Contribution ID: **419** Type: **Oral**

Impact of unaccounted doses on the effectiveness of radiation therapy

Tuesday 1 July 2025 18:20 (20 minutes)

Radiation therapy is widely used for the treatment of various types of cancer. However, several factors remain unaccounted for during the treatment planning stage, which may lead to additional dose exposure to the patient.

When medical electron linear accelerators operate at energies above 8 MeV, secondary neutron fluxes are generated. The dose contribution from these secondary neutrons is neither evaluated nor incorporated in current treatment planning systems [1]. To assess this contribution, a computer model of the linac head was developed and verified using measured percent depth dose (PDD) distributions in water. Monte Carlo simulations were performed to obtain the spectra of secondary neutrons and to evaluate their contribution to both absorbed and equivalent doses [1, 3].

Secondary neutrons may also be generated in structural components of proton accelerators and even within the patient's body during proton and hadron therapy. Modeling was carried out to estimate the additional neutron-induced dose from a rotating range modulator wheel of a proton accelerator. Additionally, to assess risks to staff and accompanying persons, neutron radiation parameters were calculated for proton beams interacting with a water phantom.

Another unaccounted factor is distortion in MR imaging, which can lead to discrepancies between the delivered and planned radiation therapy [2]. Experimental studies were conducted using MRI scanners with magnetic field strengths of 0.5 T and 1.5 T to evaluate image distortions in custom-made phantoms. Based on these MR images, a treatment plan was generated and compared with a plan based on CT imaging, and the resulting unaccounted dose was evaluated.

1. Chernyaev, A., Belikhin, M., Lykova, E., & Shcherbakov, A. (2023). GEANT4 Simulation of Photoneutron Spectrum from Medical Linear Accelerator. Quantum Beam Science, 7(3),27. https://doi.org/10.3390/qubs7030027
2. Lykova, E. N., Shcherbakov, A.A., Strelkovskaya, A. P., et al. (2024). Experimental Evaluation of MRI Image Distortion for Radiation Therapy Planning. Bulletin of Moscow University. Series 3: Physics. Astronomy, 79(4), 2440703. (In Russian)
3. Chernyaev, A. P., Lykova, E. N., & Shcherbakov, A. A. (2023). Contribution of Secondary Particles to Absorbed Dose Formation During Radiation Therapy. Russian Nanotechnologies, 18(4), 540–546. https://doi.org/10.56304/S1992722323040052 (In Russian)

Primary author: SHCHERBAKOV, Alexey (Lomonosov Moscow State University)

Co-authors: Dr LYKOVA, Ekaterina (Lomonosov Moscow State University); Dr STUDENIKIN, Felix (Lomonosov Moscow State University); Prof. CHERNYAEV, Aleksandr (Lomonosov Moscow State University)

Presenter: SHCHERBAKOV, Alexey (Lomonosov Moscow State University)

Session Classification: 7. Nuclear medicine

Track Classification: Section 7. Nuclear medicine.