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Massive Inflationary Amplitudes: Differential Equations and Complete Solutions for General Trees

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We construct and solve a complete system of differential equations for general tree-level inflation correlators with an arbitrary number of massive scalar exchanges and time-dependent couplings. Any massive tree correlators can be uniquely fixed by solving this system of equations with appropriate boundary conditions. We take a hybrid approach to solve this system, using the differential equation to get the inhomogeneous solution and the bulk time integrals to determine the homogeneous solution. Altogether, we obtain analytical results for all tree-level massive inflation correlators with generic kinematics, expressed as multivariate hypergeometric series of energy ratios. The result can be neatly organized as a sum of the completely inhomogeneous solution, which we call the massive family tree, and all of its cuts. As simple applications, we provide full analytical expressions for tree correlators with one, two, and three massive exchanges.

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