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Evolution of Anomalous Chemical Composition in Primordial High-Temperature Regions Confined Within Domain Walls

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This study investigates thermonuclear nucleosynthesis within hypothetical hot primordial regions of the early Universe, which are separated from the Hubble expansion and confined within domain walls. We present a numerical model simulating the evolution of nuclide concentrations at constant extreme temperatures exceeding 5 MeV. Under these conditions, the confinement of neutrinos makes weak interaction reactions reversible, leading to rapid local thermodynamic equilibrium and stabilizing both the temperature and the proton-to-neutron ratio. Our results demonstrate the formation of a unique, anomalous hydrogenless chemical composition, as practically all free nucleons efficiently bind into helium-4 (^4He). Subsequently, the saturation of the plasma with helium-4 triggers an intense, explosive synthesis of carbon-12 (^{12}C) via the triple-alpha process. Unlike standard stellar nucleosynthesis, this high-energy process is not solely dominated by the Hoyle resonance and is instead accurately described by the generalized Caughlan-Fowler formula, which accounts for highly excited states of the carbon nucleus. Finally, the strict conservation of the total baryon number throughout the calculations verifies the physical accuracy and stability of the applied numerical methodology.

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