FSUE "D.V. Efremov Scientific Research Institute of Electrophysical Apparatus"
(NIIEFA)

Saint-Petersburg, Russia

"ELLUS-6M"
Linear Electron Accelerator for Radiotherapy

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ELLUS-6M

LINEAR ELECTRON ACCELERATOR for RADIOTHERAPY

- **“ELLUS-6M”, a compact medical accelerator of new generation, has been designed and manufactured for radiotherapy by 6MeV photons in the multi-static and arc modes. The gantry of the accelerator can be rotated through ±185^0 and ensures setting accuracies of the irradiator rotation velocity and positioning sufficient for the IMRT mode. The computerized control system is compatible with the treatment planning system and allows upgrading by adding new modules.**

- **To realize the conformal radiotherapy, the following additional medical equipment has been developed: a multi-leaf collimator, a portal vision system for the dose field verification during irradiation and an upgraded treatment table made as a semi-pantograph.**

- **In 2010, it is planned to finish clinical tests of the “ELLUS-6M” accelerator with the additional medical equipment carried out in the N.N. Petrov Scientific Research Oncology Institute, Pesochny, St.Petersburg.**

ELLUS-6M

LINEAR ELECTRON ACCELERATOR for RADIOTHERAPY

The accelerator is intended for conformal beam therapy in multi-static and arc modes in specialized oncological medical institutions.

The “ELLUS-6M” accelerator under technical tests; dose fields are being measured in a water phantom

Irradiator in the main and rotated positions.

Rotation angle is ± 185^0.

Medical Accelerator ELLUS-6M

The accelerator will be supplied to clinics with the given below auxiliary equipment designed and manufactured in NIIEFA:

1) **Multi-leaf collimator intended to form therapy bremsstrahlung fields of required configuration;**
2) **Portal image-based verification system;**
3) **X-ray system for anatomo-topometric preparation and dose field verification.**

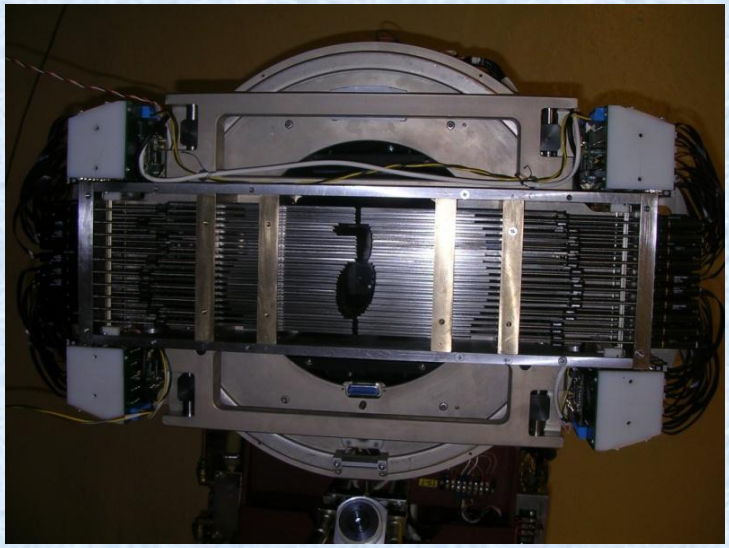
All options are under tests in the N.N. Petrov Institute of Oncology (Sankt-Petersburg)

Technical Parameters	
Energy of accelerated electrons, MeV	6
Max absorbed bremsstrahlung dose rate, Gy/min	up to 5
Field size 1m from target, cm	from 2×2 up to 40×40
Parameters of the gantry rotation around horizontal axis passing through the isocenter: Irradiator rotation angle Rotation velocity, °/min	 ±185° from 36 up 360
Radiation head rotation angle, degrees	180°
Central beam deflection from the isocenter under irradiator rotation, mm, no more than	±1

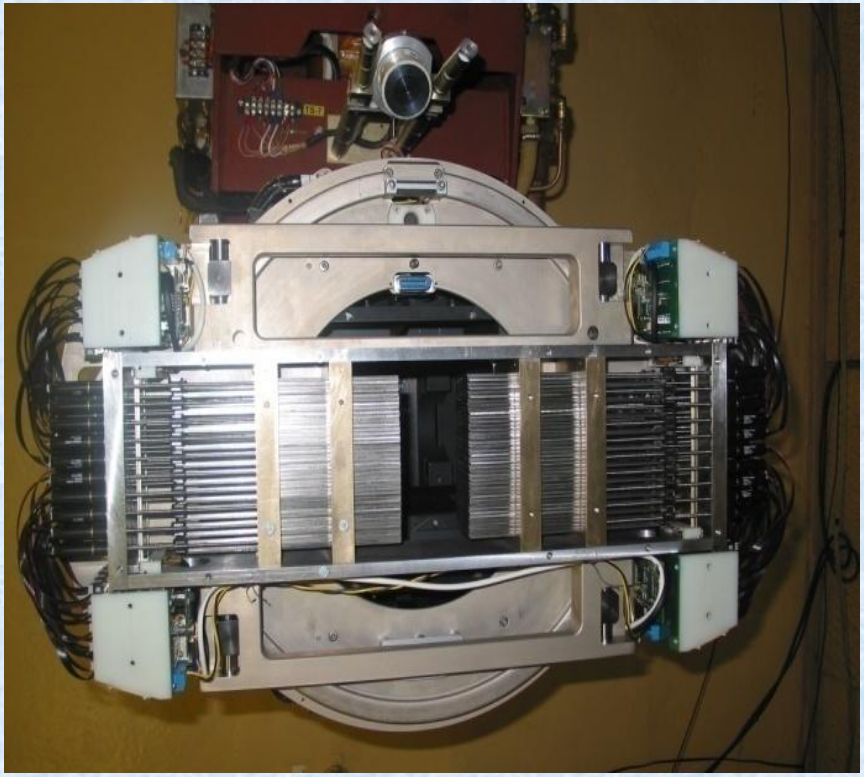
ELLUS-6M
Main Units and Auxiliary Equipment

Patient Treatment on the Accelerator with the Multi-Leaf Collimator and Portal Vision System

Treatment Table



Multi-Leaf Collimator



Multi-Leaf Collimator (MLC)

Beam attenuation when passing through collimator leaves – no more than 5%

Number of collimator leaves – 80 (40 on each side)

Velocity of the leaf projection travel 1m from target – not less than 10 mm/s

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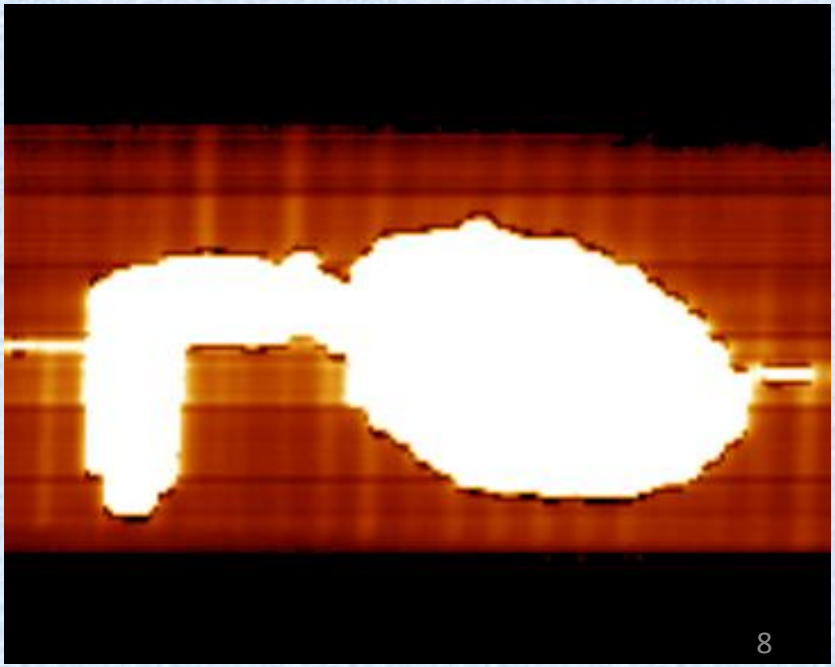
Maximum radiation field size 1 m from target – 20×20 cm

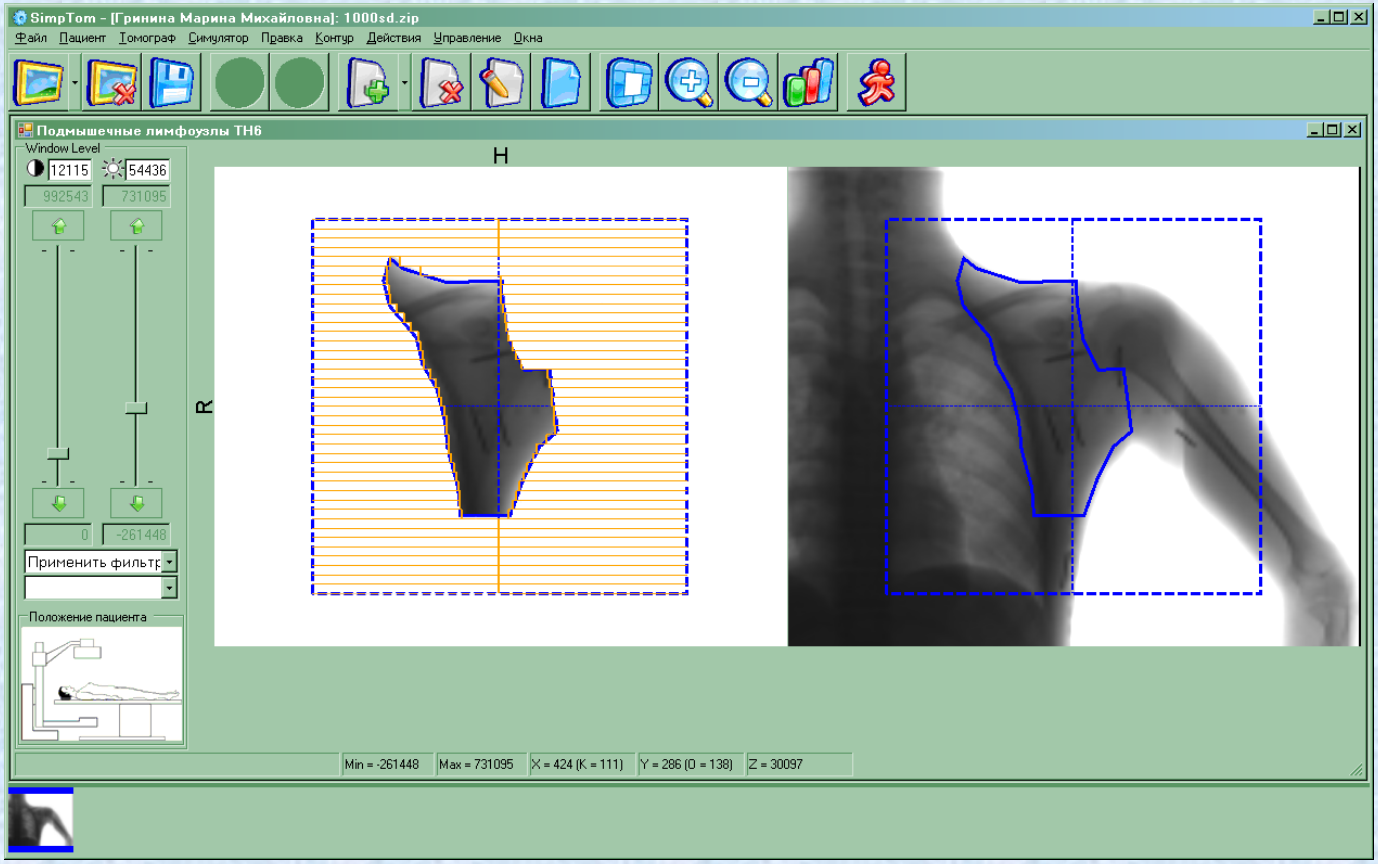
Multi-Leaf Collimator

MLC mounted on the SL-75-5 accelerator



Radiation fields of required configuration formed with the MLC; the field image is obtained by using the portal image-based verification system

Multi-Leaf Collimator



Irregular field chosen for treatment by a radiologist on the basis of a patient body projection image (right) and computations of MLC leaves' coordinates (left)

Treatment Table

Max load-carrying capacity – 200 kg

Table top vertical travel – from 650 up to 1900 mm

Table top transversal travel – ± 200 mm

Table top longitudinal travel – not less than 800 mm

Table top bending in the isocenter transversal plane with a load distributed along the table top – no more than 5 mm

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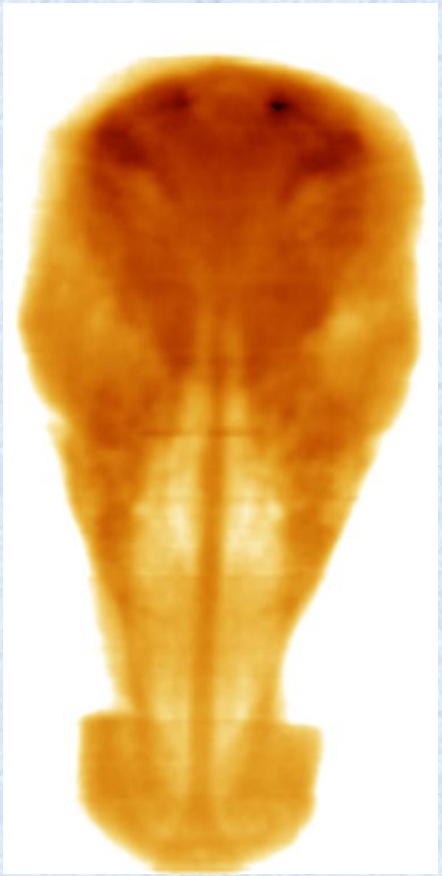
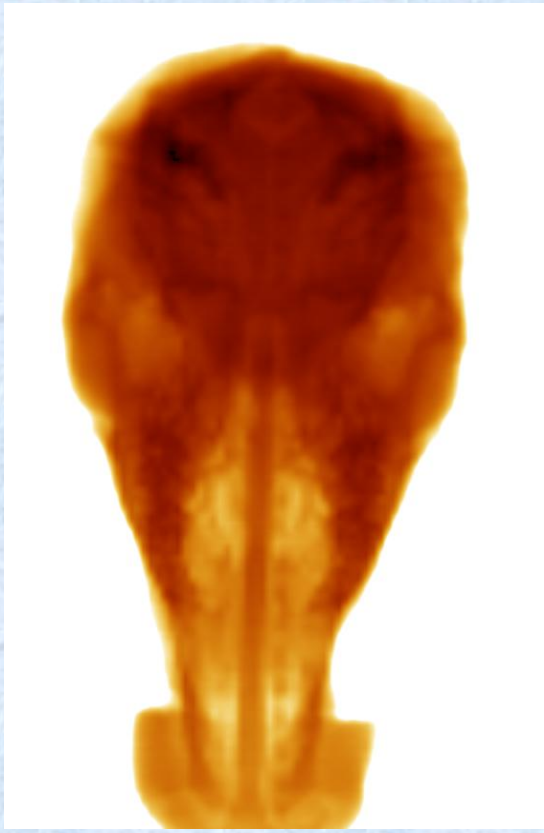
Range of table rotation around vertical axis passing through the isocenter – ± 95^0

Range of velocity variation of the table top linear travels – from 1 up to 50 mm/s

Portal image-based verification system





Calf head as a tested object.
The image obtained with the therapeutic beam of the SL-75-5 accelerator (left) and a longitudinal tomogram obtained on the TSR-100 topometric system (right)

So, the radiotherapeutic system on the basis of the linear electron accelerator “ELLUS-6M” equipped with the multileaf collimator, portal vision system for treatment verification, treatment table and other auxiliary devices allows the main problems of radiotherapy to be successfully solved satisfying the requirements of modern beam therapy techniques.