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Courant-Snyder Parameters in a FODO Beam Line; 4.5 Hill's Equation; 4.6 Courant-Snyder Parameters and Particle Distribution; 5 Coupled Optics; 5.1 Transverse-Longitudinal Coupling; 5.1.1 Dispersion; 5.1.2 Momentum compaction and phase slip; 5.1.3 Synchrotron motion; 5.2 Fully Coupled Motion; 5.3 Dispersion Revisited; 5.4 Examples of Coupled Optics; 5.4.1 Uniform solenoid field; 5.4.2 Flat-beam electron source; 6 Linear Imperfections in Storage Rings; 6.1 The Closed Orbit; 6.2 Dipole Field Errors; 6.3 Quadrupole Alignment Errors 6.4 Focusing Errors 6.5 Beam-Based Alignment of Quadrupoles; 6.6 Coupling Errors; 7 Effects of Synchrotron Radiation; 7.1 Classical Radiation: Radiation Damping; 7.2 Quantum Radiation: Quantum Excitation; 7.3 Equilibrium Emittance and Lattice Design; 7.3.1 Natural emittance in a FODO storage ring; 7.3.2 Double-bend achromat; 7.3.3 TME lattices and multibend achromats; 7.4 Computation of Equilibrium Emittances; 7.5 Synchrotron Radiation and Spin Polarisation; III Single-Particle Nonlinear Dynamics; 8 Examples of Nonlinear Effects in Accelerator Beam Lines 8.1 Longitudinal Dynamics in a Bunch Compressor 8.2 Chromaticity in a Linear FODO Beam Line; 8.3 Chromaticity in Storage Rings; 9 Representations of Transfer Maps; 9.1 Lie Transformations; 9.2 Power Series Map for a Sextupole; 9.3 Mixed-Variable Generating Functions; 10 Symplectic Integrators; 10.1 Splitting Methods; 10.2 Explicit Symplectic Integrator for s-dependent Fields; 10.3 Symplectic Runge-Kutta Integrators; 11 Methods for Analysis of Single-Particle Dynamics; 11.1 A Lie Transformation Example: the -I Transformer; 11.2 Canonical Perturbation Theory 11.2.1 Dipole perturbations: closed orbit distortion

Sommario/riassunto

Particle accelerators are essential tools for scientific research in fields as diverse as high energy physics, materials science and structural biology. They are also widely used in industry and medicine. Producing the optimum design and achieving the best performance for an accelerator depends on a detailed understanding of many (often complex and sometimes subtle) effects that determine the properties and behavior of the particle beam. Beam Dynamics in High Energy Particle Accelerators provides an introduction to the concepts underlying accelerator beam line design and analysis, taking an ap
