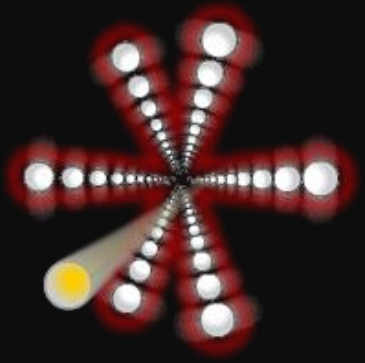


ELECTRON BEAM MODULATION BY 3D PRINTED PLASTIC SAMPLES



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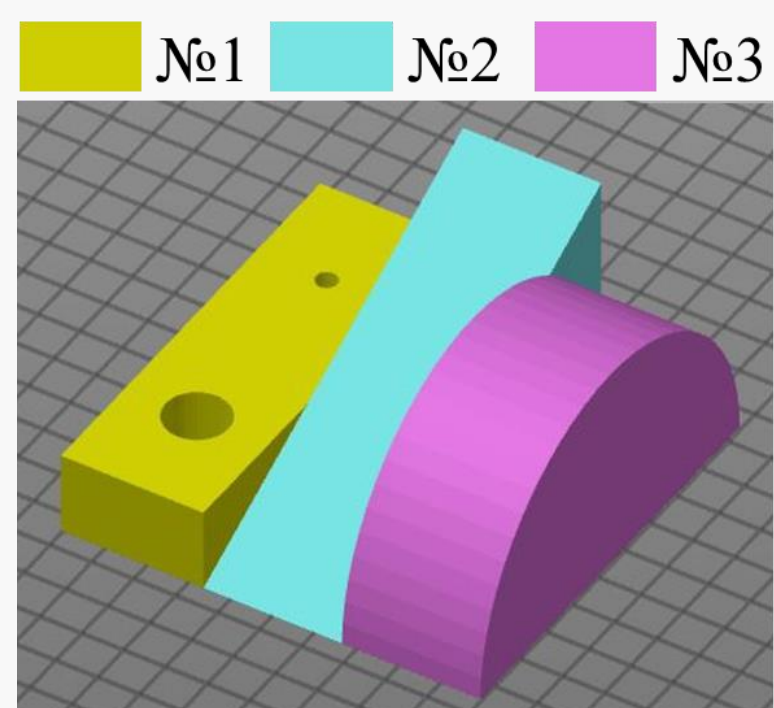
RELEVANCE

Nowadays, modulation of the electron beam depth dose distributions in radiation therapy sessions is provided by sets of tissue equivalent plates or individually shaped thermoplastic boluses. In this study we propose to use 3D printed samples for depth dose distribution modulation in electron radiotherapy. This approach allows producing patient-specific boluses and compensators.



The aim of the study: to prove the possibility of electron beam dose modulation by plastic samples produced with 3D-printing approach.

MATERIALS AND METHODS

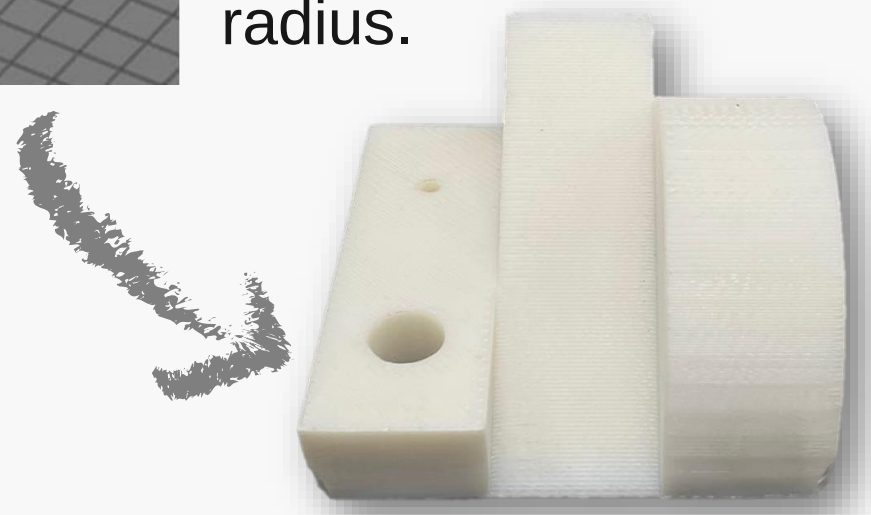


This sample has
three different functional areas:

area No1 for partial beam absorption (2 cm thicknesses) with two collimation holes of 0.5 cm and 1 cm diameters;

area No2 the wedge filter with thickness varied from 5 cm to 0 cm,

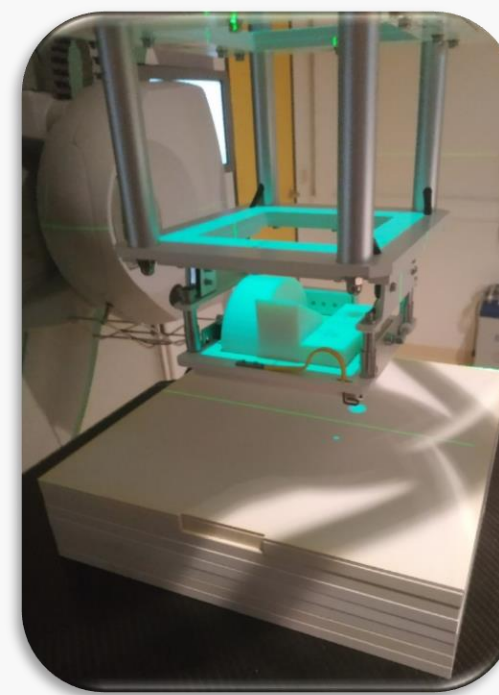
area No3 semicircle-shaped absorber of 5 cm radius.



3D-printed test sample
made of HIPS-plastic

EXPERIMENTAL STUDIES

The experimental study was performed at the Dmitry Rogachev National Research Center of Pediatric Hematology, Oncology and Immunology (Moscow, Russia) using Elekta Synergy medical linear accelerator as a source of 6 and 12 MeV electron beams.

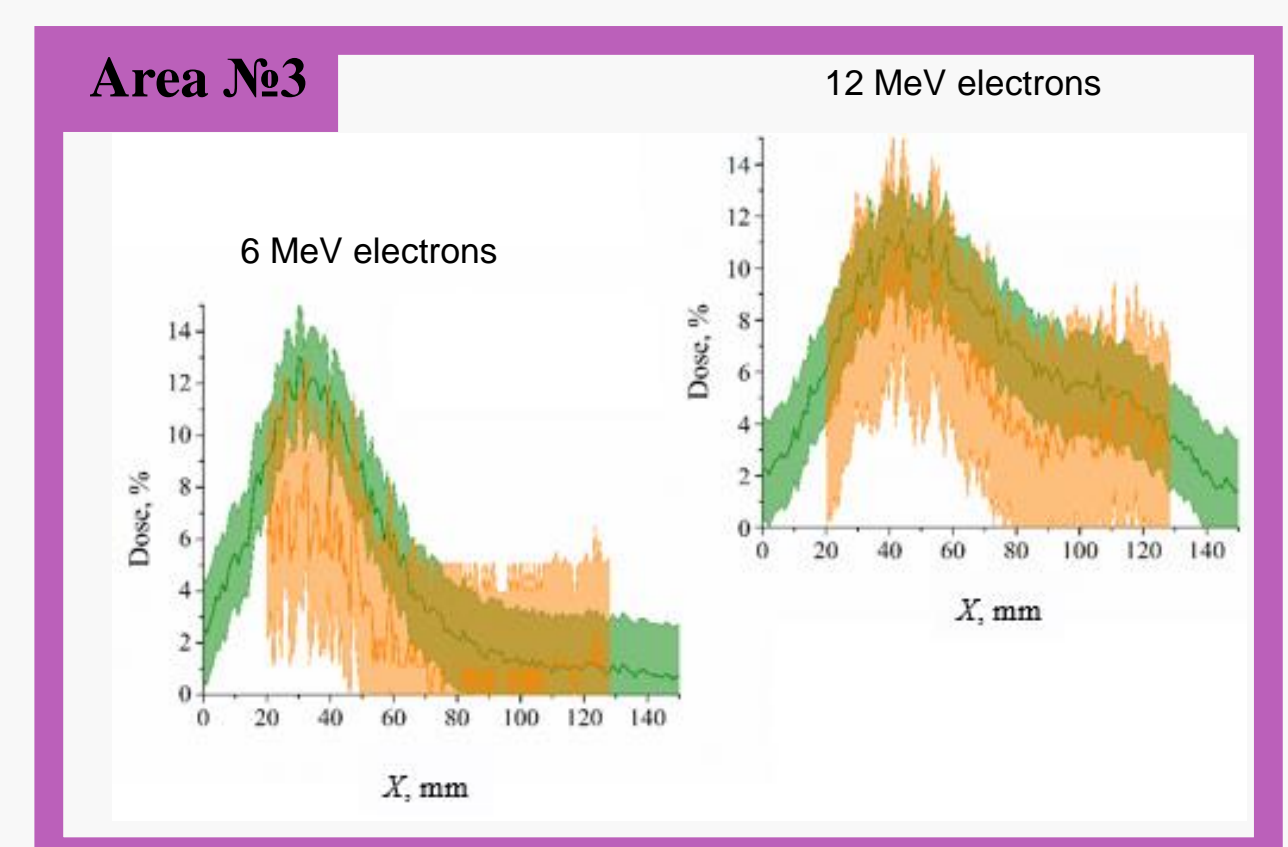
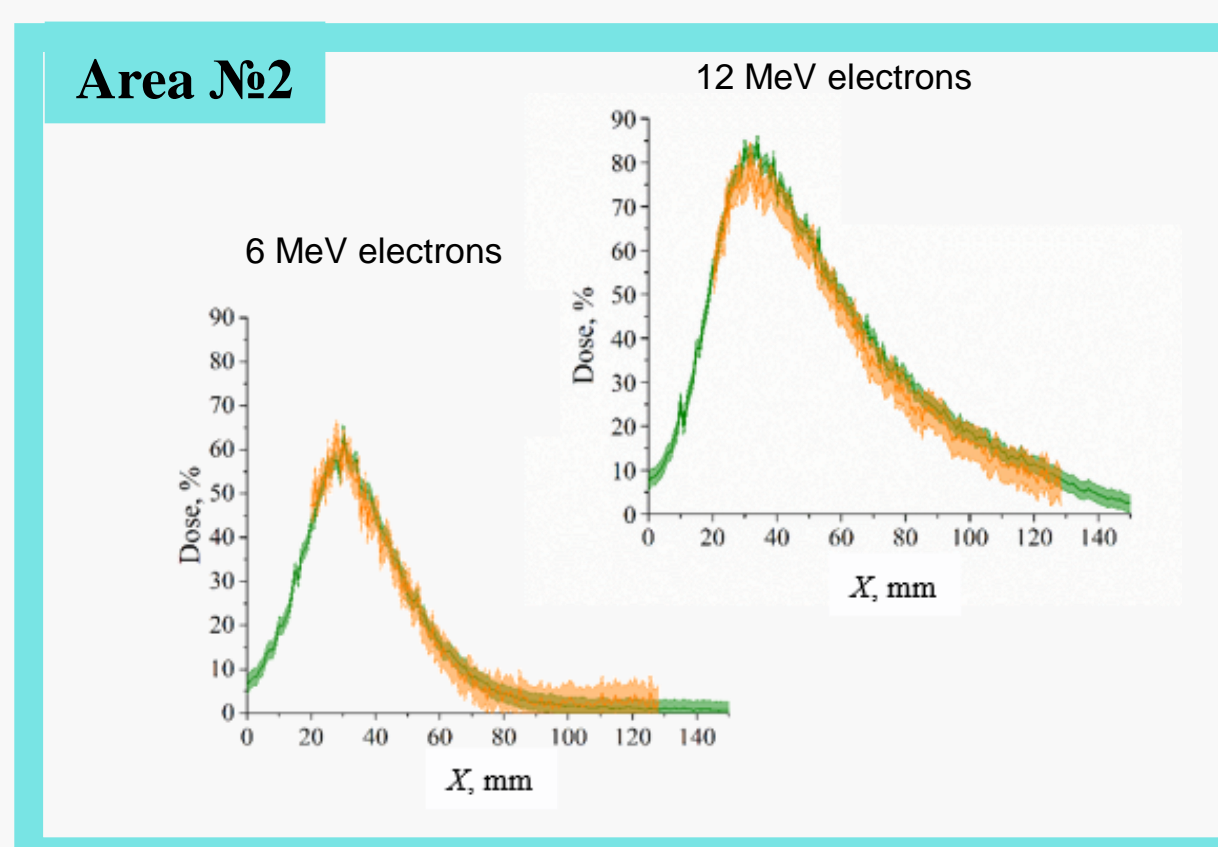
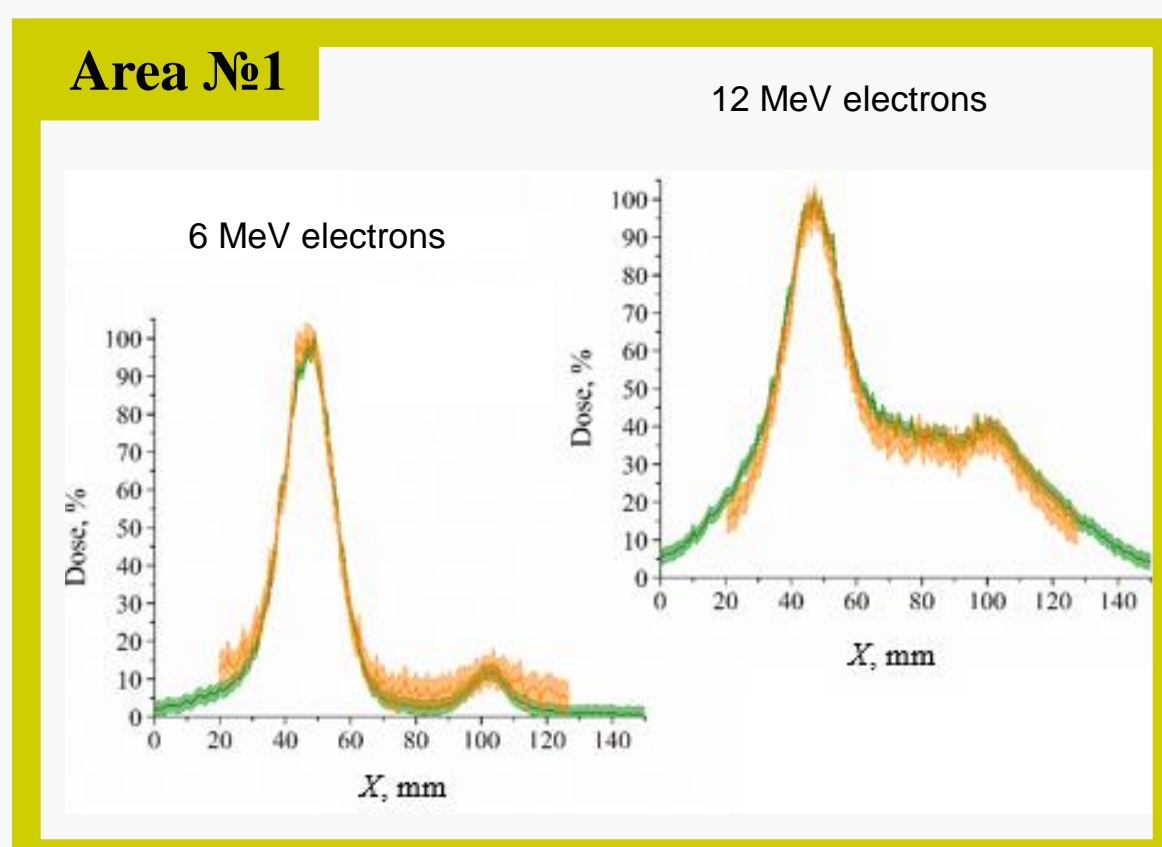
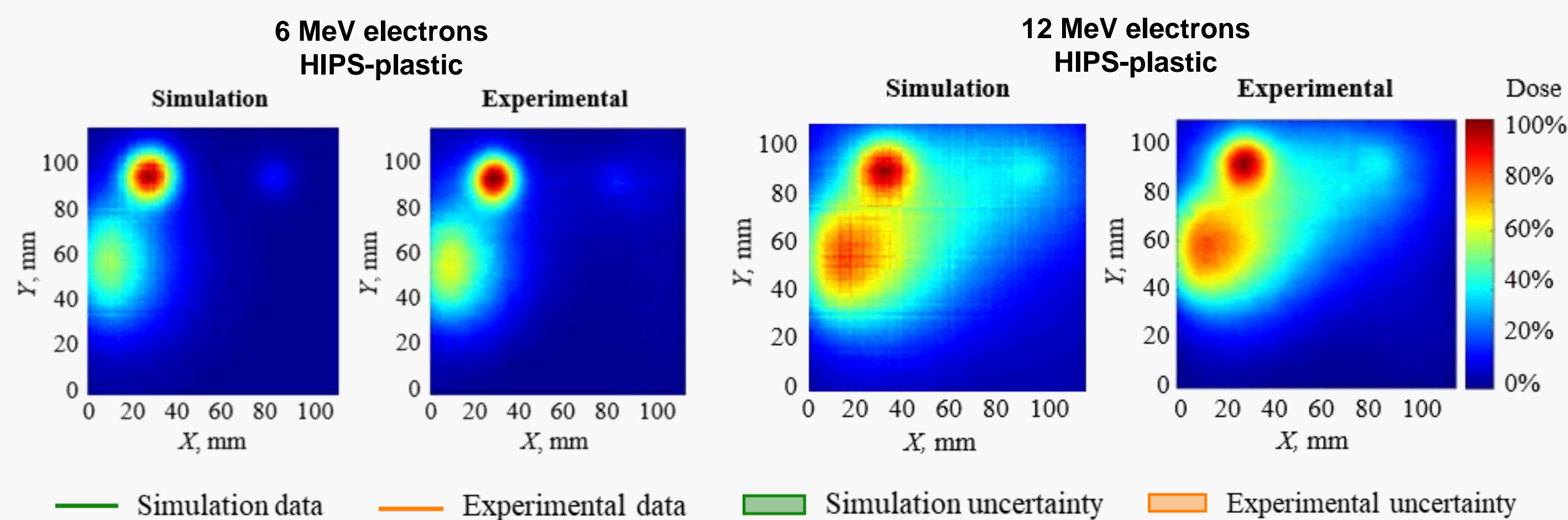


Experimental setup

Experimental studies were performed for **compensator geometry** – when the test sample placed in applicator at the distance from the surface of tissue-equivalent phantom.

Based on the experimental geometry a numerical simulation was carried out by Geant4 toolkit application.

EXPERIMENTAL RESULTS



In this study authors proposed to use polymer compensators made by fused filament fabrication for dose field formation of electron beam generated by clinical linear accelerator. Applicability of this approach was investigated in series of physical experiments and Monte Carlo numerical simulations. Obtained results showed that therapeutic electron beams of 6 MeV and 12 MeV could be modulated effectively using 3D printed polymer compensators.

CONCLUSION

- The study demonstrates the applicability of 3D printed samples for clinical electron beam modulation.
- Developed numerical model for allows estimating of electron beam dose distributions modified by polymer absorbers and choosing compensators' geometrical parameters for the particular task.

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