Contribution ID: **225** Type: **Oral talk (15 min + 5 min questions)**

OPTIMIZATION OF OPERATING MODES OF MEDICAL SYNCHROTRON FOR PROTON IMAGING APPLICATION

Proton therapy is one of the most developing forms of radiation therapy [1]. The release of most of the proton energy and, consequently, the maximum damage to biological tissues occurs in the immediate vicinity of the region where the proton beam stops. The range of protons in the patient's body must be predicted with submillimeter accuracy to maximize the physical benefits. In current clinical practice, radiation planning for proton therapy is done using an X-Ray computed tomography (CT) data of the patient. The use of X-Ray CT for proton treatment planning requires software that uses empirically derived calibration functions specific to each scanner. The process of converting the Hounsfield units obtained from the CT into the relative stopping power of protons leads to an uncertainty in the path of particles in the patient's body. Thus, the best solution would be to use proton imaging, a method in which the relative stopping power of the proton beam is reconstructed directly.

Proton imaging requires, firstly, a higher energy of the proton beam, and secondly, lower intensities of the output by the beam than those used for therapy. However, existing proton medical facilities do not fit these requirements. As part of this research work, to develop new modes, we used the synchrotron of Prometheus proton therapy complex [2]. The main feature of the facility is the ability to extract a proton beam in the range of 30-330 MeV. The limiting energy of the extracted beam is sufficient to carry out the procedure of proton imaging of the whole body of the patient without any restrictions. Currently, the standard intensity of the extracted proton beam is 2×109 protons/s.

There is no implemented solution that satisfies the requirement of a low intensity of the extracted proton beam specifically for imaging purposes. The use of therapeutic intensities in diagnostics will harm healthy tissues. In the present study new mode of operation of a Prometheus synchrotron with ultra-low intensity extraction and methods for control of low intensity proton beams have been developed. Proposals have been formulated for modifying proton therapy complexes based on this synchrotron to implement the proton imaging. The mode being developed will allow developing the research capabilities that can be provided by the Prometheus synchrotron.

1. A.P. Chernyaev et. al., Proton Accelerators for Radiation Therapy, Medical Radiology and radiation safety. 2, 1-22 (2019).
2. A.A. Pryanichnikov, V.V. Sokunov, A.E. Shemyakov, Some Results of the Clinical Use of the Proton Therapy Complex "Prometheus". Phys. Part. Nuclei Lett. 15, 981–985 (2018).

The speaker is a student or young scientist

Yes

Section

1. Design and development of charged particle accelerators and ionizing radiation sources

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Session Classification: Design and development of charged particle accelerators and ionizing radiation sources