

SCHOOL ON RADIATION
TECHNOLOGIES 2019





2019 marks the 5th World Nuclear University School on Radiation Technologies (RT School). I would like to warmly welcome our 28 Fellows from an impressive 20 countries to the RT School 2019.

This tremendous diversity of countries is only possible due to the continuous support of IAEA. We also very much appreciate the collaboration of WNA, ANSTO, WCI, and especially Rosatom. I am grateful for the excellent planning and implementation work done by Rosatom Technical Academy and WNU staff, the programme committee and Faculty.

WNU is excited to announce the publication of the first edition of the Advanced Radiation Technologies book - in time to be used as a multi-disciplinary overview of radiation technologies at the RT School 2019.

Fellows and faculty will actively participate in building the RT School 2019 over two weeks, by sharing ideas, contributing competencies, and exercising communications. Leadership skills will be developed, knowledge will be transferred, and, importantly, new light will be brought to current nuclear challenges.

We are committed to excellence, and are here to facilitate this extraordinary growing experience!

Patricia Wieland
Head of WNU

Opening Ceremony

The WNU RT School 2019 was opened by Patricia Wieland - WNU, Yuriy Seleznev – Rosatom Technical Academy, Joao Alberto Osso Junior - IAEA, Vladimir Artisyuk - Rosatom, Kath Smith - ANSTO, and Natesan Ramamoorthy - NIAS. In her welcoming address, Patricia Wieland mentioned some of the major societal problems we face today, such as climate change and poor nutrition, and the pivotal role science and international collaboration plays in solving these. She also expressed the need to bridge the gap between science and policy, in order to implement science's solutions to our problems.

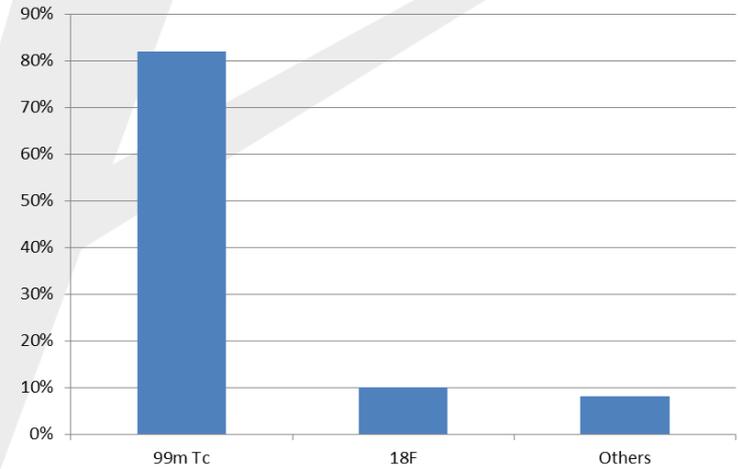
Scientists should be literate in policy to ensure their work is on the policy agenda. Policy makers should be literate in science, to ensure they fully understand the impact of their decisions. Strong leaders can bridge this gap, and build trust between the scientific community and policy makers. The RT School aims to develop the leadership and communications skills necessary for furthering the beneficial applications of radiation technologies. Fellows are invited to engage fully with the RT School and share their ideas in order to develop their skills to the highest possible degree.



Australia and Radioisotope Production

Kath Smith is the Principal Research Scientist and Section Head with the Australian Nuclear Science and Technology Organisation (ANSTO). On Tuesday she described the current status of radioisotope production in Australia. In particular, she discussed the very topical production of ^{99}Mo – a crucially important radioisotope that decays into $^{99\text{m}}\text{Tc}$, which is used in nearly 80% of diagnostic nuclear imaging procedures worldwide. She discussed the early evolution of nuclear technologies in Australia, beginning in the 1950s with the HFIAR research reactor, and the development and commercialisation of Tc-99m production in the 1970s and 1980s. She discussed developments in ANSTO since the 1990s, including the operational opening of the ANSTO Medical Plant in 2019.

She provided an international context, explaining where ANSTO products are distributed, and mentioned that in light of international shortages of ^{99}Mo in the 2010s, production facilities including ANSTO have increased supply capacity.



Use of Isotopes in Nuclear Medicine Procedures Internationally in 2017



Project Management Exercise

On Tuesday, Fellows exercised their creativity and project management skills by taking part in a project to develop an innovative mobile application supporting radiation technologies. Following this, they presented their ideas to the RT School 2019.

Technical Visit to IPPE and the First Nuclear Power Plant

On Wednesday, Fellows visited the first nuclear power plant to have been connected to an electrical grid – in 1954. The nuclear reactor stopped generating electricity commercially in 1959, and was used for radioisotope production and research until 2002. The reactor was a predecessor of the RBMK and is of enormous importance in the development of the peaceful applications of nuclear fission.



Welcome Reception

The Welcome Reception was held on Tuesday and was sponsored by Rosatom Technical Academy. Vladimir Artisyuk delivered a few words on behalf of Rosatom to the Fellows to welcome them to Obninsk. Three WNU RT School Alumni offered advice on how to make the most of the time at the RT School 2019 and shared their experiences.

It was a fantastic and memorable evening with dancing, traditional Russian food, and a performance by the winner of the Russian The Voice.

Radioactive Waste and the Environment

Dr. Vladimir Petrov is an Associate Professor at the Department of Chemistry in Moscow State University, in addition to being the Head of the Laboratory of Dosimetry and Environmental Radioactivity. On Thursday, he explained the technical and non-technical aspects of radioactive waste management and their broad environmental impacts. He went into detail about different final disposal concepts for high-level nuclear waste – likening the multibarrier disposal concept to Russian dolls.

He also discussed radiation technologies in the context of environmental protection and societal impact, such as the sterilization of male insects for pest control, and the treatment of waste incinerator gases.

Radiation Technologies and Dosimetry

Dr. Natesan Ramamoorthy has over 40 years of professional and managerial experience in the field of production and utilisation of radioisotopes and radiopharmaceuticals, which he drew on in his two lectures this week. The first was an introduction to Radiation Technologies, where he outlined the many ways the field of radiation technologies is vibrant and rapidly developing, and the need for leaders in the field to deliver unequivocal, objective messages to policy makers and stakeholders. On Thursday, he explained the types of dosimetry systems based on their characteristics, and their applications.

Natesan edited the first edition of Advanced Radiation Technologies book, published by the WNU and used as a reference text during the RT School 2019.



Effects of Radiation on Populations and Ecosystems

Stanislav Geras'kin has extensive experience in radioecology, ecotoxicity, environmental radiation protection, and radiobiology, and is the Head of Plant radiobiology and ecotoxicity laboratory at the Russian Institute of Radiology and Agreology, and professor at Obninsk Institute for Nuclear Power Engineering of the National Nuclear University.

He has published works on the radiation effects on the environmental contamination resulting from the Chernobyl accident – when over 150,000 km² was contaminated with ¹³⁷Cs with a radioactivity level above 37 kBq/m². He gave a description of some of these effects on flora and fauna, explaining the intricate way ecosystems adapt to change and how the real-world effects and adaptations depend highly on field-conditions.

“To properly understand the effect of real-world contaminant exposures, we should consider actual field conditions”

**Stanislav Geras'kin,
Russian Institute of Radiology and Agreology**



Poster Sessions

Fellows were tasked with the communications challenge of presenting important aspects of their current work or the work of their organisation concisely within a timeframe. This also functioned as a high-level information exchange in the field of radiation technologies and radioisotope production.

Economics and Socioeconomics

Carlo R. Chemaly currently works in the Research Executive Agency of the European Commission. He is an expert on the economics of radioisotope production and radiation technologies, and authored a chapter for the Advanced Radiation Technology book on this topic. He gave an overview of selected economic tools and the links between economics and social issues in the fields of radiation technologies.

Effective Communication

Patricia Wieland, Head of the WNU, spoke about strategic communication and networking. She discussed the importance of being precise, realistic, and effective when deciding on communication strategies, stressing the foremost need to know and understand your audience. Any communication strategy requires objectives, specific messages, and practical tools to reach the audience. It also needs to be delivered with warmth and competence to be engaging, trustworthy, and effective.

She explained how networking is of particular relevance to the field of nuclear technologies, due to the need for continuous international cooperation.

“Economic tools allow better understanding and predictability of the working environment. Using them efficiently helps in reaching specific objectives”

**Carlo R. Chemaly,
European Commission**

Developments in Nuclear Technology in Russia

Eugenii Varseev, from Rosatom Technical Academy, gave an overview of the current activities of Rosatom, and their exciting developments in nuclear technologies – notably the Nuclear Icebreakers.







UN Sustainable Development Goals

Ms. Najat Mokhtar is the Deputy Director General of the IAEA, which has the motto “Atoms for Peace and Development”. She gave a description of how the IAEA works towards the realization of 9 of the 17 Sustainable Development Goals (SDGs), from land-use to agriculture to health, and - of course - energy. She discussed IAEA research and research facilities, before discussing the long path ahead of those developing technologies and plans for sustainability, from national strategies to regulatory infrastructure, development, research, and public sector buy-in.



UN SDGs impacted by IAEA work

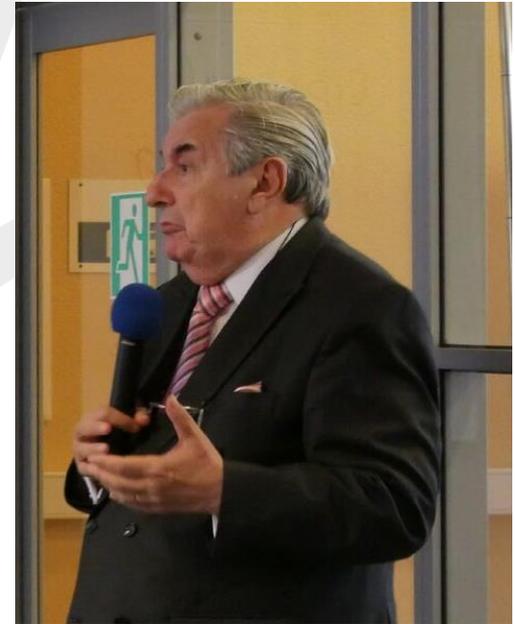
Advances in External and Internal Beam Radiotherapy

Ibrahim Duhaini is the chief medical physicist and RSO in Rafik Hariri University Hospital in Lebanon, and is also a mentor at the WNU RT School 2019. He spoke to Fellows about the current status of advanced techniques in radiation therapy, both brachytherapy (internal beam) and external beam. One particularly exciting advancement outlined in his presentation was the Gamma Knife, which is used routinely in the Gamma Clinic in Obninsk. It is a radiosurgical device with a history of over forty years which produces 201 circular gamma ray beams directed at a single focal point at an SAD of 40 cm.

Risks and Regulations in Medical and Industrial Applications

Abel Gonzalez is the Senior Advisor to the Argentine Nuclear Regulatory Authority. On Monday, he gave an overview into medical applications of radiation technologies in diagnosis, therapy, research, and sterilization. Explaining the history of radiological protection, beginning with the founding of the ICRP, he discussed the evolution of thinking regarding patient safety. While acknowledging intergovernmental and IAEA achievements in developing and enacting safety standards, he shared his insight into where the industry could improve – notably in adherence to existing safety standards – and modern problems faced by the industry, such as cyber security and adventitious exposure in countries with developed nuclear medical services.

On Tuesday, he discussed the industrial applications of radiation technologies, such as industrial radiography, irradiators, well logging, gauging devices, and other measuring systems. He explained the specific risks for these industrial applications, illustrating the discussion with specific case studies, reminding Fellows of the serious consequences of industrial accidents. This puts onus on the operating organisation, radiation protection officers, experts, workers, and clients to exercise due diligence by performing safety assessments and adhering to safety standards and protocols.



Technical Visit to Tecleor

Tecleor LLC provides disinfection and antimicrobial treatment services to the food industry, to prolong shelf-life and ensure the reliable exclusion of pathogenic microbiota in food products. This is a physical, nonthermal process which reduces food waste and improves safety of the products. On Monday, Fellows were invited on a technical tour of the irradiation facilities at Tecleor in Obninsk.



Technical Visit to A. Tsyb Medical Radiological Centre

On Tuesday, Fellows were invited to the national Medical Radiological Research Centre, which is a branch of the Ministry of Health in Russia and collaborates with the World Health Organisation in research and training staff for radiation epidemiology.

Fellows attended a presentation about the facilities and were invited to tour the radiation-epidemiological sector, as well as the experimental radiology sector with a radiopharmaceuticals development lab.



Prospects for Radioisotopes and Radiation Technologies in Industry

Meera Venkatesh was the Director of the Division of Physical and Chemical Sciences in the Department of Nuclear Applications, IAEA until February 2019 when she retired. She is a mentor at the WNU RT School 2019.

On Tuesday, she gave an overview of radiation based applications in industry – defined as any large scale operation, inclusive of heavy industries, power projects, food, healthcare, chemical, and environmental remediation. She provided the current status in various major areas of industry, explaining that most industrial radiation technology techniques are very well established and form a part of quality control and fulfil regulatory requirements.

She then discussed the exciting prospects for the future of these technologies, and areas which require more research. She stressed the importance of involvement from all stakeholders to further key fields– such as food irradiation for preservation and safety. When establishing a new facility, she drew from her experience in saying that it is very important to involve all stakeholders from the beginning, and to have a thorough planning of the requirements and strategies.



Cultural Exchanges

Throughout the WNU RT School, Fellows showcased elements of the cultures of their countries during self-organised Cultural Exchanges. Music, food, dance, traditional dress, and more were sampled by Fellows.

Network for Innovation in Nuclear Applications

The Network for Innovation in Nuclear Applications (NINA) is a module held in the second week of the RT School, and holds central importance in the programme. It is an opportunity for Fellows to collaborate in teams to intensely investigate important global nuclear issues, and to draw from their education and experience to bring new light to them. Although each topic is guided by a mentor who is an expert in the area, the work is driven and conducted by the Fellows.

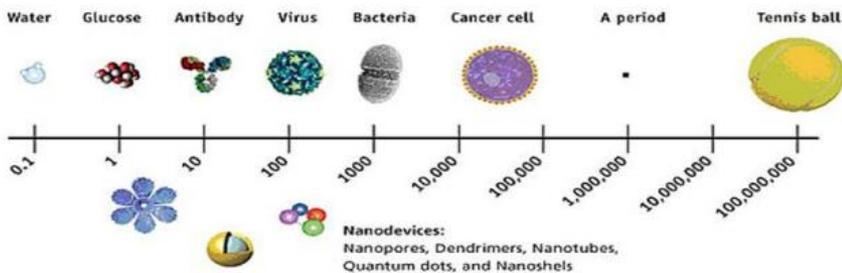
As future leaders in the fields of radiation technologies and radioisotope production, Fellows contribute their unique perspectives and innovative ideas. The output of the teams will be compiled into a magazine, which will be published on the WNU website following the completion of the module.

At the WNU RT School 2019, the three topics were regarding the global outlook of Ac-225/Bi-213 production facilities; planning the start-up of an industrial company in the radiation technology field; and theranostics in the detection and management of distant recurrences of prostate cancer.

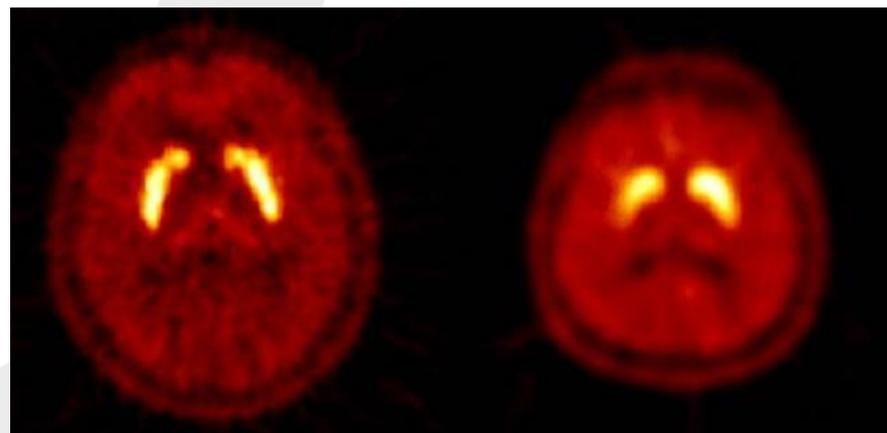


Production of Radioisotopes

Valery Radchenko is a mentor at the WNU RT School 2019, and a research scientist in TRIUMF in Canada, where his work focuses on the production of therapeutic radionuclides. TRIUMF is a multidisciplinary research organisation, owned and operated by a consortium of 20 universities, which has been operating for over 50 years. He provided a history of radionuclide production, and discussed production for various end-uses in nuclear medicine. He discussed the current work at TRIUMF and other vanguard research organisations, including the exciting research into determining the origins of Parkinson's disease and developing new treatments carried out at the Pacific Parkinson's Research Centre.



Size comparison of nanodevices to reference objects



F-18 PET scan of a healthy brain (left) compared to one suffering from Parkinson's disease (right)

Nanoradiopharmacy

Tamer Sakr is an Associate Professor at the Egyptian Atomic Energy Agency and a radiopharmacist working on radiopharmaceutical development. In 2012 he participated in the WNU RT School as a Fellow. He talked about the emerging field of nanotechnologies (under 100 nm) in nuclear medicine, explaining their pivotal role in molecular imaging and therapy of cancers, delivering optimal therapeutic payloads with minimal leakage outside of the target sites.



WNU RT School 2019 Week 2