Nuclear Medicine Physics in Georgia

Lia Chelidze, George Japaridze, Rezo Shanidze
(I.Javakhishvili Tbilisi State University)

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http://collaborations.fz-juelich.de/ikp/cgswhp

Content

- Introduction
- Nuclear medicine
- External beam radiation therapy (EBRT)
- Nuclear medicine physics in TSU
- Summary and Outlook

Nuclear Technologies in Georgia

Commission of the Nuclear and Radiation Safety Problems.

Ministry of Environment and Natural Resources Protection of Georgia

IAEA
International Atomic Energy Agency

MINISTRY OF LABOUR HEALTH AND SOCIAL AFFAIRS

MINISTRY OF EDUCATION AND SCIENCE OF GEORGIA

Research Institute of Clinical Medicine

HTMC

Tbilisi Cancer Center

EVEX Medical Corporation

AVERSI

MED CENTER ONCOLOGY SURGERY

TSU

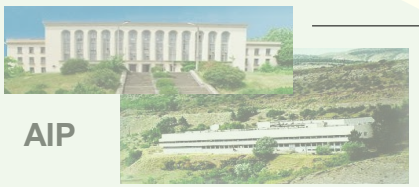
ISU

GTU

AUG

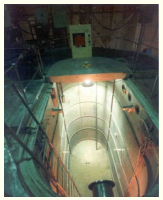
TSMU

IBCOEB



AIP

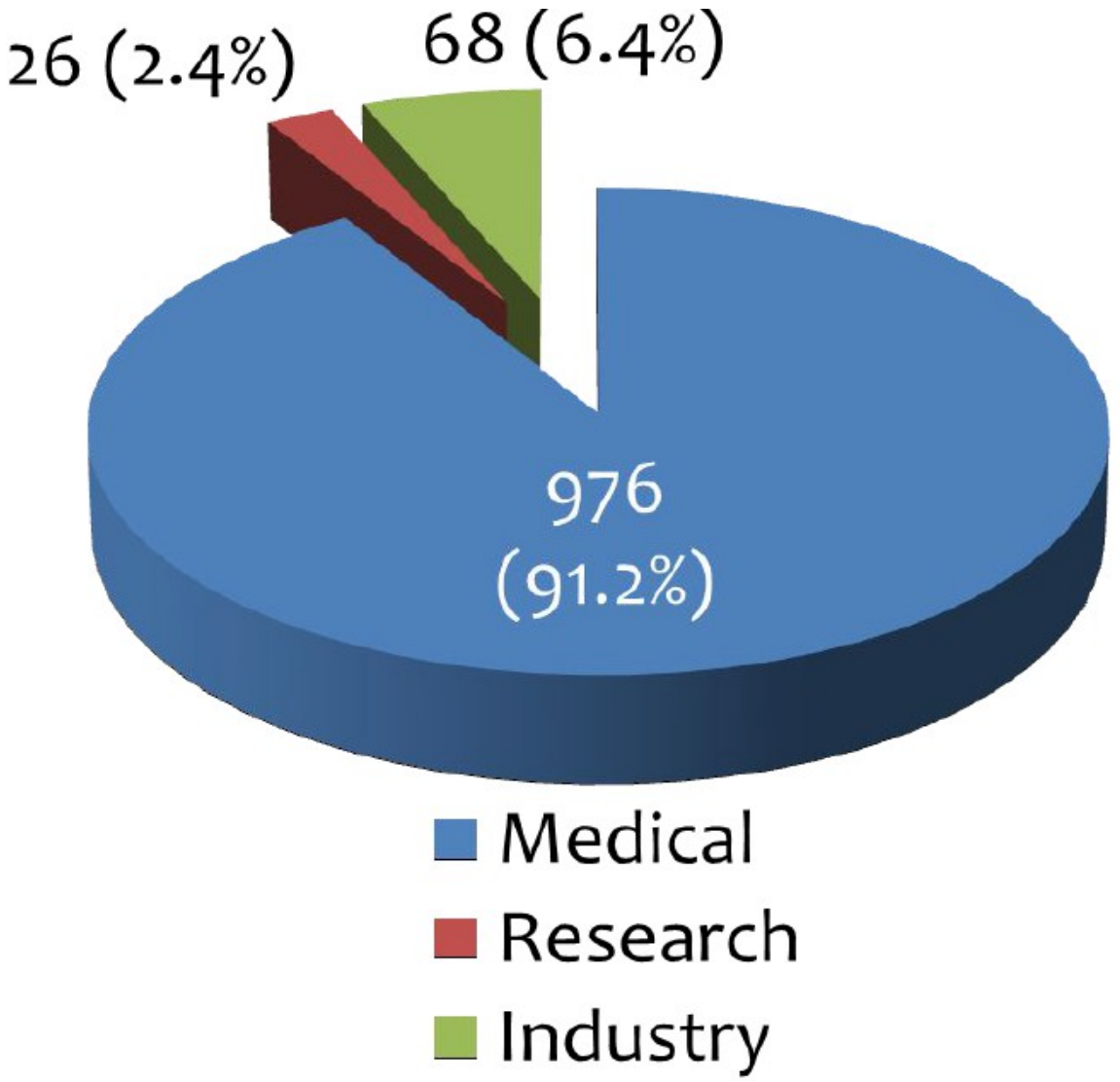
HEPI



Research Reactor IRT=M (Decommissioned)

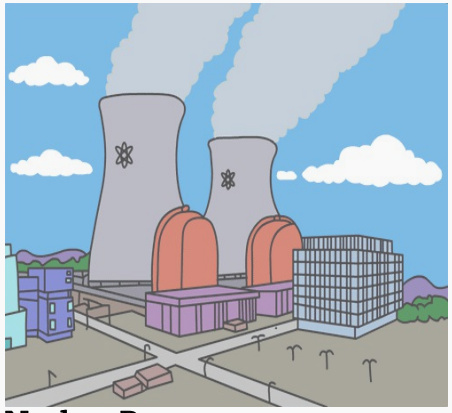
Radioactive Sources in Georgia

- Medicine is the largest user of radiation sources
- Number of medical rad sources increasing annually



Nuclear Medicine

Radionuclide Production



Nuclear Reactor

Cyclotron

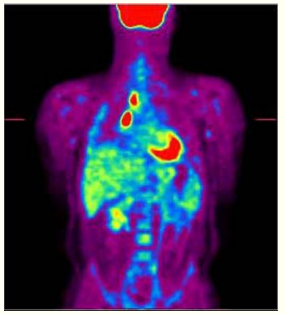
Radiopharmaceuticals

Diagnostics

Nuclear medicine imaging

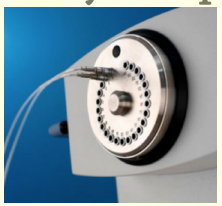
Gamma Camera
SPECT

PET Scanner



Therapy

Brachytherapy



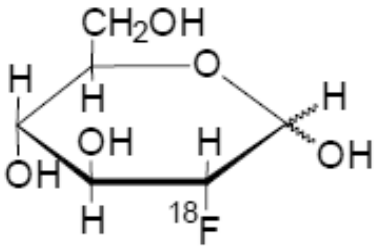
Teletherapy
(External Beam Radiation Theraphy, EBRT)

As Low As Reasonably Applicable
ALARA

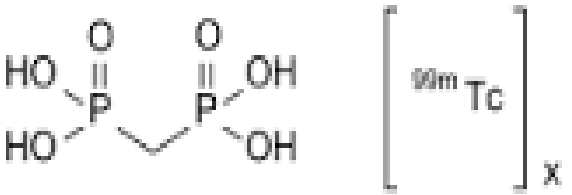
Radiopharmaceuticals

Isotope	$T_{1/2}$	E_γ (keV)	R- Pharmaceutical	Nucl. Med.	Production
^{18}F (β^+)	109.78 m	511	^{18}F-FDG	Imaging(PET)	Cyclotron
^{99m}Tc (γ)	6.01 h	140	^{99M}Tc-MDP, . . .	Imaging(SPECT)	Reactor ($^{99}Mo/^{99m}Tc$ Generator)
^{131}I (β^-)	8.02 d	364	Iodide salt, ...	Imaging, Treatment	Reactor

- Technetium-99m (^{99m}Tc) - the principal radioisotope used in medical diagnostics.



Fludeoxyglucose (^{18}F=FDG)



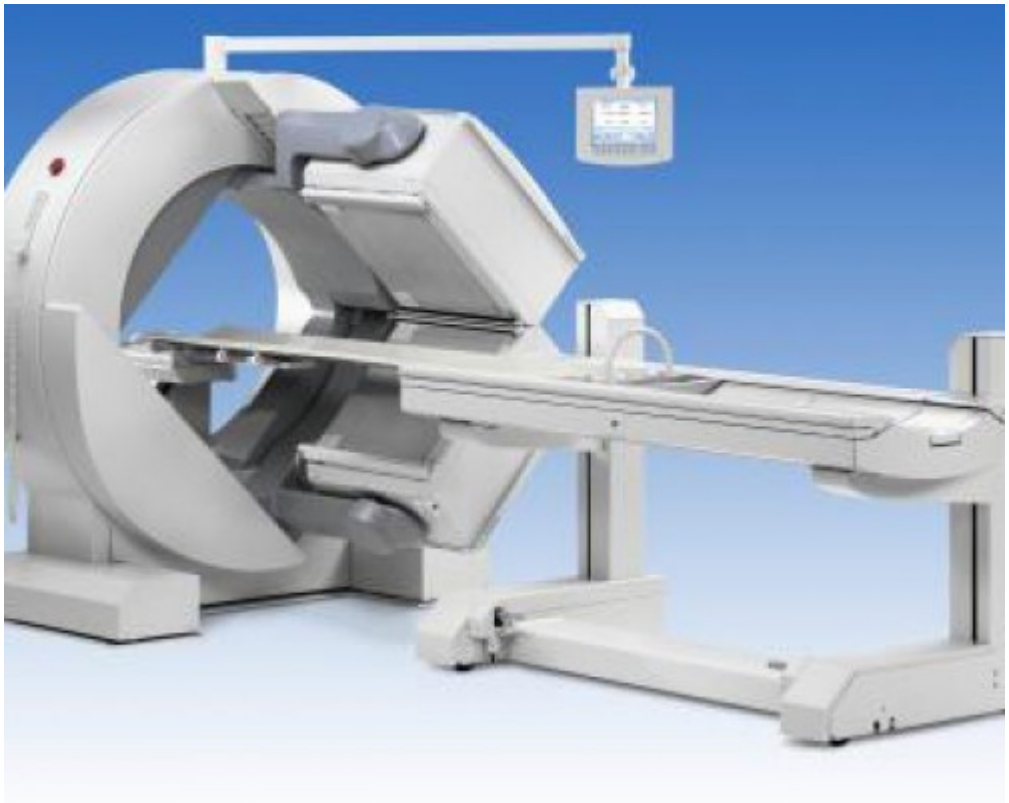
Technetium (^{99m}Tc) medronic acid

Eczacıbaşı | monrol

Eczacıbaşı-Monrol (Turkey, 2008):
Radioisotope research and development / production of radiopharmaceuticals for nuclear medicine.

Gamma Camera and SPECT

- Research Institute of Clinical Medicine
  - "E.CAM Systems"
  - "E. Cam Extended Dual Detector Systems
- High Technology Medical Center (HTMC)
  - MiE Detector



Radioisotopic and topographic examination:

bone, the thyroid and parathyroid glands;

Liver, lung, kidney, peripherial-lymphatic system, brain.

- mamoscintigraphy;
- photon emission CT examination of the myocardium;
- investigation with ^{99m}Tc labeled erythrocytes;
- determination of the lung perfusion, estimation of the lung functional state;
- evaluation of the kidney morpho-functional condition;

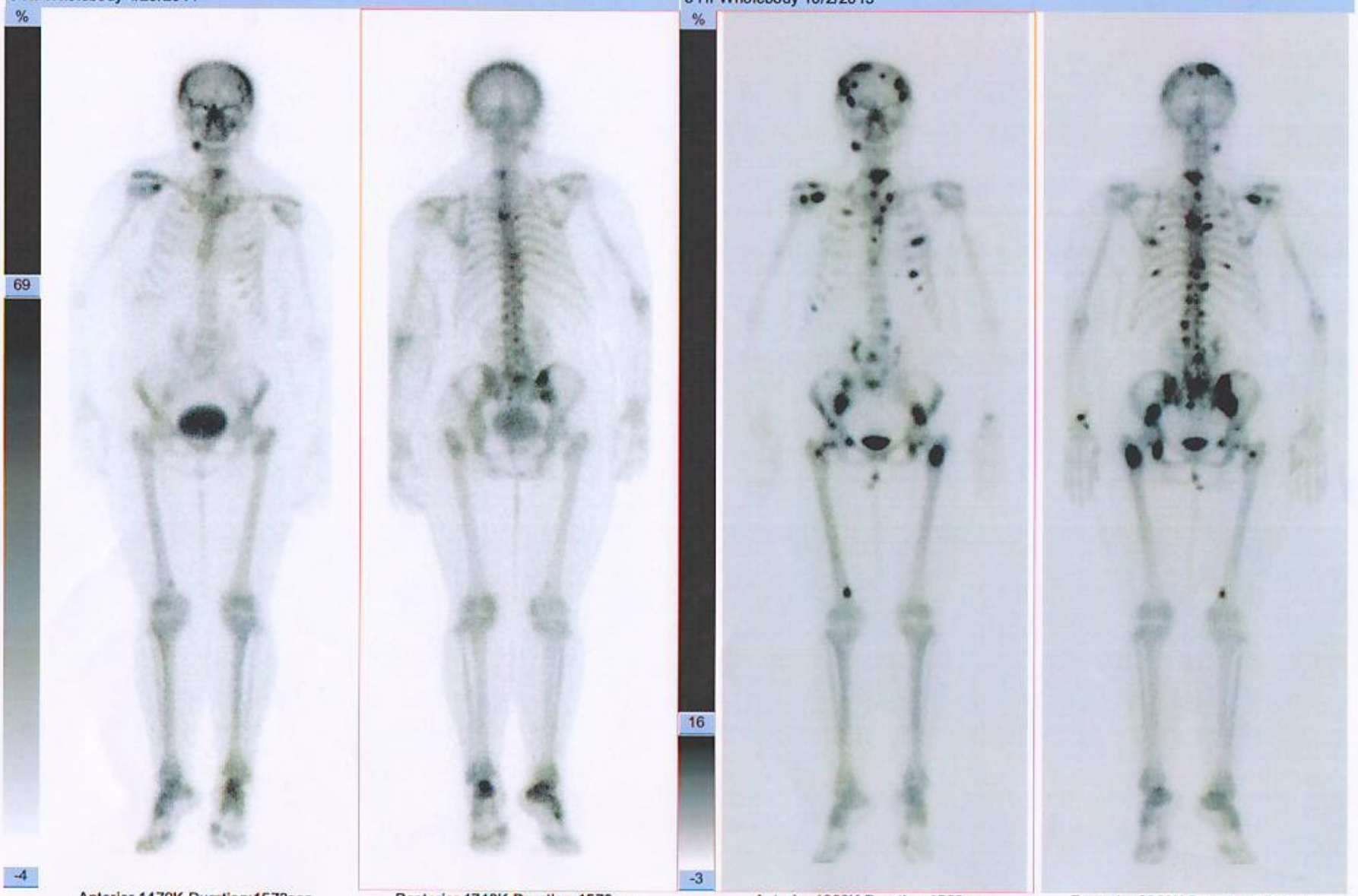
Bone Scane (CRI)

[redacted]

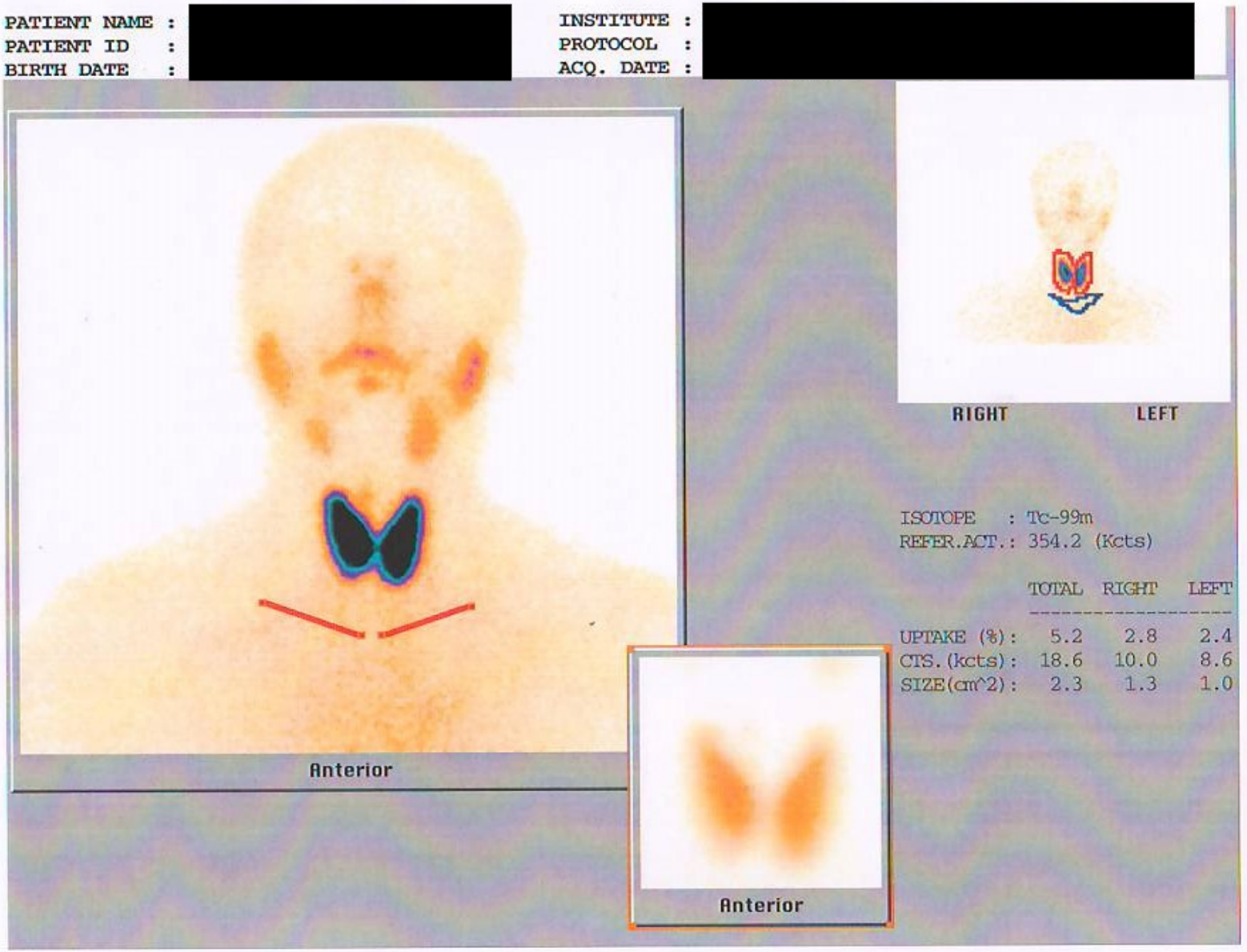
STUDY DATE: [redacted]

Patient Name [redacted] DOB: [redacted]

Study Name:	Study Date: 4/23/2014	Series Description: 3 Hr Wholebody	Study Name:	Study Date: 10/2/2013	Series Description: 3 Hr Wholebody
Series Date: 4/23/2014			Series Date: 10/2/2013		



Thyroid Scintigraphy



Research Institute of Clinical Medicine, Tbilisi, Georgia

PET/CT

http://www.htmclinic.com/en/news/clinic-news/21-wpetct

- **PET/CT @ HTMC**

  Discovery (GE Healthcare)

- First PET scanner in Caucasus and middle Asia

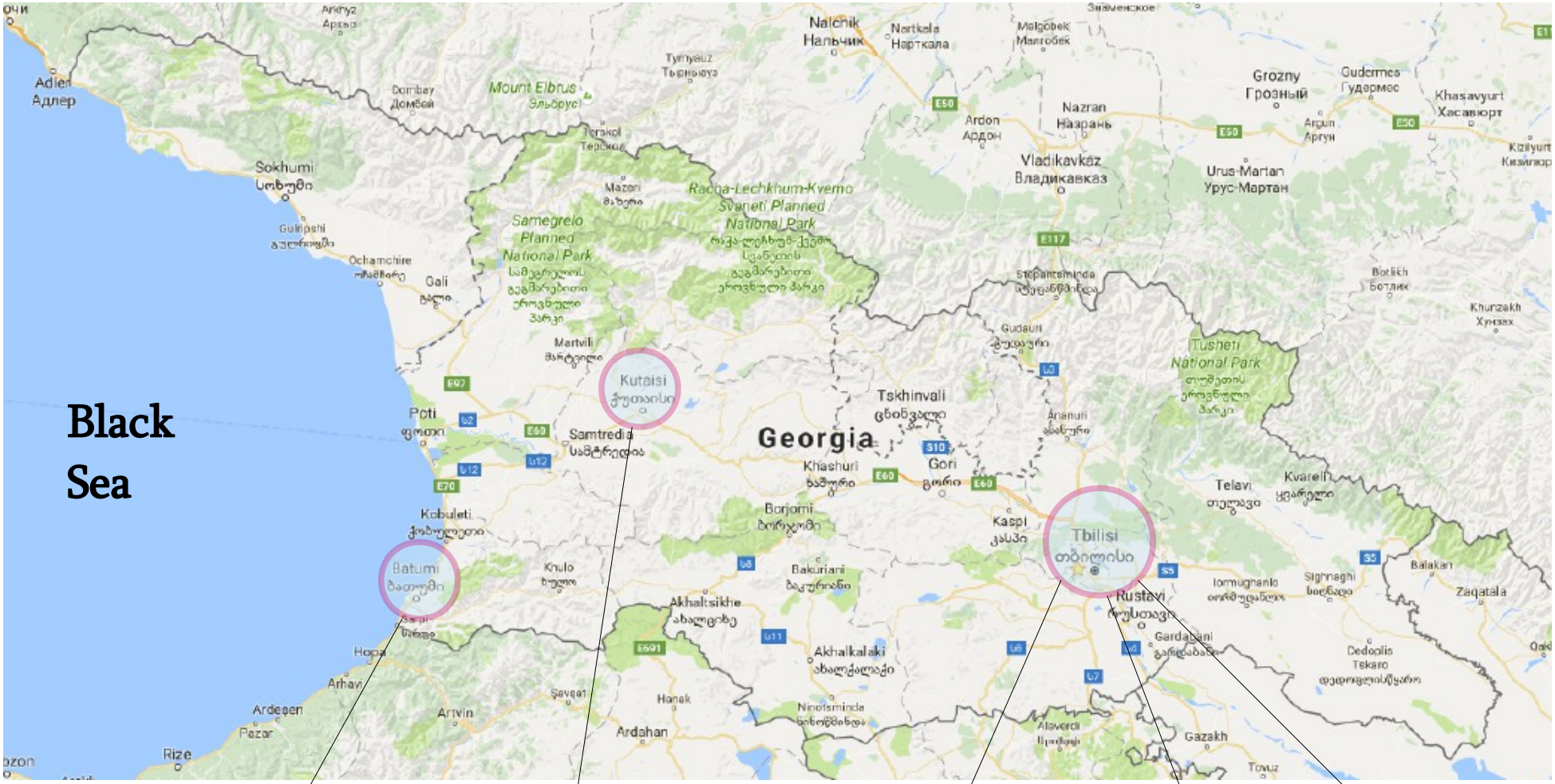
- Limiting factor:

  FDG-F-18 supply.

2017:

- PET/CT in the Research Institute of Clinical Medicine
- Accelerator (cyclotron, GE Healthcare) for ^{18}F production - Aversi

External Beam Radiotherapy



External Beam Radiotherapy (EBRT) Centers

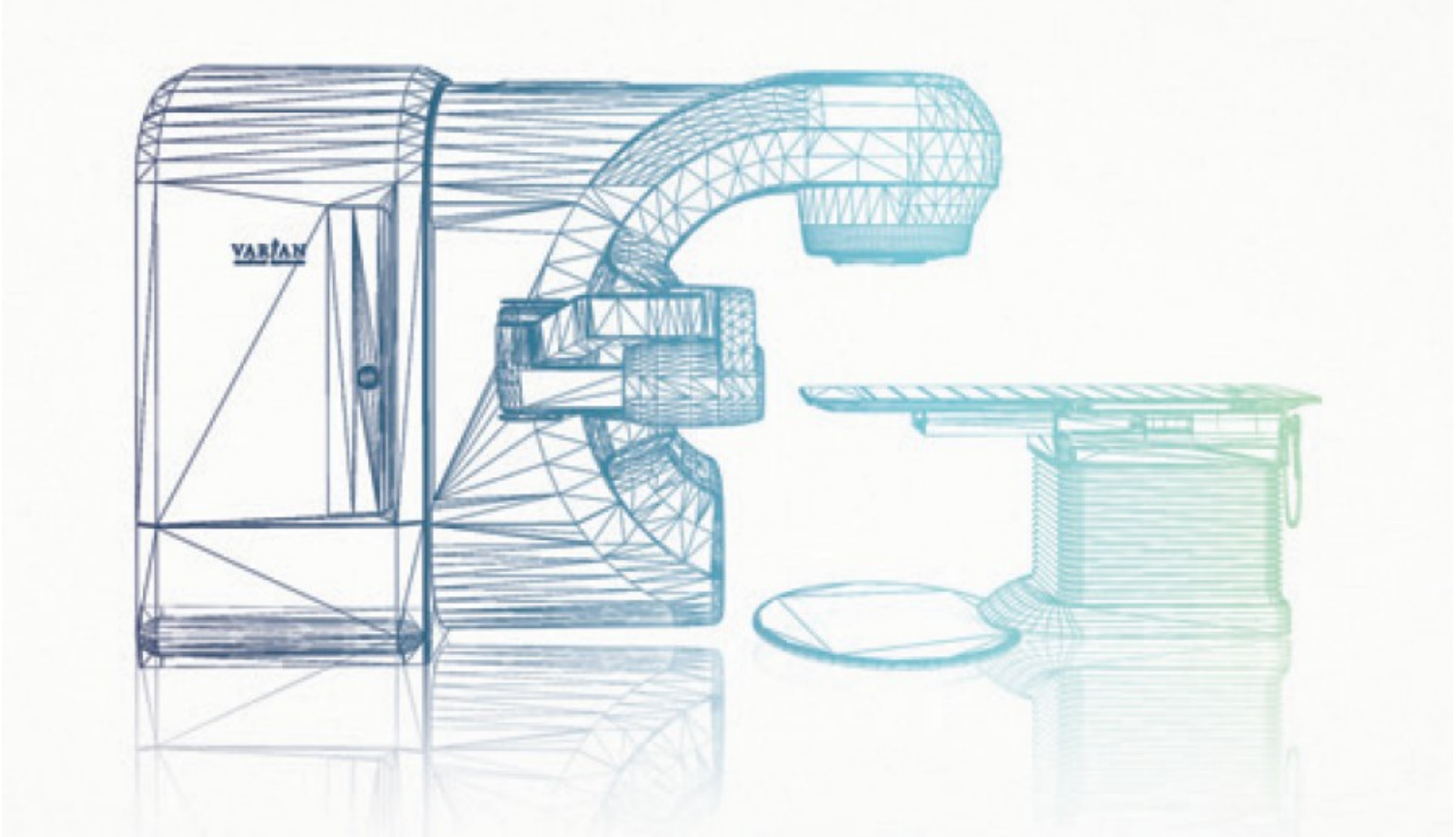
	Med. Clinic	Location	#	Type
1	HMTC	Tbilisi	2	Clinac 600C, Clinac 2100iX
2	Reseach Institute of Clinical Medicine	Tbilisi	2	TrueBeam™ (2)
3	Tbilisi Cancer Center	Tbilisi	1	Clinac® iX (?)
4	West Georgia Oncology Center	Kutaisi	1	Clinac® iX (?)
5	MedCenter	Batumi	1	Clinac® iX
	Total EBRT accelerators		7	

2017: EDGE Radiosurgery system (Varyan) in
the Research Institute of Clinical Medicine

VARIAN
medical systems

TrueBeam™ Radiotheraphy System

Electron (MeV):	6, 9, 12, 15, 16, 18, 20, 22
HDTSE:	6 HDTSE, 9 HDTSE
Maximum output dose rates HDTSE	1000 MU/min Energies at 2500 MU/min



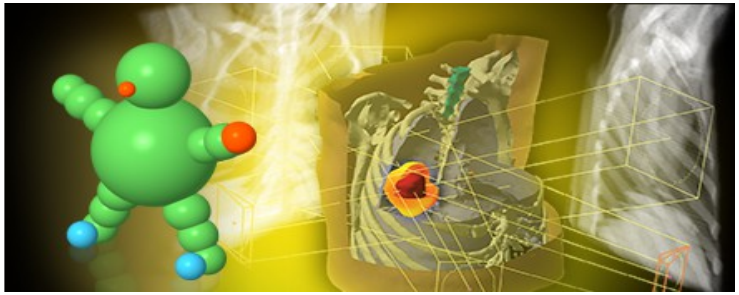
EBRT Modes

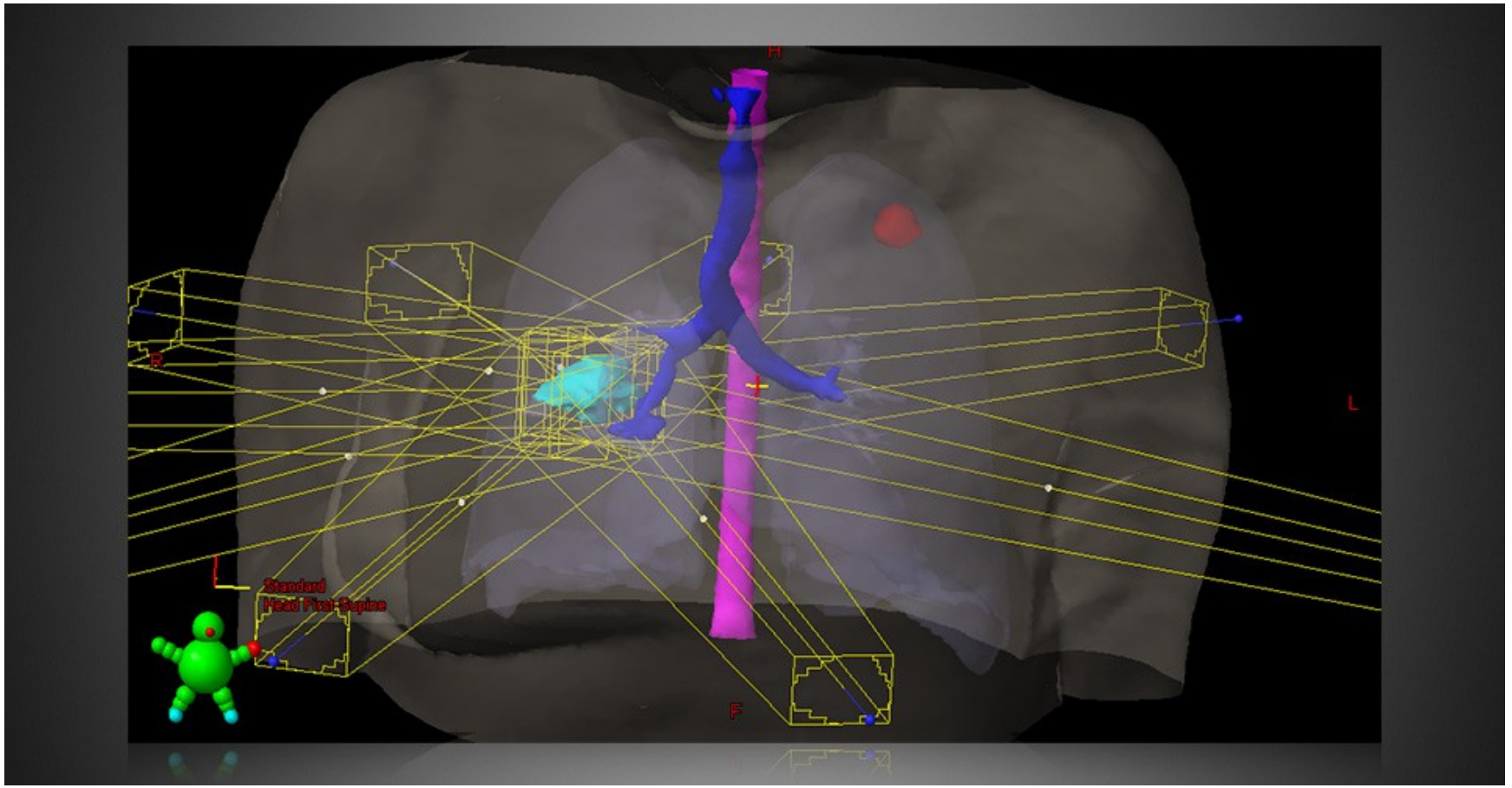
- 3D conformal radiation therapy (3DCRT)
- Image-guided radiation therapy (IGRT)
- Intensity modulated radiation therapy (IMRT)
- Stereotactic radiosurgery (SRS)

Treatment Planning System

VARIAN
medical systems

ECLIPSE





Nuclear Medicine Physics in TSU (1)

Faculty of Exact and Natural Sciences

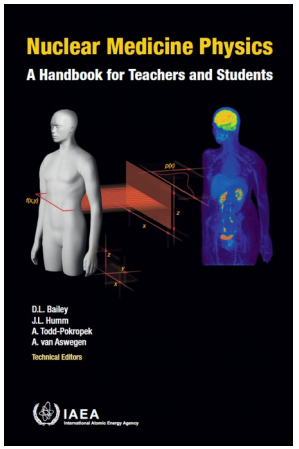
Physics Department

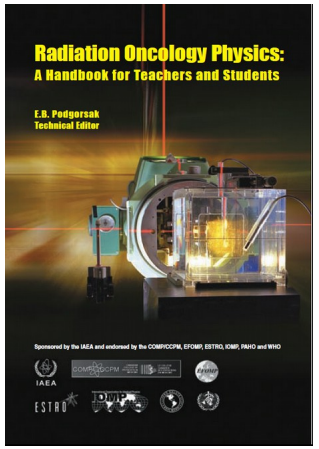
MS Applied Physics

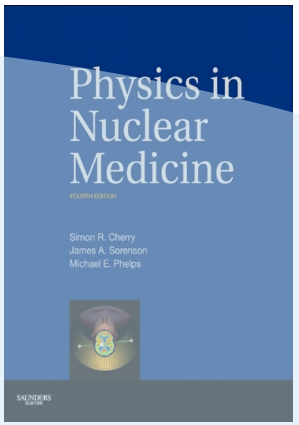
Nuclear Medicine Physics

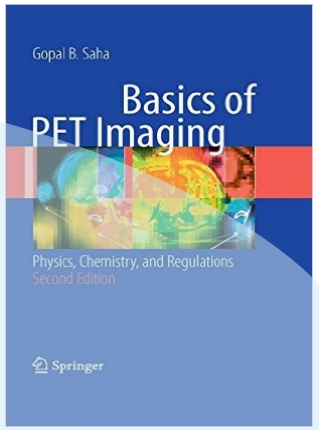
Faculty of Medicine

?









- Radiation Biology
- Physical Principles of Diagnostic Radiology and Nuclear Medicine
- Medical Dosymetry
- Nuclear Medicine Instrumentation
- Physical Principles of Radiation Therapy
- Computing in Nuclear Medicine Physics

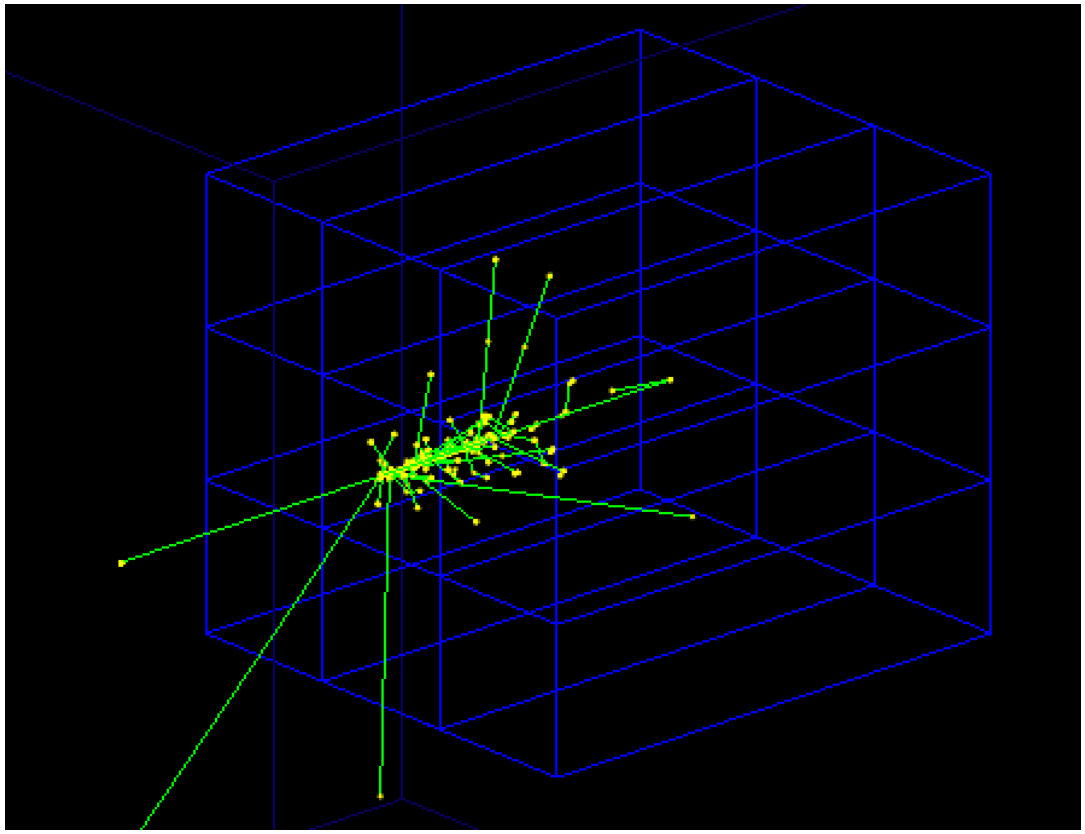
Nuclear Medicine Physics in TSU (2)

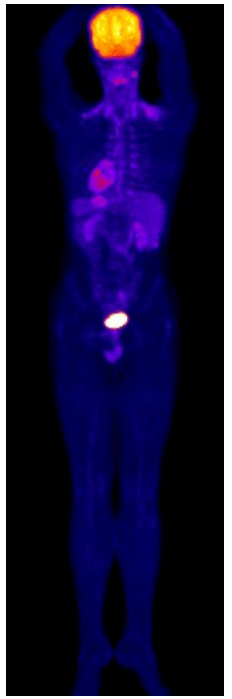
Geant 4

a toolkit for the simulation of the passage of particles through matter

https://geant4.web.cern.ch/gean4/

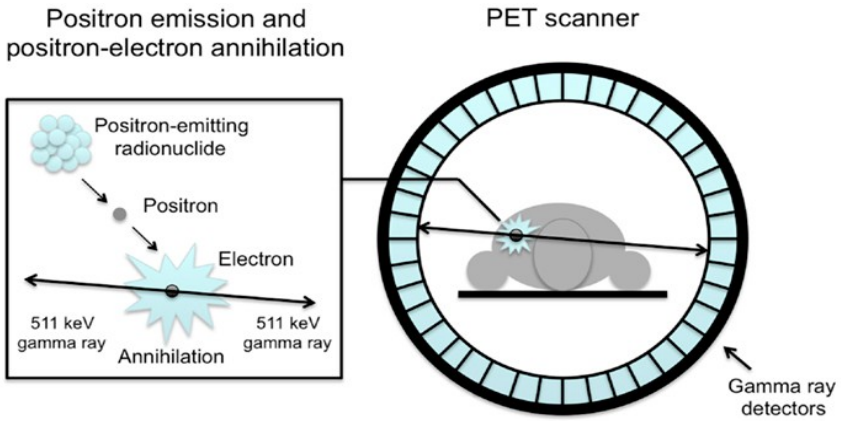
GATE - **G**eant4 **A**pplication for **T**omographic **E**mission





Geant 4 Simulation for EDM (G. Macharashvili, HEPI TSU)

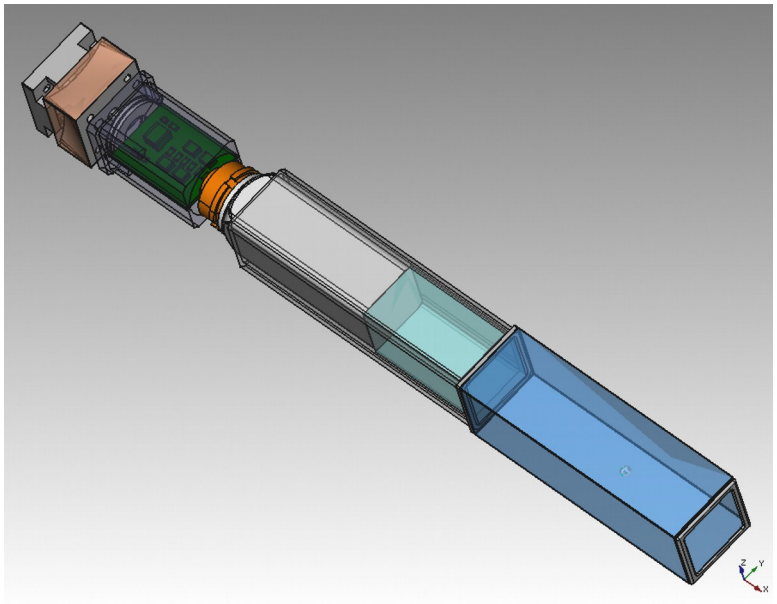
Nuclear Medicine Physics in TSU (3)



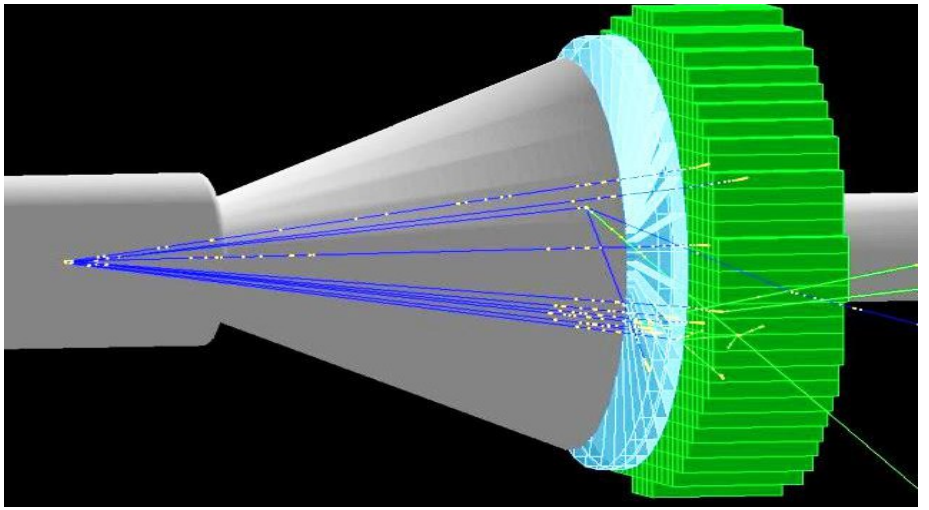
HEP experiments in TSU(HEPI):

srEDM

COMET μ e



100 mm LYSO crystal attached to the 48 mm light guide and dual channel PMT.



GEANT simulations:

The walls of the COSY beam pipe and target chamber = gray color, LYSO crystals - green, scintillation hodoscopes – light blue.

I. Keshelashvili, PoS PSTP2015 (2016) 026

Summary and Outlook

- Nuclear medicine (NM) is a very active field in Georgia.
- Supply (export) of the short-lived radiopharmaceuticals is the main limiting factor for NM.
- Medical accelerator and the new instruments for diagnostics and treatment could provide further boost for NM in Georgia.
- New TSU MS program in nuclear medicine physics (NMP) will start from the Winter Semester of 2017.
- Further development of the field needs research projects in the NMP.
- Future research institute in Georgia (Institute of Technology) has a strong interest in the NMP.

Technology Institute in Georgia

The Technology Institute will be located in Tbilisi's Digomi district

- The Institute will be created to develop fundamental and applied research in **physics, chemistry, biology, mathematics, engineering and computer technology.**
- The most important component of the project is the construction of a **particle accelerator.**
- "With it, a new generation of scientists will be able to conduct important studies, including in medicine- in the direction of oncology and 'Hadron Therapy'."
- Collaboration with some of the world's leading reseacrh centers, including CERN, INFN, CNAO (National Center for Hadron Therapy).
- The government founded the Georgia Institute of Technology with the financial support of International Charity Fund Cartu. Construction of the institute will take up to 7 years.