Highlights from the Recent IAEA Conference on Accelerators for Research and Sustainable Development

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July 2022
Purpose and Objective

• Not only scientific results and innovative applications of accelerator-based research, but also success stories and case studies to address the following SDGs:

  • Zero hunger
  • Good health and wellbeing
  • Clean water and sanitation
  • Affordable and clean energy
  • Industry, innovation, and infrastructure
  • Climate action
  • Partnership for the goals
Overview

- Almost 200 participants in person and 300 virtual attendees from 72 IAEA member states
- Six plenary sessions featuring 16 key-note invited talks
- Sixteen parallel sessions, where as many as 80 contributed talks presented
- Four side events and two technical tours
- Over 70 posters (in person and virtual)
- Awards the best oral and poster presentations by young researchers

https://www.iaea.org/events/acconf22
Large Scale Accelerator Facilities

In Belgium, for Europe and the world, sustainable and innovative nuclear power.

The Rare Isotope Factor Challenge (RIF) and more and more experiments are planned.

SPIRAL2, FRIB USA, RIBF Japan.

Concept of DERICA (Dubna Electron – Radioactive Ion Collider Facility) project.

- Linac-100 (E_{el} \leq 100 \text{ AMeV})
- DERICA Fragment Separator DFS
- Fast Ramping Ring Synchrotron FRR: E_{rib} \leq 300 \text{ AMeV}
- Gas jet target p.d.\(^{3}^{4}\)He
- Collector Ring CR: E_{rib} \leq 300 \text{ AMeV}
- LINAC-30 (E_{e}\text{linac} = 30 \text{ AMeV})
- Experimental hall EH-2: Ribbs 15–70 \text{ AMeV}
- Experimental hall EH-1: Application science
- Ion Sources
- Electron cooler
- Neutron source 2 \times 10^{10} \text{n/cm}^2
- Experimental hall EH-3: reaccelerated Ribs 5 – 300 \text{ AMeV}

Stage 0: Lol, CDR, R&D etc. 2018-2019
Stage 1: Buildings, Linac 100, DFS EH-1.2
Stage 2: Gas cell etc., Linac-30, FRR, EH-3
Stage 3: CR, e-RIB collider, ring experiments 2025-2030
Compact Neutron Sources

The ensemble of these sources provide $10^{12}$ n/sec

7 MeV protons
100 µA
Be target

2.49 MeV protons
100 µA
Li target
Accelerators for Medical Applications

- Radioisotope production with accelerators
  - Production of radioisotopes with high energy proton linacs
  - Production of radioisotopes with PET cyclotrons
  - Production of novel/exotic isotopes using isotope separation online

- Radiotherapy with electron linacs and proton centers

- Accelerator-produced neutrons for boron neutron capture therapy (BNCT)
Accelerators for Environment

- Environmental samples characterization with ion accelerators (more than 30 elements from H to U)
- Identifying hidden sources of greenhouse gases – dissolved organic matter in groundwater
- Radiation treatment of biohazards and organic pollutants in waste waters, sludge, and flue gases

14C as a key tool in identifying a hidden source of greenhouse gases – organic matter in groundwater

- When groundwater – especially from deep down – is pumped to the surface, it brings with it dissolved organic matter preserved from long ago.
- Once sunlight and oxygen hit this matter, it can easily turn into carbon dioxide.
- That means groundwater is likely to be yet another source of planet-heating greenhouse gases (GHG) that is not included in our carbon budgets.
Accelerators for Cultural Heritage

• Ion beam Analysis (IBA) allows preserve cultural heritage objects as well as detect art forgeries

• PIXE techniques can determine original compositions of different alloys - for example to reveal the past of Apoxyomenos statue

• Accelerator Mass Spectroscopy (AMS) can distinguish original pieces from fake ones - for example Leger’s painting
Regulatory Aspects

• New uses of accelerators and new accelerator-based facilities can be a challenge to the regulatory bodies, who have to deal with new technologies, for which no specific requirements may exist in the national legal and regulatory framework.

• Regulatory bodies have to quickly adjust and find solutions
  • to authorize and inspect the facilities and activities
  • to review and assess complex safety cases, including shielding and ventilation systems
  • to optimize authorization and inspection process, for example by establishing a new categorization for the different accelerators

• Regulatory bodies face challenges to adjust their National Regulatory framework for this widely and very evolving technology in terms of requirements, training and regulatory processes.
Side Events

• The IAEA Collaborating Centres and their role in applying and promoting nuclear techniques for a host of societal applications and training in nuclear science

• Promotion of Self-Reliance and Sustainability of National Nuclear Institutions

• The position, role, and achievements of women in accelerator-based science

• Recent developments on accelerator-based sources of radiation for industrial purposes
  • Neutron sources (Jerome Schwindling, CEA, France)
  • Electron sources (Anne-Laure Lamure, RadiaBeam, USA)
  • X-ray sources (Arnaud Pierard, IBA, Belgium)
Conclusions

• Other topics not mentioned in this overview:
  • Accelerators for material science
  • Nuclear data
  • Food and agriculture
  • Education
  • Cost efficiency and improving public acceptance

• IAEA support:
  • Collaborating Centers, Coordinated Research Projects and Technical Cooperation Projects, Training opportunities, Publications and Databases, etc

• New ion beam facility in Siebersdorfr?
• Next conference in 2025?