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Spin-Orbit Maps and Electron Spin Dynamics for the Luminosity Upgrade Project at HERA (in English), Alfvén Laboratory, Division of Accelerator Technology, Royal Institute of Technology, Stockholm 2001

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Abstract

HERA is the high energy electron(positron)–proton collider at Deutsches Elektronen–Synchrotron (DESY) in Hamburg. Following eight years of successful running, five of which were with a longitudinally spin polarized electron(positron) beam for the HERMES experiment, the rings have now been modified to increase the luminosity by a factor of about five and spin rotators have been installed for the H1 and ZEUS experiments. The modifications involve nonstandard configurations of overlapping magnetic fields and other aspects which have profound implications for the polarization. This thesis addresses the problem of calculating the polarization in the upgraded machine and the measures needed to maintain the polarization. A central topic is the construction of realistic spin–orbit transport maps for the regions of overlapping fields and their implementation in existing software. This is the first time that calculations with such fields have been possible. Using the upgraded software, calculations are presented for the polarization that can be expected in the upgraded machine and an analysis is made of the contributions to depolarization from the various parts of the machine. It is concluded that about 50 % polarization should be possible. The key issues for tuning the machine are discussed. The last chapter deals with a separate topic, namely how to exploit a simple unitary model of spin motion to describe electron depolarization and thereby expose a misconception appearing in the literature.

Descriptors

electron polarization, luminosity upgrade, overlapping fields, spin rotators, numerical spin–orbit maps, spin diagnostics, unitary model