



# **CERN: state-of-play:** Lithuanian University of Health Sciences

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# About Lithuanian University of Health Sciences



- The largest institution of higher education for biomedical sciences in Lithuania;
- Integration of studies, research and clinical practice.
- Consists of two main academies: Medical Academy and Veterinary Academy.
- **Includes 7 faculties, 6 research institutes, two animal clinics and the Hospital of LUHS.**
- Has more than 7,000 students enrolled.

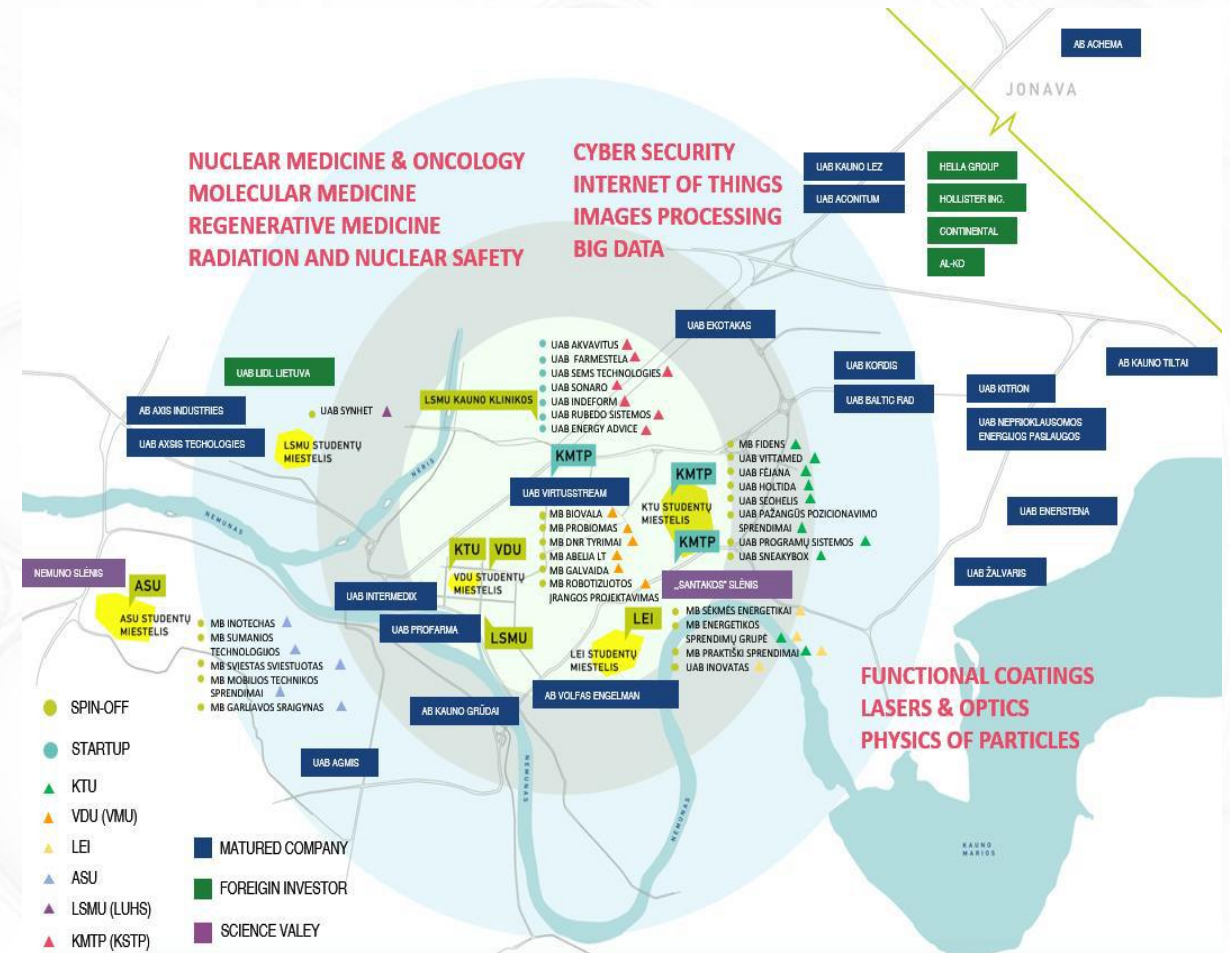
# Collaboration with CERN

During the last years training of medical physicists and radiation oncologists was organized in collaboration with CERN.

Development of nuclear medicine is closely related to the deployment of cyclotron at LUHS University Hospital.

Oncology institute: CERN- activities related 6 projects in Radiobiology.

We have implemented five radiobiology research projects related to CERN activities. We are currently continuing this research with another CERN related project. These projects funded by the Lithuanian Science Council.



# INSPIRE project

- €5M (Coordinated by Manchester)
- Integrating proton research across Europe
- 17 partners
- Networking, Transnational Access, Joint Research Activities
- 13 TNA providers
- 11 PBT centres; national hubs
- Varian and IBA



***“.....the aim of INSPIRE is to integrate national infrastructures in proton beam therapy (PBT) research and make them available to researchers from academia, hospitals and industry to ensure that excellent multi-disciplinary research is undertaken and best practice shared....”***

Grant Agreement Number 730983

[www.protonsinspire.eu](http://www.protonsinspire.eu)





# LUHS activities in INSPIRE project

- **WP7 – Radiobiology.** We investigated molecular mechanisms of sensitivity and resistance to radiotherapy in breast cancer cell lines.
- Cell exposure to different chemical agents and the assessment of their possible radio-sensitising activities is our innovation task in this project.
- One of our team member had the opportunity to join the **Clinical Radiobiology group at GSI** and was contributing to the developments of the protocols for 3D cell culture phantoms. Additionally, she was involved in the *in vitro* FLASH experiments assessing the cell survival after irradiation with <sup>12</sup>C ion beams at ultra-high dose rates.



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<https://protonsinspire.eu/knowledge-hub>

# Educational activities

- Oncology Institute participated in the training course related to proton beam therapy „The Christie Proton Therapy E-School at The Christie School of Oncology“.
- Attended the 1st FLASH Radiotherapy and Particle Therapy Conference where we also had the opportunity to present the abstract and e-poster from the part of our research activities in INSPIRE project.



# LUHS Research areas in radiotherapy, radiobiology and dosimetry

- Prognostic and predictive molecular markers of solid tumors;
- Radiobiology research;
- Radiotherapy optimisation using  $^{18}\text{F}$ -FDG-PET/CT images;
- Molecular mechanisms of sensitivity and resistance to radiotherapy in breast cancer or other cell lines;
- Association between common genetic variations with individual patient variability in normal tissue late radiation toxicities;
- Polymer gel dosimetry;
- New brachytherapy techniques.



# Current RT machines in Lithuania



10 dual energy Linacs +  
electron beams  
(2005 - 2020)



1 Gamma knife with cobalt sources  
(2020)



1 Halcyon: single  
energy. 1/ninth the  
time for  
Tomotherapy  
(2021)







4 Brachytherapy machines (1  
cobalt, 3 iridium sources) (2010-  
2019)



Elekta "Unity"  
guided by real - time  
MR imaging.  
Will start working  
in early 2023



# Cancer centers and Radiotherapy facilities

City	Center	Type of Cancer Treatment Modality:		Number of Patients Treated Annually (2020 Number)
		Radiation Therapy (Yes/No)	Brachytherapy (Yes/No)	
Vilnius	 NCI	Yes	Yes	2228
Kaunas	 HLUHS	Yes	Yes	2638
Klaipeda	 KUH	Yes	Yes	1086
Siauliai	 RSH	Yes	Yes	391

# Available treatment modalities in LUHS

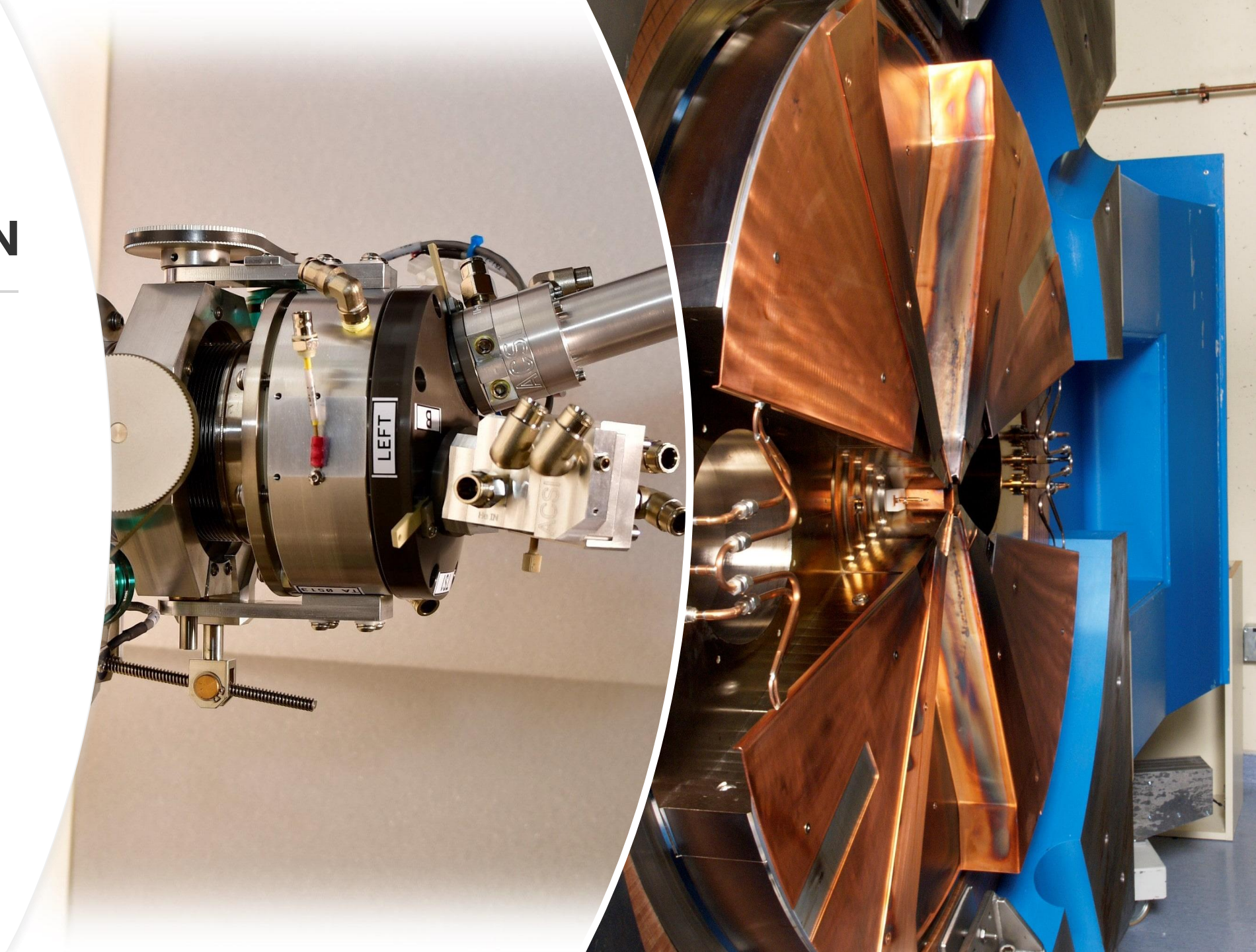
- IMRT
- VMAT
- IGRT
- 4D RT
- SBRT
- SRS
- Brachytherapy (HDR, LDR)
- TBI
- Gamma knife (SRS);



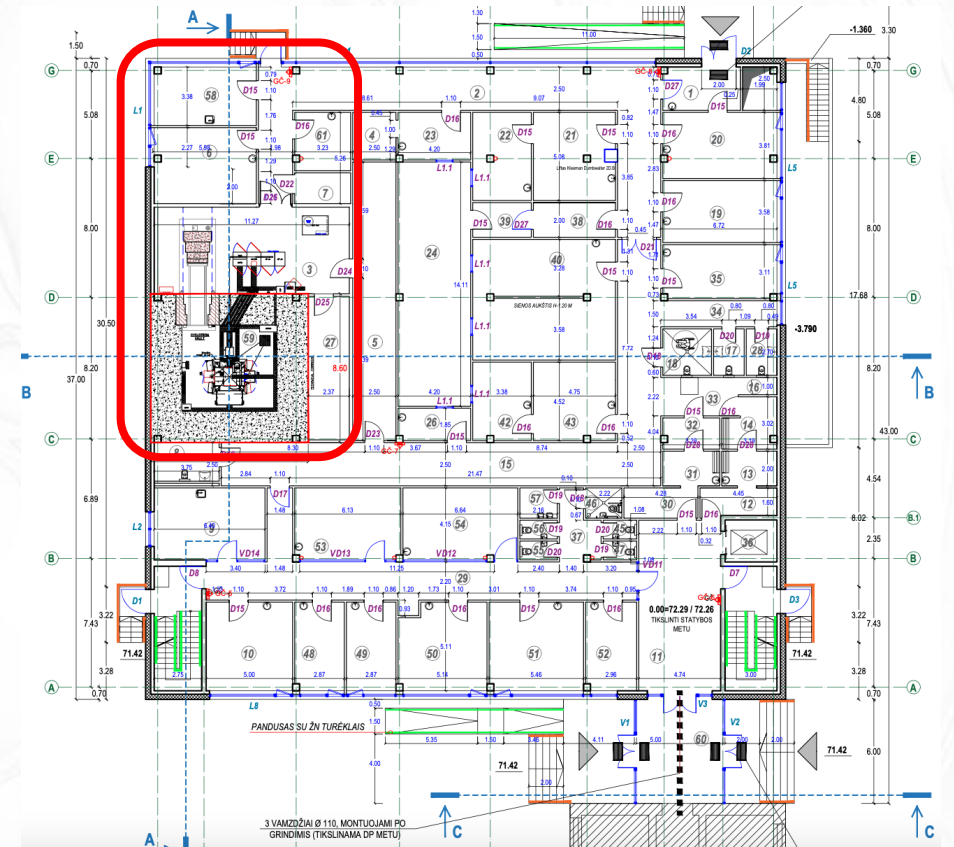
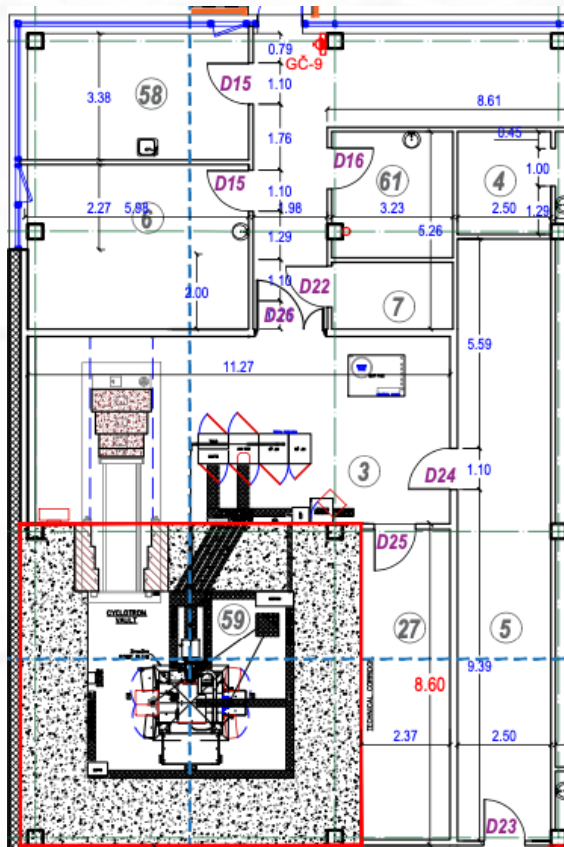


# CYCLOTRON – UNDER CONSTRUCTION

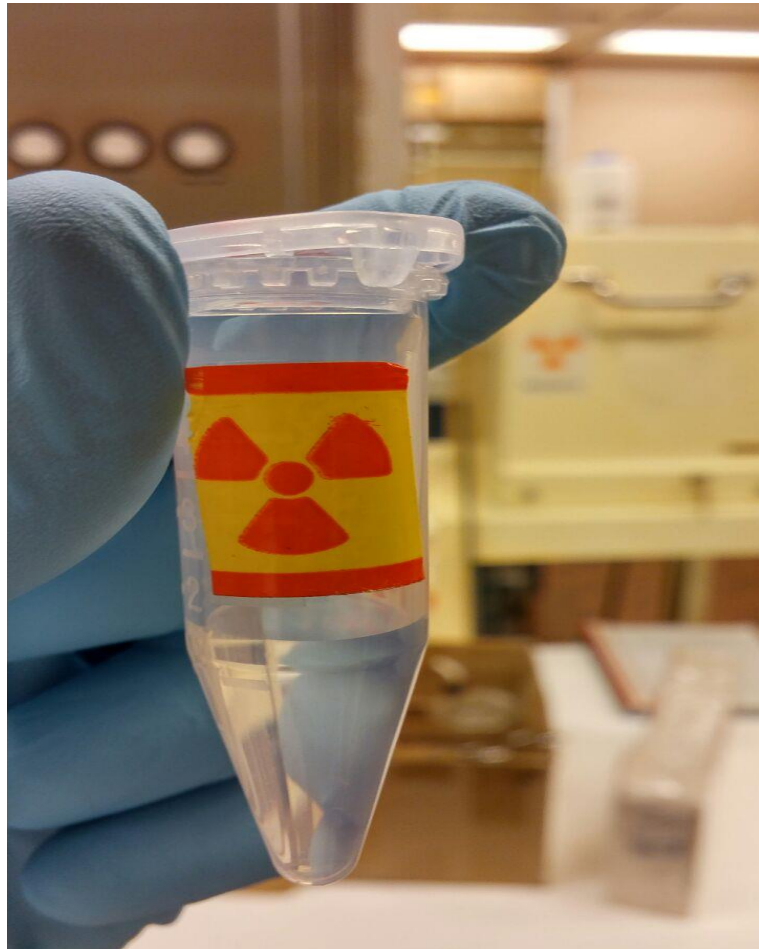
- Variable energy negative ion cyclotron (14 – 19 MeV)
- Possibility to irradiate 2 channels at the same time
- Irradiated targets - liquid, gaseous, solid



# Nuclear medicine research center – CYCLOTRON PREMISES







# PET/CT RADIOPHARMACEUTICALS

Radionuclide	Radiopharmaceutical	Usage
F-18	F18-FDG	Swiss knife in oncology + cardiology + neurology
F-18	F18-Na	Bone lesions marker (better sensitivity than Tc99m-MDP)
F-18	F18-choline	PC
F-18	F18-DOPA and it's variations	NET
F-18	F18-Flutemetamol, F18-Florbetapir	Amyloid deposition in the brain - Alzheimer's disease
F-18	F18-FLT	Tumor proliferation marker
F-18	F18-FET	Brain tumors
F-18	F18-Estradiol	Breast cancer and gynecologic cancer
F-18	F18-MISO or F18-FAZA	Tumor hypoxia marker
Other		...

## OTHER PET/CT RADIOPHARMACEUTICALS

- C11 – 20,4 min (carbon)
- N13 – 10 min (nitrogen)
- Ga68 – 67,6 min (gallium)

Radionuclide	Radiopharmaceutical	Usage
<b>C-11</b>	<b>C11-Choline</b>	<b>PC</b>
<b>C-11</b>	<b>C11- methionine C11-thirosine</b>	<b>Brain tumors</b>
<b>C-11</b>	<b>C11-Bombezin</b>	<b>PC, pancreatic cancer, small cell cancer, etc.</b>
<b>C-11</b>		<b>...</b>
<b>Ga68</b>	<b>Ga68-PSMA; Ga68-somatostatin analogues</b>	<b>PC, NET</b>
<b>N-13</b>	<b>N13-NH3</b>	<b>Myocardial perfusion</b>

## OTHER PET/CT RADIOPHARMACEUTICALS

- O15 – 2 min
- ...

<b>Radionuclide</b>	<b>Radiopharmaceuticals</b>	<b>Usage</b>
<b>O-15</b>	<b>O15-H<sub>2</sub>O</b>	<b>Myocardial perfusion</b>
<b>I-123 (SPECT)</b>	<b>I123-Na</b>	<b>Thyroid cancer</b>
<b>I-123 (SPECT)</b>	<b>I123-MIBG</b>	<b>NET</b>
<b>I-124</b>	<b>Various immunologic compounds</b>	
<b>Cu-64</b>	<b>Various compounds</b>	<b>Genetic disorders, Tumors</b>
<b>In-111, Ga-67, Tl-201</b>	<b>SPECT nuclides</b>	

# Cyclotron

2010



2022

- 2010 –
- 2012 –
- 2014 –
- .... Cod
- 2019 –
- 2020 –
- 2021 – a contract for the purchase of laboratory equipment was signed
- 2022 – end of cyclotron infrastructure design, start of construction work...

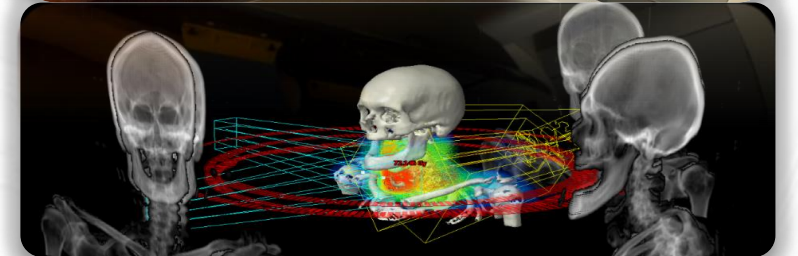
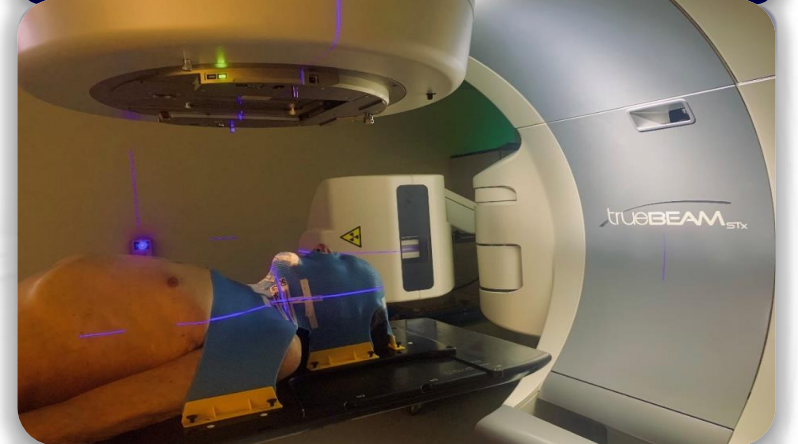
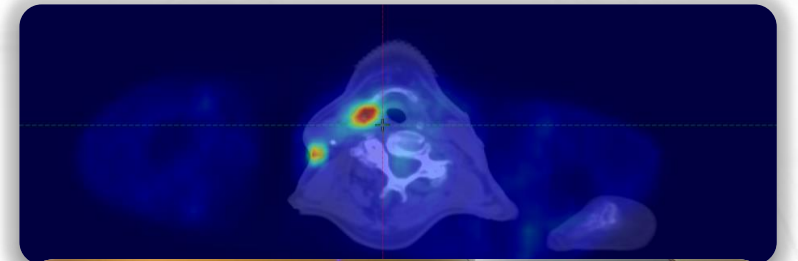
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# Conclusion

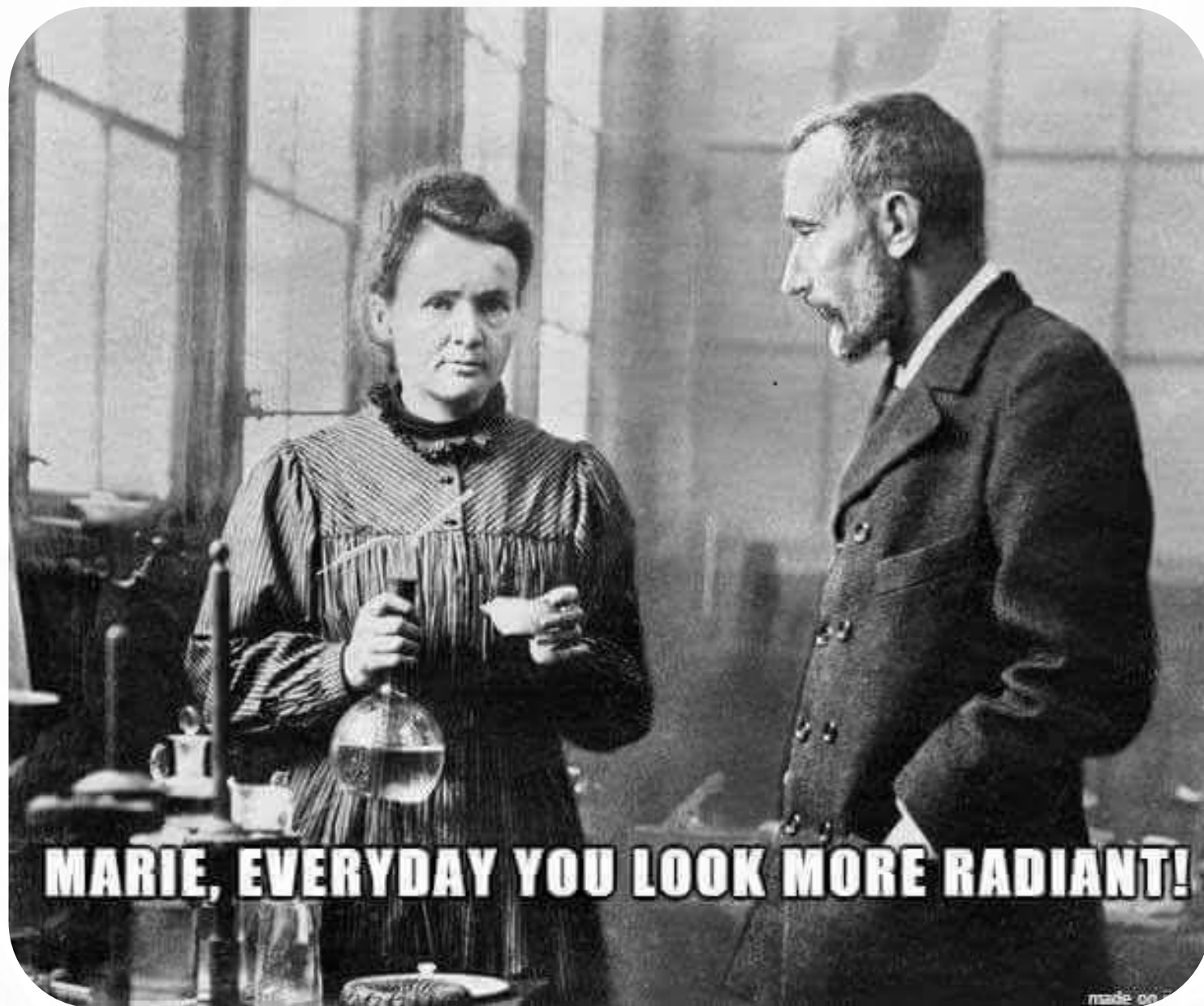
Infrastructure of radiation therapy and nuclear medicine in LUHS/HLUHS is a great platform for research and radiotherapy development.

- Large flow of patients suffering from cancer
- Experience in implementation of R&D activities
- Open and ready for cooperation with researchers and business sector.



THANK YOU FOR  
YOUR KIND ATTENTION

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