Implementing of Education and Training: Nuclear Knowledge & Data Dissemination with Nucleonica

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Implementing of Education and Training: Nuclear Knowledge & Data Dissemination with Nucleonica

What is Nucleonica?

The Nucleonica Portal

Nucleonica & Nuclear Knowledge Management

Education & Training

Networking

Case Study: Fukushima
What is Nucleonica?
What is Nucleonica?

• As a result of recent developments on issues such as energy security and sustainability, nuclear safety, security, and non-proliferation, and protection of the environment, we are witnessing a resurgence of interest in nuclear power and the nuclear sciences in general.

• In order to support this renewed interest in the nuclear sciences, we will need a nuclear skills renaissance and it is within this context that the Nucleonica nuclear science web portal (www.nucleonica.com) has been developed.

• With its roots in the traditional paper-based Karlsruhe Nuclide Chart, Nucleonica has grown to become the leading online resource in the nuclear sciences.
Who is Nucleonica aimed at?

• Nucleonica is aimed at scientists, engineers and technical personnel working in the fields of nuclear power, health physics, radiation protection, nuclear and radiochemistry, decommissioning, nuclear medicine, etc. Nucleonica is particularly suitable for education and training of young scientists, engineers and technicians in the nuclear domain.

• It can also be used by professionals for everyday calculations, obtaining quick results in various fields of applications and testing, validating and verifying complex computer models.

• Nucleonica also provides a range of consultancy services and industry cooperations. Examples of some recent studies include an analysis of the handling problems arising in the dismantling of radioactive sources, a decommissioning study of neutron sources, shielding analysis for a minor actinide laboratory, and a comparison of the radiotoxicities of wastes from fission, fusion, and coal fired power stations.
Our Customers & Partners include...

- Bundesamt für Strahlenschutz
- Paul Scherrer Institut (PSI)
- Australian Government
  Australian Radiation Protection and Nuclear Safety Agency
- Belgian Nuclear Research Centre
  Research towards a sustainable option
- European Commission
  Home Affairs
- National Academy of Sciences of Ukraine
  Kiev Institute for Nuclear Research
- Sandia National Laboratories
- IAEA.org
  International Atomic Energy Agency
- Environment Laboratories
- Ondokuz Mayis University
  1975-2010
- ENETRAP
- European Commission
  Joint Research Centre
How can Nucleonica help you?

- Nucleonica provides you with user friendly access to the latest reference data from internationally evaluated nuclear data.

- A unique feature is the wide range of web-based nuclear science applications for decay calculations, dosimetry & shielding, etc.

- A variety of networking tools are provided for scientific collaboration.

- In addition Nucleonica offers a range of introductory and advanced training courses in various areas of nuclear science. One of the main aims of these courses is to contribute to establishing a safety culture among the scientists and especially the younger scientists. This safety culture is a necessary prerequisite for a general acceptance of nuclear energy worldwide.
Nucleonica is already being used by thousands of scientists and students worldwide in over 92 countries. Due to its advanced IT features, user friendly and intuitive environment, the platform has recently been endorsed by the Sustainable Nuclear Energy Technology Platform (www.snetp.eu):

“Nucleonica plays … an important role in making nuclear education more attractive and in building nuclear knowledge for a new generation of engineers and scientists”
The Nucleonica Portal…
The Nucleonica Portal...
The NUCLEONICA Portal:

Nucleonica Architecture & Logical Structure…

- Calculation modules
- Databases (nuclear data)
- Web page
- Wiki (explicit AND implicit knowledge)

The NUCLEONICA Structure

(explicit AND implicit knowledge)
Four Pillars of NUCLEONICA: Nucleonica’s “Learning Centres”

- Data Centre
- Application Centre
- Knowledge Centre
- Community/Networking Centre
The NUCLEONICA Portal:

Nucleonica’s unique feature: Web-based Nuclear Science Applications

Nuclide Explorer

Mass Activity Calculator

Gamma Spectrum Generator

Nuclear Data Retrieval

Decay Engine

Cambio File Converter
The Nucleonica Nuclear Science Glossary...

Category: Glossary

This Glossary is based mainly on the following sources:
1. J. Magill and J. Galy, Radioactivity Radionuclides Radiation © Springer Verlag, 2005
3. Additional information can be found in the IAEA Safety Glossary, Terminology Used in Nuclear Safety and Radiation Protection 2007 Edition
4. See also the CTBTO glossary http://www.ctbto.org/glossary/

Articles in category "Glossary"

There are 178 articles in this category.

A
- A1, A2
- ADR
- AMAD
- Absorbed Dose
- Actinide(s)
- Activity
- Acute Exposure
- Alpha decay
- Alpha particle
- Annual Limit of Intake (ALI)
- Antimatter
- Atom
- Atomic Weight
- Atomic mass
- Atomic number
- Auger effect

B
- BNCT (Boron Neutron Capture Therapy)
- Barkas Effect
- Bam
- Becquerel (Bq)
- Beta decay
- Beta particle
- Binding energy

E cont.
- Exemption Levels

F
- Fermion
- Field
- Fission
- Fundamental forces

G
- Gamma radiation
- Geological repository
- Glioblastoma
- Gram atom
- Gray, (Gy)

H
- HASS Directive
- Hadron
- Hadron Therapy
- Half-life
- Halo nuclides
- High activity sealed source
- Hormesis

I
- Isotopically designed tracers

O
- Orphan source

P
- Pair production
- Parity
- Particle Therapy
- Photon
- Physical protection
- Polonium 210
- Positron
- Primordial radionuclides
- Proton

Q
- Quality factor

R
- RCM
- RDD
- RDE
- RED
- Rad
- Radiation Hormesis
- Radiation Therapy
- Radiation protection
- Radation-weighted factor
webGraphics…

The Nucleonica webGraphics Features:

• No need to buy expensive commercial software
• Easy to use
• Delivers publication quality scientific graphs
• Variety of formats available (gif, jpg, emf, eps, png, svg)
• Graphics configuration can be stored for future use
• Available at any time from any location
• Under constant further development
NUCLEONICA and KNOWLEDGE MANAGEMENT
NUCLEONICA and KNOWLEDGE MANAGEMENT

“Know-how” transfer within organisations. One of the main issues here is how to retain tacit knowledge within an organisation. Nonaka and Takeuchi proposed a model for knowledge creation and transfer: knowledge is created through a continuous and dynamic interaction between tacit and explicit knowledge. They conceptualized this model as a “knowledge spiral” in which there are four modes of knowledge conversion: socialization, externalization, combination and internalization (SECI model).
NUCLEONICA and KNOWLEDGE MANAGEMENT

Socialisation (tacit $\Rightarrow$ tacit)

Externalization (tacit $\Rightarrow$ explicit)

Combination (explicit $\Rightarrow$ explicit)

Internalization (explicit $\Rightarrow$ tacit)
Nucleonica
Education & Training
October 2010 Monaco


The NuTroNS-1 Joint EC-IAEA Nuclear Science Training Course with NUCLEONICA took place at the International Hydrographic Bureau in affiliation with the IAEA in Monaco, from the 12-15th October 2010. This was the first course devoted specifically to the use of Nucleonica within the field of Environmental Radioactivity. The course is aimed at persons who provide technical support (measurements, interpreting results, drawing conclusions, making recommendations) for the actions in response to environmental radioactivity issues. The participants included physicists, radio-chemists, health physicists, technicians, and others from a large number of organizations who may be involved in the assessment of such issues.

Guest speakers included Drs. M. Eriksson and Lashe from Sandia National Labs., Dr. H. Mayis University, Samsun, Ms. V. Klein and S. Klein included Drs. J. Magill, Z. Soti.

In total, 22 participants from Azerbaijan, Romania, Russia, Turkey took part in the course. JRC's Enlargement and Integration Activities, Potential Candidate Countries, and ENPRAN.

Links to the presentations and exercises:

- Nucleonica Overview (J. Magill)
- Nucleonica Data Centre (J. Magill)
  - Hands on Exercises: Mass Activity Calculator, Dosimetry & Shielding, Nucleonica Data Centre (Z. Soti)
- Range and Stopping Power (M. Tufan)
- Using Nuclide Mixtures in Nucleonica (R. Dreher)
- Decay Engine (J. Magill)
Karlsruhe Nuclide Chart …

http://www.KarlsruheNuclideChart.net
Karlsruher Nuklidkarte …

- New! 2009 Druck der Broschüre + Faltkarte
- New! 2010 Druck der Wandkarte
- New! Nuclide „Teppich“

Nuclide „carpet“
8m!
Networking with Nucleonica
Networking with Nucleonica...

Nucleonica Networking
- Networking
- My Profile
- My Community
- My Mailbox
- My Groups
- My Settings

Tools
- Forum
- Conference Calendar
- webGraph
- Marketplace

Application Portal
- nuclear science

Coming soon
- WESPAC

Nucleonica Blog

Nucleonica Welcome SCK-CEI users!

Through an institutional license agreement, staff at the SCK-CEN in Belgium has now full premium access to the Nucleonica modules and features. The Nucleonica team looks forward to a close interaction with the SCK-CEN colleagues and encourages a strong use of the web portal.

New JRC spin-off to work on the Nucleonica portal

As of March 2011, a new JRC spin-off company, Nucleonica GmbH, has been created. This company was established by a former staff member to undertake the further development of the Nucleonica portal — a nuclear science web portal developed at the JRC’s Institute for Transuranium Elements.

GSG output now available in IAEA.apec format

The Gamma Spectrum Generator (GSG) and GSGPro spectra can now be downloaded directly in IAEA.apec format with energy calibration. Previously, the GSG text output files had to be converted with the Cambio file translation module. Now the apec files can be used directly in Cambio and web spectrum analyser WESPAC or for other instruments.

Nucleonica Welcome ARPA-NESA users!

Through an institutional license agreement, staff at the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) has now full premium access to the Nucleonica modules and features. The Nucleonica team looks forward to a close interaction with the ARPANSA colleagues and encourages a strong use of the web portal.

Nucleonica Forum

Welcome, Joseph
- My Posts
- My Settings
- My Community

My Community Events
- You have 2 new messages
- You have 6 new contact list requests

Recent Nucleonica Members
- Mohammadreza K. Edalati
- Luigi Bruzzi
- Paul GORTMAN
- GERSINGS

ITRAC-3 Karlsruhe: Please give your feedback here!
Dear ITRAC-3 participant. We would like to you to give your opinions and remarks on the training course in this thread.

Calculating energy loss of 2 MeV electrons thru different materials
I have a 2 MeV electron accelerator that is used for pulse radiolysis experiments. I am trying to figure out the effects of changing a beam window...

Radioactive decay calculations and spontaneous fission
Networking with Nucleonica...

<table>
<thead>
<tr>
<th>Name</th>
<th>Surname</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khaled</td>
<td>Zakaria</td>
<td>Radiation Safety Department-National Center for Nuclear Safety and Radiation Control, Atomic Energy Authority – Cairo – Egypt</td>
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<tr>
<td>Cigdem</td>
<td>Acar</td>
<td>Ege University, Institute of Nuclear Sciences</td>
</tr>
<tr>
<td>Jalal</td>
<td>Aghayev</td>
<td></td>
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<tr>
<td>Andrii</td>
<td>Apostol</td>
<td>Technical Support Organization 'moltech'</td>
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<td>Andrey</td>
<td>Berlizov</td>
<td>International Atomic Energy Agency</td>
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<td>Paul Scherrer Institut</td>
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<td>Snezana</td>
<td>Dimovska</td>
<td>Institute of Public Health</td>
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<td>Raymond</td>
<td>Dreher</td>
<td>Nucleonica GmbH</td>
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<tr>
<td>Iako</td>
<td>Galj</td>
<td>Institute for Transuranium</td>
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<td>Joseph</td>
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<td>Nucleonica GmbH</td>
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<td>Institute of Public Health</td>
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<td>Nostar</td>
<td>Institute of Nuclear Sciences, Ege University</td>
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<td>Rizzi</td>
<td>Paul Scherrer Institute</td>
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<td>Soli</td>
<td>European Commission</td>
</tr>
<tr>
<td>Melsa</td>
<td>Stefanova</td>
<td>Faculty of Medical Science-University 'Goce Delcev'. Stip, Macedonia</td>
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<tr>
<td>Tanja</td>
<td>Stowasser</td>
<td>Paul Scherrer Institute</td>
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<td>Sturm</td>
<td>EC-JRC-IRMM</td>
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<tr>
<td>Magdalena</td>
<td>Toma</td>
<td>JRC-ITU-KARLSRUHE</td>
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<tr>
<td>Veiko</td>
<td>Velev</td>
<td>Institut of Public Health</td>
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Nucleonica Case Study: Fukushima
Fukushima Case Study with Nucleonica: Create / Identify a Gamma Spectrum for Released nuclides

1. Reactor simulation to obtain the radionuclide inventory
2. Identify the strongest gamma emitting nuclides
3. Create a nuclide mixture
4. Generate the gamma spectrum
5. Identify the peaks
1. Reactor simulation to obtain the radionuclide inventory.
2. Identify the strongest gamma emitting nuclides
3. Create a nuclide mixture

Fukushima Case Study with Nucleonica:
Fukushima Case Study with Nucleonica:

4. Generate the gamma spectrum
Fukushima Case Study with Nucleonica:
Fukushima Case Study with Nucleonica:

Cambio was developed in response to a need of nuclear emergency response analysts even of a widely growing number of formats used by both commercial and government detectors of nuclear detection instrumentation groups, so does the number of data formats that must be.

Manufacturers of instrumentation often need to create new and more complex versions of their new user requirements lead to new, more sophisticated instruments.

Spectrum from Fukushima measured: 14.06.2011 13:59:18 (UTC)

<table>
<thead>
<tr>
<th>Energy (keV)</th>
<th>Channel</th>
<th>Counts/keV</th>
</tr>
</thead>
<tbody>
<tr>
<td>488.500</td>
<td>488</td>
<td>4.9156e+4</td>
</tr>
</tbody>
</table>

Gamma Lines near cursor (from standard list 590 lines):

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Decay</th>
<th>Half-life</th>
<th>Energy (keV)</th>
<th>Emission Probability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>La140</td>
<td>β-</td>
<td>1.87 d</td>
<td>497.02</td>
<td>4.595E01</td>
</tr>
<tr>
<td>Pb214</td>
<td>β-</td>
<td>28.80 m</td>
<td>497.13</td>
<td>4.394E-01</td>
</tr>
<tr>
<td>Ra226</td>
<td>α</td>
<td>1.60Ky</td>
<td>497.13</td>
<td>4.394E-01</td>
</tr>
<tr>
<td>Te129</td>
<td>β-</td>
<td>1.16 h</td>
<td>487.31</td>
<td>1.418E00</td>
</tr>
<tr>
<td>Ir192</td>
<td>β-</td>
<td>73.33 d</td>
<td>489.06</td>
<td>1.987E-01</td>
</tr>
</tbody>
</table>
Fukushima Case Study with Nucleonica:

Web-based Gamma Spectrum Analyser - WESPA

Select a Gamma Library for analysis:
- medical lib
- natural lib
- standard lib
- Upload own library

Logarithmic scale

Next step:
- Measurement Setup
Fukushima Case Study with Nucleonica:

![Graph showing a spectrum with detected peaks and a table of energy and channel values.](chart_by_amCharts.com)

Detected peaks, select an energy peak to obtain the list of proposed nuclides:

<table>
<thead>
<tr>
<th>Energy</th>
<th>Channel</th>
<th>FWHM</th>
<th>Area</th>
<th>Assigned Nuclide</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>30</td>
<td>0</td>
<td>879220.8</td>
<td></td>
</tr>
<tr>
<td>50.04</td>
<td>50</td>
<td>0</td>
<td>171694</td>
<td></td>
</tr>
<tr>
<td>80.09</td>
<td>80</td>
<td>0</td>
<td>72527.89</td>
<td></td>
</tr>
<tr>
<td>228.53</td>
<td>228</td>
<td>24.02857</td>
<td>1178558</td>
<td></td>
</tr>
<tr>
<td>328.88</td>
<td>328</td>
<td>0</td>
<td>1535407</td>
<td></td>
</tr>
<tr>
<td>364.37</td>
<td>364</td>
<td>0</td>
<td>1519100</td>
<td></td>
</tr>
<tr>
<td>486.1</td>
<td>487</td>
<td>42.46741</td>
<td>1515834</td>
<td></td>
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<tr>
<td>562.75</td>
<td>562</td>
<td>0</td>
<td>560840.8</td>
<td></td>
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<tr>
<td>744.69</td>
<td>748</td>
<td>85.54502</td>
<td>2813094</td>
<td></td>
</tr>
</tbody>
</table>

Nuclide proposal, select a nuclide and show own spectrum:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Energy from Library</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sr125</td>
<td>635.88</td>
</tr>
<tr>
<td>Pm140</td>
<td>636.68</td>
</tr>
<tr>
<td>I131</td>
<td>636.97</td>
</tr>
<tr>
<td>Sr124</td>
<td>648.85</td>
</tr>
<tr>
<td>Pu239</td>
<td>645.98</td>
</tr>
<tr>
<td>Ba133</td>
<td>550.2</td>
</tr>
<tr>
<td>Ag110</td>
<td>557.76</td>
</tr>
<tr>
<td>Cs137</td>
<td>581.66</td>
</tr>
<tr>
<td>Ca143</td>
<td>684.57</td>
</tr>
</tbody>
</table>
Fukushima I Nuclear Power Plant, 460 MW

Power release during 7d decay of 60 tHM BWR UOX 40 MWd/kg

- γ-Actinides
- γ-Fission-Products
- n-Actinides

5 MW

50 tons water per hour to remove this heat (see Nucleonica script!)
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Networking

Case Study: Fukushima
Thanks!
NUCLEONICA Application Development (Socialisation)
The first step in the development of a Nucleonica application involves the Nucleonica team working together with an expert to develop an application module. This step can be directly compared with the "socialization" step in the SECI knowledge spiral model in which the "tutor" is the expert and the "apprentices" are the Nucleonica developers. The main issue here is developing a close relationship with the expert or "tutor" to try to crystallise his knowledge and knowledge and to concentrate on the essential features of the program. A further goal in this first step is the creation of a "knowledge object" i.e. a full working version of the web-based scientific application.

NUCLEONICA Wiki (Combination)
Within the SECI model, the "Combination" process makes extensive use of a wiki systemizing explicit knowledge. The primary use of this wiki is to provide all the technical documentation or articles required to support the various Nucleonica applications. The basic characteristic of a wiki is that it allows the article author to directly edit and add content online (the word "wiki" means fast in Hawaiian) - there is no need for a web master or programmer to convert the text into html. In addition to providing an online Help for the applications, the Nucleonica wiki is also used to provide additional EKOs such as a Glossary of Nuclear Science, Ask an Expert and Frequently Asked questions (FAQs). These features allow Nucleonica to grow organically and provide a powerful nuclear science information source for its users.

NUCLEONICA Forum (Externalisation). The main goal of the Nucleonica forum is to capture the tacit knowledge of experts and peers alike within the specific context of the Nucleonica applications. Initially the user will have little knowledge of the application. However, after some experimentation, the user can post questions in the Nucleonica forum dedicated to this particular application. The approach is based on a question and answer interaction between the expert (and the Nucleonica developers) who possesses tacit knowledge and users. The knowledge or know-how flow is "externalized" by the fact that the question and answer dialogue is fully recorded in the forum database. Initially, the interaction primarily takes place in a dialogue between the expert(s) and the users. Once a certain amount of interaction has taken place, the users start interacting with each other until the point where the tacit knowledge of the expert has been made explicit in the forum database. At this point, the tacit knowledge has been transformed into explicit knowledge.

NUCLEONICA Application (Internalisation)
The final step in the SECI knowledge spiral is the internalization. Internalization is the conversion from explicit to tacit, which is triggered through "Learning by Doing". This is the process by which tacit knowledge that has been made explicit through externalization and combination, is then integrated back into the tacit knowledge base of other members of the organisation. Thus, at the end of the spiral process, when knowledge has been socialized, combined, externalized and internalized, one or more individuals in the organisation have acquired new tacit knowledge. The Learning by Doing concept refers to the ability of workers to improve their skills by regularly repeating the same types of action. The Nucleonica applications are a direct manifestation of this concept. No expert knowledge is required to use the applications. At the simplest level, the user can "play" with the user friendly scientific applications with one or two mouse clicks. Technical Help is given in the wiki. As the user becomes more confident and gains increasing experience, he can attempt more sophisticated calculations.
The NUCLEONICA Portal:

Nucleonica Contents

What is Nucleonica?

Nuclear Data
- Nuclide Explorer
- DataSheets
- Nuclear Data Retrieval
- Fission Yields
- Universal Nuclide Chart
- Karlsruhe Nuclide Chart

Tools
- webGraph
- Scientific Calculator and Conference Calendar
- Nuclide Mixtures
- Gamma Library Creation
- Nucleonica Scripting

Applications
- 10. Mass Activity Calculator
- 11. Decay Engine
- 12. Decay Engine for Large Nuclide Sets
- 13. Gamma Dosimetry & Shielding
- 14. Range & Stopping Power
- 15. webKORIGEN
- 16. Neutron Activation with webKORIGEN
- 17. Gamma Spectrum Generator
- 18. Cambio File Converter
- 19. WESPA web spectrum analyser
- 20. In Silico Dosimetry

Networking
- Register as a Nucleonica User
- Wiki, Blog, Forum and Nuclear News
- Nuclear Science Training Courses
NUCLEONICA as a platform for scientific applications development

- Currently NUCLEONICA consists of individual modules
- Modules can be “combined” for batch processing through the NUCLEONICA scripting language
- Open up NUCLEONICA to external developers

Checklist of tools required:
- Access to the NUCLEONICA databases
- A testing environment where the developer and the NUCLEONICA team can test new application
- An upload facility whereby the developer can upload the application to the NUCLEONICA platform

Recent Example: development of an *In silico* dosimetry module
Conclusions: Key Advantages of Nucleonica

- Keep informed with the latest news on nuclear issues
- Use internationally evaluated nuclear data in your work
- Extensive range of nuclear science applications
- Manage all your data in a single browser-based system and keep track of your recent activities
- Prepare a lecture or a training course with Nucleonica materials (graphics, etc.)
- Prepare publication quality scientific graphs
- Stay in contact with your colleagues from previous employment, workshops or conferences
- Meet scientists from your areas of interest and build up an international contact list and represent yourself and your Institute/Organisation in the international science community
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