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Trajectory design for passing through solenoid magnet fringe field and method for adjusting its strongly X-Y coupled phase space for three-dimensional spiral beam injection

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A three-dimensional spiral beam injection scheme has been developed to realize very precise measurement of the muon spin precession frequency in the level of sub-ppm. A 300MeV/c muon beam is injected into a precisely adjusted storage magnet of sub-ppm uniformity by applying medical MRI magnet technologies for J-PARC muon $g-2$ /EDM experiment. A strongly X-Y coupled beam is required to deliver beam into the storage volume via strong radial fringe field volume of solenoid magnet followed by beam injection channel through iron yoke. A dedicated design work of reference trajectory and beam phase space has been made in this injection section. In this presentation, we show evaluated the tolerance for the accuracy of the reference trajectory and the orbital position dependence of the required X-Y coupling parameters and discuss the required accuracy of the transport line placed upstream of the beam-line which includes eight rotating quadrupoles on the 10m of beam transport line*. Additionally, a pair of dedicated magnets called active shield steering magnet will be set at the entrance and the exit of the beam channel to perform orbital correction of the reference trajectory.

Footnotes

*H. Iinuma, et al., Oct 1. 2016 12pp, Published in: Nucl.Instrum.Meth.A 832 (2016) 51-62, <https://doi.org/10.1016/j.nima.2016.05.126>

** H. Iinuma, H. Nakayama, M. Abe, K. Sasaki, and T. Mibe, IEEE Trans. Appl. Supercond., vol. 32, no. 6, pp. 1-5, Sep. 2022. doi:10.1109/TASC.2022.3161889; Hiromi Iinuma et al., Journal of Physics: Conference Series, Volume 2687, Colliders and other Particle Physics Accelerators J. Phys.: Conf. Ser. 2687 022034

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Author: IINUMA, Hiromi (Ibaraki University)

Co-authors: OGAWA, Shinji (High Energy Accelerator Research Organization); SASAKI, Ken-ichi (High Energy Accelerator Research Organization); TAKAYANAGI, Tomohiro (Japan Atomic Energy Agency); ABE, Mitsushi

(Hitachi, Ltd.); OTANI, Masashi (High Energy Accelerator Research Organization); MIBE, Tsutomu (High Energy Accelerator Research Organization); MATSUSHITA, Ryota (The University of Tokyo); YAMANAKA, Takashi (Kyushu University)

Presenter: IINUMA, Hiromi (Ibaraki University)

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