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# *IAEA activities in support of accelerator facilities, accelerator-based research and applications*


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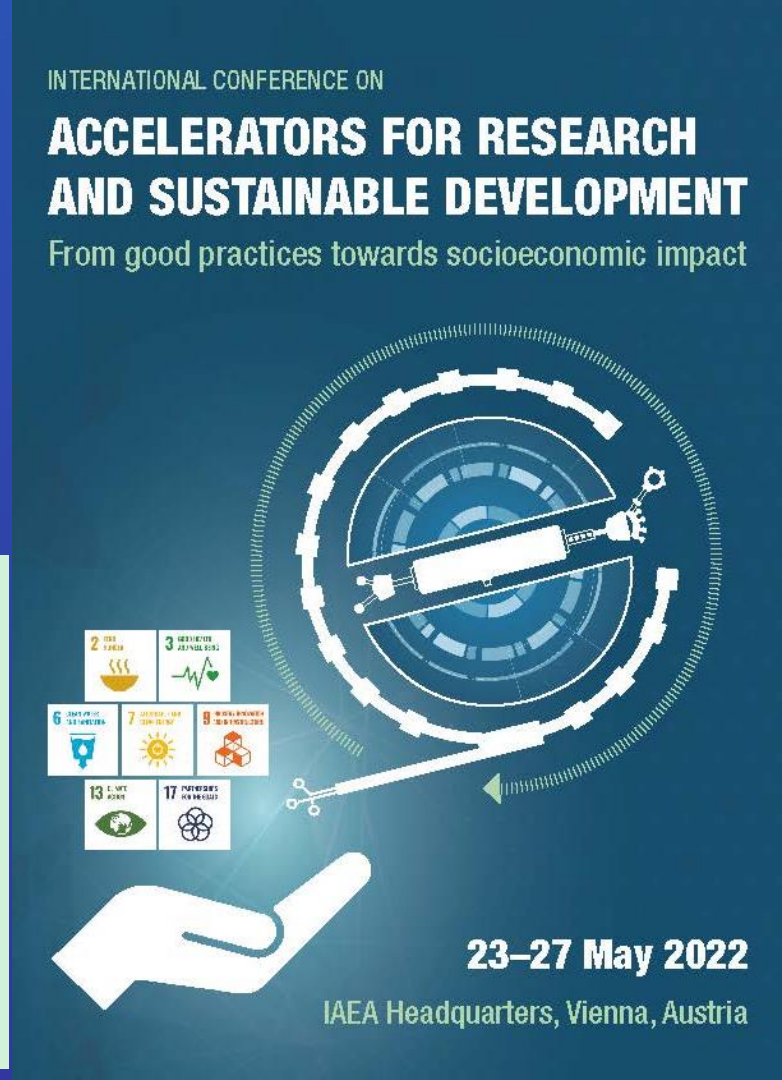
Physics Section / NAPC / IAEA

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# IAEA and Particle Accelerators

- Promoting nuclear techniques in the IAEA Member States is one of the objectives within the mission of the IAEA
- Activities focusing on accelerator-based research and applications in multiple disciplines fit to these objectives and are being implemented by the Physics Section
- Among these, activities facilitating access to accelerator facilities and capacity building are of key importance and of primary interest

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# IAEA tools to support accelerator-based research & applications

- Consultancy Meetings: 5 to 10 experts are invited to provide specialized advice and recommendations on particular scientific or other aspects of relevance for the IAEA's programmes and activities.
- Technical Meetings: Technical events with 30-40 participants, aiming at enhancing interaction among experts, share knowledge and expertise, establish scientific collaborations and create topical networks.
- Coordinated Research Projects (CRPs): Networks of 10-15 research institutes from developed and developing countries that work in coordination for 3-5 years to acquire and disseminate new knowledge/technology. Periodic meetings are organized to report progress and plan/coordinate future activities.
- Training Workshops, Courses and dedicated Schools: Events enabling participants to acquire specific knowledge – theoretical or practical or both – on a given subject of interest. Organized at IAEA laboratories, ICTP Trieste, or at labs in member states
- Publications of technical documents and guides: Publications of reported results, shared good practices and lessons learned; produced by CRPs or Technical Meetings.
- National, regional, interregional Technical Coordination (TC) projects: projects to build capacity via Expert Missions (internal and/or external Experts), training of personnel, purchase of equipment, assistance in establishing new facilities, …

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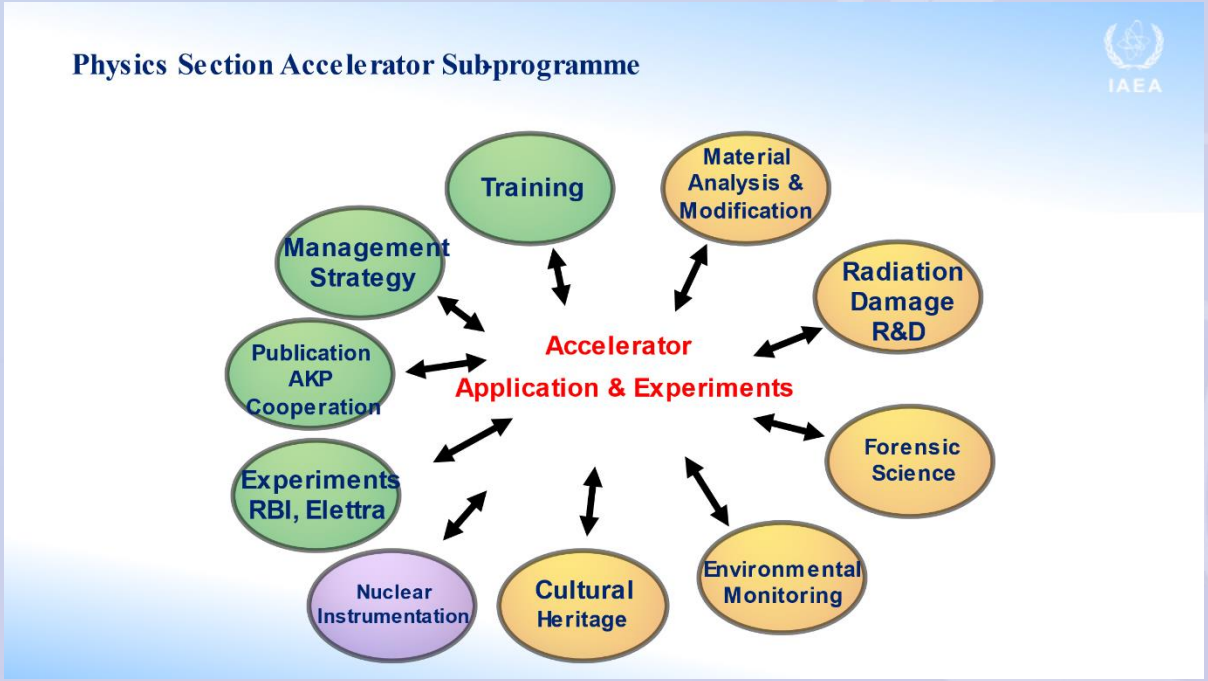
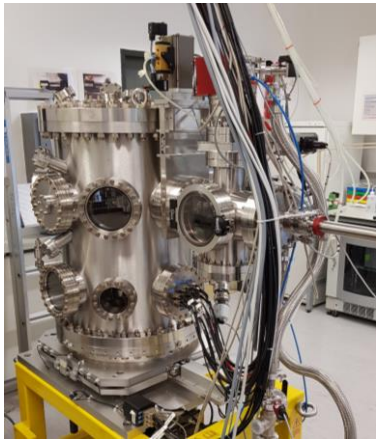
# Examples of the IAEA support to accelerator facilities: access, research and operation



# Facilitating access to state-of-the-art accelerator facilities:

## Elettra-Sincrotrone Trieste



IAEA has a long-standing agreement with EST concerning the end-station at the XRF beamline. Together we run an annual training school and support access for users from developing countries.

IAEA Collaborating Centre

Elettra-Sincrotrone Trieste S.C.p.A.

### IAEA – Elettra (Trieste) Cooperation Agreement

- Dedicated beam-time for users; So far, more than 20 research groups from more than 18 Member States conducted experiments. Access through direct application to EST
- In 2018, Training Workshop held in SESAME, Jordan, with remote connection to Elettra

- EST became an IAEA collaborating centre to support developments of light sources and their applications in 2020.

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# Facilitating access to state-of-the-art accelerator facilities:

## IAEA – RBI (Zagreb) Cooperation Agreement

- New He ion source for dual-beam irradiation capabilities commissioned (fusion research)
- 20 days of beamtime available, annually, for research groups from developing countries (available through CRP 42008 and direct request to PS)
- Biannual hands-on training courses on (more on next slides):
  - Electrostatic accelerator technology and associated instrumentation, incl. operation & maintenance (Dec. 2019; Nov. 2021-virtual)
  - Advances in Ion Beam techniques & their applications (March 2021-vIrtual, next in Nov. 2022)

# Support to the synchrotron facilities

## SESAME synchrotron in the Middle East:

- Through a series of TC projects, Physics section has supported this shared facility in the Middle East throughout its development, providing experts, equipment, and training for staff and users.

Design — Construction — Commissioning — Operations

| 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| INT1055 | | | INT0086 | | | | INT0092 | | | | INT0099 | | |
| 2010-2011 | | | 2012-2015 | | | | 2016-2019 | | | | 2020-2023 | | |
| 525,000 | | | 534,000 | | | | 689,000 | | | | 300,000 | | |

## THAI SYNCHROTRON NATIONAL LAB:

- IAEA supported the development of the ASEAN microXRF beamline with silicon drift detector, ionization chambers, ancillary equipment, and training.

# Support to the electrostatic accelerator facilities

- hands-on training of scientific and technical personnel in accelerator operation and maintenance
- assistance in refurbishment and modernization of beam lines and associated instrumentation
- assistance in feasibility and design studies and the preparation of business and strategy plans
- technical support in specifications, procurement, installation, repairs & upgrades of experimental devices.

collaboration with TC Dept.

List of countries supported by Expert Missions, procurement of equipment or other types of assistance in a few previous years through TC programme or financed by Member States

- Algeria
- Egypt
- Ghana
- Greece
- Nigeria
- South Africa
- Bangladesh
- Croatia
- Jordan
- Lebanon
- Mexico
- Slovakia
- Syria
- Thailand


Accelerator facility in Lebanon


Accelerator facility in Bangladesh


Accelerator facility in Algeria

# Training young scientists and accelerator operators

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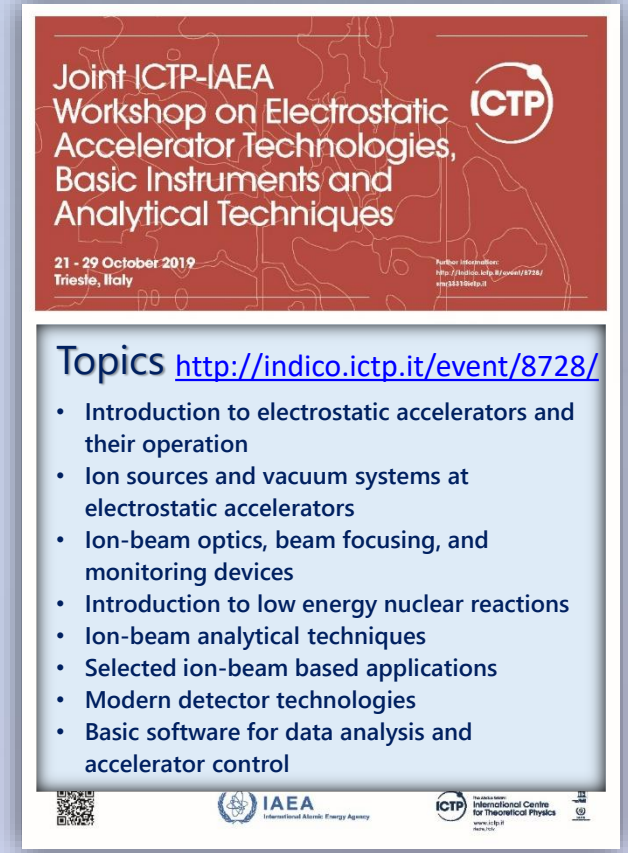




7 Lecturers
(22 lectures; 4 hrs practical exercises on ion beam optics simulation)

17 Trainees <age>=33; 1/3 women

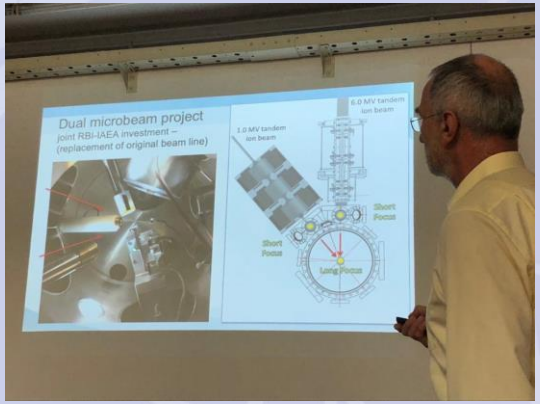
Attendees from 12 countries all around the world!

2 full day Lab visits
- Laboratori Nazionali di Legnaro, Italy
- Jozef Stefan Institute, Ljubljana, Slovenia

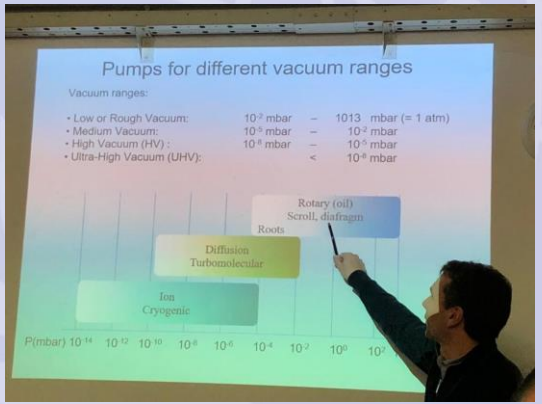
Hands-on experience in PIXE spectra measurement and analysis


# Training young scientists and accelerator operators

Training Workshop: Hands-on Operation & Maintenance of Electrostatic Accelerators; RBI, Zagreb, Croatia 9-13 Dec. 2019




- ✓ Accelerator controls, control software, voltage measurements and stabilization (CPU – GVM – slits), Dew point measurements, Magnetic hysteresis evaluation, Terminal voltage calibration.
- ✓ Vacuum systems: setting up & measurements, leak detection, RF & DC discharges in gases.
- ✓ Ion sources: beam extraction, beam current measurements, changing source parameters, element selection & optimization, changing Duoplasmatron operation (negative <-> positive)
- ✓ Beam optics: Basic theory, beam focusing & steering, quadrupole alignment, beam brightness and size measurements.



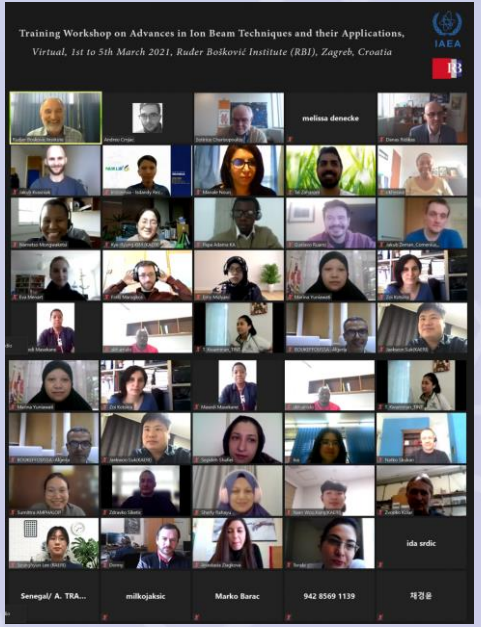
# Trainings in times of COVID

(Virtual) Training Workshop: Advances in Ion Beam Techniques and their Applications, RBI, Zagreb, Croatia, 1-5 March 2021

- Intro-lecture (60-90 min) –
- Demo video (≈20 min.)
- Discussion/Questions/Exercises (90 min)
- Homework (data analysis)

Stats:

- 36 trainees-17 women
- 16 Member States
- Total numbers higher than with physical trainings
- A set of videos produced (by RBI, Croatia)





https://nucleus.iaea.org/sites/accelerators/Pages/IBA-video-demonstrations.aspx

# Trainings in times of COVID

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## (Virtual) Training Workshop on Operation and Maintenance of Electrostatic Accelerators, Vienna, 22-26 November 2021

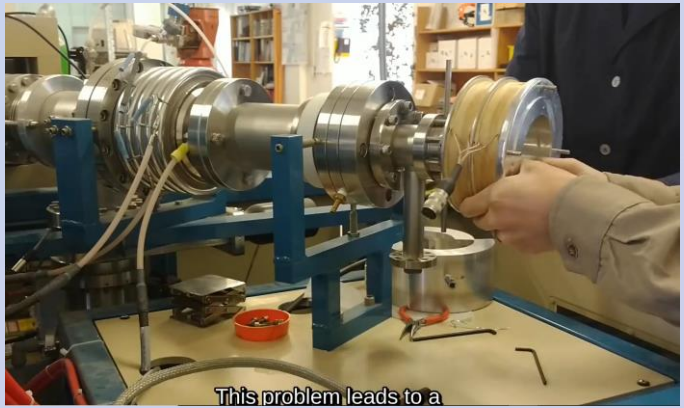
- Form of round table
- Mixed: Participants with experience and less experienced
- Two different types of presentations:

Issues in operation and maintenance followed by discussion (30 min each)
Lectures on different aspects on O&M

Stats:

- 64 participants-8 women
- 23 Member States
- Total numbers higher than with physical trainings
- A set of videos produced (by participants): some to better explain issues, others to show good practices in O&M

Meeting was a success in given situation: will be organized annually!





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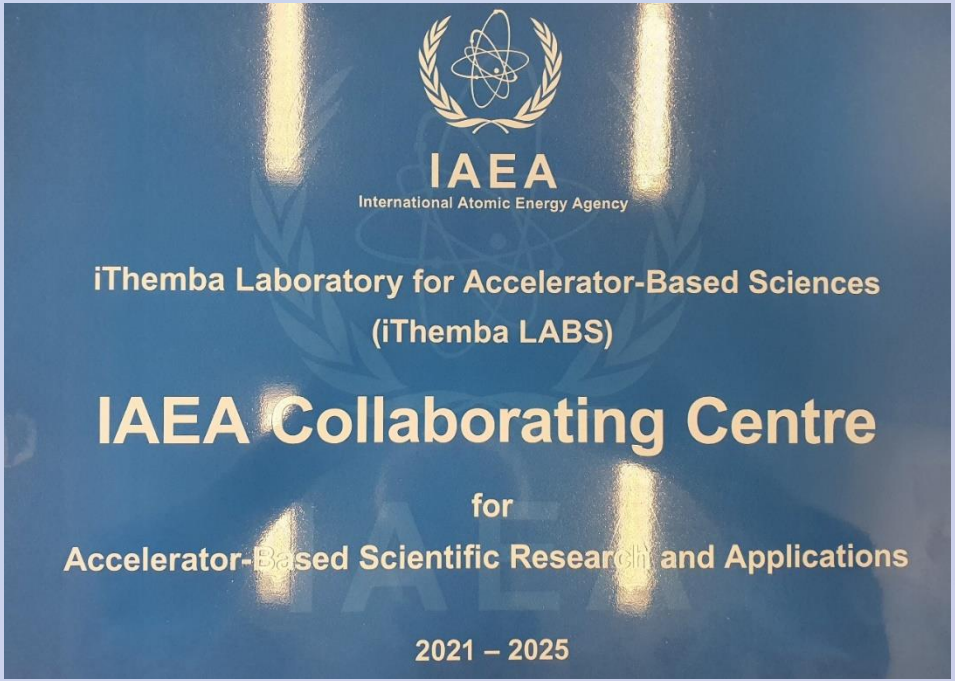
- First training workshop at iThemba LABS, the new Collaborating Centre!
- Intended mostly for the facilities in Africa!

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**Training Workshop on the Operation and Maintenance of Electrostatic Accelerators and Associated Instrumentation**

**Hosted by the**

**Government of South Africa**

**through the**

iThemba LABS

**Johannesburg, South Africa**

**5 to 9 December 2022**

**Ref. No.: EVT2104016**

# G42008 CRP: Facilitating experiments with Ion Beam Accelerators

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Distribution of electrostatic accelerators:
IAEA Accelerator Knowledge Portal

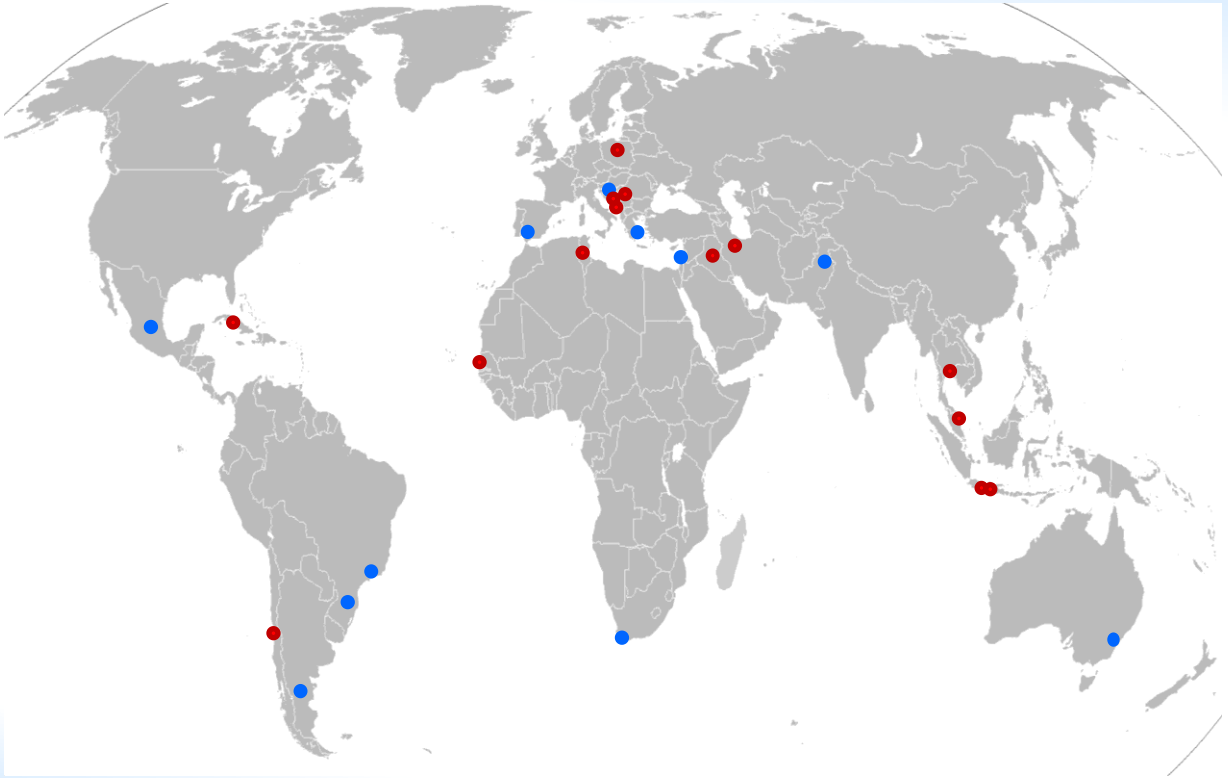

https://nucleus.iaea.org/sites/accelerators

- A very uneven distribution of the electrostatic accelerators for IBA throughout the world.
- Many scientists from developing countries have less chance to be exposed and use IBA techniques
- The aim: A worldwide transnational access to IBA (and other) methods for the scientists not having such possibilities in their countries

Applications of IBA methods in:

- Cultural heritage
- Environmental monitoring and climate change
- Materials characterization and modification
- Material studies for fusion energy
- Earth sciences
- Biosciences and Human Health
- And many others

# CRP G42008: Facilitating Experiments with Ion Beam Accelerators
## Status: December 2021



11 Beam providers

Planned/conducted so far 14 experiments

In different phases of planning

- Agriculture 1
- Archaeology 1
- Biology 2
- Ecology 5
- Geology 1
- Nuclear physics 1
- Solid state physics 3

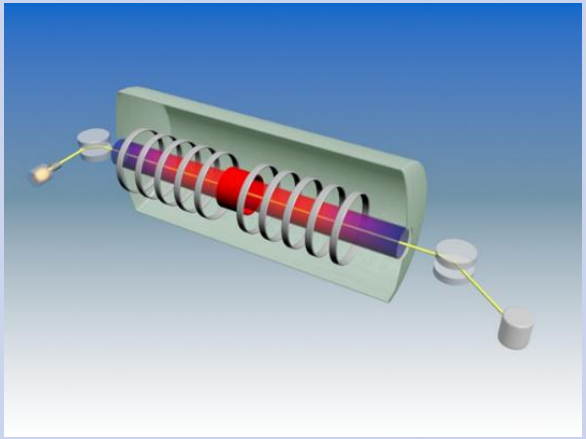
➢ Three experiments finalized

➢ One partially done

Visit the page: https://nucleus.iaea.org/sites/accelerators/Pages/beamtime.aspx

Covid pandemic postponed most of the planned experiments, some for more than a year!

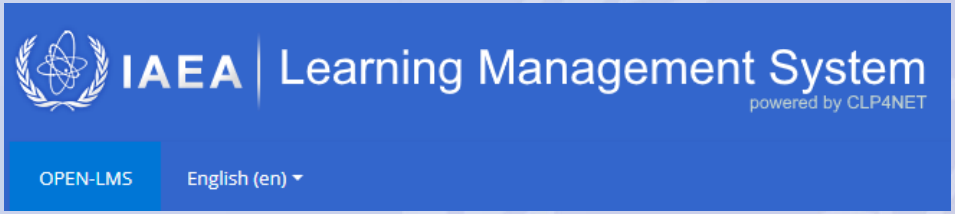
# E-learning materials



Introduction to electrostatic accelerators: from basic principles to operation and maintenance

- The electrostatic accelerator
- Ion sources
- Beam transport
- Vacuum
- Safety considerations

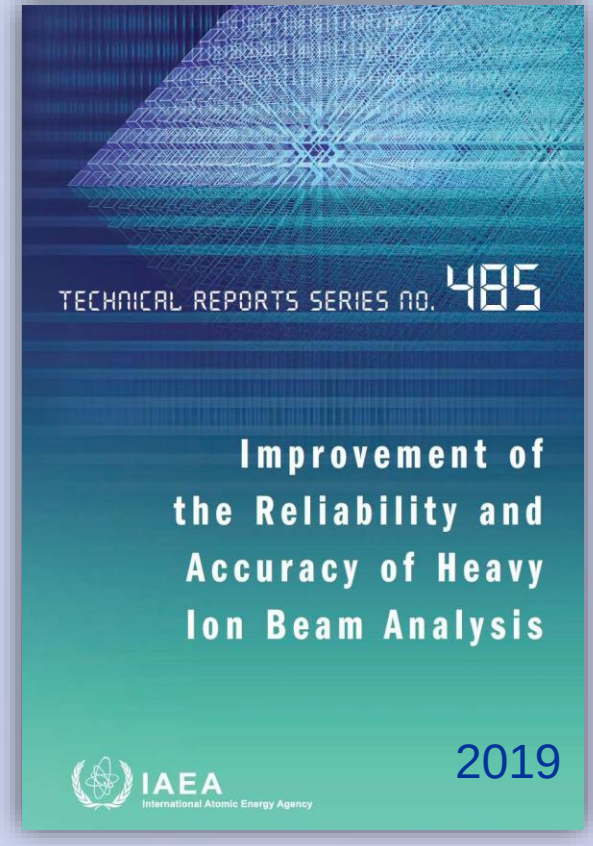
Recommended for students, laboratory staff, and users of these facilities.

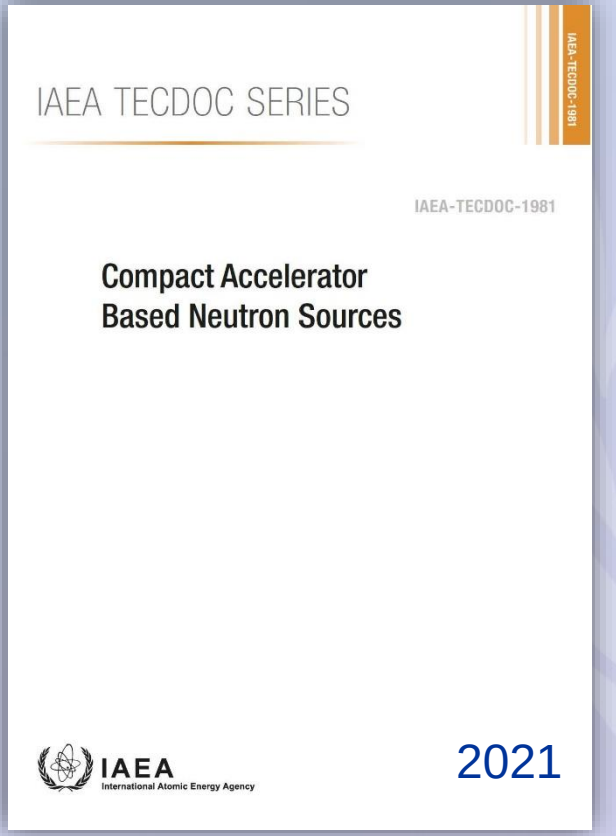



https://elearning.iaea.org/m2/course/index.php?categoryid=108

- **Some other e-learning materials:**
- Nuclear Analytical Techniques for Forensic Science
- Introduction to X Ray Emission Spectrometry
- Portable X-Ray Spectrometry Techniques for Characterization of Valuable Archaeological/Art Objects
- Neutron Activation Analysis

# Publication of technical documents




**To be published soon!**

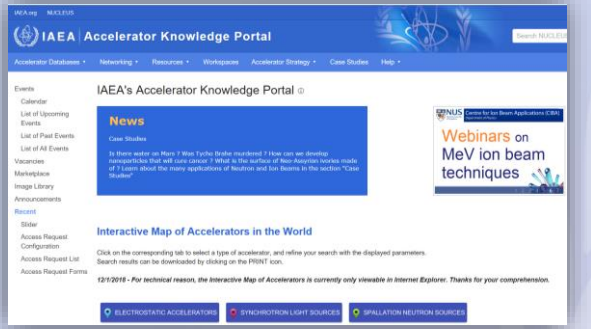
***Operation and Maintenance Guidelines for Low Energy Electrostatic Accelerators***



- Operational procedures and good laboratory practices
- Safety considerations in an accelerator laboratory
- Ion sources
- Electrostatic accelerator charging and control systems
- Acceleration tubes and voltage grading
- Tandem accelerator ion stripping systems
- Insulating gases
- Water cooling systems
- Vacuum pumps, measurement and leak detection
- Beam transport elements
- Computer control

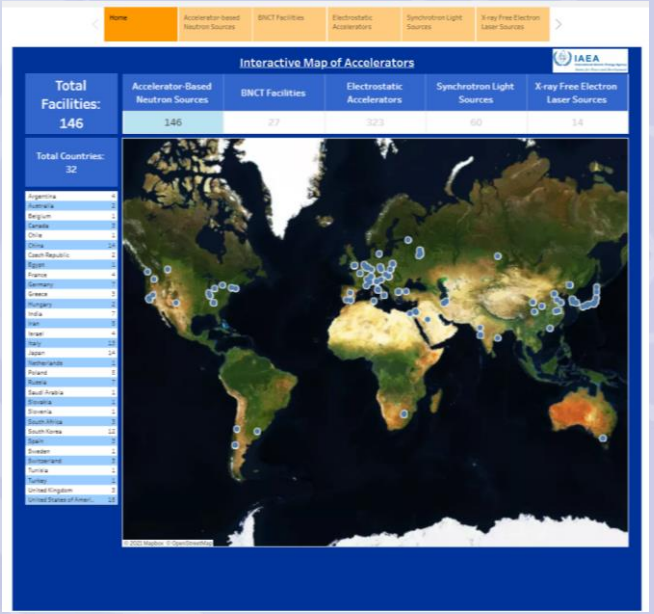
# Management of databases and thematic portals

- Accelerators: https://nucleus.iaea.org/sites/accelerators/
- Research reactors: https://nucleus.iaea.org/RRDB/
- Fusion: https://nucleus.iaea.org/sites/fusionportal/
- Nuclear Instrumentation: https://nucleus-new.iaea.org/sites/nuclear-instrumentation/





Interactive maps of accelerators and other facilities
https://nucleus.iaea.org/sites/accelerators/




Accelerator Knowledge Portal

- 3135 visitors/users in 2018
- ≈1700 accelerator-based facilities
- New entries: 1270 med. cyclotrons and 91 AMS facilities
- Planned to add proton/hadron therapy facilities and RIB facilities
- Includes case studies with Neutron and Ion Beam techniques

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# Scientific events in cooperation with the IAEA

IOP Institute of Physics

## International Nuclear Physics Conference 2019

INPC

29 July – 2 August 2019, Scottish Event Campus, Glasgow, UK

Home · Abstracts · Register · Programme · Location · Exhibition · Sponsorship · Membership · Contacts · Policies

Book your stand

Abstract submission

Sponsors

IUPAP

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SUPA
Scottish Universities Physics Alliance

*Organised in co-operation with IAEA*

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## EUROSCHOOL on Exotic Beams

Fuglsøcentret
Aarhus, Denmark

2019
AUG 25-31

KU LEUVEN

JYVÄSKYLÄN YLIOPISTO

JINR

GSI FAIR

GANIL

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**Lecturers and topics**

| | |
|---|---|
| Anu Kankainen | Nuclear astrophysics with radioactive beams |
| Dolores Cortina-Gil | Beams and experiments with in-flight fragmentation |
| Hanna Frånberg | Beams and experiments with the ISOL technique |
| Frédéric Nowac | |
| Antonio Moro | |

**Board of Directors**

Dolores Cortina-Gil, Uni. de Santiago de Compostela, Spain
Sotirios Charisopoulos, IAEA, Vienna, Austria
Hans O.U. Fynbo, Aarhus University, Denmark

## Nuclear Photonics

Kurashiki Japan

3rd International Conference on
Nuclear Photonics (NP2020)
June 1-5, 2020, Kurashiki, Okayama, Japan

First Circular

Nuclear Photonics 2020 is organized in cooperation with the International Atomic Energy Agency (IAEA).

OSAKA UNIVERSITY

SINCE 1972 50 YEARS
Institute of Laser Engineering
Osaka University

RCNP

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## Advanced Nuclear Science and Technology Techniques (ANSTT3) Workshop

16-20 March 2020
J Block
Africa/Johannesburg timezone

- Overview
- Scientific Programme
- Keynote Speakers
- Thematic Programme
- Call for Abstracts
- Registration
- Participant List
- Accommodation
- Social Functions
- Travel to Cape Town
- Satellite Meeting
- Dark Skies Event

Support
anstt2020@tlabs.ac.za


Participants at the ANSTT meeting in 2019

The ANSTT3 will be a 5 day workshop to be held at iThemba LABS, Cape Town to focus on accelerator mass spectrometry, metrology and applications, environmental measurements and nuclear structure studies at iThemba LABS. This follows on from the ANSTT series of meetings held in 2018 and 2019.

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# *Thank you!*

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