On the accuracy of some mapping techniques used to study the magnetic field dynamics in tokamaks

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(Ergodisation of the magnetic field)

The dynamics of magnetic field lines and of charged particles in toroidal chambers are commonly analyzed by solving numerically the dynamical equations. They may also be analyzed using deterministic reduced models i.e. low dimensional discrete time approximations (maps) of the Hamiltonian continuous time models. We report on the accuracy of the latter method, by considering the influence of some components of the mapping technique (implementation of different numerical integrators, different sets of map equations that may be derived using Hamilton-Jacobi method, use of non-canonical coordinates instead of canonical ones). In particular, we study the dynamics of magnetic field lines, using some local criteria expressed in terms of the root mean square of the error in energy or in terms of the error in canonical action, in order to determine the optimum time stepping. A special attention is given to the analysis of the structure of the stochasticity produced by the time discretization.