In this Issue

- Nucleonica Online Applications
- Dedicated Training Courses
- Karlsruhe Nuclide Chart, new 10th Edition 2018

2017 in Review

Dear Nucleonica Users,

Hopefully you had a successful 2017 and a good start into the new year. For the Nucleonica Team, a major focus during the past year was on the development of a new Nucleonica landing page. In addition, a new web page (App Portal) has been specifically designed to enhance the navigation through the ever-increasing number of Nucleonica applications and tools. These web pages are based on the principles of Responsive Web Design (RWD) and are optimised for easy navigation across devices (i.e. PCs, tablets and smartphones). Through the use of filters, the user can access all Nucleonica applications and tools ("show all") or a subset of these applications and tools based on the most recently used ("last used"), most popular ("popular"), type ("applications", "data", "knowledge"), etc. enabling you to find your desired application more easily and quickly.

Nucleonica Online Applications
Again, we have extensively upgraded and re-written a wide range of applications. In particular, the following new applications have been created: Reduced Decay Schemes, Coincidence Summing Corrections++, Beta Energy Spectra, Beta Dose Rates, App Portal, CoReT Concept Repository Temperatures. Pages 2-9 describe these new developments in more detail.

Dedicated Training Courses
Introductory and advanced courses provide expert training for our users. Specialist courses on nuclear security demonstrate the power of the Nucleonica applications in this area. For more information see pages 12-13.
To enquire about Nucleonica training courses, please send an email to info@nucleonica.com.

Karlsruhe Nuclide Chart, new 10th Edition 2018
The new 10th edition of the Karlsruhe Nuclide Chart is in the final stages of preparation. Publication is planned for early 2018 to coincide with the 60th anniversary of the Chart through collaboration with the European Commission’s Joint Research Centre. The new element names recently accepted by IUPAC have been included in the new edition. To order copies of the most recent version of the Chart, please click here. More information can be found on pages 10-11.

We Welcome your Feedback
We value the many suggestions and proposals which we received during 2017 from all our partners and users that helped us improve the platform. Three major new applications on Coincidence Summing Corrections, Beta Dose Rates, and Concept Repository Temperatures (CoReT) have been developed through collaboration with our colleagues from SCK-CEN, CERN, and the Interkantonales Labor (Switzerland), respectively.

On the following pages, this Newsletter informs you in more detail about the above developments.
I would like to thank you for your continued support and best wishes for 2018.

Sincerely yours,

Joseph Magill
Managing Director
What's New in Nucleonica (2017)

1. Reduced Decay Schemes

The Reduced Decay Schemes is a new application for displaying the decay schemes of selected nuclides.

The nuclear data contained in the nuclide boxes (in the Karlsruhe Nuclide Chart for example) is concise due to the very limited space available. In order to obtain maximum benefit from the nuclide chart, it is important to know how to interpret the box contents correctly. In the new application, the contents of the nuclide boxes are explained in detail by making reference to the nuclide reduced decay scheme in order to relate the box contents containing information on energies of emitted particles with the energy levels in the nucleus in the decay scheme diagram. Additional data has been taken from the Nuclear Data Sheets and Nucleonica’s Datasheets.

To improve understanding, some transitions not mentioned in the box are added and indicated as dotted lines. Corresponding data is also indicated in grey. Radiations with a low emission probability indicated by dots or brackets in the nuclide box are also drawn with dotted lines. Additionally a gamma spectrum of the particular nuclide is shown (generated by Nucleonica’s Gamma Spectrum Generator application).

2. Coincidence Summing Corrections++

True Coincidence Summation occurs when two gamma-rays are emitted during the same decay event of the nucleus, so that they appear to be emitted instantaneously. This seemingly instantaneous emission of separate gamma-rays is known as coincidence. In this situation the detector will see both of the gamma-ray energies as one larger energy deposited in the detector. A tell-tale sign of coincidence is a summation peak that appears at...
the combined energy of the two characteristic gamma-rays of the source.

The Coincidence Summing Corrections++ application offers the possibility of calculating the coincidence summing correction factors for a large number of radionuclides and for virtually any detector and sample size, density and composition. The results are given gamma-line by gamma-line, with the unaffected lines having a correction factor of 1.

3. Nucleonica website connections now encrypted.

From 27 March 2017 the Nucleonica website connection has been encrypted through the use of a SSL certificate. Access to Nucleonica is now through https://www.nucleonica.com. Using the older link http://www.nucleonica.com will result in a redirection to the new secure link.

Pages that need to transmit private information, such as credit cards, personal information and passwords, need to have a secure connection to help prevent attackers from gaining access to your information. (A secure connection will have “HTTPS” in the address bar, along with a green lock icon.)

The Dosimetry & Shielding H*(10) has been further extended to include a new tab giving detailed information on the mass coefficients and buildup factors for a range of materials. The data is available in both graphical and tabular form.

The list of shield entries, which has been extended to include 14 new materials, now consists of: Air, Aluminium, Argon, Beryllium, Boron, Calcium, Carbon, Concrete, Copper, Gadolinium, Iron, Lanthanum, Lead, Magnesium, Molybdenum, Nitrogen, Oxygen, Phosphorus, Potassium, Silicon, Sodium, sulfur, Tin, Tungsten, Uranium, Water.

5. Beta Energy Spectra

The Beta Dose Rate application has been extended to include the beta energy spectrum using the end-point energies for all beta- and beta+ emitters. Beta spectra can be generated for both individual nuclides and nuclide mixtures.

The graph shows the spectrum for each of the three beta end-point energies for Cl-38. In addition, the sum of the spectra is also shown. It is also possible to show the end-point energies, the spectrum, and the end-point energies superimposed on the spectra.

The underlying data used in the calculations are currently from the international nuclear datafiles.
6. Beta Dose Rate Application

Nucleonica’s Beta Dose Rate application has been extended to include the personal dose equivalent \(Hp(0.07)\) @ 10cm in air for over 760 beta emitting nuclides. The beta spectrum for each end-point beta energy is used to calculate the flux at a distance of 10 cm from the source. Using the conversion coefficients (from Monte Carlo calculations) for electrons for flux to dose in air, the dose rates at a depth of 0.07 mm are calculated.

Of the 763 beta emitters for which data is available, there is good agreement to within 20% for 88% of all nuclides with recent literature values (Otto 2016). For 66 nuclides (8.6%) agreement is in the range 20 - 100% (i.e. a factor two). For 22 nuclides there is quite a large disagreement (> factor 2).

A colour coding system has been introduced: green (good agreement within 20%); yellow (agreement to within a factor 2); and red where there are larger discrepancies. In the latter case care must be used with the values given (i.e. need to check the underlying nuclear data).

8. New Blog category for Forum and FAQ posts

From 2017, Forum and FAQ posts will be hosted together in a new Blog category FAQs. Pre-2017 Forum and FAQ posts have been moved to Wiki page FAQs.

9. Nucleonica Get a Quote

It is now possible for new users to obtain a quote for a Nucleonica licence directly from the Nucleonica landing page. The new application allows the user to select the product (Nucleonica portal, Karlsruhe Nuclide Chart Online), their organisation type (academic, government, commercial) and the number of licences being requested.

Additionally, after entering some personal details, a pdf quote can be downloaded for the user’s purchasing / finance department.
7. New Nucleonica Landing Page

The Nucleonica landing page at www.nucleonica.com has undergone a complete redesign to make it more compatible with tablet and mobile devices using the principles of Responsive Web Design.

Nucleonica Landing Page at www.nucleonica.com. The main graphic shows how the page is displayed on a PC. The inset shows the page on a mobile device.

- The landing page provides links to the most important information for potential users: Applications, Pricing, Clients, KNC Shop (Karlsruhe Nuclide Chart Shop). For users interested in registering for Free Restricted access, the SIGN UP NOW buttons are shown prominently. Existing users can access the portal via the login button with username and password.

- The new Landing Page features are supported by most major browsers including Chrome, Firefox, Internet Explorer, Safari.

10. Virtual Cloud Chamber revisited

The Virtual Cloud Chamber has been updated. The previously used Cortona VRML plugin viewer used to view the GEANT4 3D simulations is no longer supported by modern browsers and has been discarded. In its place, the VMRL WRL files are now converted from WRL to X3D HTML format using a tool from InstantReality. A major advantage is that the converted files can now be shown directly in the browser – without the use of a plugin.

10 MeV photons incident on a lead target showing the production of electron-positron pairs in the presence of a magnetic field.

Animations can also be generated by the Virtual Cloud Chamber but these cannot be shown directly in the browser. To view the 3d animations, the user should download the Instant Reality player (instantplayer) for this purpose.
11. New App Portal

A new web page has been specifically designed to enhance the navigation through the ever-increasing number of Nucleonica applications and tools. The web page “App Portal” is based on the principles of Responsive Web Design (RWD) and Flat Design and is optimised for easy navigation on a variety of devices and window or screen size (e.g. tablets and smartphones). The new page has the following main features:

- Through the use of filters, the user can access all Nucleonica applications and tools (“show all”) or a subset of these applications and tools based on the most recently used (“last used”), most popular (“popular”), type (“applications”, “data”, “knowledge”), etc.

- Icons are colour coded according to the categories: nuclear science applications (blue), data visualisation (green) and knowledge tools (violet). The last used nuclides (brown) have their own category (“last nuclides”).

- Each icon has the form of a box with header (similar to nuclide boxes in a nuclide chart). In the header part, a short name for the application/tool is given (e.g. DE++). In the central part of the icon, the full name of the application/tool is given (e.g. Decay Engine++).

- There is a “Classic” icon which allows users to access the previous version of the App Portal i.e. Nucleonica Classic applications page. This will be supported for a limited period to allow users to become familiar with the new App Portal page.
12. Fundamental Constants updated

Nucleonica’s Physical Constants have been upgraded to account for recent 2016 values for fundamental constants. Based on state-of-the-art measurements, the updated values of the constants were prepared by the CODATA Task Group on Fundamental Constants. The recently updated constants including the Boltzmann constant, the Planck constant, the electron charge and the Avogadro constant will be included in the next 2018 CODATA publication.

![Physical Constants](image)

13. CoReT: Concept Repository Temperatures

The disposal of high-level radioactive waste in deep geological repositories requires stable and foreseeable physical conditions over very long time scales. During this period, the chemical stability of both the natural and the engineered barriers is governed by thermally activated processes. These in turn are driven by the heat pulse generated by the nuclear decay of waste products. The technical concept to cap the temperature peak in the repository is thus an important aspect for the proof of safety of disposal facilities.

![CoReT](image)

With the CoReT (Concept Repository Temperatures) application in Nucleonica, the user can specify the repository configuration (galleries and waste canisters), waste canister properties and thermal properties of surrounding environment and estimate the temperature evolution at various points in the repository as a function of time. Extensive validation of the new application is described in the wiki page.
The temperature evolution in a repository containing 2187 canisters at 650m depth with a typical Nagra heat power vector. The repository layout denoted by (g-27(40m)-81(8m)) implies a grid (g) of 27 galleries with 81 canisters in each gallery. Galleries are separated by a distance of 40m from each other. The canister separation distance is 8m.

The CoRet application was developed through collaboration between Nucleonica and Dr. Joachim Heierli from the Interkantonales Labor in Switzerland.

CoRet has undergone extensive validation tests which are documented in the wiki.

Print versions of the Karlsruhe Nuclide Chart...

To order copies of the most recent version of the Chart, please place your order...

Online shop

The Karlsruhe Nuclide Chart
Fold-out Chart (A4)

The Roll Map (170x120cm).

Auditorium Chart, 43 cm x 316 cm.

**Karlsruhe Nuclide Chart**

**New 10th Edition (2018) of the Karlsruhe Nuclide Chart**

Through a joint collaboration between Nucleonica GmbH and the European Commission’s Joint Research Centre (JRC), the 10th Edition of the Karlsruhe Nuclide Chart will be published in early 2018.

The new edition of the "Karlsruher Nuklidkarte" contains new and updated radioactive decay data on 696 nuclides (47 new nuclides) not found in the previous (2015) edition. In total, nuclear data on 4040 experimentally observed ground states and isomers 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 88 examples.

The new names and chemical symbols of elements nihonium (113, symbol Nh), moscovium (115, Mc), tennessine (117, Ts), and oganesson (118, Og) have been updated in the Karlsruhe Nuclide Chart.

This new 10th Edition coincides with the 60th anniversary of the Karlsruhe Nuclide Chart – the first edition appeared in 1958. Sadly, Gerda Pfennig, “Mother” of the Karlsruhe Nuclide Chart, died on 16 February 2017 aged 86. Since the first edition, Frau Pfennig has co-authored all editions of the Chart. In the field of nuclear data Frau Pfennig was both conscientious and dedicated and an inspiration to her colleagues.

**Reduced Decay Schemes**

The nuclear data contained in the nuclide boxes is concise due to the very limited space available. In addition, there are a number of rules governing how the data is given in the nuclide box. In order to obtain maximum benefit from the nuclide Chart, it is important to know how to interpret the box contents correctly. In the new 10th edition of the Chart, there are in total 88 reduced decay schemes to assist in the interpretation of the contents of the nuclide boxes. In addition, reference is made to the nuclide decay scheme in order to relate the box contents with information on energies of emitted
More information on the Reduced Decay Schemes

Order Details:
The Karlsruhe Nuclide Chart Online (KNCO) is accessible and can be ordered through the Nucleonica portal http://www.nucleonica.com.

More information on the Karlsruhe Nuclide Chart Online

-particles with the energy levels in the nucleus in the decay scheme diagram.

Radiations indicated in the nuclide box are drawn as plain lines in the diagram. To improve understanding, some transitions not mentioned in the box are added and indicated as dotted lines. Corresponding data is also indicated in grey. Radiations with a low emission probability indicated by dots or brackets in the nuclide box are also drawn with dotted lines.

Karlsruhe Nuclide Chart Online (KNCO++)

The Karlsruhe Nuclide Chart Online (KNCO++) has been upgraded to provide the following new features:

- The colours used in the KNCO++ have been historically based on the modes of decay. A new colour scheme has been introduced which shows, in addition, the half-lives of the nuclides. The user can toggle between the decay modes and half-lives charts to obtain the complimentary Chart views.

- The user can now select various pre-defined background colours to enhance the visual impact of the Chart.

- When the mouse cursor is placed over a nuclide, the nuclide box is highlighted and magnified (see example of U-238 above). On clicking on the highlighted nuclide, the Chart is zoomed to the nuclide selected thus provided a useful navigation tool.

- Literature references for the nuclide data are now available. A mouse right click on a nuclide opens a context menu from which a link to the references can be selected.
Dedicated, in depth training onsite for your organisation

We provide dedicated training onsite for staff in your organization on request. Courses focus on decommissioning & waste management nuclear security, environmental radioactivity, etc., or on particular Nucleonica applications.

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

Conferences / Meetings 2017

Training Courses 2017

April 2017, CERN

Introduction to Nucleonica: Core Applications and Tools, 5-6 April, CERN, Switzerland, 2017.

Photo: Nucleonica training course at CERN

This 2-day training course took place at CERN, Switzerland, during the 5-6 April 2017. 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 H*(10). A key lecture was given by Mr. Yann Donjoux (CERN) on the e-Ship++ radiological transport assistant application in Nucleonica. 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 CERN.

September 2017, JRC Ispra

An overview of Nucleonica was given at the 9th International Summer School on Operational Issues in Radioactive Waste Management and Nuclear Decommissioning, 11-15 September 2017, at JRC Ispra in Italy. See...http://2017.radioactivewastemanagement.org/

November 2017 Berlin


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 7-8 November 2017. This was an intermediate 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 Radiological Converter, Nuclide Mixtures, Decay Engine++, and Dosimetry and Shielding H*(10).

Nuclear security related case studies were given on the identification of suspected nuclear and radioactive materials using Cambio and WESPA++. In
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.

---

total, 12 persons took part in the course from the various BfS locations in Germany.

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 2017 and we look forward to working with you in 2018. We would like to thank everyone who has contributed during 2017. Thanks also to Dr. Zsolt Sóti from the JRC for collaboration on the new 10th edition (2018) of the Karlsruhe Nuclide Chart; Dr. Tim Vidmar from SCK-CEN on Coincidence Summing Corrections++; Dr. Joachim Heierli from the Interkantonales Labor in Switzerland on the Concept Repository Temperatures (CoReT) application; and from CERN we acknowledge the collaboration of Drs. Gérald Dumont, Yann Donjoux, Nicolas Riggaz, Alexandre Dorsival and Joachim Vollaire on the Beta dose rate application and e-Ship++.

In 2017 Nucleonica has made donations to SOS Kinderdorf, Médecins Sans Frontières and UNICEF.

---

Impressum

Nucleonica Newsletter, Issue 7, January 2018

The Nucleonica Newsletter is prepared by Nucleonica GmbH,
Magdeburger Str. 2, 76139 Karlsruhe

E-Mail: info@nucleonica.com
Homepage: www.nucleonica.com
Copyright © Nucleonica GmbH 2018, All rights reserved.

---