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Particle motion in Hamiltonian Formalism I

Wednesday 1 October 2025 17:25 (1 hour)

The purpose of this lecture is to introduce the Hamiltonian formalism of theoretical mechanics for analysing motion in generic linear and non-linear dynamical systems, including particle accelerators.

This framework allows the derivation and integration of equations of motion, in order to describe the particle trajectory evolution with respect to time.

Starting with the relativistic Hamiltonian of particles in E/M fields and a series of canonical (or symplectic) transformations and approximations, the accelerator ring Hamiltonian is derived. Thereby, introductory concepts of beam dynamics such as invariants and transport matrices are revisited and extended towards generic concepts such as action-angle variables and symplectic maps.

Thereby, the ground is prepared for the advanced methods and tools used for studying non-linear motion in particle accelerators.

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