



IAEA

International Atomic Energy Agency
Atoms for Peace and Development

TRIUMF

Science Week

2020

August 17-21, 2020

“IAEA Radioisotope Program”

TRIUMF SCIENCE WEEK – 2020

18-08-2020

Joao Alberto Osso Junior

Head, Radioisotope Products and Radiation Technology Section

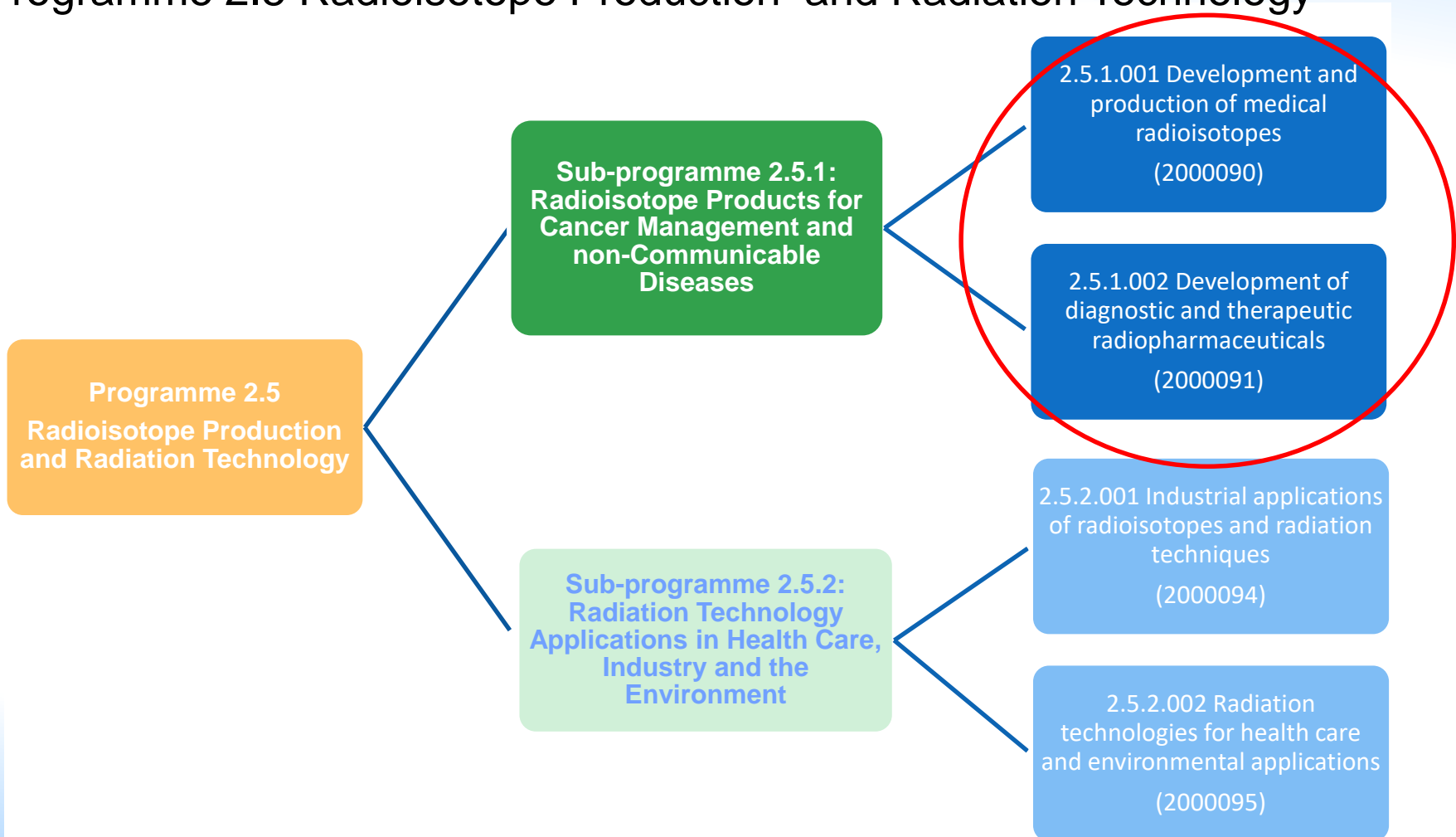
RPRT/NAPC/NA/IAEA

J.A.Osso-junior@iaea.org

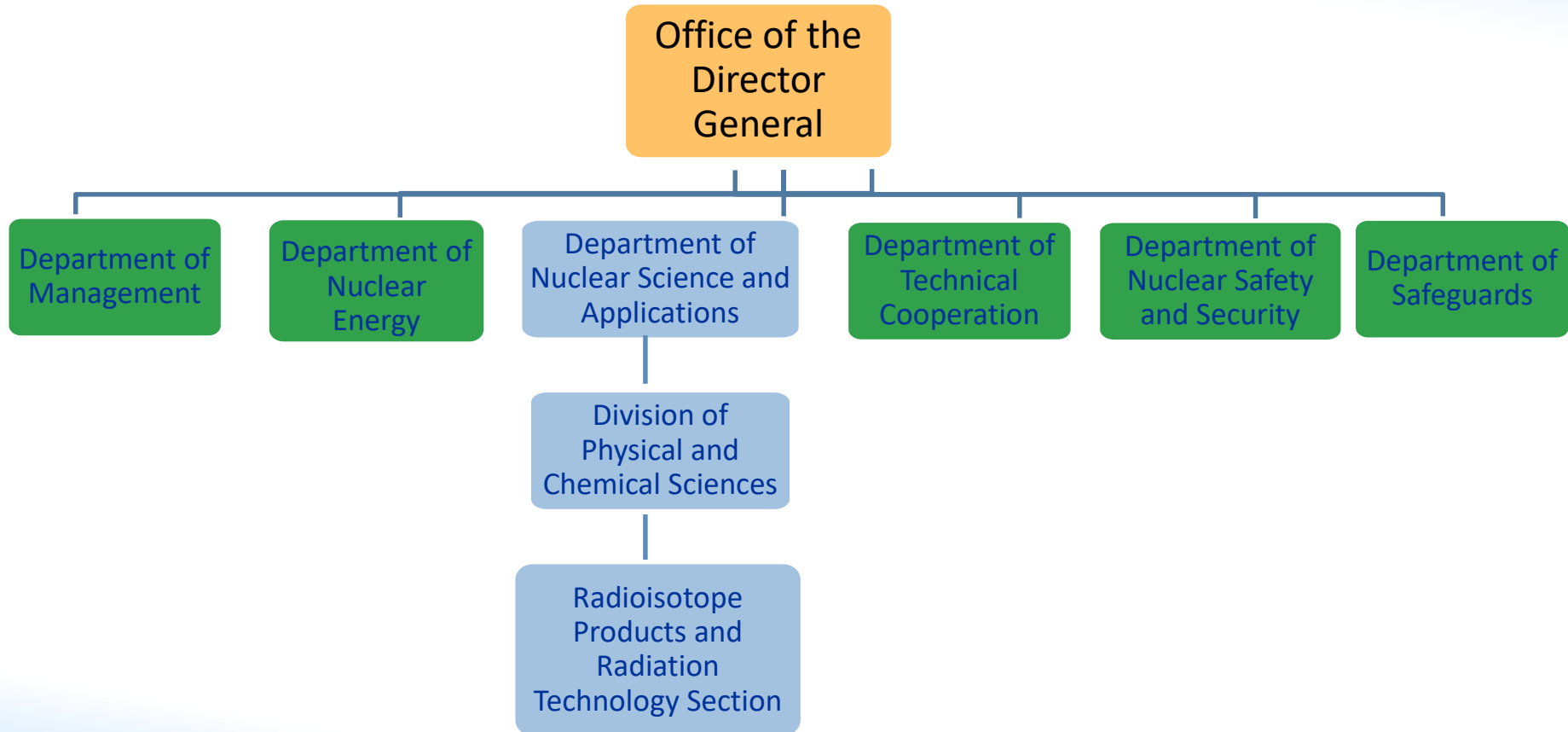
Programme description/objectives

Radioisotope Products and Radiation Technology Section

Programme 2.5 Radioisotope Production and Radiation Technology



IAEA Organization – RPRT Section





IAEA

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NAPC Radioisotope Products and Radiation Technology Section



IAEA Projects: RPRT Section



Planning of activities



- Planning & Budget: biannual cycles (18-19; 20-21; 22-23)
- Annual meeting planning
- Inputs:
 - GC resolutions (Mo-99)
 - TOs experience and network
 - Requests from MSs (health regulatory issues)
 - Experts recommendations (meetings, missions, etc)
 - Evaluation of IAEA Conferences
 - Recommendations/Collaborations: key partners (EC-JRC, WHO)
 - SAGNA recommendations
 - Collaborating Centres
 - EB funding
 - Alignment with SDGs

Resolutions GC63 (2019)

- ❖ A. Non power nuclear applications 1. General
- ❖ 8. Calls upon the Secretariat to continue to address identified priority needs and requirements of Member States in the areas of nuclear science, technology and applications, such as:
 - ❑ i. use of radioisotopes and radiation in human health, including through enhancing access and quality,
 - ❑ x. use of cyclotrons, research reactors and accelerators for the production of affordable radiopharmaceuticals
- ❖ 18. Requests the Secretariat to continue to provide to interested Member States, upon request, technical assistance regarding production and transport of medical isotopes and radiopharmaceuticals;
- ❖ 19. Requests the Secretariat to continue providing assistance to Member States with capacity building for the development, production and quality control of new generations of therapeutic radiopharmaceuticals (such as alpha emitters);

Resolutions GC63 (2019)



- ❖ 21. Urges the Secretariat to continue to implement activities that will contribute to securing and supplementing the molybdenum-99/technetium-99m production capacity, including in developing countries, in an effort to ensure the security of supplies of molybdenum-99 to users worldwide and further urges the Secretariat to continue its cooperative work towards this goal with related initiatives undertaken by other international organizations such as the OECD Nuclear Energy Agency;
- ❖ 22. Requests the Secretariat, upon request from interested Member States, when technically and economically feasible, to provide technical assistance to emerging national and regional efforts to establish non-HEU based molybdenum-99 production capabilities, and to provide technical assistance to transition existing production capabilities to utilize non-HEU-based methods and facilitate training activities such as workshops to support Member States in their efforts to achieve self-sufficiency in local production of medical radioisotopes and radiopharmaceuticals;
- ❖ 23. Urges the Secretariat to continue exploring the use of accelerators for various radiation technology applications and to facilitate demonstrations and training for interested Member States;
- ❖ 24. Requests the Secretariat to make efforts together with Member States in developing industrial irradiation facilities such as electron accelerators and their accessories for use in, inter alia, healthcare practices, crop improvement, food preservation, industrial applications, sanitization and sterilization, and further requests the provision of technical support for the use of research reactors in the production of radiopharmaceuticals and industrial radioisotopes;

Activities/Applications

Korde, Aruna



Jallian, Amirreza



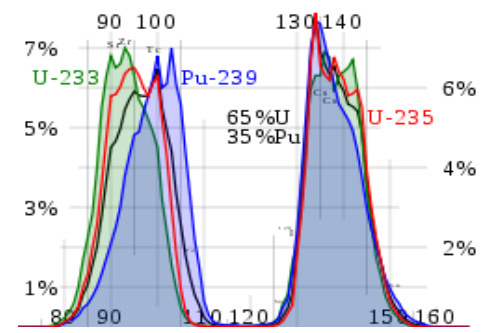
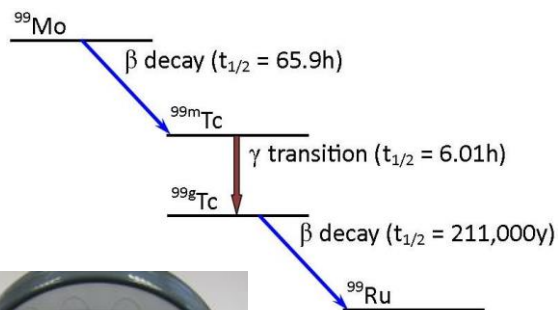
Starovoitova, Valeriia





Cyclotrons / Accelerators

Production of radioisotopes



Radionuclide generator

Mo-99 and Ac-225

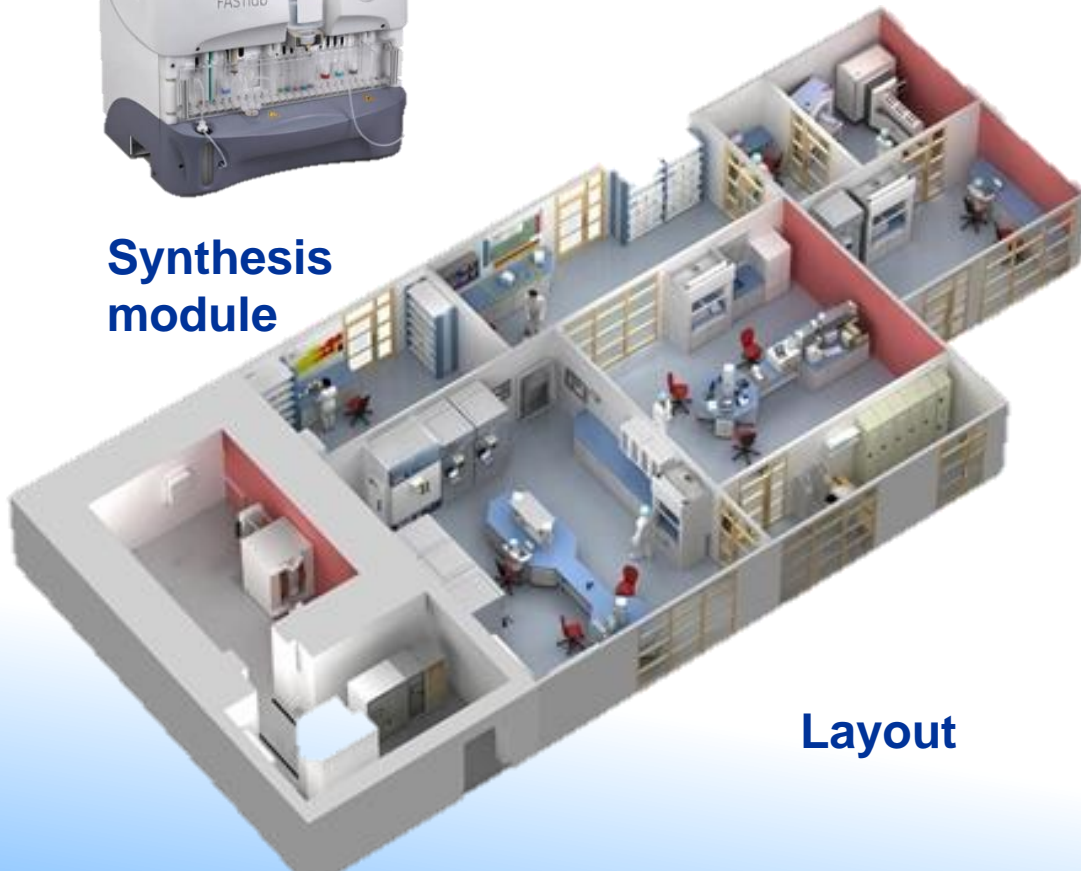
Research Reactor



Production of Radiopharmaceuticals



**Synthesis
module**



Layout

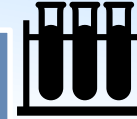


Main activities



1. Production of radioisotopes

2. Production of radiopharmaceuticals



3. Quality control and assurance

4. Conferences, meetings, capacity building



5. Education (e-learning, training modules, syllabus for Universities)



6. Regulatory issues: Due to the increasing complexity of radiopharmaceutical preparations and the mandatory requirement of patient's safety, there exists a widespread demand to support regulators and preparation of guidelines of Good Manufacturing Practice (GMP)



7. Publications: CRPs, guidelines

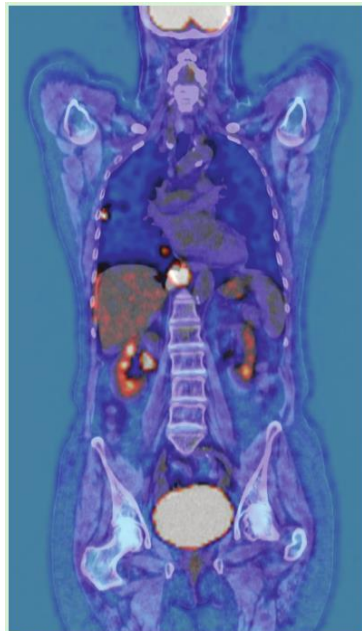


8. International Pharmacopeia in cooperation with WHO

Radioisotopes and Radiopharmaceuticals for Diagnosis and Therapy



- Radiopharmaceuticals for SPECT (Single Photon Emission Computed Tomography): **Tc-99m**, In-111, Ga-67...
- Radiopharmaceuticals for PET (Positron Emission Tomography): **F-18**, **Ga-68**, **Cu-64**, **Zr-89**....
- Radiopharmaceuticals for therapy: **Lu-177**, Y-90, I-131, Cu-67, Cu-64, alpha emitters(**Ac-225**), Auger



FDG scan of a cancer patient with metastatic diseases

PET/CT



SPECT/CT bone

Radioisotope production technologies

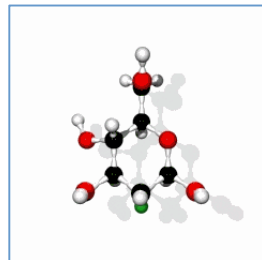
CRPs

- Production and utilization of Emerging Positron Emitters for Medical Applications with an Emphasis on **Cu-64 and I-124** (2010-2014)
- Accelerator-based Alternatives to Non-HEU production of **Mo-99/Tc-99m** (2011-2015)
- Sharing and Developing Protocols to Further Minimize **Radioactive Gaseous Releases** to the Environment in the Manufacture of Medical Radioisotopes, as Good Manufacturing Practice (August 2015)
- Therapeutic Radiopharmaceuticals Labelled with New Emerging Radionuclides (**^{67}Cu , ^{186}Re , ^{47}Sc**) – (2016-2019)
- New Ways of Producing **Tc-99m and Tc-99m Generators** – **3rd RCM in 2021**
- Production of Cyclotron-Based **Gallium-68** Radioisotope and Related Radiopharmaceuticals – **1st RCM in 2021**

Radiopharmaceuticals: production, quality aspects and clinical use

CRPs

- ❖ Development of **Ga-68** based PET-Radiopharmaceuticals for Management of Cancer and other Chronic Diseases (2010-2015)
- ❖ Development and preclinical evaluations of therapeutic radiopharmaceuticals based on **Lu-177 and Y-90** labeled monoclonal antibodies and peptides (2011-2015)
- ❖ **Nanotheranostic**: Nanosized delivery systems for radiopharmaceuticals (2014-2019)
- ❖ **Cu-64** Radiopharmaceuticals for Theranostic Applications – (2016-2020)
- ❖ Production of **Zr-89** and Development of **Zr-89 Radiopharmaceuticals** – new 2019 – 1st RCM 2021



TMs/CMs 2020

- ❖ Regional training workshop on Preparation and Quality Control of **Alpha/Beta Emitter Labelled Peptides** (Latin America-Colombia): **2021**
- ❖ Regional Training course on Preparation and Quality Control of **SPECT Radiopharmaceuticals** (Africa): **2021**
- ❖ TM on New Generation of **Technetium-99m Kits** for Oncology Applications: **2021**
- ❖ CM on IAEA Publication on **Nanosized Delivery Systems** of Radiopharmaceuticals
- ❖ CM on Recent Advances in the Production and Quality Control of **Fluorine-18 radiopharmaceuticals**
- ❖ CM on the Formulation of WHO/IAEA Guidance Documents on **Good Manufacturing Practices** for Radiopharmaceutical Products

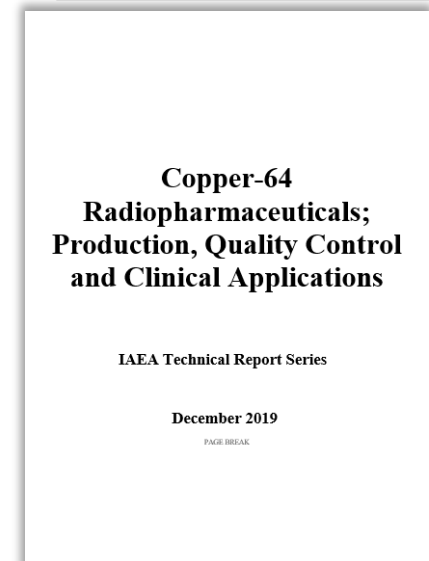
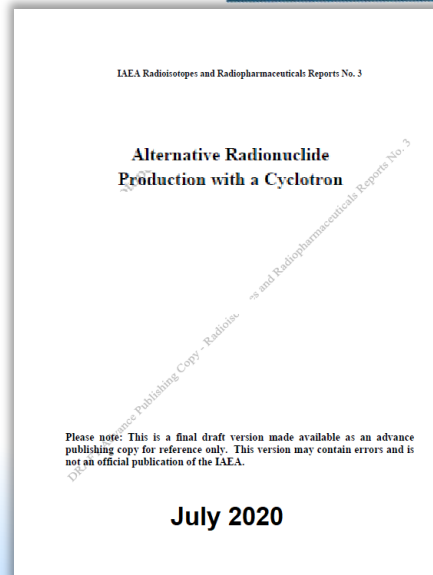
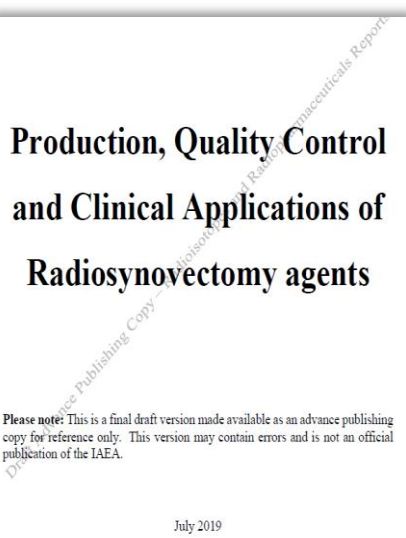
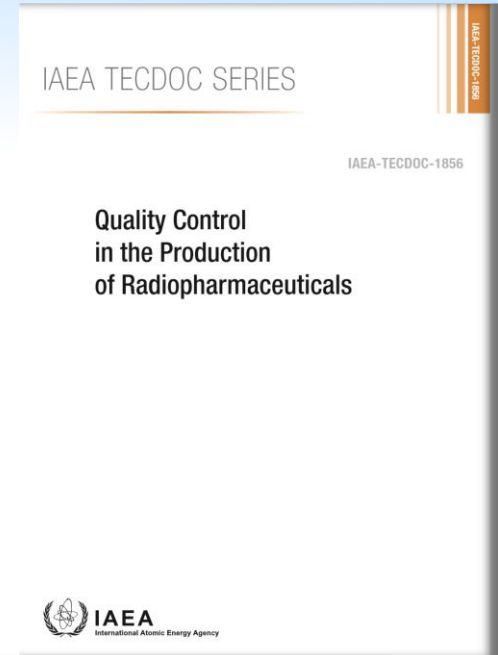
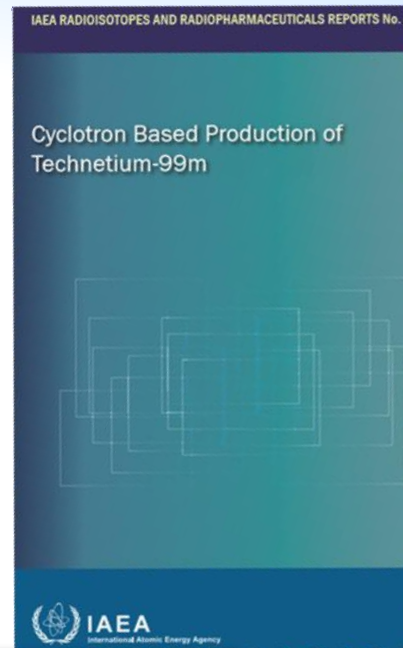
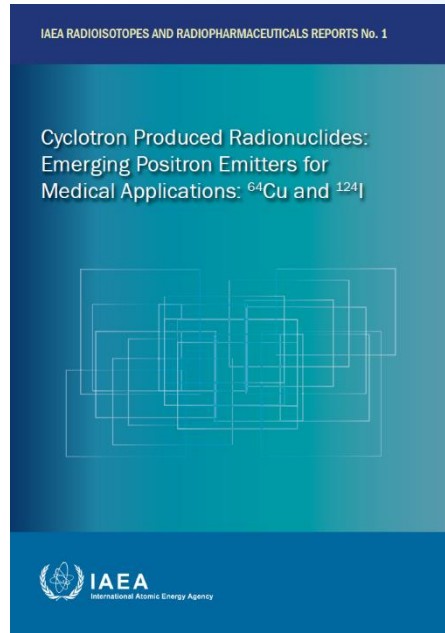
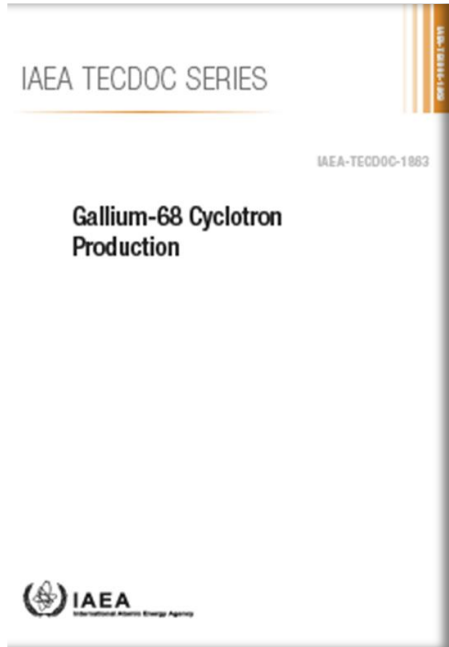
TMs/CMs 2021 (not approved yet)

- ❖ CM on the Development of Molecular Probes for **Multimodality Imaging**
- ❖ CM on Preparation of Guidelines for Design and Operation of **SPECT Radiopharmacy Facility**
- ❖ CM on the Status of **Alpha Emitters and** Radiopharmaceuticals
- ❖ TM on the **Preclinical Testing** of Radiopharmaceuticals
- ❖ CM on the Status of Emerging Radioisotopes of **Arsenic and Antimony** for Radiopharmaceutical Development
- ❖ TM on Practical Aspects Related to the Production of **Molybdenum-99 by Photonuclear Reaction: CII**
- ❖ CS on the Preparation of Technical Document on Development of Radiotracers for **CNS: bench to bedside**
- ❖ Technical Workshop on Production of **Theranostic Radiometals** using a Medical Cyclotron
- ❖ TM on the **Status of Lu-177** Theranostic Radiopharmaceuticals
- ❖ CM on Preparation of Guidelines for Design and Operation of **PET Radiopharmacy Facility**

Cycle 22/23 (planning stage)

- ❖ New CRPs: *Ac-225*; new kits for Tc-99m; new kits for Theranostic
- ❖ Auger emitters
- ❖ Radioisotopes/Radiopharmaceuticals in COVID-19
- ❖ Women in Radiopharmaceutical Sciences
- ❖ WHO

Recent Publications: more 10...



TC Projects

- ❖ **More than 160 projects**
- ❖ **Capacity Building : FE, SV, NTC, Experts**
- ❖ **Setting up facilities through TC projects**
 - ✓ **Technetium-99m Generator Production facility;**
 - ✓ **Cyclotron facility for PET radiopharmaceuticals and RPHs;**
 - ✓ Upgrade of gamma facilities
 - ✓ Training/certification on NDT and radiotracers for industry



Initiation of a 5 year project in Africa



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IAEA Helps African Countries in the Production and Use of Radiopharmaceuticals for Cancer and Other Diseases

21/2018

Kampala, Uganda

MAY

1

2018



Related resources

- [Radiopharmaceutical production](#)
- [Radiopharmaceuticals - A Key Component of Nuclear Medicine](#)

Successful training course on alpha and beta emitter peptides, Poland June 2018



New Technique to Fight Prostate Cancer: IAEA organizes first-of-a-kind training for Radiopharmacists

Aleksandra Peeva, IAEA Department of Nuclear Sciences and Applications

JUL
10
2018



For the first time, radiopharmacists from across Central and Eastern Europe learned about an emerging technique in treating prostate cancer at an IAEA course organized at the [National Centre for Nuclear Research in Poland](#) last

Related Stories



[African Radiopharmacists Put New Skills to Use](#)



[IAEA Helps African Countries in the Production and Use of Radiopharmaceuticals for Cancer and Other Diseases](#)

Related Resources

-  [Radiopharmaceuticals - A Key Component of Nuclear Medicine](#)
-  [Diagnostic radiopharmaceuticals](#)
-  [Radionuclide therapy](#)
-  [Ministerial Conference on Nuclear Science and Technology: Addressing Current and Emerging Development Challenges, 28-30 November 2018](#)



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Collaborations

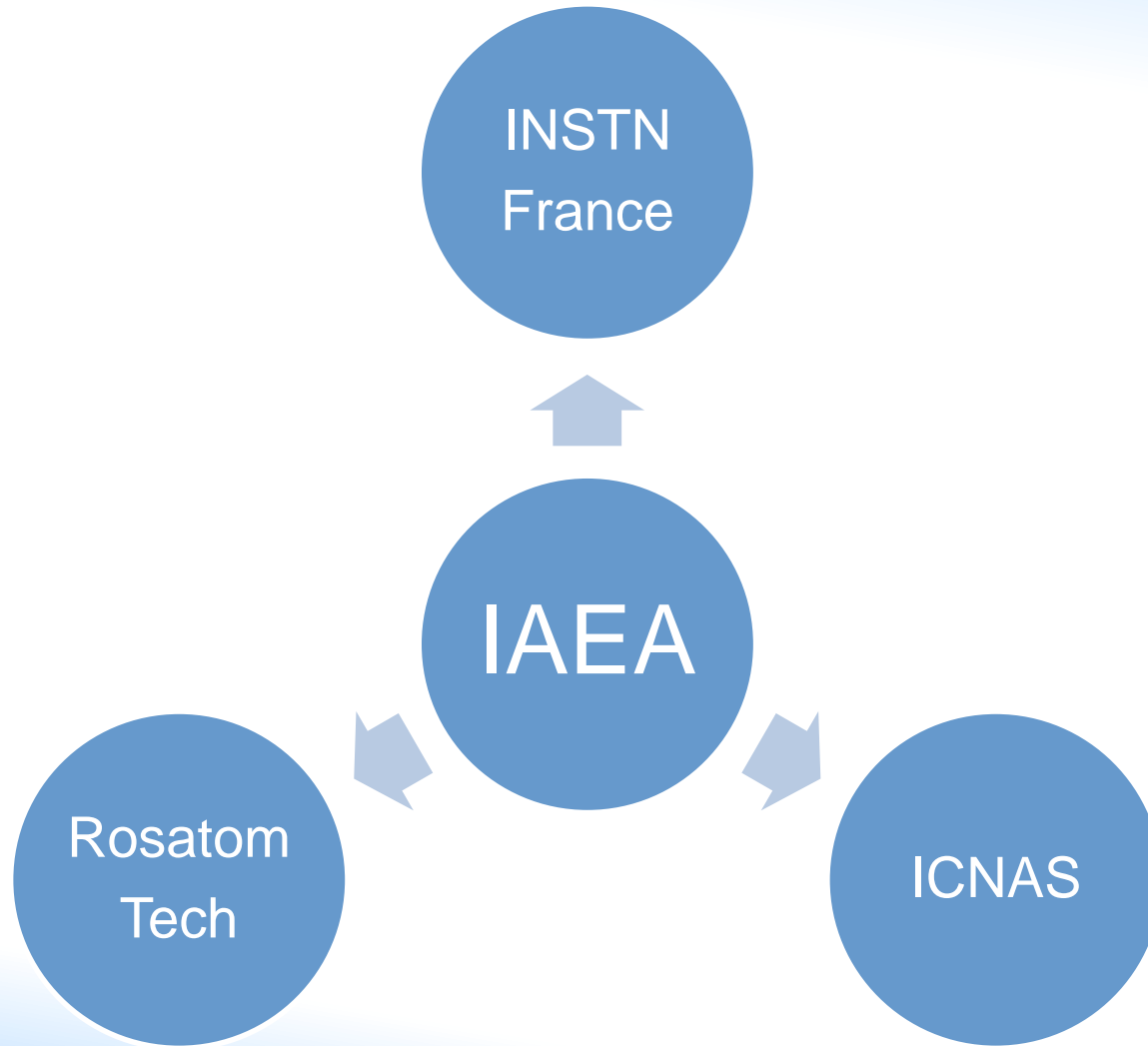
External Collaboration

- CCs
- EC-JRC
- SRS, EANM, iiA, ISTR, A,
- DOE labs
- TRIUMF, CNL, CII, Universities
- CERN
- US National Academies of Sciences, Engineering, and Medicine, Russian Academy of Sciences
- KOICA-KAERI-WCI (3 courses/year)
- WHO
- PA:EC, Okayama University (BNCT), WNU



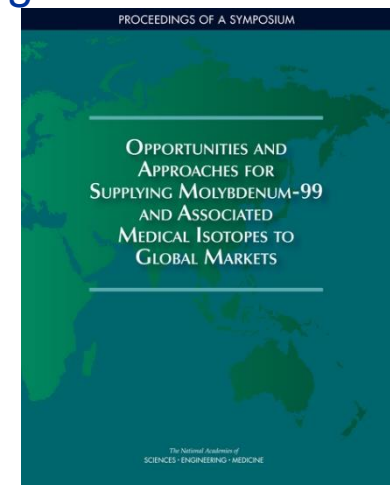
IAEA

Collaborating Centres - Radiopharmacy



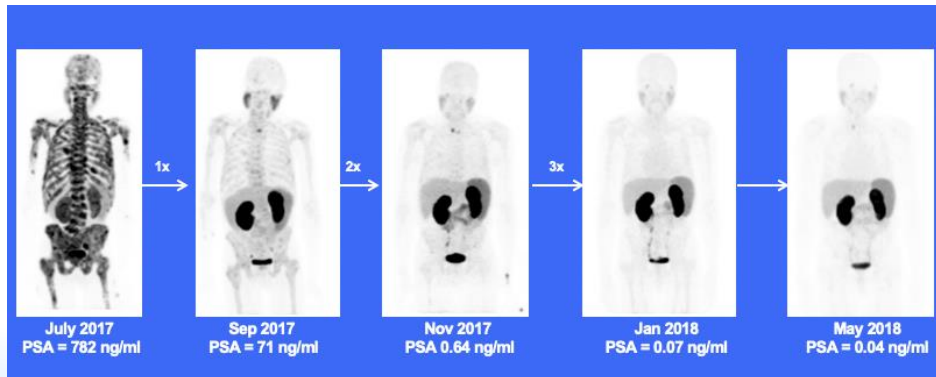
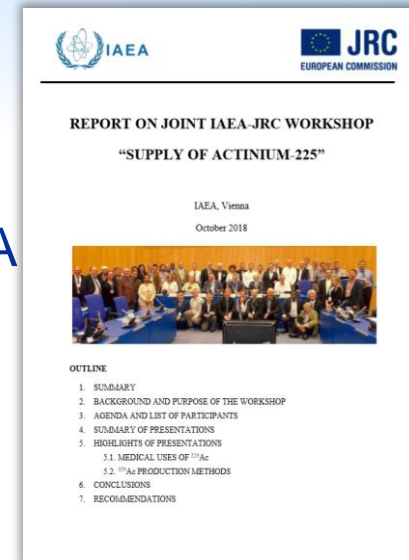
Symposium on Opportunities and Approaches for Supplying Molybdenum-99 and Associated Medical Isotopes to Global Markets

- 17-19 July 2017; IAEA HQ; 100 participants
- Co-hosted by the **US National Academies of Sciences, Engineering, and Medicine** and the **Russian Academy of Sciences** and held in cooperation with the International Atomic Energy Agency. Sponsored by the U.S. Department of Energy's National Nuclear Security Administration.
- Trends in global demand and supply for Mo-99 and associated medical isotopes.
- Prospects and approaches for developing new global supplies of Mo-99 and associated medical isotopes.
- Technical, regulatory, economic, and policy considerations for producing Mo-99 and associated medical isotopes for global markets using uranium-fission and other processes.



Workshop on Supply of Ac-225

- 09-10 October 2018; IAEA HQ; 80 participants, 17 MSs
- In collaboration with **EC-JRC** (PA: NA and EC)
- Cross cutting: NDS, PS, NEFW, NMDI, NS
- Trends in global demand and supply for Ac-225
- Motivation: excellent clinical trials results of Ac-225-PSMA
- Report finalized
- New TM in December 2019: guidelines
- New CRP with NAHU



Mike Sathekge et al, European Journal of Nuclear Medicine and Molecular Imaging (2019) 46:129–138

Collaboration IAEA-WHO



World Health
Organization



IAEA

- **PA** being prepared
- Update of monographs for radiopharmaceuticals
- Review of general monograph for radiopharmaceuticals: meeting May 2019
- Guidelines on GMP for radiopharmaceutical production:
 - ❖ Good Radiopharmaceutical Practises: update guidelines on Annex 3 (2003): Meeting at IAEA in 05-09 November 2018 with experts
 - ❖ The guidelines were opened to public consultation in early 2019.
 - ❖ Meeting June 2019 to evaluate comments
 - ❖ Guidelines published

Databases

Database: Cyclotrons used for Radionuclide Production



- >1350 cyclotrons
- 89 MSs
- Online data inquiry
- World-wide map
- Continuous data acquisition
- Live and streaming
- List of products
- Contact info
- Still in completion process

Cancer Centre (VCCC)						
No Title	...	Australia	Perth	IBA	CYCLONE 18	18
No Title	...	Australia	St. Lucia QLD 4072	IBA	CYCLONE 18	18
CycloPET Pty Ltd	...	Australia	Sydney	GE	PETTrace	16
Liverpool Hospital	...	Australia	Sydney	GE	PETTrace	16
No Title	...	Australia	Sydney	IBA	CYCLONE 30	30
No Title	...	Australia	Sydney	Siemens	ECLIPSE	11
No Title	...	Australia	Sydney	Siemens	ECLIPSE	11
Princess Alexandra Hospital	...	Australia	Woolloongabba	GE	PETTrace	16
Argos Zyklotron Klagenfurt	...	Austria	Klagenfurt	GE	PETTrace	16
Argos Zyklotron Linz	...	Austria	Linz	GE	PETTrace	16
Seibersdorf Laboratories	...	Austria	Seibersdorf	GE	PETTrace	16
AKH Wien	...	Austria	Wien	GE	PETTrace	16
No Title	...	Azerbaijan	Baku	IBA	CYCLONE 18	18
King Hamad Univ. Hospital	...	Bahrain	Manama	GE	PETTrace	16
Masihe Daneshavari Hospital	...	Bangladesh	Dhaka	GE	MiniTrace	10

Pages - Cyclotrons used X Cyclotrons used for Radionuclide Production

https://nucleus.iaea.org/sites/accelerators/Pages/Cyclotron.aspx

Home Gmail Google PCMF Home CRA Online - Coordir Enterprise Oasis Travel details - accor

IAEA.org NUCLEUS

IAEA Accelerator Knowledge Portal

Accelerator Databases Cyclotron Database Networking Resources Workspaces Accelerator Strategy Case Studies Help

Cyclotrons used for Radionuclide Production

Cyclotron community
Cyclotron Events
Cyclotron Resources

Database of Cyclotrons for Radionuclide Production

How to edit or add information

In order to add or edit information about your facility you can:

- download and fill the [dedicated form](#) and send it via [email](#) to A. Jallilian, M. Haji-Saeid, D. Schlyer and J. Forneris, or
- fill a [dedicated online form](#). You will receive a receipt notifying the successful data submission.

Cyclotrons map

An interactive world map displaying the location of cyclotron facilities is available below. The number of facilities can be displayed on a country and city basis. Click on the arrow at the left of the top bar to customize the view.

Cyclotrons used for Radionuclide Production

Navigation tips

Below you will find the database of the Cyclotrons used for radionuclide production. Click on the facility name to display the full information data.

<https://nucleus.iaea.org/sites/accelerators/Pages/Cyclotron.aspx>

Spotlight, webinars, conferences

Spotlight on Radiopharmaceuticals



spotlight
REGISTER NOW

16 July, 11:30-12:15
WEBEX

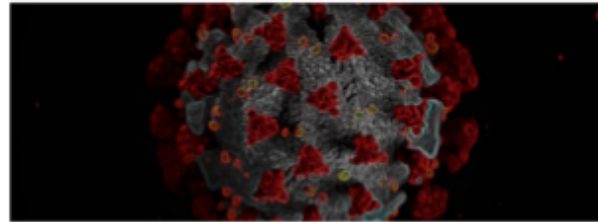
How have radiopharmaceuticals changed the landscape for cancer-related medical interventions?

Join this virtual Spotlight session, 16 July, 11:30-12:15, Webex

□ □ ■ □ □

10/07/2020 at 16:43 | Spotlight | 0 6 😊

Your Weekly
InSite



Join our Webinar!

COVID-19 Pandemic: Supply of Medical Radioisotopes and Radiopharmaceuticals

The IAEA, in collaboration with International Organizations, is committed to supporting facilities for radioisotope and radiopharmaceutical production during current COVID-19 pandemic. Join us on the webinar “COVID-19 Pandemic: Supply of Medical Radioisotopes and Radiopharmaceuticals” on Thursday, April 23, 2020, 14.00 – 15.30 CET (Vienna time)

The webinar will have the format of a virtual town-hall meeting, in which an international panel of experts will answer questions related to how to deal with the production of medical radioisotopes and radiopharmaceuticals & its supply for clinical use during the COVID-19 pandemic.

The webinar will address practical considerations and challenges:

1. Operation of reactor- and accelerator-based production facilities
2. Distribution and supply of radioisotopes and radiopharmaceuticals
3. Radiopharmacy operation, including staffing
4. Extra safety considerations during the crisis

This webinar will also function as a platform to share and exchange experience and best practice. There will also be a question and answer session with experts.

Chair: Mr Joao Osso Jr (IAEA)

Date: Thursday, April 23, 2020

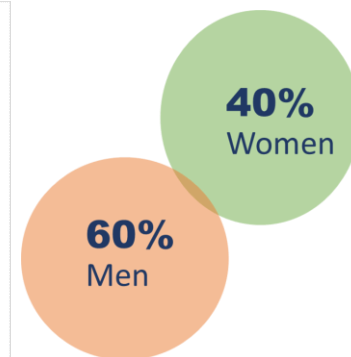
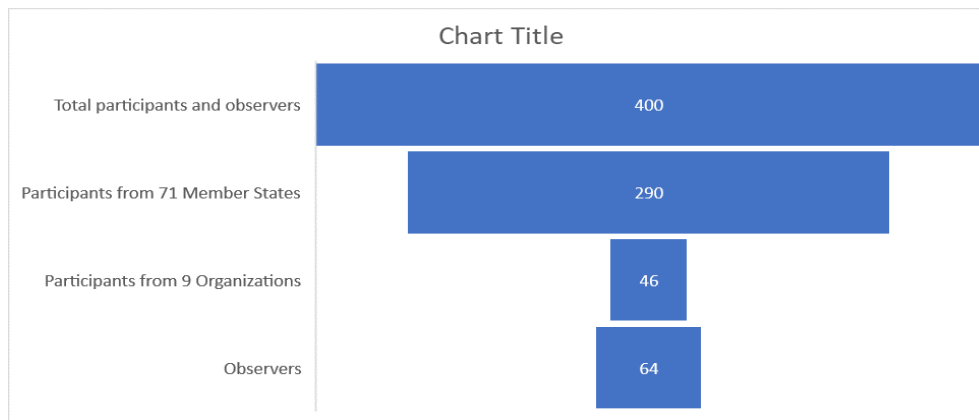
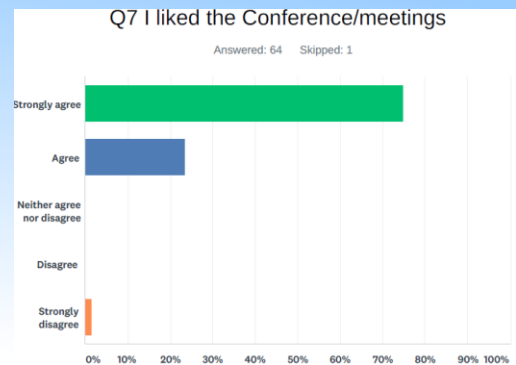
Time: 14:00 – 15:30 CET (Vienna time)

Modality: Webinar

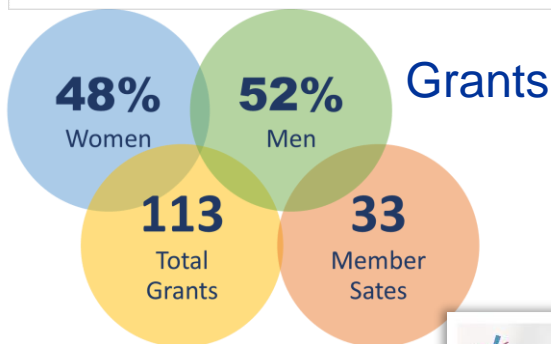
Platform: WebEx

- 821 attendees from 74 MSs
- 18 short presentations
- 4 from IAEA

ISTR-2019



Network of Women
in Radiopharmaceutical
Sciences



Future Conferences



2nd International Conference on
Applications of Radiation
Science and Technology

#ICARST2021

19–23 April 2021
IAEA Headquarters
Vienna, Austria

An abstract graphic consisting of several thin, curved lines in various colors (green, purple, blue, yellow) that sweep across the lower half of the poster, creating a sense of movement and connectivity.

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CN-290

An abstract graphic featuring stylized molecular structures in shades of blue and green. Several isotopes are highlighted with yellow labels and wavy lines representing radiation: ^{225}Ac , ^{89}Zr , ^{68}Ga , ^{177}Lu , ^{18}F , and $^{99\text{m}}\text{Tc}$.

INTERNATIONAL
SYMPOSIUM
ON TRENDS IN
RADIOPHARMACEUTICALS

#ISTR-2023

IAEA Headquarters
Vienna International Centre
Austria

28 October – 1 November 2019
24-28 April 2023

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iaea.org/events/istr-2019



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Thanks!

