Contribution ID: **226** Type: **Oral talk (15 min + 5 min questions)**

NMR-BASED INJECTION FIELD MEASUREMENT SYSTEM FOR MEDICAL PROTON SYNCHROTRON

Friday, 15 July 2022 15:00 (20 minutes)

One of the main processes in a proton synchrotron is capture of particles during injection. For successful capture, it is necessary to measure the magnetic field in the orbit with high accuracy. Widely used Hall sensors have many disadvantages: not very high precision and long-term stability, low radiation resistance, angular dependence and etc. All these cause difficulties in setting of the synchrotron and reduce the stability of its operation, which is especially important for medical accelerators. Therefore, the development of new methods for control of the injection field, will improve the stability of medical synchrotrons and reduce the treatment time [1].
The purpose of this work is to develop a high-precision NMR-based system for measuring and controlling the injection magnetic field for the medical proton synchrotron [2].
The developed system is based on a pulsed proton NMR-gaussmeter. The magnetic field measurement is made by measuring the frequency of spin echoes after 180-degree pulses in Carr-Purcell-Meiboom-Gill sequence. The measuring probe is installed in the vacuum chamber of the synchrotron in close proximity to the injection channel. The NMR-gaussmeter is built on a modern electronic element base. Control, frequency measurement and data transfer are realized by high-speed ARM-microcontroller. The NMR-gaussmeter is configured and controlled using PC-software designed in Lab Windows CVI.
The measuring probe provides an NMR-signal from the quasi-constant synchrotron's magnetic field of about ≈1000 Gs (corresponding to proton injection energy of ≈1 MeV) with the possibility of digital tuning of the resonant frequency in the range of ±50 Gs. The magnetic field is measured with an accuracy of no worse than 0.1 Gs. The measurement time is 20 ms. The signal-to-noise radio is at least 5.
The developed system makes it possible to measure the injection magnetic field in real time directly in the acceleration cycle and to ensure the stable capture of particles.

1. Chernyaev A.P., Klenov G.I., Bushmanov A.Y., Pryanichnikov A.A., Belikhin M.A., Lykova E.N. Proton Accelerators for Radiation Therapy // Medical Radiology and radiation safety . 2019. no. 2. pp. 11-22.
2. A.A. Pryanichnikov, V.V. Sokunov, A.E. Shemyakov, Some Results of the Clinical Use of the Proton Therapy Complex «Prometheus», Physics of Particles and Nuclei Letters, 2018, Vol. 15 no. 7., P.981-985.

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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