the nuclide of interest a list of all nuclides with this first letter is shown. Thereafter, the desired nuclide can be selected or a second letter can be inserted to further refine the search, etc. This is a more efficient procedure for nuclide navigation.

More information on the Mass Activity Converter

– The nuclide mixtures are now listed in the nuclide selector drop-down menu by clicking on the "mixtures" hyperlink. Clicking again on the "nuclides" hyperlink will restore the list of nuclides.

– Clicking on the small icon adjacent to the nuclide box icon (top left of page) will activate a pop-up menu showing the position of the nuclide and its daughters in the nuclide chart (Nuclide Explorer++).
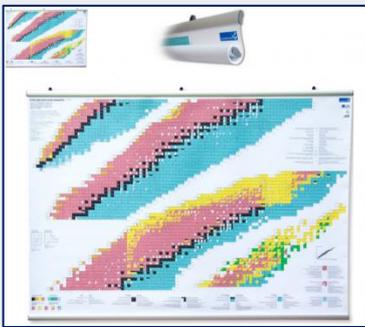
– Internally the code has been significantly streamlined and simplified. When the application is loaded all relevant nuclide data are available in the client browser. When calculations for a different nuclide are required, no further calls to the server are required.

The Karlsruhe Nuclide Chart Fold-out Chart (A4)

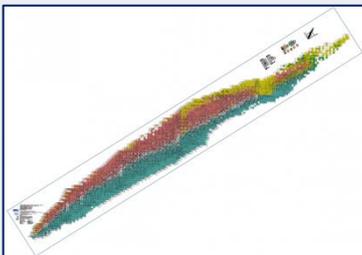The Roll Map (170x120cm).

The Auditorium Chart, 43 cm x 316 cm.

The Karlsruhe Nuclide "Carpet" (approximate dimensions 100cm x 650m). Courtesy CERN

Karlsruhe Nuclide Chart

9th Edition (2015) of the Karlsruhe Nuclide Chart

Through a joint collaboration between Nucleonica GmbH and the European Commission's Joint Research Centre (JRC), the 9th Edition of the Karlsruhe Nuclide Chart was published in 2015. In this latrest edition there are 147 new nuclides not listed in the previous and 1497 updates. In total, nuclear data on 3992 experimentally observed nuclides are presented. The accompanying booklet contains the multi-lingual "Explanation of the Chart of Nuclides" in English, German, French, Spanish, Chinese and Russian. The booklet has been substantially expanded to include the reduced nuclide decay schemes with a total of 50 examples.
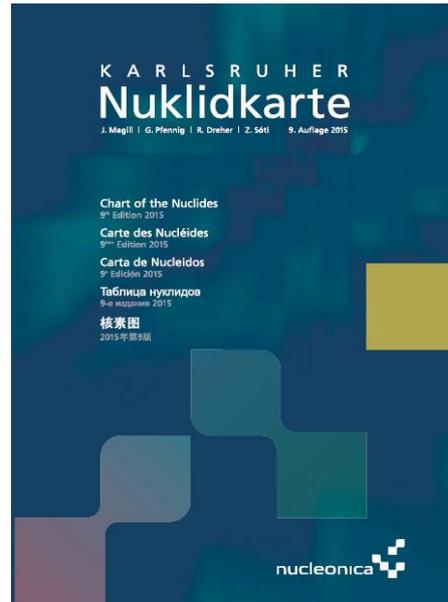
9th Edition (2015) of the Karlsruhe Nuclide Chart

New names for elements 113(Nh), 115(Mc), 117(Ts), 118 (Og)
They are nihonium (with the symbol Nh), moscovium (Mc), tennessine (Ts), and oganesson (Og). Until now, the quartet have been referred to simply by the number of protons in each atom – 113, 115, 117 and 118, respectively. The new names and symbols have been updated in Nucleonica and in particular the Karlsruhe Nuclide Chart Online.
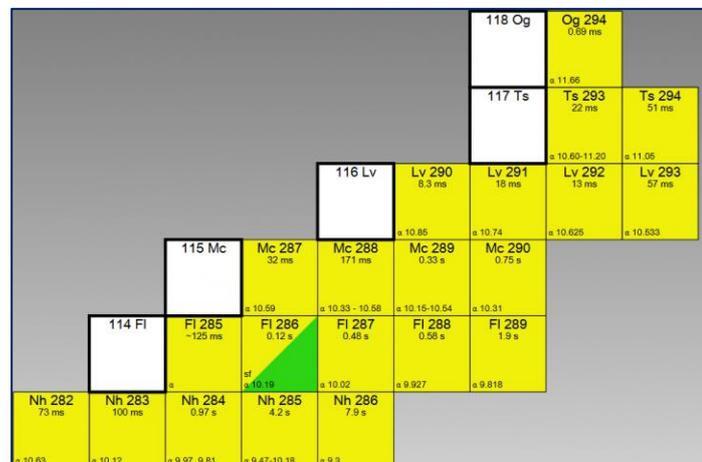
Nihonium references the Japanese name for Japan. The atom was discovered at the RIKEN Nishina Center for Accelerator Science. Moscovium was named after the Moscow region, the location of the Joint Institute for

Nuclear Research in Dubna. Tennessine recognises the US state of Tennessee and the local contributions made to the discovery by the Oak Ridge National Laboratory and Vanderbilt University. Oganesson honours the nuclear physicist Yuri Oganessian, who has played a leading role in the search for new elements including the one that will now bear his name.

Conferences / Meetings 2016

Training Courses 2016

May 2016 CERN

Introduction to Nucleonica: Core Applications, CERN, 18-19 May 2016.

Photo: CERN computer centre

This 2-day training course took place at CERN during 18-19 May 2016. The course focused mainly on the Nucleonica Core Applications and tools. A detailed description of nuclear data with particular reference to the various Nucleonica nuclear databases was given. Core applications were demonstrated through the use of Nucleonica tools such as the Decay Engine++, and Dosimetry and Shielding++. A key lectures were given by Mr. Yann Donjoux (CERN) on the e-Ship++ radiological transport assistant applications in Nucleonica. In total, 14 persons took part in the course from the various CERN departments.

June 2016 Karlsruhe

Introduction to Nucleonica: KIT/WAK, 16.June, 30. June and 13 Oct. 2016.

These 1-day training courses took place at KIT/WAK Karlsruhe (WAK GmbH, WAK Decommissioning and Waste Management Company) in 2016. The courses focused mainly on the Nucleonica Core Applications and tools. A detailed description of nuclear data with particular reference to the various Nucleonica nuclear databases was given. Core applications were demonstrated through the use of Nucleonica tools such as the Decay Engine++, and Dosimetry and Shielding++. These courses were mainly in the area of decommissioning and nuclear waste characterization with emphasis on final repository declarations, nuclear material accountancy, plausibility checks, etc. In total, 30 persons took part in the course from the various WAK departments.

Photo: WAK training course

Nucleonica presentation at JRC Ispra, September 2016

An overview of Nucleonica was given at the 8th International Summer School on Operational Issues in Radioactive Waste Management and Nuclear Decommissioning, 12-16 September 2016, at JRC Ispra in Italy. See…http://2016.radioactivewastemanagement.org/

November 2016 Berlin

Nucleonica Training on Nuclear Security with Case Studies, 2-3 November, BfS Berlin, 2016.

This 1-day training course took place at the offices of the Federal Office for Radiation Protection (Bundesamt für Strahlenschutz BfS) in Berlin, during the 2-3 November 2016. This was an introductory level training course which focused mainly on the Nucleonica core applications with emphasis on Case Studies. A detailed description of nuclear data with particular reference to the various Nucleonica nuclear databases was given. Nuclear security related case studies were given on the identification of suspected nuclear and radioactive materials using Cambio and WESPA++. In total, 12 persons took part in the course from the various BfS locations in Germany.

November 2016 Jülich

Introduction to Nucleonica: Core Applications and Tools, JEN mbH, Fz-Juelich 22-23 Nov. 2016.
This 1.5-day training course took place at the offices of the JEN mbH in Fz-Juelich, during the 22-23 November 2016. This was an introductory level training course which focused mainly on the Nucleonica core applications with emphasis on Case Studies.

A detailed description of nuclear data with particular reference to the various Nucleonica nuclear databases was given. Core applications were demonstrated through the use of Nucleonica applications such as the new Radiological Converter, Nuclide Mixtures, Decay Engine++, and Dosimetry and Shielding++. A special session was devoted to gamma spectrometry tools including the Gamma Spectrum Generator, Gamma Library, Cambio and WESPA. The latter tools (Cambio and WESPA) were used for the identification nuclear and radioactive materials. In total, 12 persons took part in the course from both JEN mbH and Fz-Juelich.

Careers

Nucleonica is looking for scientific software developers with a physics and informatics background, who would like to grow with us, who share integrity, intellectual curiosity and the desire to work in a collegial atmosphere with like-minded people. Nucleonica offers full and part time jobs.

You should have experience in:

- Software development in VB, C#
- Experience in HTML5, CSS, PHP, etc.
- Client and server side development with JavaScript

Internships are available to undergraduate and advanced degree students throughout the year. We are also open for collaborations and meeting potential partners.

If you would like to apply, simply send us your CV and cover letter by email to:

joseph.magill@nucleonica.com

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

The mission of Nucleonica is to provide you with the most reliable online tools for nuclear science applications, easy access to the latest nuclear data, and to make nuclear education and training more effective and interesting.

Photo: Nucleonica training course

To enquire about Nucleonica training courses, please send an email to info@nucleonica.com.

Thank you!

The Nucleonica Team would like to thank the many organizations which have signed up for Premium use of Nucleonica during 2016 and we look forward to working with you in 2017. We would like to thank everyone who has contributed during 2016. Thanks also to Dr. Zsolt Soti from JRC for the collaboration on the 9th edition (2015) of the Karlsruhe Nuclide Chart, Dr. Tim Widmar from SCK-CEN and Dr. Andrey Berlizov from the IAEA.

In 2016 Nucleonica has made donations to SOS Kinderdorf, Médecins Sans Frontières and UNICEF.