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Non Linear Dynamics - Methods and Tools I

Wednesday 20 November 2024 14:30 (1 hour)

The goal of this lecture is to present the contemporary methods and numerical tools of non-linear dynamical systems in order to analyse the motion in particle accelerators. After a short introduction to non-linear effects and their impact to beam performance, the lecture will briefly review elements of classical mechanics, essential for the study of non-linear dynamics, including the Lagrangian and Hamiltonian formalism, canonical transformation and simplicity. Starting from the relativistic Hamiltonian for E/M fields, elements of canonical perturbation theory will be presented, showing its limitation, for particle accelerators. In this respect, concepts of linear and non-linear beam transport will be introduced, represented by matrices or more generally maps. The Lie formalism will be employed in order to elaborate and analyse these maps through non-linear normal form construction. An introduction to Truncated Power Series through differential Algebra will be also given, as it is essential for constructing 1-term maps. Finally, elements of symplectic integration will be reviewed.

Presenter: PAPAPHILIPPOU, Yannis (CERN)