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Beam storage monitor to achieve 3-D spiral injection in muon g-2/EDM experiment at J-PARC

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Anomalous magnetic moment ($g-2$) of a muon has been precisely measured by the BNL and FNAL experiments, and there is a discrepancy from the Standard Model prediction. A new measurement of muon $g-2$ is planned at J-PARC based on a different strategy. In the J-PARC experiment, a low emittance 300 MeV muon beam is injected into a compact storage orbit by newly developed 3-D spiral injection scheme*. Injected muons follow a vertical betatron oscillation around the storage orbit. A reduction of betatron oscillation amplitude is a key to achieve the physics goal of this experiment.

This paper presents a new beam profile monitor which measures vertical distribution of stored muons to realize the 3-D spiral injection and to minimize vertical oscillation amplitude. There is a stringent requirement on the effective material budget in order to suppress multiple scattering of muon beam which passes through this monitor for hundred times on every cyclotron period. To achieve this, the monitor utilizes thin scintillating fibers of 0.2 mm diameter are placed with an interval of 10 mm. Reconstruction procedure of vertical beam motion from measured hit distribution will also be discussed.

Footnotes

- H. Iinuma et al., “Three-dimensional spiral injection scheme for $g-2$ /EDM experiment at J-PARC”, Nucl. Instrum. Methods Phys. Res. A, vol. 832, pp. 51–62, 2016.

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