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The trajectory folding-period method in transmutation analysis

The depletion problem describes the evolution of the nuclide composition over time. The formation of new isotopes can take place due to a natural radioactive decay or due to nuclear reactions induced by neutrons (or other particle). The depletion problem is described by the first-order differential equation known as Bateman equations. This problem can be solved by using the linear chain approach where linear chains represent series of physically occurring nuclide transitions. Transition chains preserve entire quantitative information about transmutation process. Consequently, reaction rates in the depletion problem are time-dependent, therefore the procedure is performed in calculation steps. Doing so, the properties in which transmutation chains are described by transition and passage function after more than one step are lost. The new proposed approach introduces methodology, which extends representation of formed trajectory sets described by transition and passage beyond one step. Trajectories prepared for each computing time step are combined in the process of period folding enabling representation of the nuclide field evolution for broader representation. This procedure responds to the folding-period trajectory. Procedure can be recursively repeated by adding following-on steps obtained through standard solution in order to build time dependent physical evolution of transmutation chains and observe the simulated system with new specific tool. The novel folding-period method is implemented into the Monte Carlo Burnup (MCB) code. The graphical representation of the trajectory period-folding is performed by parent pointer tree data structure.

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