Introduction to Accelerator Physics, 18 September - 01 October 2022, Kaunas, Lithuania



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Transverse Linear Beam Dynamics II

Monday 19 September 2022 16:30 (1 hour)

The subject of this introductory course is transverse dynamics of charged particle beams in linear approximation. Starting with a discussion of the most important types of magnets and defining their multipole strengths, the linearised equations of motion of charged particles in static magnetic fields are derived using an orthogonal reference frame following the design orbit. Analytical solutions are determined for linear elements of a typical beam transfer line(drift, dipole and quadrupole magnets), and stepwise combined by introducing the matrix formalism in which each element's contribution is represented by a single transfer matrix. Application of this formalism allows to calculate single particle's trajectories in linear approximation. After introducing the beamemittance as the area occupied by a particle beam in phase space, a lineartreatment of transverse beam dynamics based on appropriately defined opticalfunctions is introduced. The formalism is applied to the concepts of both weakand strong focusing, in particular discussing the properties of the widely-used FODO cell. Specific characteristics of transverse beam dynamics in periodicsystems like circular accelerators are studied in detail, emphazising the effectsof linear field errors on orbit stability and introducing the phenomena of opti-cal resonances. Finally, the dynamics of off-momentum particles is presented, introducing dispersion functions and explaining effects like chromaticity.

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