Nuclear Physics Activities at the IAEA

Ralf Kaiser, Physics Section Head
Topics

• Short Introduction to the IAEA
• Current Projects of the Physics Section
• Perspectives for Cooperation between IAEA and NuPECC
President Eisenhower, UN, 8 December 1953
“It is not enough to take this weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace.”

President Dwight Eisenhower / United Nations, Dec. 8, 1953
SURE—AND HOW ABOUT ALL THOSE OTHER THINGS...

"ATOMIC FLYING MACHINES ON MY BACK."

"ATOMIC DISINTEGRATOR GUNS."

"ATOMIC ROCKETS TO THE MOON."

"ATOMIC 'PILLS' TO RUN OUR AUTOS FOR YEARS."

HOLD ON, JOHNNY... YOU'VE BEEN READING TOO MANY COMICS!
• Founded in 1958, seat in Vienna, Austria
• 159 Member States (most recently Swaziland, 2013)
• 71 intergovernmental and non-governmental organizations worldwide having formal agreements with the Agency.
• about 2300 professional and support staff
• €333 million total regular budget for 2012, plus extrabudgetary contributions of €66 million.
• 2 liaison offices (in New York and Geneva) and 2 safeguards regional offices (in Tokyo and Toronto).
• 2 international laboratories (Seibersdorf and Monaco).
• 120 active Coordinated Research Projects
IAEA Organisational Structure

- Nuclear Energy
- Nuclear Applications
- Nuclear Safety
- Safeguards
- Management
- Technical Cooperation
### IAEA Regular Budget 2012

<table>
<thead>
<tr>
<th>Activity</th>
<th>Euro (M€)</th>
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<tbody>
<tr>
<td>Nuclear Power, Fuel Cycle and Nuclear Science</td>
<td>33.724</td>
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<tr>
<td>Nuclear Techniques for Development and Environmental Protection</td>
<td>38.664</td>
</tr>
<tr>
<td>Nuclear Safety and Security</td>
<td>33.998</td>
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<tr>
<td>Nuclear Verification</td>
<td>128.780</td>
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<tr>
<td>Policy, Management and Administration Services</td>
<td>75.354</td>
</tr>
<tr>
<td>Management of Technical Co-operation for Development</td>
<td>20.389</td>
</tr>
<tr>
<td>Reimbursable Work for Others</td>
<td>2.385</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>333.297</strong></td>
</tr>
<tr>
<td><strong>Technical Cooperation Fund 2012</strong></td>
<td><strong>Euro (M€)</strong></td>
</tr>
<tr>
<td>-----------------------------------</td>
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<tr>
<td>Voluntary Contributions to the TCF</td>
<td>66.000</td>
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<tr>
<th><strong>Examples of Other Extra-budgetary Contributions</strong></th>
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<tbody>
<tr>
<td>Fukushima Action Plan (Japan, spread over several years)</td>
<td>13.000</td>
</tr>
<tr>
<td>Peaceful Uses Initiative (USA and others, target 100 M€ until 2015)</td>
<td>~12.000</td>
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</tbody>
</table>
• Coordinated Research Projects (Developed & Developing Countries)
• Technical Cooperation Projects (Developing Countries)
• Networks (e.g. Research Reactor Networks)
• Conferences, Technical Meetings, Workshops
• IAEA Missions (of very different flavours)
• Data Bases (e.g. Research Reactors, Nuclear Data)
• Services (e.g. dosimetry, reference materials)
• Publications (TecDocs etc.)
Depending on which aspect is seen the IAEA can be perceived as very different things:

- nuclear watchdog
- safety and security agency
- technical development agency
- funding agency
- publisher
- conference organiser
- part of the United Nations system
- the labs in Seibersdorf and Monaco can be seen as ‘international lab for countries without national labs’
Accelerators
Accelerators

Nuclear Instrumentation

Research Reactors

Fusion
IAEA Laboratories in Seibersdorf

- about 200 staff
- Safeguards & Nuclear Applications Labs
- Modernisation planned/under way
Gamma Spectrometry

SPECTROMETRY

X-Ray Fluorescence
Unmanned Aerial Vehicle (UAV, aka drone) based rapid environmental mapping.

IAEA X-ray fluorescence beamline at ELETTRA synchrotron in Trieste

Ion Beam Accelerator for NA Laboratory in Seibersdorf as part of the Laboratory Modernisation
• 4 different instruments
• 114 165 measurements
• 2 ½ days of measurements
• Maps of surface DR produced for 5 areas with potential radiological hazard

<table>
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<tr>
<th>Dose rate (nSv/h)</th>
<th>Number</th>
<th>(%)</th>
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</thead>
<tbody>
<tr>
<td>10 - 114</td>
<td>61 267</td>
<td>56.7</td>
</tr>
<tr>
<td>114 - 250</td>
<td>24 771</td>
<td>22.9</td>
</tr>
<tr>
<td>250 - 500</td>
<td>11 660</td>
<td>10.8</td>
</tr>
<tr>
<td>500 - 1140</td>
<td>5 283</td>
<td>4.9</td>
</tr>
<tr>
<td>1140 - 10400</td>
<td>5 036</td>
<td>4.7</td>
</tr>
</tbody>
</table>
- Maps of surface DR for 3 areas (2 remediated sites, one disposal facility)
- 4 different instruments
- Total area surveyed: ~ 30 ha (16.04, 6.32 and 7.66)
- Total length of each pathway: ~ 15 km (5.4, 2.9, 6.5)
- 2 ½ days of measurements
Feasibility for $^{137}$Cs soil erosion study

- Feasibility of the instruments assessed for surface and bore-hole measurements
- Activity levels and changes detectable with LaBr detector
After the Fukushima accident, it would have been nice to have had a drone with a spectrometer that transmits the radiation data and GPS location in real time and makes them available on an online map. But nobody had one.

The technology was/is available; small drones have made huge progress recently, mainly thanks to parts from the smartphone industry: batteries, GPS, accelerometers.

The Physics Section has a project under the Fukushima Action Plan to develop a UAV-based radiation monitoring and mapping system.

We have expertise in mobile gamma spectrometry and are now transferring it to UAVs.
Production of a low-cost UAV-based mobile gamma spectrometry system

- Selection of UAV system
- Development and construction of detectors and readout
- Integration of UAV, detectors, geo-information system and software

Deliverables

- UAV with two detector packages (dose rate meter and spectrometer)
- Software, Documentation, Training

Next Steps

- UAV Consultancy Meeting Vienna, 14.-17. May 2013 with participants from Japan, Switzerland, Germany and USA (NNSA)
• IAEA Ultra-High Vacuum Chamber will be installed on the new XRF beam line at the ELETTRA synchrotron in Trieste in Sept. 2013

• Cooperation with TU Berlin and PTB Berlin

• 40% of the beam time (about 49 days) will be available for IAEA projects

• Training, Workshops and Schools in collaboration with ELETTRA and ICTP

• Access for Research Groups from developing Member States
• SESAME - Synchrotron-light for Experimental Science and Applications in the Middle East

• Connection between IAEA beamline at ELETTRA and SESAME synchrotron in Jordan through CRPs, TC fellowships, workshops; R.Kaiser TO for SESAME

• Recent SESAME Council at IAEA in Vienna, 28.-29. May 2013
• NSAL Laboratory has longstanding experience with Ion Beam Analysis; beamline at Ruder Boskovic Institute in Zagreb since 1996

• Ion Beam Analysis is the topic with the most staff members with direct expertise in the Physics Section (7 staff members)

• Large number of TC projects related to Ion Beam Analysis, some involve setting up entire Ion Beam Accelerator Labs.

• Involvement in two EU Framework Programme projects, SPIRIT and SPRITE

• Consultancy Meeting in March 2011 on Future Options for the NSAL Laboratory identified an Ion Beam Accelerator as the key equipment for a Modernisation of the Laboratory
Proposal - Ion Beam Accelerator

Single-ended Ion Beam Accelerator

Multi-Purpose Chamber

Control Room
Office Space

micro-probe
Beamline

1 m

Tuesday, 28 May 13
Proposal - Ion Beam Accelerator

Estimated Cost:
- priority 1: 2.6 M Euro (building) + 1.8 M Euro (accelerator)
- priority 2: 1.3 M Euro (lab equipment)
Some ideas in no particular order:

• Horizon 2020 Projects, IAEA (hopefully) will be able to be a full partner, negotiations currently ongoing (e.g. follow-up project for SPIRIT, ERDIT)

• Nuclear Physics News - IAEA correspondent a possibility, reporting about Seibersdorf and projects in developing countries

• Setting up a NuPECC-like committee/network for Africa and/or the Middle East, in the Middle East perhaps in connection with SESAME

• Accelerator Data Base - under development at the IAEA
Thank you for your attention
Do Safeguards ever find anything?

HEU Confirmed Incidents

- 1993: 1
- 1994: 3
- 1995: 3
- 1996: 1
- 1997: 1
- 1998: 1
- 1999: 1
- 2000: 1
- 2001: 1
- 2002: 1
- 2003: 2
- 2004: 2
- 2005: 2
- 2006: 2
- 2007: 2
- 2008: 3
- 2009: 5
- 2010: 5