Analyzing Historical Polarization and Orbit Data from Relativistic Heavy Ion Collider (RHIC) Runs

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The Relativistic Heavy Ion Collider (RHIC) accelerates heavy ions through electromagnetic fields to relativistic speeds in order to observe the conditions at the beginning of the Universe. The specific pattern of dipole and quadrupole magnets around the ring guide and focus the beam of particles as it travels around RHIC's perimeter. The purpose of this study was to develop python scripts to be able to figure out what correctors are needed to produce a certain design orbit, as well as calculate the imperfection spin resonances of the ions in orbit based off of this design orbit. The code was first tested to model vertical bumps at beam position monitors (bpms) 50-53 and 100-103. The code was then used on the actual design orbit from RHIC by modeling the difference between an ideal orbit and the actual orbit. A pseudoinverse of the spin response matrix mapping kicker strength to orbit was calculated in order to get the correctors needed to create the respective orbit. From these correctors, the imperfection spin resonances for each orbit were calculated.

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