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A Spin Tune Model for Spin Coherence Time Optimisation at Storage Rings

Electric Dipole Moments (EDMs) are very sensitive probes of physics beyond the Standard Model (SM). The JEDI collaboration aims to measure the EDMs of charged particles making use of polarized beams in a storage ring. Such a precision experiment requires the maximization of the Spin Coherence Time (SCT). To identify the working conditions that maximize the SCT, the spin tune of the single particles must be tracked with high precision.

With this experiment in mind, this paper presents a model that accurately tracks the spin tune in a variety of lattices representing existing storage rings as well as a future class of dedicated storage rings. These lattices differ in the combination of electric and magnetic fields used for particle confinement and the number of sextupole families. Furthermore, the parameters used in the model are shown to be directly accessible from beam diagnostics and sextupole field strengths via linear models. Finally, the study explores the implications of the model on the decoherence of a beam stored in such storage rings. The spin tune model outcomes were verified by comparison to those of the brute force searches of configurations with SCTs of more than 1000 seconds. The result was a deeper mathematical understanding of the phenomenon as well as a method to find the setting which optimizes the SCT.

Primary author: SHANKAR, Rahul (University of Ferrara and INFN)

Co-authors: Ms PICCOLI, Anna (University of Ferrara); LENISA, Paolo (University of Ferrara); Prof. LEHRACH, Andreas (RWTH Aachen University and JARA-FAME)

Presenter: SHANKAR, Rahul (University of Ferrara and INFN)

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