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Dynamics of Scalar-Field Quintom Cosmological Models

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We present a comprehensive dynamical analysis of scalar-field Quintom cosmological models,focusing on scenarios with exponential potentials and both quintessence and phantom compo nents. These models accommodate transitions across the phantom divide ($w = -1$), permittingrich cosmological behavior including multiple inflationary epochs and bouncing solutions. Em ploying a compact phase-space formulation, we identify critical points, classify their stability,and explore their physical interpretations–such as attractors linked to inflation and non-singular bouncing trajectories. We also incorporate spatial curvature and demonstrate the robustness of inflationary solutions under its influence. Linear perturbation theory is developed within theNewtonian gauge using gauge-invariant variables, enabling us to analyze the evolution of escalar perturbations in an extended phase space. This framework enhances predictive power for struc ture formation and cosmic history. Our findings provide foundational insights for constructing viable models of early- and late-time cosmic acceleration, grounded in scalar field dynamics [1, 2]. References

[1] Jonathan Tot, Balkar Yildirim, Alan Coley, Genly Leon, The dynamics of scalar field Quintom cosmological models, Phys. Dark Univ. 39 (2023), 101155.

[2] Genly Leon, Alan Coley, Jonathan Tot, Balkar Yildirim, AndronikosPaliathanasis, Global dynamics of two models for Quintom Friedman–Lemaˆıtre–Robertson–Walker universes, Phys. Dark Univ. 45 (2024) 101503.

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