

Non-linear perturbation of black branes at large D

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The Einstein equations describing the black-brane dynamics both in Minkowski and AdS background were recently recast in the form of coupled diffusion equations in the large- D (imension) limit. Using such results in the literature, we formulate a higher-order perturbation theory of black branes in time domain and present the general form of solutions for arbitrary initial conditions. For illustrative purposes, the solutions up to the first or second order are explicitly written down for several kind of initial conditions, such as a Gaussian wave packet, shock wave, and rather general superposed sinusoidal waves. These could be the first examples describing the non-trivial evolution of black-brane horizons in time domain. In particular, we learn some interesting aspects of black-brane dynamics such as the Gregory-Laflamme (GL) instability and non-equilibrium steady state (NESS). The formalism presented here would be applicable to the analysis of various black branes and their holographically dual field theories.

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