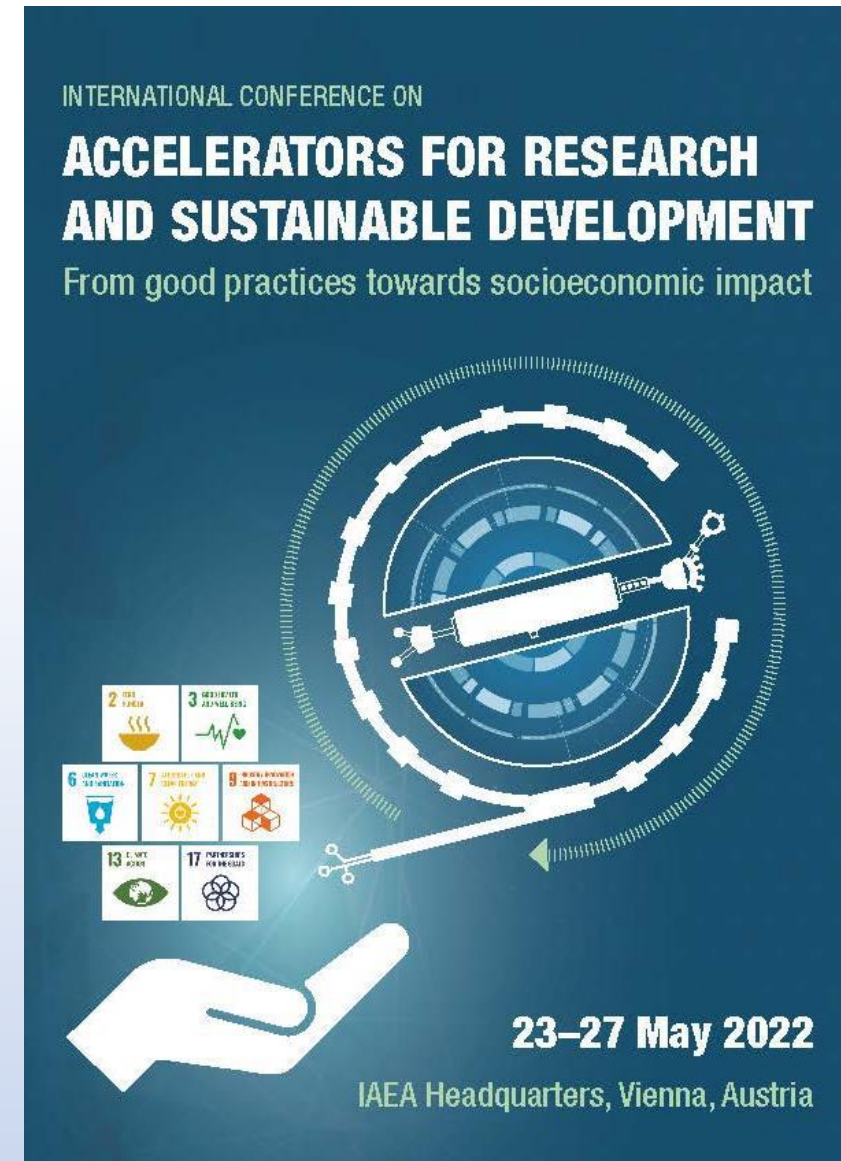


Highlights from the Recent IAEA Conference on Accelerators for Research and Sustainable Development

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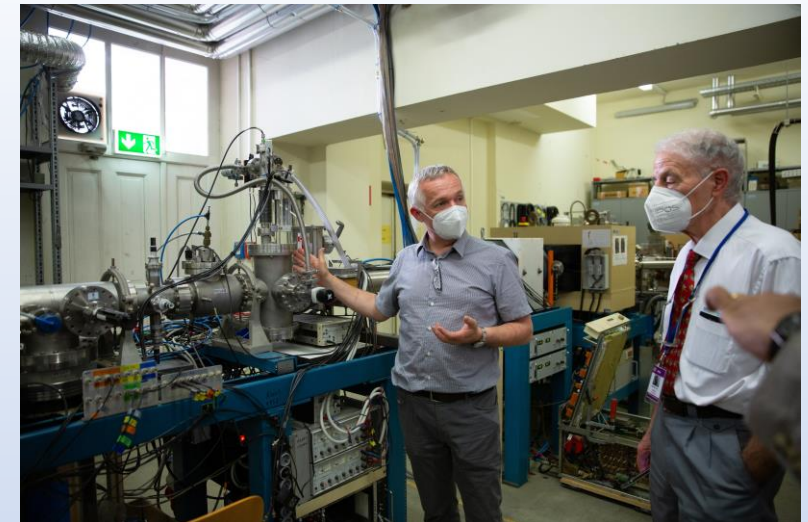
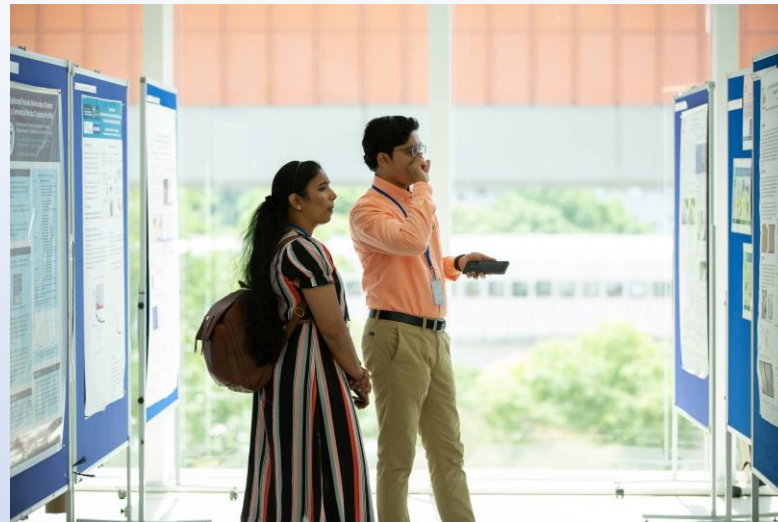
Purpose and Objective

- 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



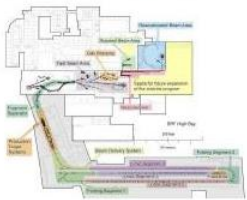
Large Scale Accelerator Facilities

The Rare Isotope Factory and more and more experimental facilities



SPIRAL2 France

FRIB USA



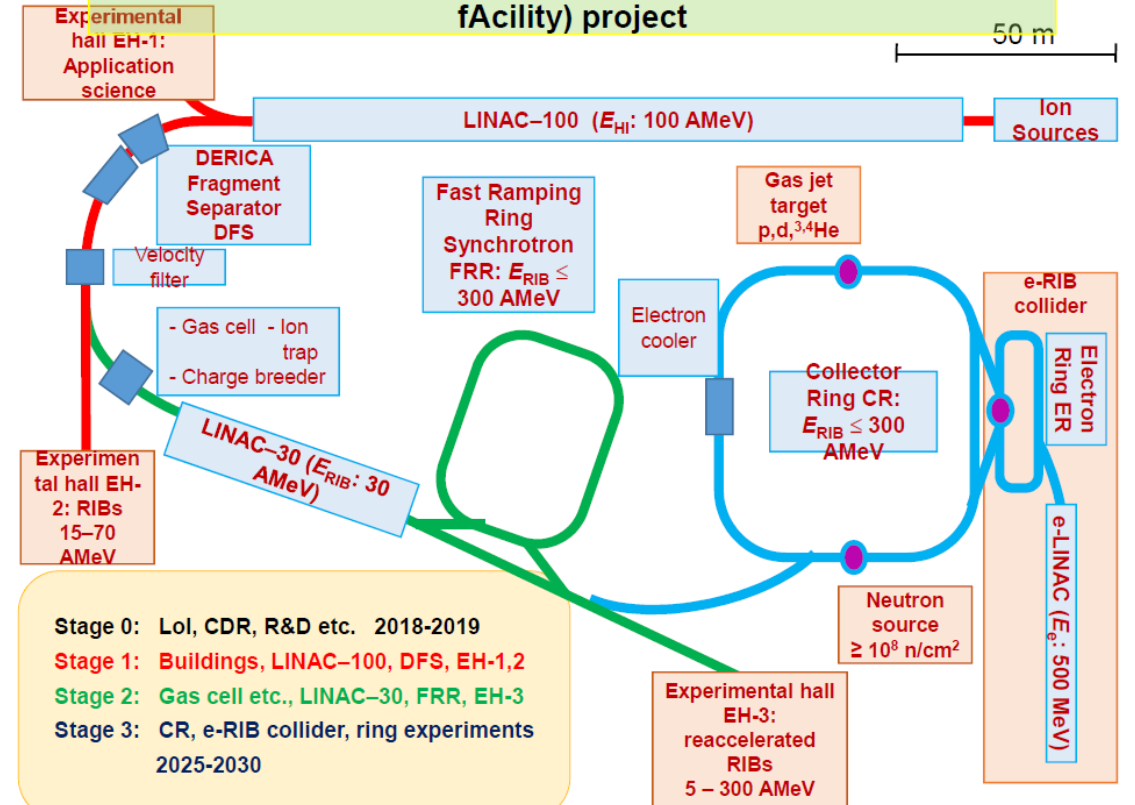
RIBF Japan



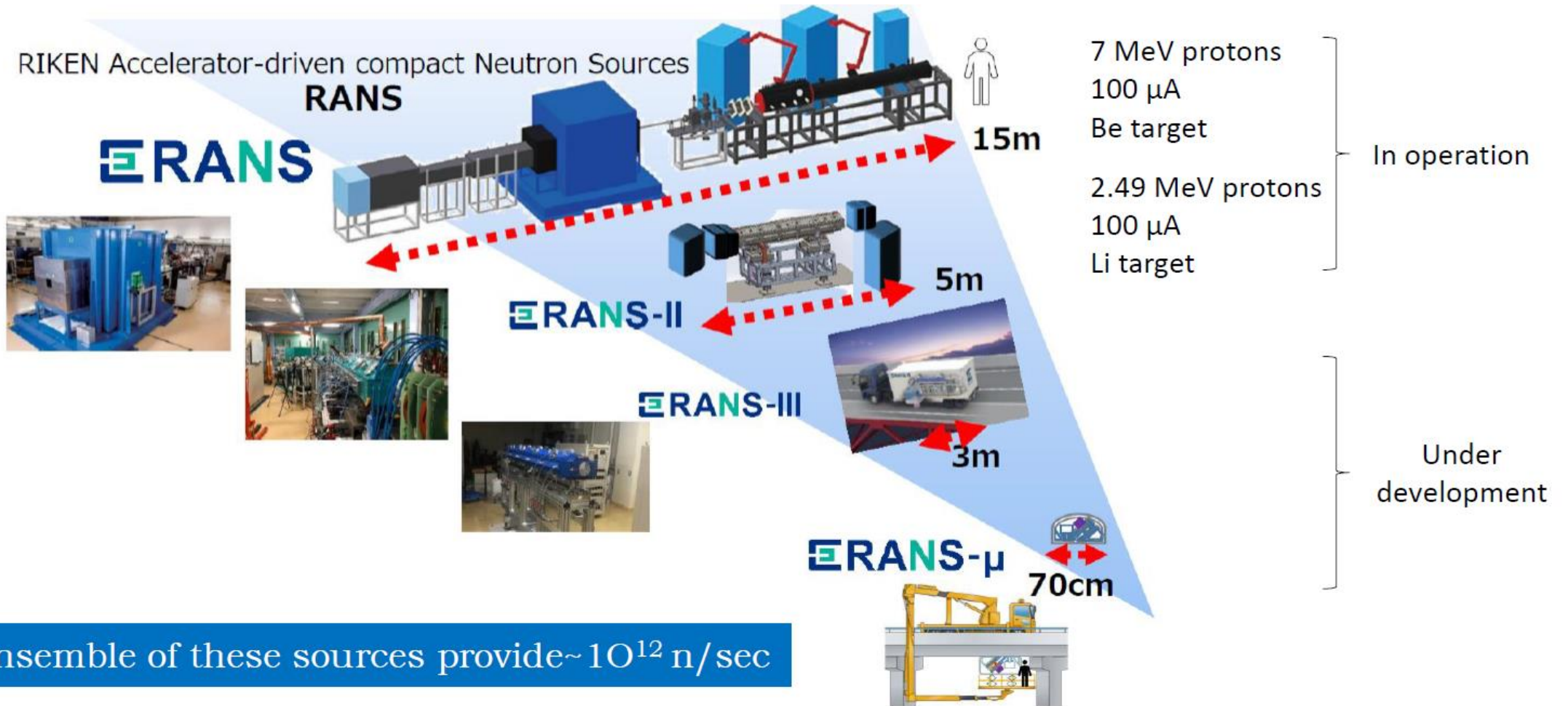
Experimentier- und Speicherringe

100m

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



Compact Neutron Sources

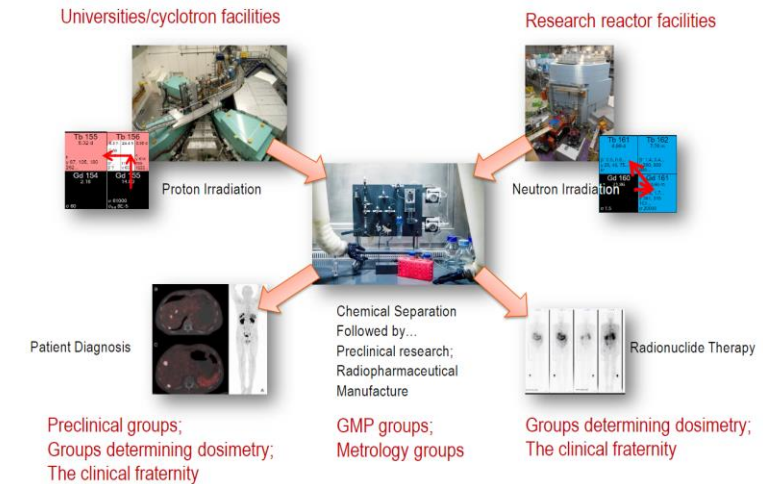


Accelerators for Medical Applications

- 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)

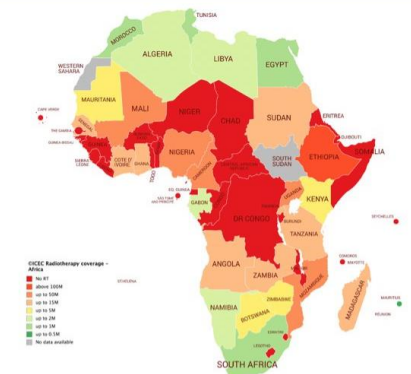


Radionuclides: broadening the network for radiopharmaceutical application



Access to radiation therapy, particularly LINACs is an excellent metric of the gap in comprehensive cancer care.
Map showing the number of people per functioning machine in countries in Africa

Country	LINACs	Population	People per LINAC
Ethiopia	1	115 M	115,000,000
Nigeria	7	206 M	29,000,000
Tanzania	5	59.7 M	11,900,000
Kenya	11	53.9 M	4,890,000
Morocco	42	36.9 M	880,000
South Africa	97	59 M	608,000
UK	348	67 M	195,000
Switzerland	72	86 M	119,000
US	3827	331 M	87,000

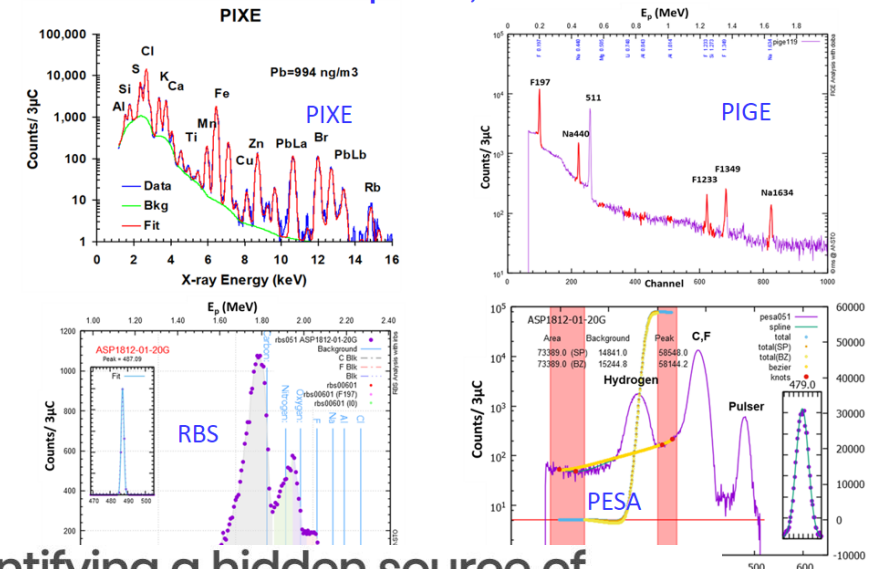


- 28 countries have LINAC-RT facilities
- 12 countries only one facility
- 27 no LINACs for RT
- 385 RT-LINACs for > 1 billion people
- Nigeria has 85 radiation and clinical oncologists and only a few trained linear accelerator maintenance engineers for its nearly 200 million people

Accelerators for Environment

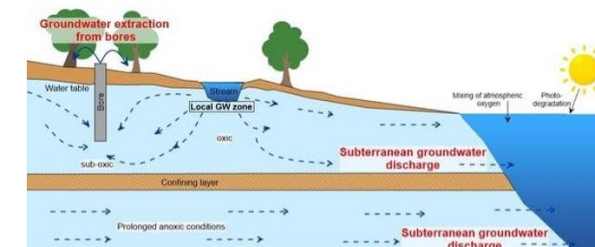
- Environmental samples characterization with ion accelerators (more than 30 elements from H to U)
- Identifying hidden sources of greenhouse gases – dissolved organic matter in groundwater
- Radiation treatment of biohazards and organic pollutants in waste waters, sludge, and flue gases

IBA Spectra – iBAT Analysis Code
2.5 MeV protons, 10nA for 5mins



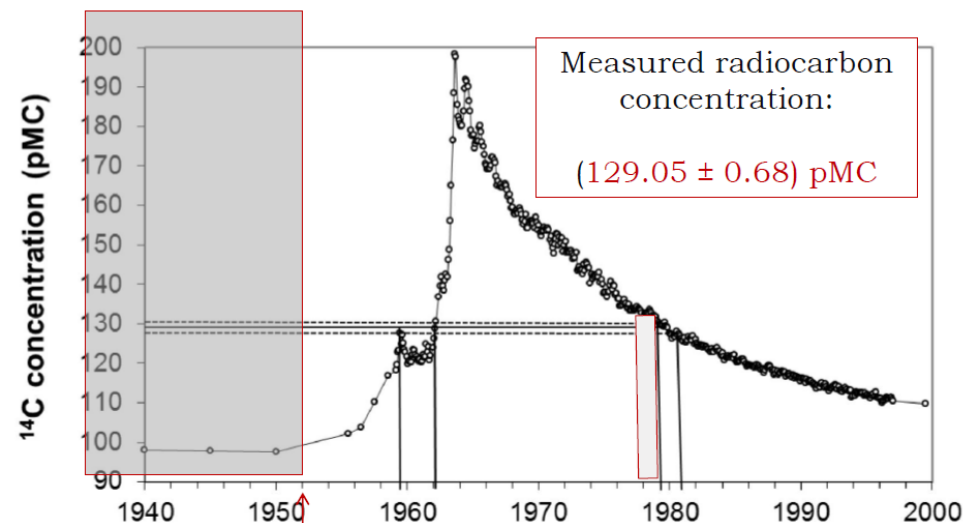
¹⁴C a key tool in identifying a hidden source of greenhouse gases – organic matter in groundwater

- 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) -> 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



Léger's death → the painting is a fake

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.

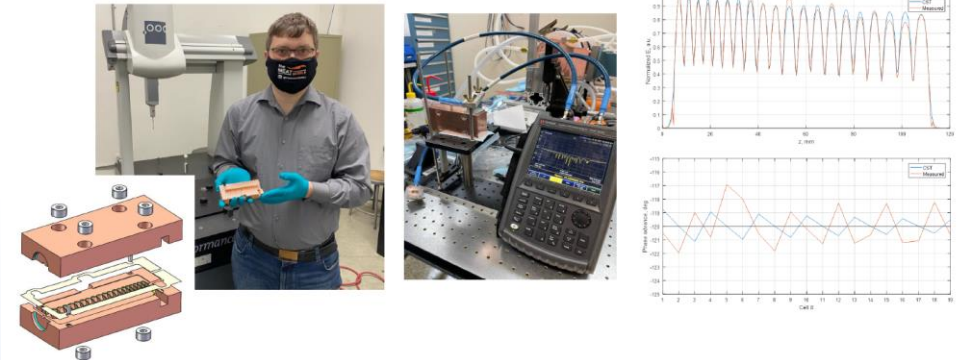
Side Events

- 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)

21 Accelerating Structure Tests



- Complete RF structure was fabricated
 - Machined and brazed
 - RF measurements demonstrate that no additional tuning is required



Context and agenda

- **Very strong demand** for high-power X-ray in the second part of 2021 and continuing in 2022.
- Increasing activities in **US and Asia**.
- **X-Ray represents more than 50%** of the demand for IBA Industrial accelerators.
- Increase in the number of projects **partially funded by governments** when focus is put on improving sustainability.
- IBA aims at a corporate level to be **carbon-neutral in 2030** and puts sustainability at the core of its values.



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 Siebersdorf?
- Next conference in 2025?