The stochastic transport equation in nuclear physics: advances and applications

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Abstract

Perhaps the most basic equation in both reactor statics and dynamics is the transport equation, describing the neutron population in the system in term of the neutrons birth, death and scattering intensities.

Unlike the classic transport equation (Boltzman equation), where the conservation laws are written in terms of the average neutron population, in the stochastic transport equation conservation laws are written in terms of population distribution and the complete probability theorem. On one hand, this allows us to study higher moments of the neutron population, while on the other, the high complexity of the equations provides as from modeling even simple spatial, energetic and systematic effects. In the talk, I will introduce the stochastic transport equation in the context of nuclear physics, explain why the higher moments are of such importance, and introduce two advances from the recent years: the mathematical modeling of dead time effect, and a multi-energy multi-cell formalism for the stochastic transport equation,

Finally, I will introduce some very natural question arising from the stochastic transport equation, with a surprisingly simple mathematical formalism, which are still open problems.