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Four-dimensional phase space control with a strongly X-Y coupled beam for the three-dimensional spiral trajectory with a validation experiment with 0.12 m radius of compact storage ring

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“Three-dimensional spiral beam injection scheme”[1] is a key to realize J-PARC muon g-2/EDM experiment exploring the beyond standard model of elementary physics. Muon is stored in a compact orbit of 0.33 m radius in the super conducting solenoid storage magnet. Appropriate X-Y coupled beam phase space, which strongly coupled radial and solenoid axes, is crucial to inject the beam passing through the static solenoid fringe field. Vertical kicker [2] is also crucial to stabilize beam motion in the storage ring.

In this report, results from the validation experiment [3] which utilize 80 keV electron beam and super compact storage ring with 0.12 m radius orbit are discussed: how well we do with (1) extended Twiss parameters for X-Y coupled beam in accordance with parameter weighting priority, (2) evaluate four-dimensional sigma-matrix of such strongly X-Y coupled beam phase space, (3) control the beam size during the injection, especially along the solenoid-axis. Utilizing several beam diagnostic methods in the storage volume (beam visualization monitor, wire-scan system), we discuss comparison between design and real data, and judge strategic robustness.

Footnotes

[1] H. Iinuma et al., Nucl. Instrum. Meth. Phys. Res. Sect. A, vol. 832, pp. 51–62, 2016.

doi:10.1016/j.nima.2016.05.126

[2] H. Iinuma et al., in Proc. IPAC'23, Venice, Italy, May 2023, pp. 304-307. doi:10.18429/JACoW-IPAC2023-MOPA110

[3] R. Matsushita et al., in Proc. IPAC'23, Venice, Italy, May 2023, pp. 327-330. doi:10.18429/JACoW-IPAC2023-MOPA118

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