

8TH GEORGIAN - GERMAN SCHOOL AND WORKSHOP IN BASIC SCIENCE (GGSWBS'18)



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I.Javakhishvili Tbilisi State University
High Energy Physics Institute

Nuclear Medicine Physics
in Tbilisi State University

23 August 2018
Tbilisi, Georgia



August 20 – 25, 2018 • Tbilisi, Georgia

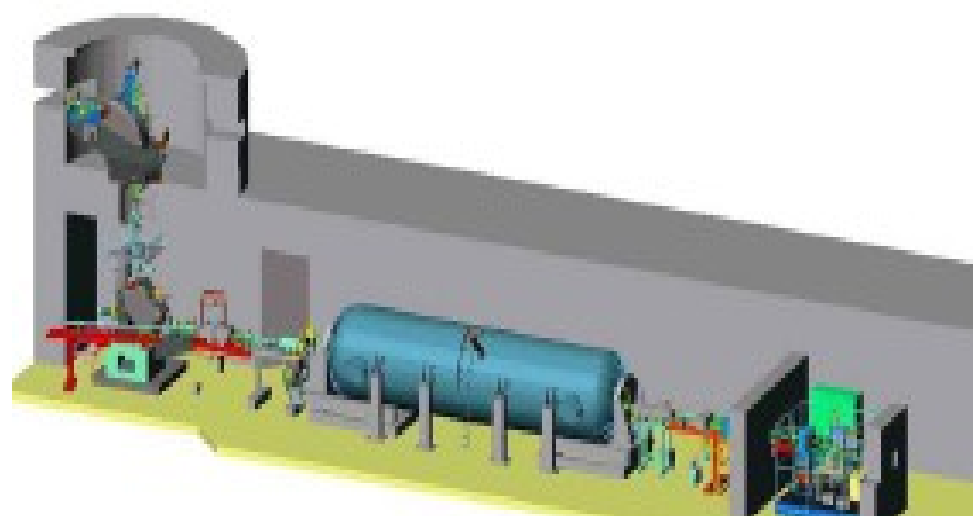


TANDEM@Caucasus

Tbilisi Accelerator based Nuclear, Dating and Environmental Monitoring Regional center



R. Shanidze
University of Erlangen
and
HEPI TSU



The AMS facility for TANDEM

- The Accelerator Mass Spectrometry (AMS):
Ultrasensitive analysis tool for:
 - Archeology
 - Biology, medicine and pharmacology
 - Chemistry
 - Environmental studies,
 - Physics, . . .
- Modern experimental tools for scientific research and high education.
- Reasonable installation/running costs.
- Possibility to serve large scientific community in Georgia and South Caucasus region.
- Close collaboration with research groups in EU (USA, Japan,..)

Contents

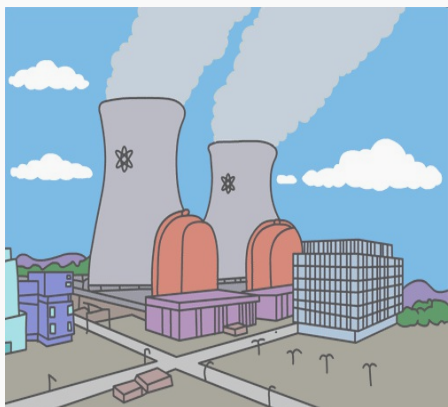
NMP in Georgia - teaching in TSU – prospects for research

- Introduction
- Nuclear medicine in Georgia
- Nuclear medicine physics (NMP) program in TSU
- Future research projects
- Summary and Outlook



Nuclear Medicine

Radionuclide Production



Nuclear Reactor

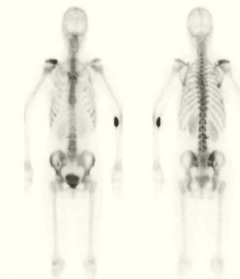
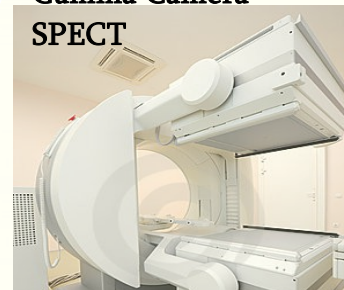
Radiopharmaceuticals



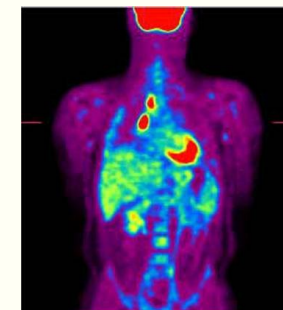
Diagnostics

Nuclear medicine imaging

Gamma Camera
SPECT

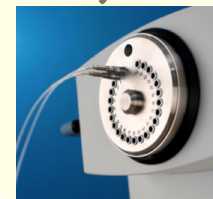


PET Scanner



Therapy

Brachytherapy

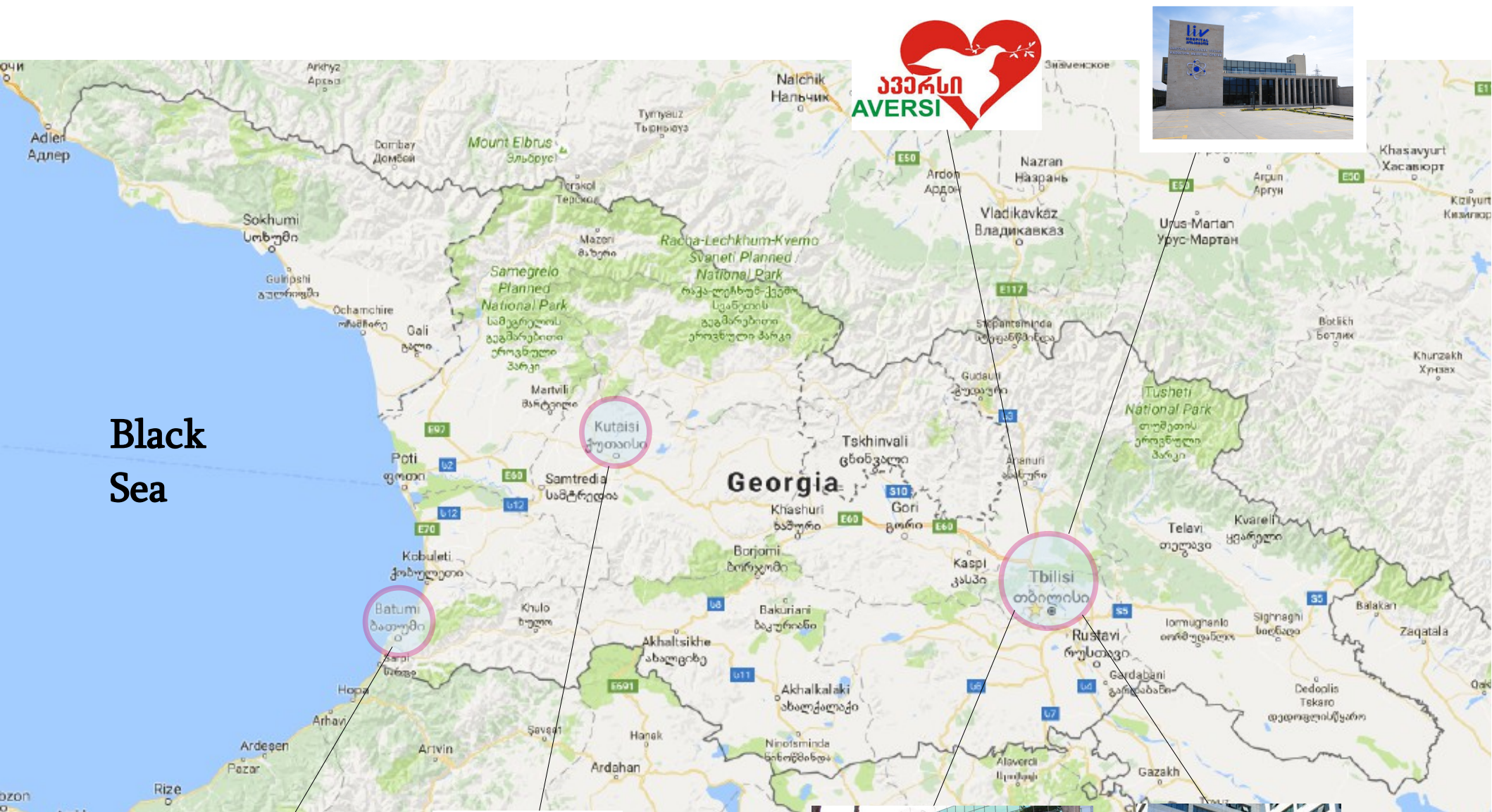


Teletherapy (External Beam Radiation Therapy, EBRT)

As Low As Reasonably Applicable



Nuclear Medicine Centers in Georgia



Nuclear Medicine Equipment in Georgia

Nuclear medicine centers in Georgia:

MN Centers	Diagnostics Nucl. imaging		Therapy		Radioisotops
	SPECT	PET	Brachy	EBRT	
RICM (“Todua”)	SPECT	PET	Yes	3	^{18}F , $^{99\text{m}}\text{Tc}$, ^{131}I , ^{192}Ir
HTMC (“Ingorokva”)	SPECT	PET	Yes	2 + 1	^{18}F , $^{99\text{m}}\text{Tc}$, ^{131}I , ^{192}Ir
RMC	SPECT	-	-	2 + 1	$^{99\text{m}}\text{Tc}$, ^{131}I , ^{60}Co
Aversi	SPECT	-	-	2	$^{99\text{m}}\text{Tc}$, ^{131}I ,
Ewex (Kutaisi)	-	-	-	2	-
Batumi	-	-	-	1	-

Radioisotopes for nuclear medicine in Georgia: M. Abramisvili

Nuclear Medicine Equipment in Georgia

- New generation PET/CT: GE Discovery IQ was recently installed in Research Institute of Clinical Medicine (Medical Center of Acad. Todua)*



- 5 ring detector system
- Lightburst detector with enhances sensitivity for F18 labeled pharmacies by factor 2
- Highest sensitivity in the industry at up to 22 cps/kBq

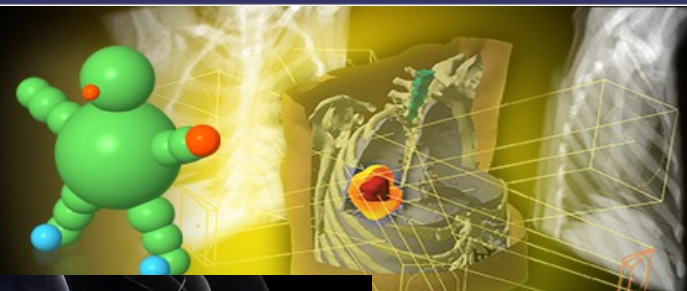
* <http://clinicalmedicine.ge/siaxleebi/ptomografi>

http://www3.gehealthcare.com/en/products/categories/molecular_imaging/pet-ct/pet-ct_scanners/discovery_iq

Treatment Planning Systems



ECLIPSE

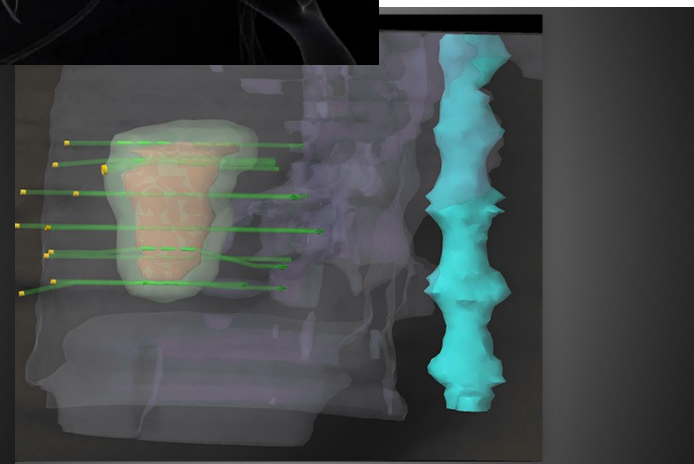
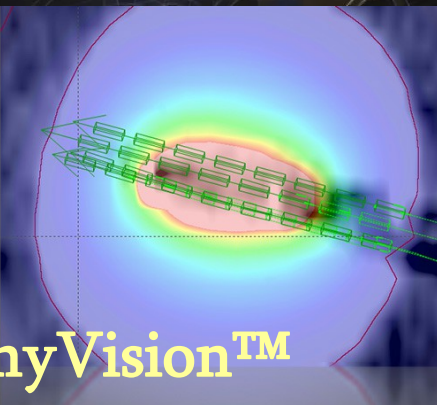


Monaco



Brachytherapy:

BrachyVision™



In the students session:

- Tea Avaliani - Brachytherapy treatment planning
- Nino Batselashvili - Teletherapy treatment planning



World Health Organization

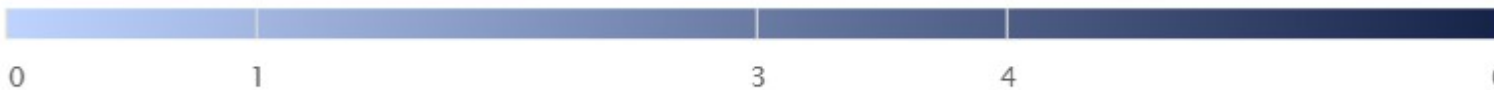
Gamma cameras (equipments per 100 000 population)



Moldova (0.08, 2013)

Georgia (0.11, 2013)

Greece (1.39, 2013)





Tbilisi State University

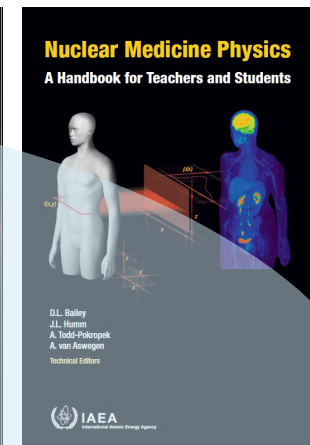
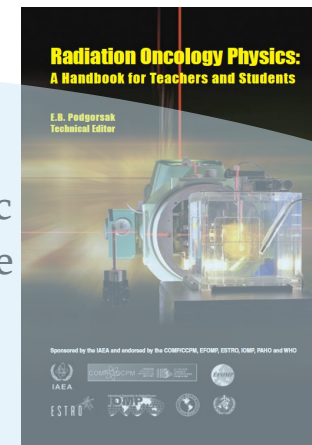
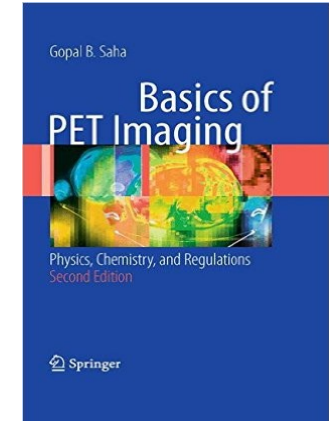
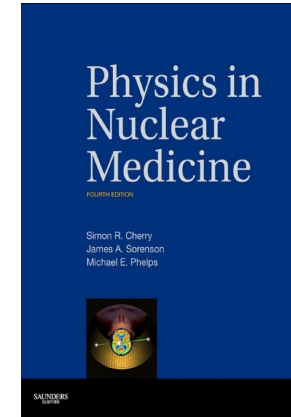
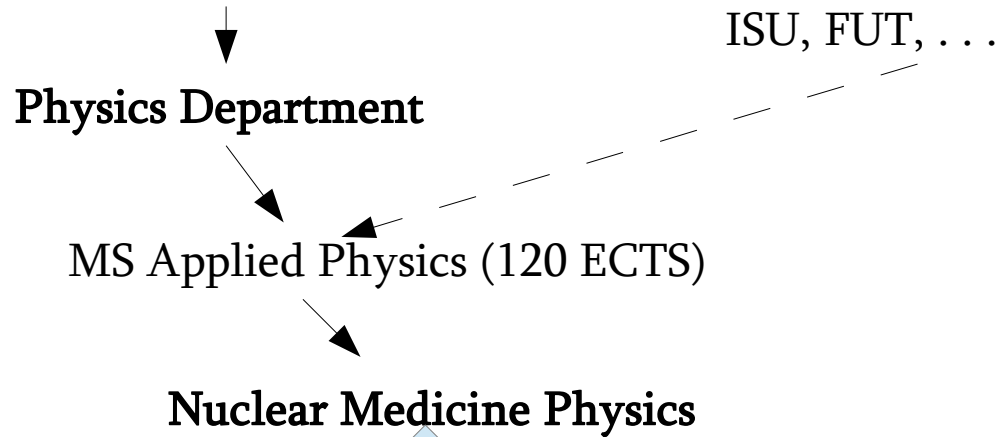


- Oldest University in Georgia and Caucasus
- Largest University in Georgia: > 20 000 active students of all levels
- 7 Faculties:
Economics and business, **Exact and natural sciences**, Humanities, Law, **Medicine**, Psychology and educational sciences, Social and political sciences
- 67 BS , 96 MS and 50 PhD programmms
- Largest research institution in Georgia: 16 research instututes



Nuclear Medicine Physics in TSU

Faculty of Exact and Natural Sciences



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

Nuclear Medicine Physics Program in TSU

- Physics department, MS program **Applied Physics** (120 ESCT credits)

		Semester			
		I	II	III	IV
1	Introduction in Condensed Matter Physics		Radiation Detectors*	Computing in Medical Physics	Master Project/Thesis
2	Propagation of E-M Waves		Radiation Biology	Applications of Nuclear Magnetic Resonance *	
3	Theory of Radiation		Medical Dosimetry	Diagnostic Radiology Physics*	
4	Introduction in Microelectronics		Medical Physics Instrumentation	Physics Principles of Radiation Therapy	
5	Applied Nuclear Physics		Selected Course 1	Selected Course 3	
6	Anatomy		Selected Course 2	Selected Course 4	



TSU: Nuclear Medicine Physics -2018



Program of nuclear medicine physics in TSU was prepared by:
B. Bochorishvili, L. Chelidze, G. Japaridze, R. Shanidze



First students of the program: T.Avaliani, N. Batselashvili



Geant4 Research Tool

Geant 4

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

<https://geant4.web.cern.ch/geant4/>

Software tool, which was developed for particle physics at CERN and found many applications in: Medicine, Space and radiation, Technology

Medical application examples:

GAMOS: Geant4 based **A**rchitecture for **M**edicine-**O**riented **S**imulations

GATE: Geant4 Application for Tomographic **E**mission

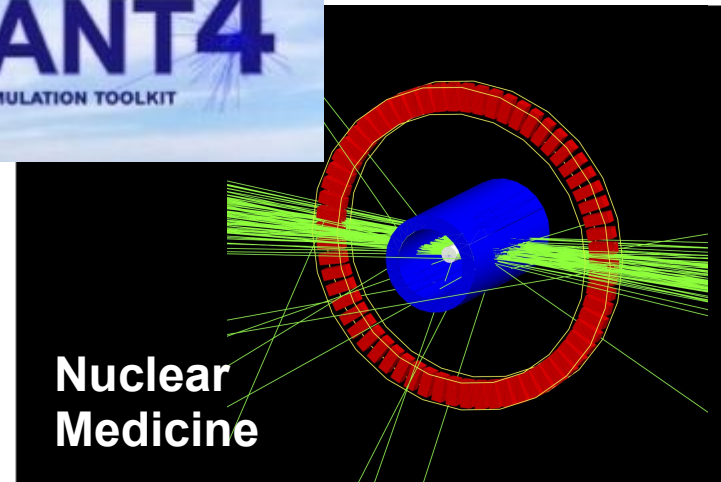
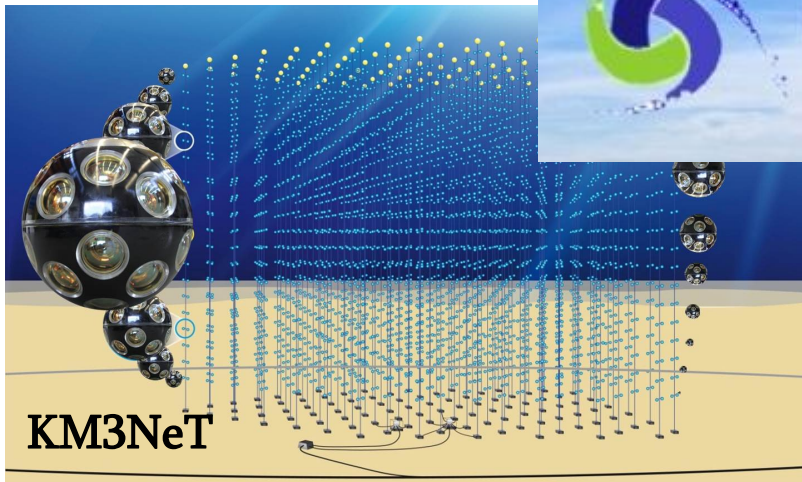
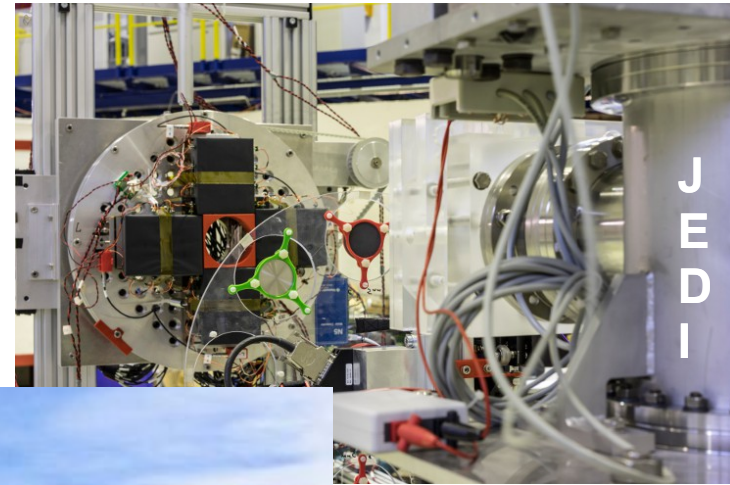
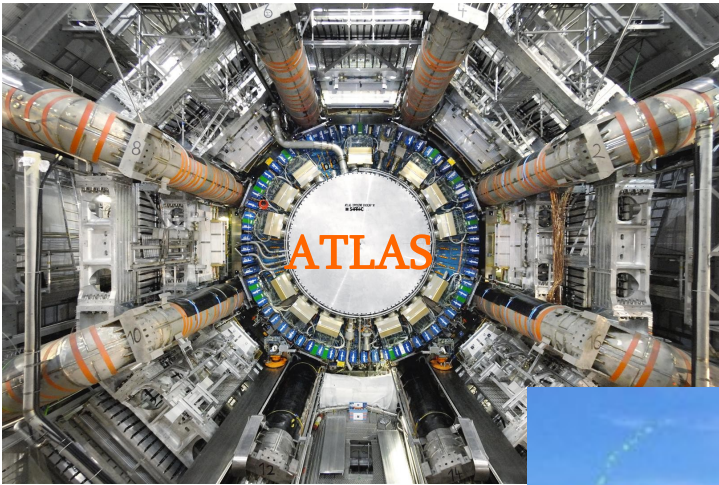


GHOST: Geant4 **H**uman **O**ncology **S**imulation **T**ool





Geant4 in HEPI TSU



Geant4 @ HEPI TSU

(M. Abuladze, G. Macharashvili, G. Papalashvili, R. Shanidze)

- Applications for particle and astroparticle physics projects (ATLAS, JEDI, KM3NeT)
- G4 in nuclear medicine physics - talk of M. Abuladze



JavaScript for Nuclear Medical Physics

Web-application example:

Calculations for radioisotope activity, mass in a sample, . . .

ბირთვული სამედიცინო ფიზიკა

მაგალითი 1

ამ მაგალითში ხდება რადიო-იზოტოპის (ZX^A) მასის (m) გამოთვლა იმ ნივთიერებაში, რომლის აქტიობა (A) გამოწვეულია ამ რადიო-იზოტოპით. რადიო-იზოტოპის ნახევარ-დაშლის პერიოდია $T_{1/2}$, ატომური მასა (m_A).

მასის გამოთვლისთვის შეიყვანეთ რადიო-იზოტოპის აქტიობა, ნახევარ-დაშლის პერიოდი (დრო) და ატომური მასა. წინასწარ შეარჩიეთ აქტიობის და ნახევარ-დაშლის პერიოდის ერთეულები. მასის გამოთვლა ხდება შესაბამისი დილაკის (გამოთვლა) საშუალებით.

MBq ▾ რადიო-იზოტოპის აქტიობა (A)

წუთი ▾ ნახევარ-დაშლის პერიოდი ($T_{1/2}$)

რადიო-იზოტოპის ატომური მასა (m_A)

გამოთვლა

რადიო-იზოტოპის მასა ნივთიერებაში:

2.9503e-11 გრამი

Summary and Outlook

- MS program in nuclear medicine physics (NMP) is active in TSU from the Winter Semester of 2017/2018.
- The program is supported by the Reserch Institute of Clinical Medicine, the leading nuclear medicine and radiation therapy instutution in Georgia.
- Research directions for this program are under consideration (Geant4 tool for physics and medicine)
- Next step: internationalization of nuclear medicine program and research projects in TSU.

Vielen Dank!



დიდი მადლობა!