$\mathbf{O}(D, D)$ completion of the Friedmann equations

Stephen Angus,[*1] Kyoungho Cho, Guilherme Franzmann, Shinji Mukohyama, and Jeong-Hyuck Park

[*]presenting author

[1]Institute of Mathematical Sciences, Ewha Woman's University
52 Ewhayeodae-gil, Seodaemun-gu, Seoul 03760, Republic of Korea
sangus@ewha.ac.kr

Abstract

In string theory the closed-string massless NS-NS sector forms a multiplet of $\mathbf{O}(D, D)$ symmetry. This suggests a unique modification to General Relativity in which the entire NS-NS sector is promoted to stringy graviton fields. Imposing $\mathbf{O}(D, D)$ symmetry fixes the correct couplings to other matter fields uniquely, leading to a generalization of Einstein's equations with an enhanced energy-momentum tensor. Here I will explore the cosmological implications of this '$\mathbf{O}(D, D)$ principle' and show that it yields an enriched framework beyond typical string cosmology, with solutions characterized by two equation-of-state parameters (w, λ) rather than one (w). This includes a line in parameter space where GR-like solutions with constant dilaton are admitted for any w. However, in contrast to GR, neither an $\mathbf{O}(D, D)$-symmetric cosmological constant nor a scalar field with positive energy density gives rise to a de Sitter solution, suggesting that de Sitter may simply be an artefact of GR and belong to the swampland. When taken seriously, the $\mathbf{O}(D, D)$ principle rules out many previous approaches to string cosmology, restricting it to an '$\mathbf{O}(D, D)$-world' of possibilities.