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The practice of electron and proton accelerators utilizing for industry, education and science

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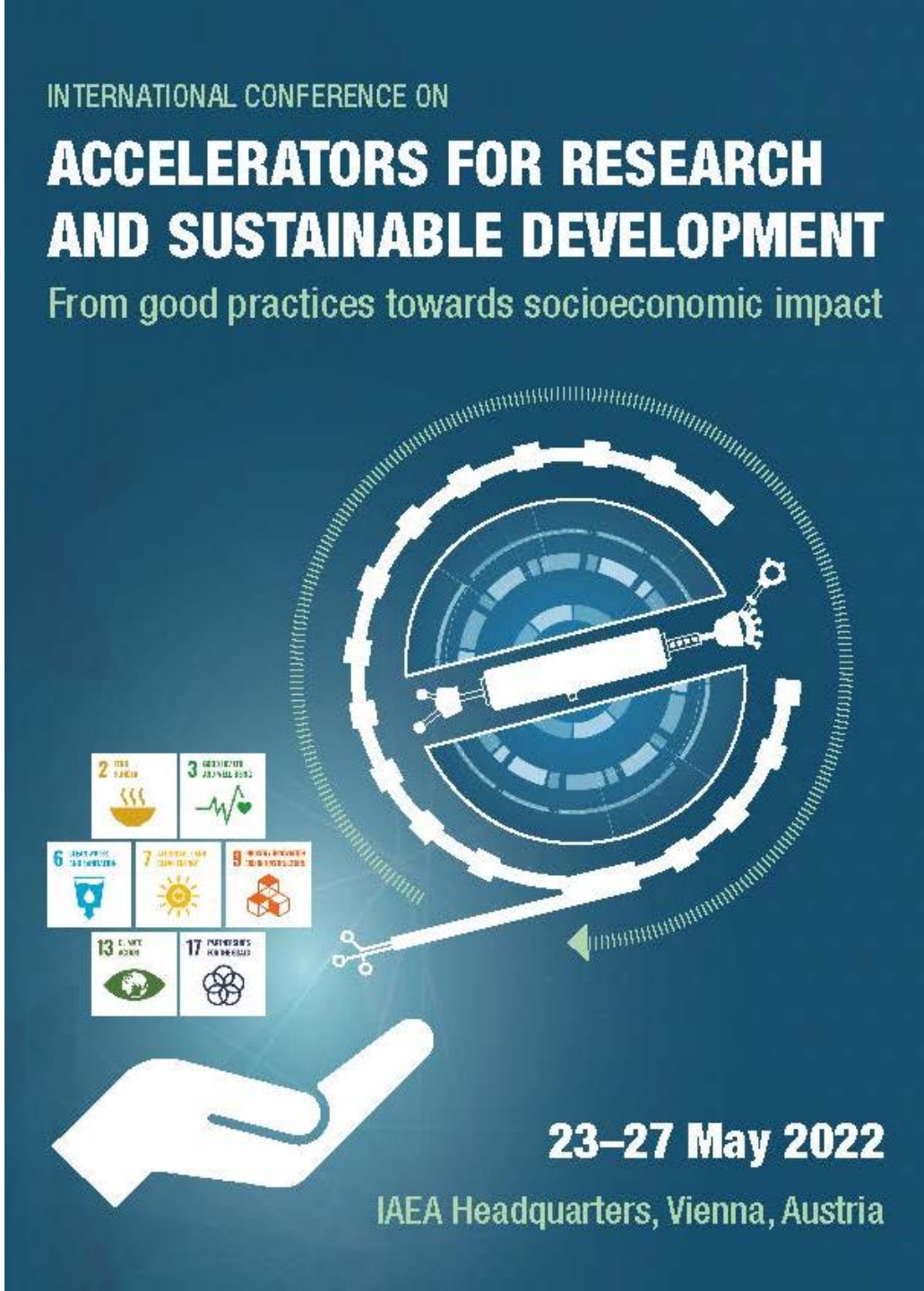


About Ekaterinburg

- **3rd Largest** city in Russia
- **Industrial** capital
- The **constructivist** capital of Russia
- Metal produced in Yekaterinburg was used to make the **Eiffel Tower, the Houses of Parliament, and the Statue of Liberty**
- The capital of **mayonnaise-lovers**
- **Border** between Europe and Asia

Ural Federal University: about us

35 000 students

14 studying campuses

4519 scientific workers

4300+ international students from 101 countries around the globe

462 Bachelor, Master and PhD programs

72 research excellence centers

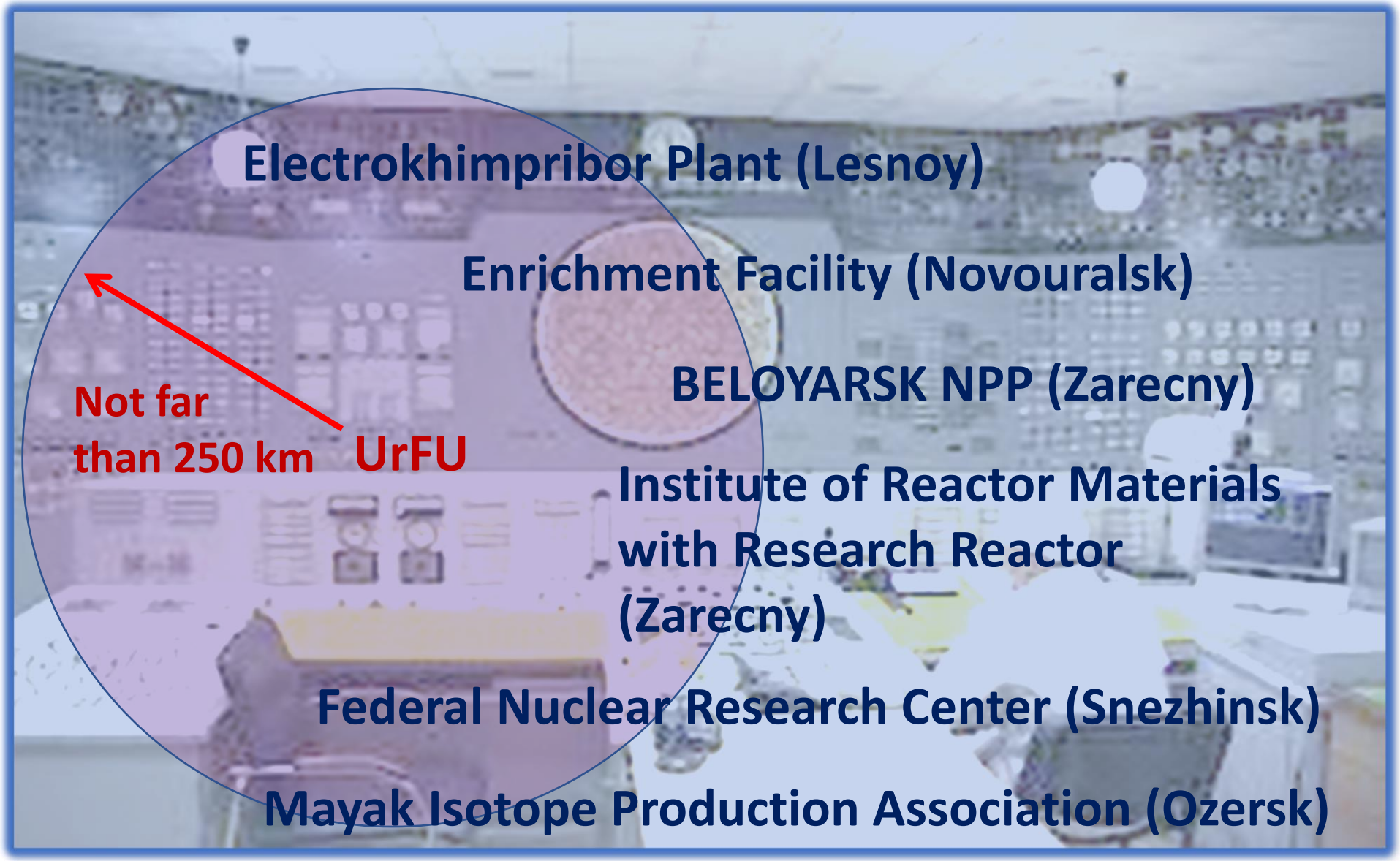
The history of **Ural University** started in **1920**.

- Later, it was divided into two separate institutions: **Ural State University** (USU) and **Ural State Technical University** (USTU-UPI).
- In **2009**, the University was awarded the federal status.
- In **2011**, both institutions were merged once again, becoming **Ural Federal University**.
- Education and research Priorities of University are realized trough 13 institutes, that forming the structure of university

As a part of UrFU - Institute of Physics and Technology

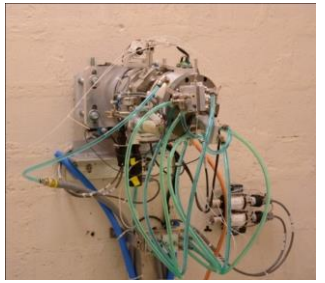
- Was founded in 1949.
- Prepare employees for the nuclear industry.
- Educational paradigm is bringing together fundamental education and practical application of knowledge.

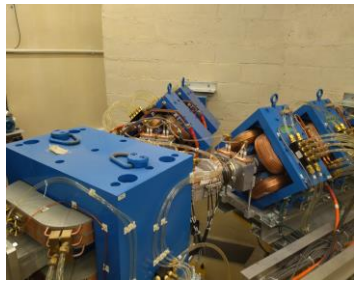
Close Cooperation with Nuclear Plants of Ural Region



Department of experimental physics

Accelerators





Radiation Sterilization Center

Construction moments

Was financed by Government program for Federal Universities in Russia

Dosimetric tools for absorbed dose measurements and process control

Dosimetry system on the base of polymer film covered by fenazil coating traceable to RF primary standard.
Produced for energy ranges :
1-10 kGy (550 nm);
5-50 kGy (512 nm);
30-200 kGy (580 nm).
Traceable to national RF standard of absorbed dose

Ris0 calorimeters
3-40 kGy
Traceable to international NPL standard of absorbed dose

DTU

DANAK

HDRL
Rise High Dose Reference Laboratory
Technical University of Denmark
DTU Nutech, Bld. 201
DK 4000 Roskilde
Denmark
Tel +45 4677 4224
Fax +45 4677 4959
e-mail arni@dtu.dk

Rise High Dose Reference Laboratory is accredited by *DANAK - Danish Accreditation*

Reference Dosimeter Certificate

Certificate no.: 17C-29

Measurement with **alanine reference** dosimeters irradiated at the customer's facility according to HDRL instruction HDRL-I-15 and HDRL-I-16.

Customer: Radiation Sterilization Centre
Ural Federal University
Mira, 19
620002, Ekaterinburg
Russia

Attention: Oleg Ryabukhin

File 17C-29 Ekaterinburg Rad Steril
Date 2017.07.12

Signature

Torben Esmann Mølholt
Quality Manager, Riso HDRL

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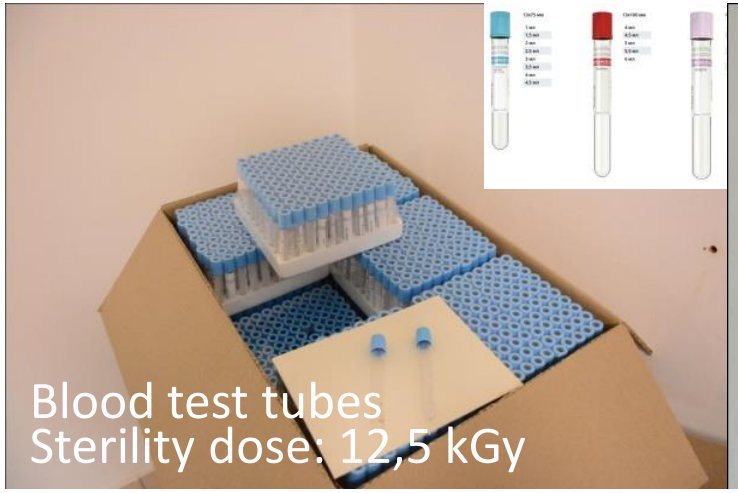
Equipment takes part in IAEA intercomparision program

Utilizing for Industry, radiation sterilization

up to 7000 m^3 of products per year



Utilizing for Industry, polymer materials processing


Cross-linking

Doses
120 – 170 kGy

Packaging for juice and wine disinfection for product's storage period increasing

Doses 15-20 kGy

Utilizing for education, students

Bachelor programs, 4 years

- Nuclear Physics and Technologies
- Biotechnological Systems

Master programs, 2 years

- Technology of radiation safety
- Technology of nuclear medicine

Specialist programs, 5 years

- Electronics and Automatization of Physical Installations

More than 100 students totally

Education process in topics of:

- Nuclear and Applied Nuclear Physics
- Radiation technologies
- Dosimetry
- Radiation safety
- Detectors of radiation
- Radiation protection

Realized trough:

- Lectures
- Practice
- Laboratory works
- Student Scientific researches
- Diploma works

Utilizing for education, training

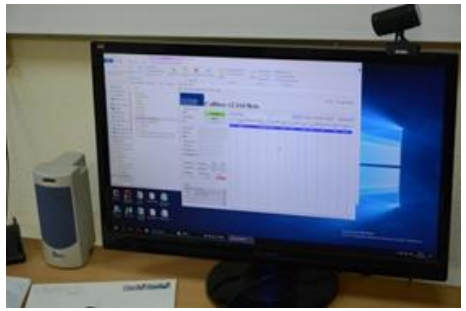
IAEA C7-RER-1.017 Regional training course on dosimetry at electron beam facilities, 4-8 of September, 2017

IAEA EVT/1/019 – EVT1900401 Regional Training Course on Dosimetry at E-beam and Gamma- irradiation Facility, 26-30 August 2019








Next courses are planned for 2023 in frame of RER 1021

IAEA International Atomic Energy Agency

Utilizing for education, training

TN-RER1019-1900401
REGIONAL TRAINING COURSE ON DOSIMETRY AT ELECTRON BEAM AND GAMMA IRRADIATION FACILITIES
Ekaterinburg, Russian Federation
26 to 30 of August, 2019
Agenda

Day 1

9:00	Welcome & Opening Remarks
9:05 – 10:30	Fundamental aspects of radiation dosimetry for high dose measurement (IQ, OQ, PQ, RC, Calibration) **(András Kovács)**
10:30 – 11:00	Coffee break
11:00 - 12:00	Electron beam and gamma (X-ray) based radiation processing facilities **(Oleg Riabukhin, András Kovács)**
12:00 – 13:00	Lunch break
13:00 – 15:00	Country Presentations
15:00 – 15:30	Coffee break
15:30 –17:00	Country Presentations

Utilizing for education, training

Day 2

9:00 – 10:00 Practical aspects of dosimetry in IQ, OQ and PQ (dose mapping) in the products in radiation processing using electron accelerators and gamma facilities
(Oleg Riabukhin, András Kovács)

10:00 – 10:20 Coffee break

10:20 – 11:20 Aspects of single used medical devises production and validation
(Nilokay Polyakov, Tatyana Gribova)

11:20 – 12:30 E-beam facility and radiation processing in UrFU. Cooperation with customers
(Stepan Zyryanov)

12:30 – 13:30 Lunch break

13:30 – 17:30 Practical exercises: (a) Calibration irradiation of routine film dosimeters; (b) OQ measurements: (1) conveyor speed vs. nominal dose relationship; (2) electron energy; (3) uniformity of beam parameters (scanning width and homogeneity, process interruption). Doses: 5 – 10 – 15 kGy and three conveyor speeds. X-ray radiation of routine dosimeters
(**Oleg Riabukhin and András Kovács)**

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Day 3

9:00 –10:00 Process control in electron beam and gamma radiation processing by dosimetry and by controlling machine parameters
(Oleg Riabukhin, András Kovács)

10:00 – 10:30 Coffee break

10:30 –12:30 Practical exercises: Practical exercises Group A and B: (a) Calibration irradiation of routine film dosimeters; (b) OQ measurements: Conveyor speed vs. nominal dose relationship; Doses: 20 – 25 kGy and two conveyor speeds.
Group C measures their films (after calibration of spectrophotometer).
(Oleg Riabukhin and András Kovács)

12:30 – 13:30 Lunch break

13:30 –17:00 Practical exercises: PQ measurements, dose mapping in product (different types of production).
(Oleg Riabukhin and András Kovács)

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Day 4

9:00 – 10:30 Practical exercises: Demonstration measurements: (1) process interruption; (2) routine process control
(Oleg Riabukhin and András Kovács)

10:30 –11:00 Coffee break

11:00 – 12:30 Evaluation Test for participants
(András Kovács and Oleg Riabukhin)

12:30 – 13:30 Lunch

13:30 –17:00 Visit to facilities. Excursion to “Zdravmedtech” company, medical products manufacturer
(Oleg Riabukhin)





Utilizing for education, training

Day 5	
9:00 – 10:30	Discussion on the evaluation test **(Oleg Riabukhin and András Kovács)**
10:30 – 11:00	Coffee break
11:00 – 12:00	Feedback from the participants, evaluation of the course **(Oleg Riabukhin and András Kovács)**
12:00 – 13:00	Awarding Certificates & Closing Session

Participants from: Portugal, Croatia, Hungary, Poland, Serbia, Slovakia, Estonia, Turkey, Russia, Moldova, Belarus, Uzbekistan, Azerbaijan

At each course usually 16 participants take part. Four groups by 4 persons for practical exercises.

Utilizing for education, training

TECHNICAL ACADEMY ROSATOM

“Multipurpose irradiation centre as a component in Centre of nuclear science and technologies”, supported by Rosatom Corporation

Module 1 Physical, chemical and biological basics of civil radiation technologies

Module 2 Multipurpose irradiation centre as the component of CNST

Module 3 IAEA recommendations and standards for radiation processing

Module 4 Radiation safety (practice)

Module 5 Metrology of radiation sources. Dose mapping in radiation processing (practice)

Module 6 Process control on electron beam facilities (practice)

Final report

Utilizing for education, training

Training program objectives

1. To give the basics of ionizing radiation interaction with matter and dosimetry.

2. To acquaint with the international standards regarding radiation safety and radiation technologies

3. To give knowledges in field of civil radiation technologies

4. Strengthen skills and attitudes in fields of radiation processing of different kind of materials (medical products, polymers and food) and radiation safety

Utilizing for education, training

Started in November 2019, was continued in October 2021,
next one are planned for autumn of 2022






Participants from: Nigeria, Serbia, Bolivia, Egypt, Uzbekistan, Zambia – total 16 persons
Four groups by 4 persons for practical exercises.

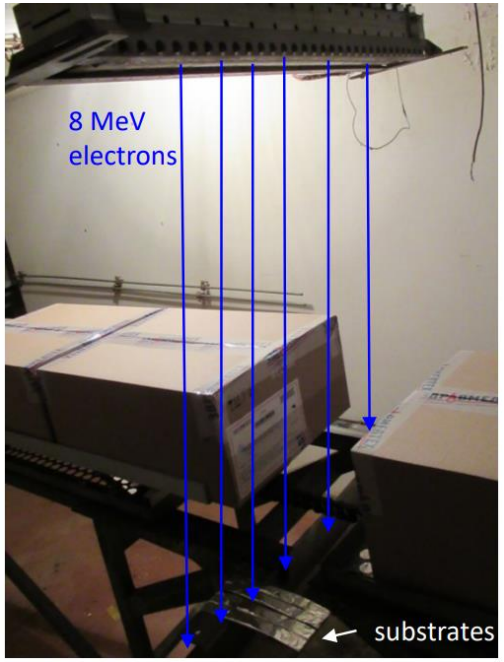
Utilizing for scientific researches

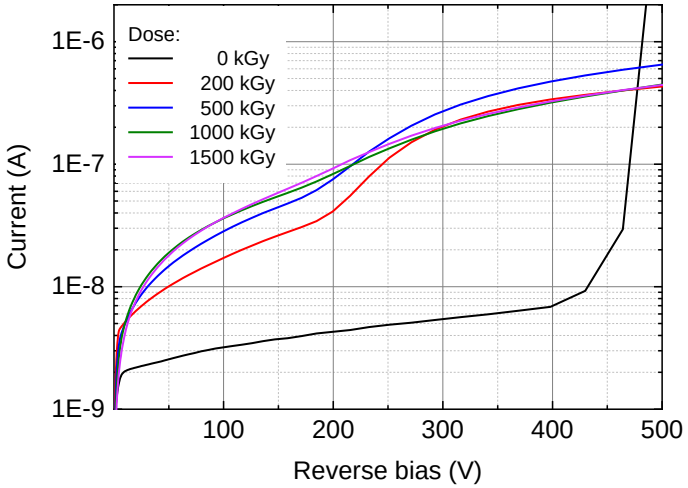
The main implementation of accelerator is irradiation of different kinds materials.

E-beam accelerator gives the possibility to irradiate materials by electrons with dose rates up to 1kGy/s, by bremsstrahlung with dose rates up to Gy/s.

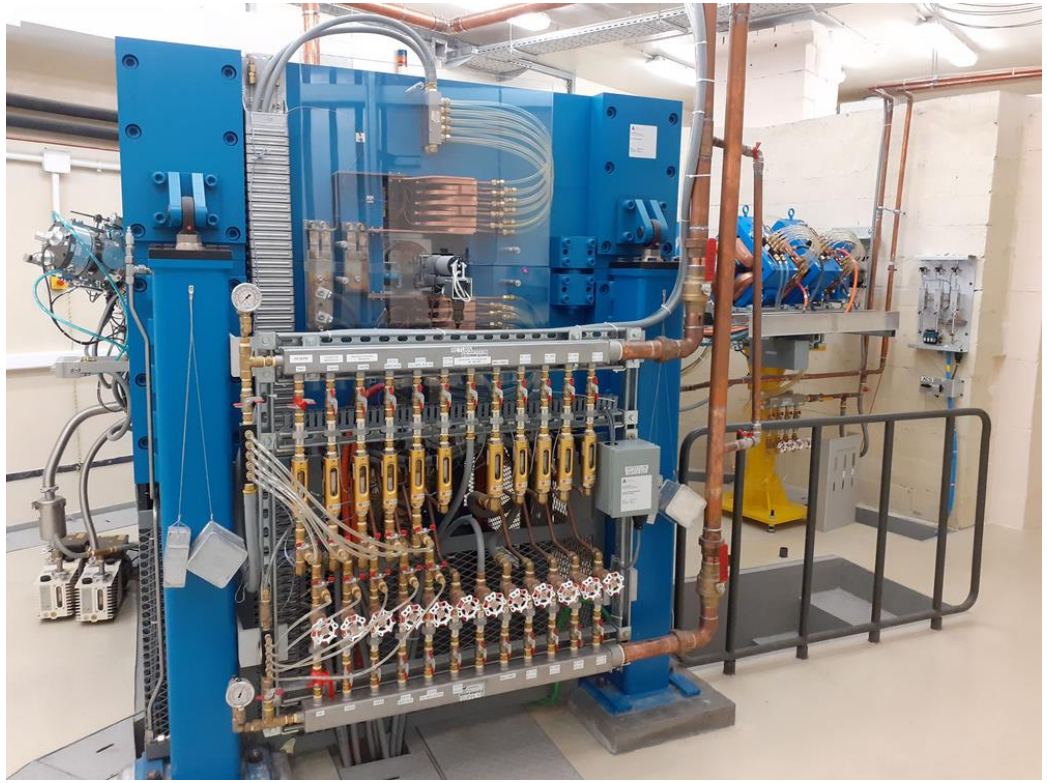
Researches of physical, chemical and biological properties changed under E-beam and gamma - irradiated in:

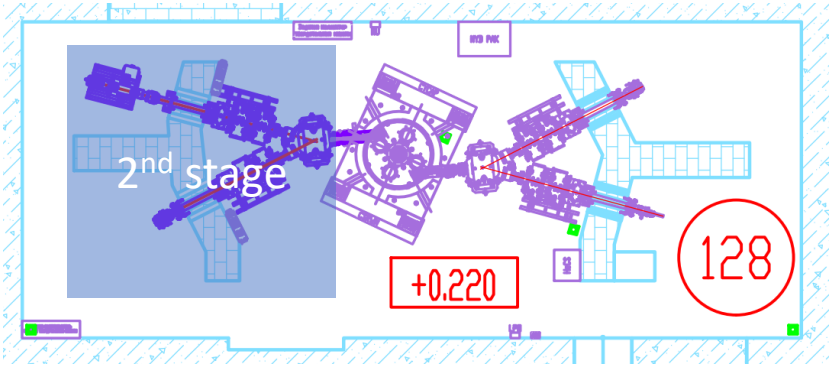
- Solid states (polymers, dielectrics, semiconductors, microelectronic components, detectors, solar cells, powders for various purposes);
- Biological objects (food products, microorganisms, fungus);





Cyclotron TR-24 (ACSI, Canada) Parameters





Main characteristics:

- E_p = 18…24 MeV
- Beam current up to 300 uA
- Dual beam configuration
- External multi-CUSP ion source
- PET: 11C, 13N, 15O, 18F,124I, 64Cu, 68Ge
- SPECT: 123I, 111In, 67Ga, 57Co, 99mTc

(1st stage, 2nd stage of reconstruction)

- Licensing stage
- Starting to form GMP documentation
- Ready for experimental irradiation

Benefits from accelerator's facility university location:

1. Supporting of educational programs in nuclear physics, radiation technologies, radiochemistry, dosimetry etc. Possibility of fundamental and applied research in radiation technologies.
2. Extensive experience in dosimetry (research, equipment production, expertise)
3. Possibility of student and staff training
4. Synergy of study, science and production

Thank you

Acknowledgements:

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