

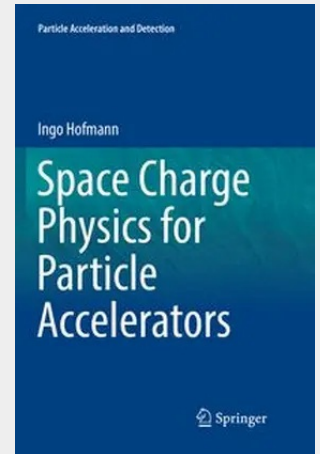
Space Charge Physics for Particle Accelerators

Understanding and controlling the physics of space charge effects in linear and circular proton and ion accelerators are essential to their operation, and to future high-intensity facilities. This book presents the status quo of this field from a theoretical perspective, compares analytical approaches with multi-particle computer simulations and – where available – with experiments. It discusses fundamental concepts of phase space motion, matched beams and modes of perturbation, along with mathematical models of analysis – from envelope to Vlasov-Poisson equations. The main emphasis is on providing a systematic description of incoherent and coherent resonance phenomena; parametric instabilities and sum modes; mismatch and halo; error driven resonances; and emittance exchange due to anisotropy, as well as the role of Landau damping. Their distinctive features are elaborated in the context of numerous sample simulations, and their potential impacts on beam quality degradation and

beam loss are discussed.

The book is intended for advanced beginners in accelerator research, and for experts interested in the mechanisms of direct space charge interaction and their modeling.

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