

GEORGIAN-GERMAN SCIENCE BRIDGE (GGSB) 2022

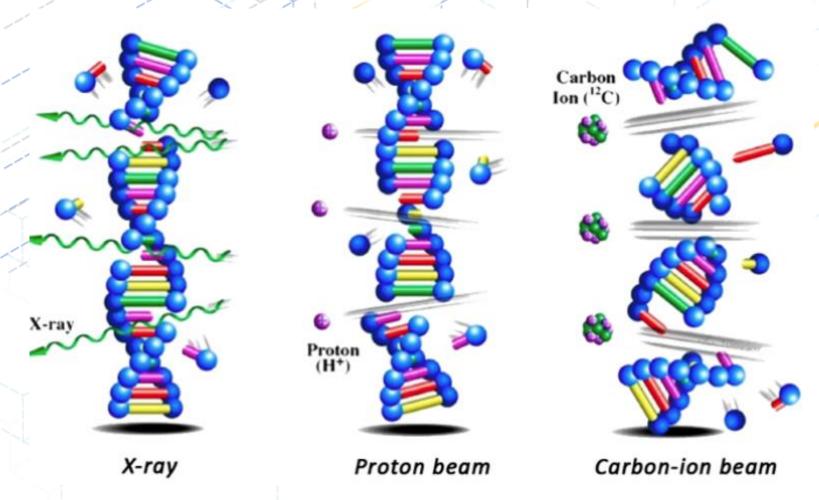


HADRON THERAPY CENTER OF KUTAISI INTERNATIONAL UNIVERSITY

Rezo Shanidze
Kutaisi International University
Tbilisi State Uniersity

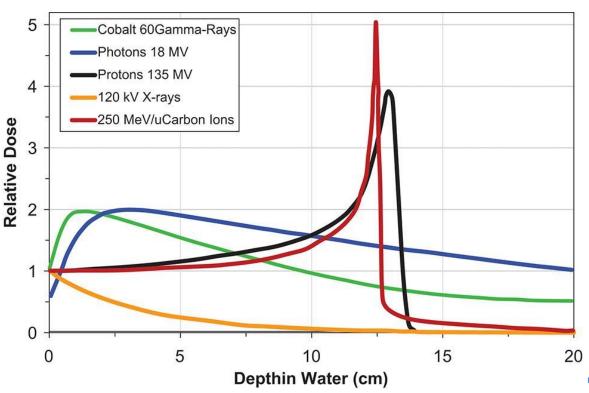
September 13, 2022

Radiation Therapy



V. Marx., Narure 508(2014), 133–138

- Brachytherapy
- Teletherapy (EBRT)
 - \Box X and γ radiation
 - ☐ Charged particles:
 - protons, ¹²C-ions



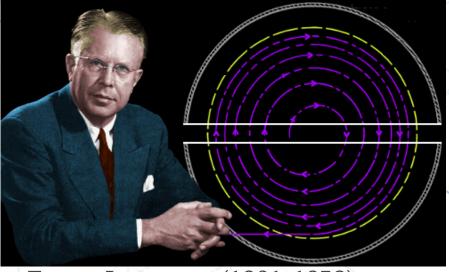


Radiological Use of Fast Protons



Robert R. Wilson (1914-2000)

UNIVERSITY



Ernest Lawrence (1901-1958) The inventor of a cyclotron. Nobel prize in physics 1939

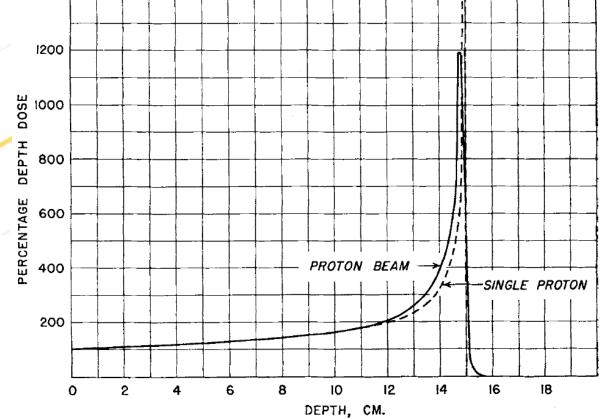
Radiology 47 (1946), 487

Radiological Use of Fast Protons

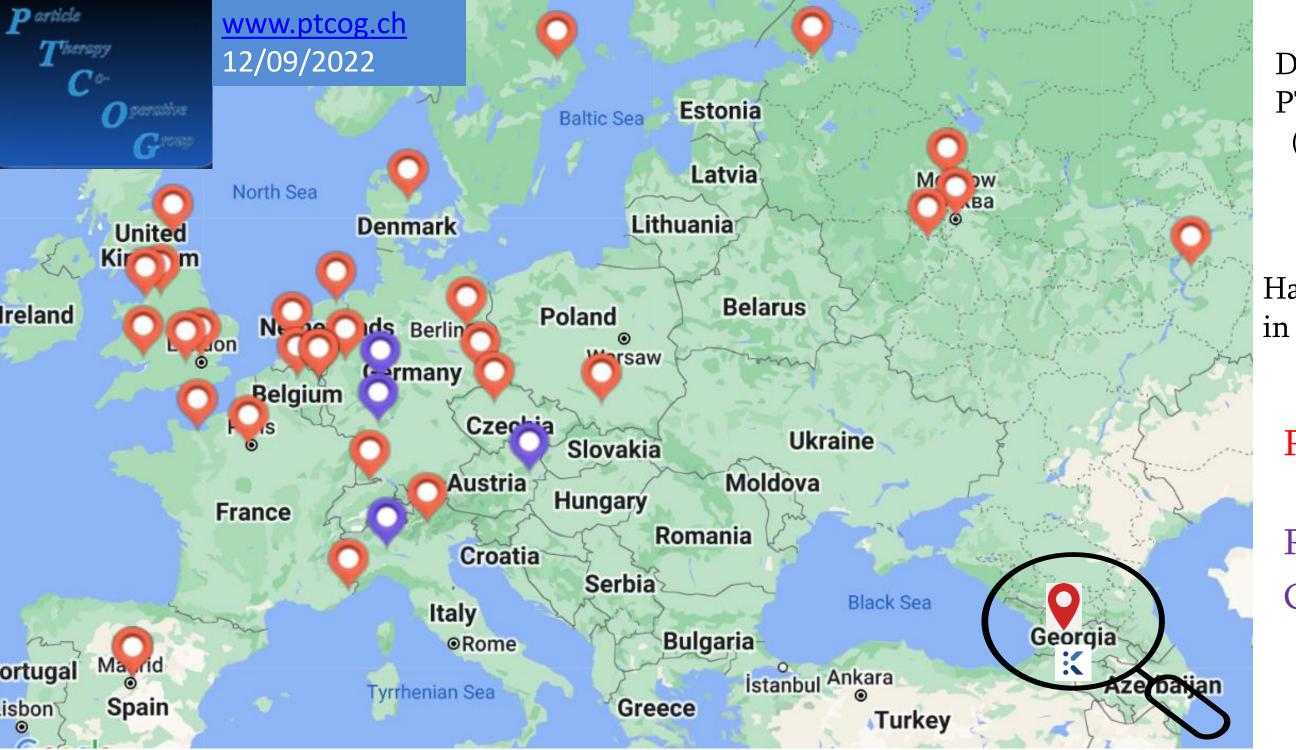
ROBERT R. WILSON

Research Laboratory of Physics, Harvard University

KUTAISI
Cambridge, Massachusetts



"It will be possible to treat a volume as small as 1 cc anywhere in the Body and to give that volume several times the dose of any other neighboring tissue. The exact behavior of protons of the energy considered here will became known only when such protons are available for experiment."



Data from PTCOG (ptcog.ch)

Hadron therapy in Europe.

Protons

Protons /
Carbon-ions

Hadron Therapy Center of Kutaisi International University (KIU HTC)

HTC: Treatment and research with IBA S2C2.





Hadron Therapy Center of the Kutaisi International University



IBA S2C2 (Super-Conducting Synchro-Cyclotron)



Maximum Energy: 230/250 MeV

Yoke/pole radius: 1.25 m/0.50 m

Weight: 50 tons

Mag. field central/extraction: 5.7 T/5.0 T

Initial cooldown: 12 days

Beam pulse rate/length: 1000 Hz/7 µsec

RF system frequency: 93-63 MHz

Voltage: 10 kV

Power: 60 kW





Radiation protection

Test Beam Option (Testing detectors)

 $B_{ragg\ Peak\ Position} \ (p_{rompt\ Photons,\ PGI})$

Proton Computed Tomography (pCT)

Irradiation facility (biology, new materials ...)

pA interactions

Production of radionuclides (¹¹C, ¹⁰C, ¹³N, ¹⁴O, ¹⁵O, . . .)

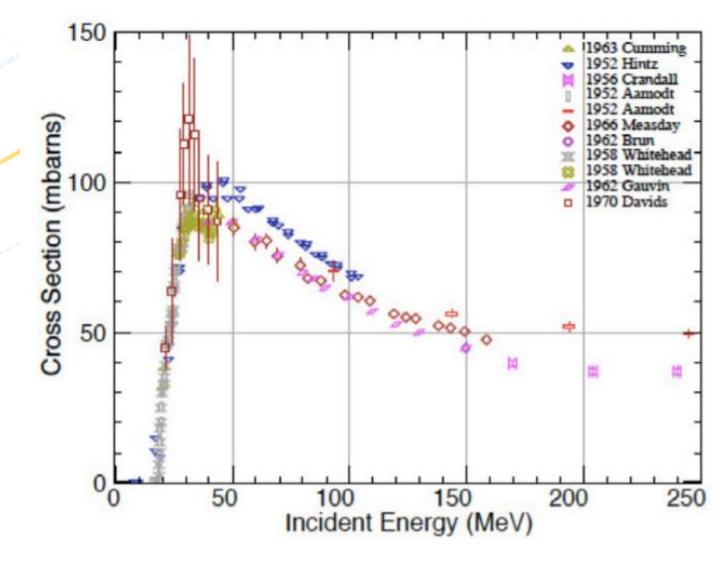
Gamma-spectroscopy

(A = H, C, N, O, Na, K, Ca)



Production of Radioisotopes in the Human Tissue

	Reaction		
С	¹² C(p,pn) ¹¹ C ¹² C(p,p2n) ¹⁰ C	¹¹ C ¹⁰ C	20.33 m 19.29 s
N	¹⁴ N(p,2p2n) ¹¹ C, ¹⁴ N(p,pn) ¹³ N ¹⁴ N(p,n) ¹⁴ O	^{13}N	9.96 m
O	¹⁶ O(p, pn) ¹⁵ O ¹⁶ O(p,3p3n) ¹¹ C ¹⁶ O(p,2p2n) ¹³ N ¹⁶ O(p,p2n) ¹⁴ O ¹⁶ O(p,3p4n) ¹⁰ C	15O 14O	122.24 s 70.61 s
P	$^{31}P(p,pn)^{30}P$	^{30}P	2.50 m
Ca	40 Ca(p,2pn) 38 K	$^{38}\mathrm{K}$	7.64 m





E. Palomares et al. Phys. Med. Biol. 56(2011) 2687 Study of the reliability of the cross-sections used to model the production of PET isotopes with proton beams



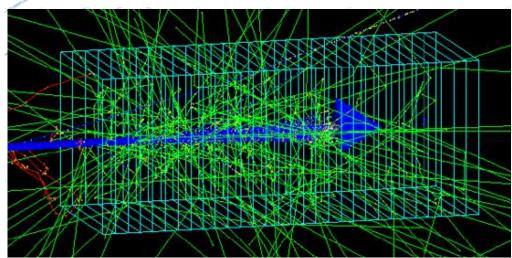
RNTHAACHEN UNIVERSITY

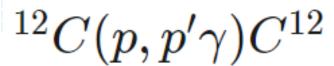




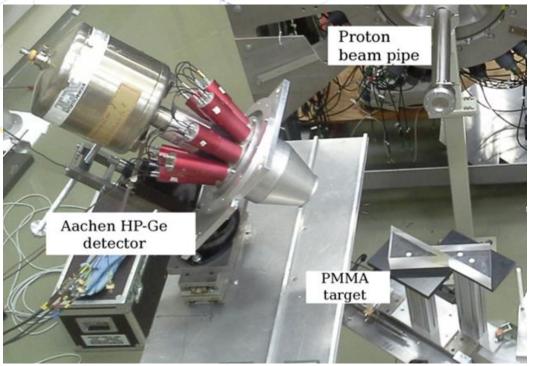


Simulations for proton therapy

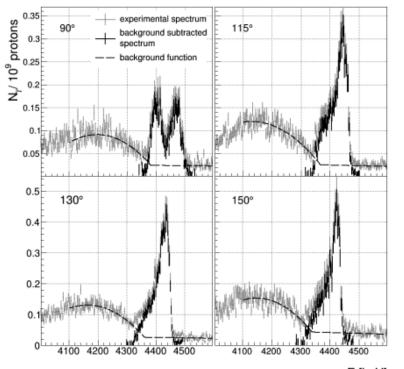




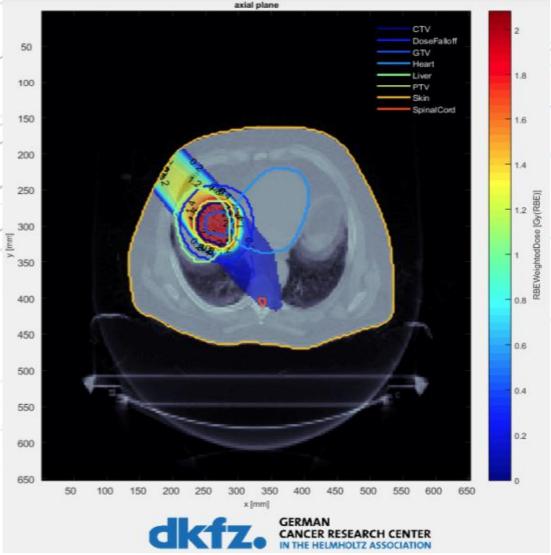








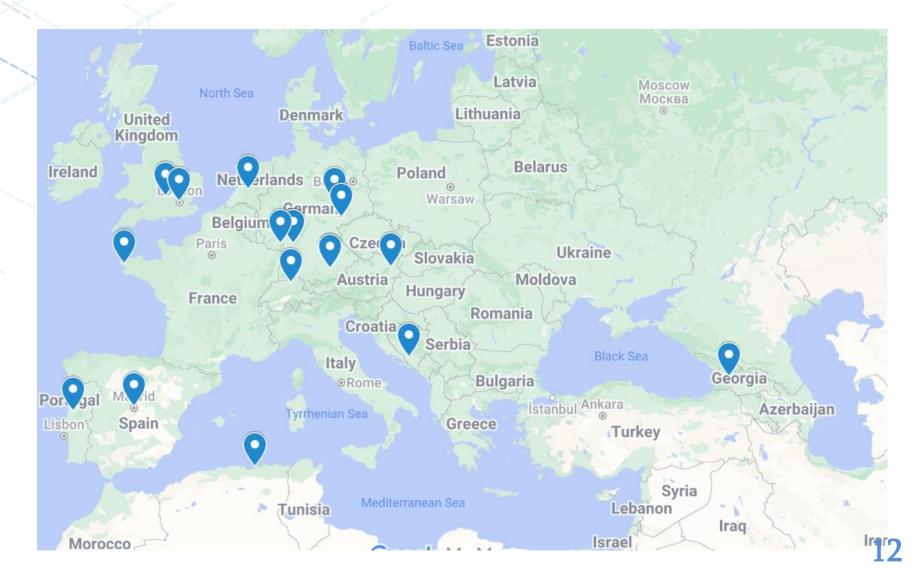
matiac

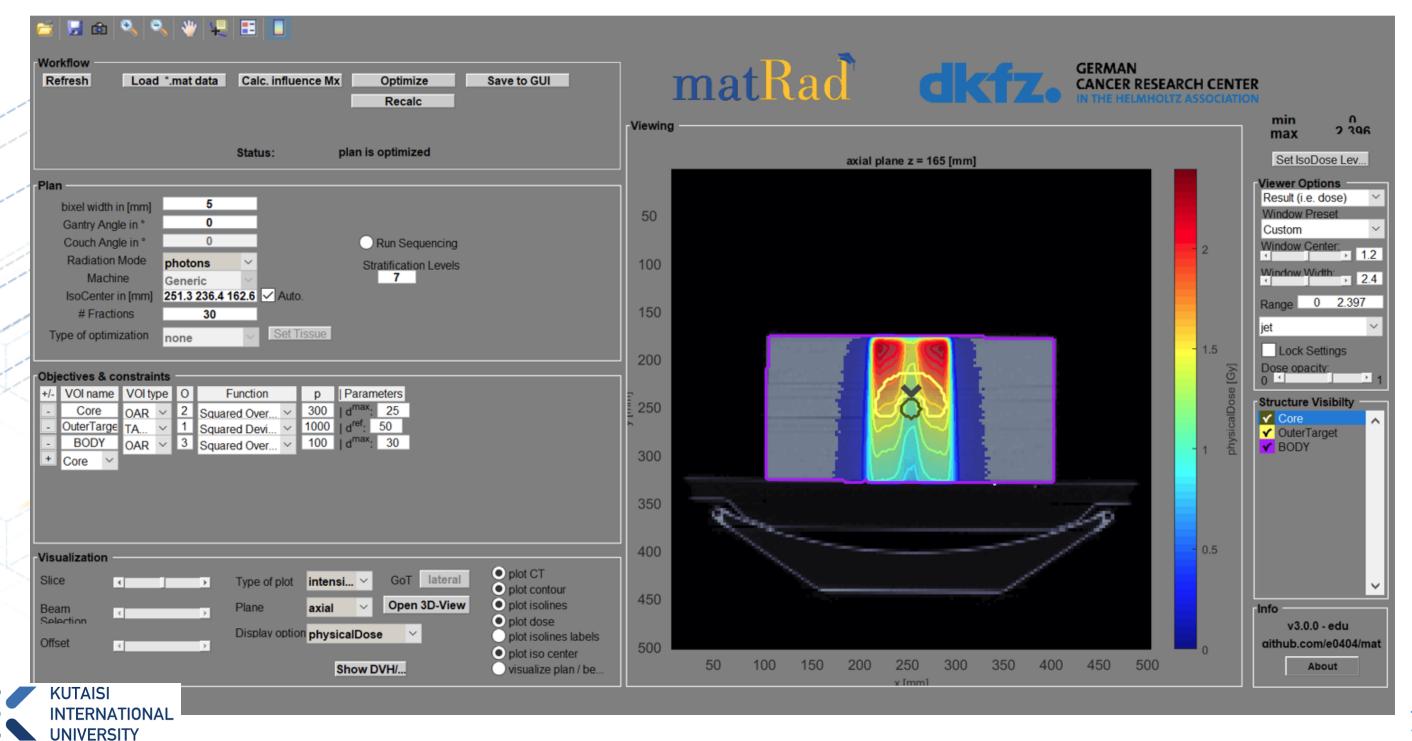


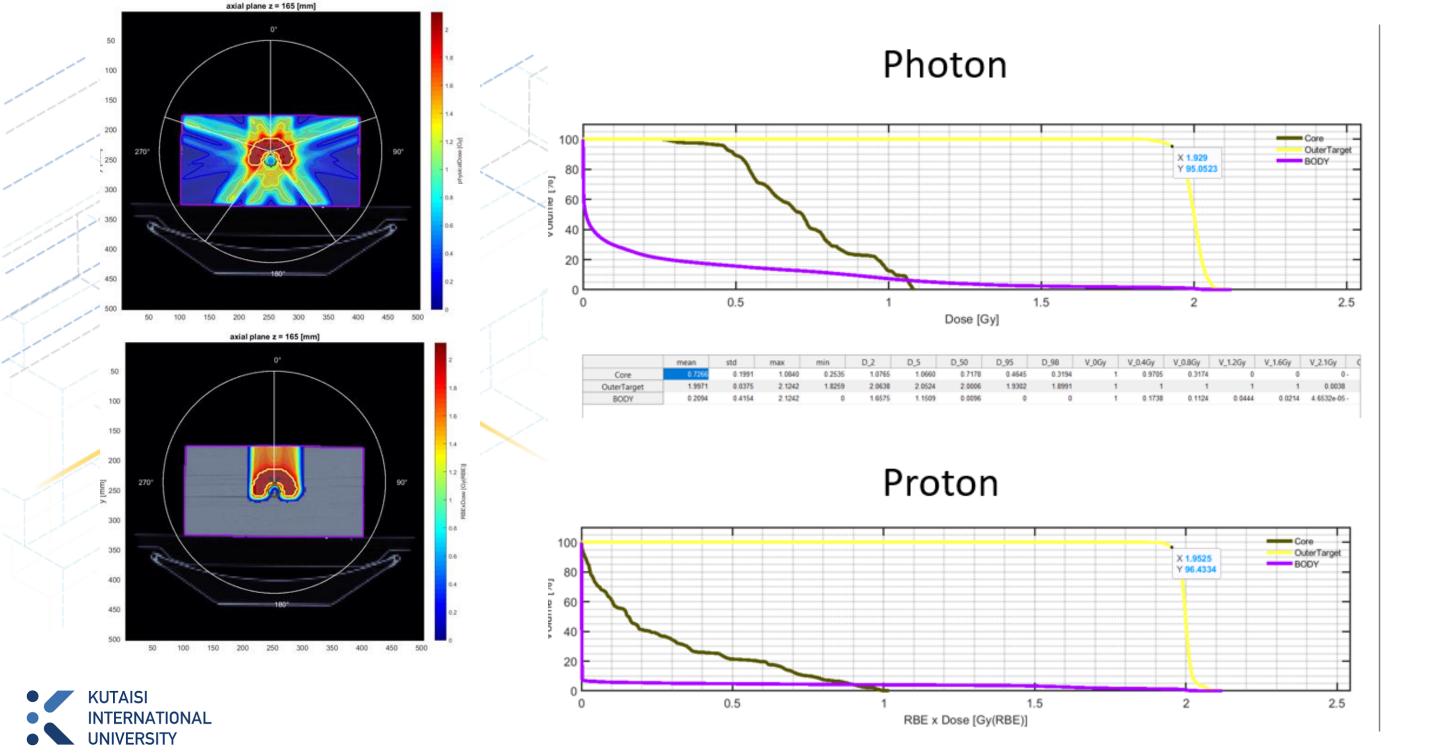


Open source software for radiation treatment planning for photon, proton, and carbon ion therapy. Developed for educational and research purposes.

Entirely written in MATLAB.







Preparation of the Research Infrastructure

















Donation for the ATLAS Collaboration from CERN. Includes scintillator tales developed for the ATLAS HCAL, photodetectors, and electronic components. From Edisher Tskhadaze (KIU/TSU).

KIU HTC and Georgian Research Centers

- Georgian National Academy of Sciences (GNAS)
- High Technology National Center of Georgia
- Ivane Beritashvili Center of Experimental Biomedicine
- Andronikashvili Institute of Physics of the Tbilisi State University



- Chavchanidze Institute of Cybernetics of the Georgian Technical University

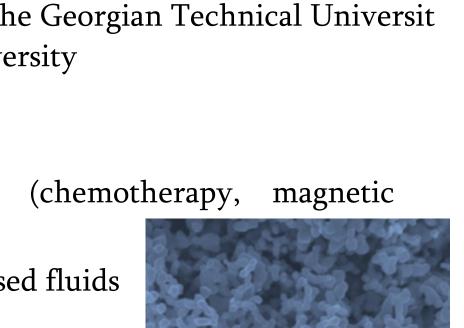
- Combining proton therapy with other treatment modalities (chemotherapy, magnetic

hyperthermia, . . .)

- Improving localization: different kinds of nanomaterials and nano-based fluids
- Additional nuclear reactions:

$$p + {}^{11}B \rightarrow 3\alpha + 8.7 \; MeV$$





CuNi nanoparticles

European Projects and International Cooperation



Infrastructure in Proton International Research

European Research Project that aims to provide a world-leading integrating activity for European research in Proton Beam Therapy (PBT).

EURADOS

The European Radiation Dosimetry Group (EURADOS) is a network of 80 European institutions (Voting Members) and more than 600 scientists.

European Particle Therapy Network (EPTN)

... in response to the anticipated increase in the number of particle therapy centers in Europe. ... The need to cooperate among centers and integrate particles in the framework of clinical research networks.





Kutaisi International University Hadron Therapy Group



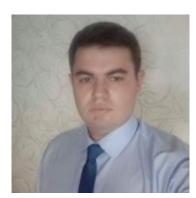
Alexander Tevzadze



Vakhtang Tsagareli



Mariam Abiladze



Vasil Beruashvili



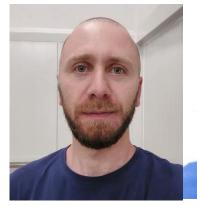
Shalva Bilanishvili



Ioseb Giorgobiani



Abesalom Iashvili



Levan Ivanisgvili



Levan Kankadze



Akali Lomia



Tengiz Mdzinarishvili



Mariam Osepashvili



Revaz Shanidze



Nikoloz Totogashvili



Edisher Tskhadaze



Danke schön!



