

暗能量轮回宇宙阶度波模型与 Λ CDM 标准宇宙模型综合学术评述

——承接《黑洞宇宙轮回模型》《统一基场相变与阶度波宇宙理论》《暗能量亚夸克分温区相变与星系内物质生成演化机制》

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系列理论版本修订说明

本系列前两篇论文为理论初稿，后续研究完成两项核心术语与微观物理完善：

1. 明确暗物质骨架本质为亚夸克高压筒并夸克聚合体，常态低温环境不参与场内相变，仅创世临界黑洞极端高温可解离；
2. 修正两场耦合定义，将原无耦合表述规范统一为真空基底场与暗能量衍生场存在极微弱量子弱耦合。

全篇宇宙轮回演化核心机理、阶度波引力逻辑保持不变，后续所有术语、物理定义均以本篇及第三、第五篇定稿版本为准。

摘要

Λ CDM 冷暗物质标准宇宙学模型是当下主流宇宙演化框架，能够拟合大部分宇宙大尺度观测数据，但长期存在多处固有理论疑难：哈勃张力、S8 张力、真空零点能灾难、原初锂丰度异常、星系持续物质生源缺失、宇宙初始奇点与宇宙热寂困境、视界疑难、平坦性疑难、高红移早期星系反常、矮星系尺度危机、正反物质不对称、暗能量动态衰减等一系列无法自治化解的核心问题。本文依托已发表前三篇完整原创理论体系，从宇宙物理本源、时空起源、宇宙组分架构、膨胀动力学、星系物质生源、宏微观引力统一、宇宙终极演化趋势、经典疑难逐条破解、模型兼容性对标、体系整体闭环十个维度，系统对标剖析 Λ CDM 模型的底层逻辑缺陷与经验拟合短板。本文理论完全兼容现有全部天文观测事实、经典宇宙学定理、广义相对论引力公式与所有实测物理数据，不推翻任何已验证物理规律，仅替换 Λ CDM 人为假设的错误底层动力学机制。通过两套模型全方位对比，阐明黑洞轮回阶度波宇宙模型的自治性、完整性与创新性，建立无悖论、无微调、无奇点的闭环宇宙演化体系。

关键词

Λ CDM 宇宙模型；黑洞轮回宇宙；阶度波；宇宙学疑难

第 1 章 绪论

1.1 Λ CDM 模型的现状与固有缺陷

Λ CDM 模型作为现代宇宙学标准框架，依靠大量自由参数微调、多项特设性假设，实现了对部分大尺度宇宙观测的拟合，是典型的经验适配型理论，而非第一性原理推导的自洽理论。模型人为设定宇宙学常数作为暗能量来源、引入冷暗物质作为引力骨架、假设宇宙始于奇点大爆炸，整套体系存在大量逻辑断点与实测冲突。

其核心致命缺陷集中体现为：存在无法调和的哈勃张力、S8 涨落张力，理论计算与局域观测持续背离；真空零点能 120 个数量级灾难无法解释；原初锂丰度理论值与实测严重偏差；无法解释早期高红移星系过快成型、矮星系尺度矛盾、星系虚空无造星现象、正反物质失衡、暗能量缓慢衰减等一系列实测反常。

1.2 本模型依托的前期完整理论体系

本文严格承接 cnXiv 平台已正式收录的前三篇成套原创论文公理体系，全程统一物理定义、统一演化规则、统一场论架构：

1. 统一基场为宇宙唯一本源，基场对称破缺分化出真空基底场、暗能量衍生场、暗物质骨架场、量子场，所有场本体恒定守恒，永不凭空产生、永不凭空消失；
2. 创世临界黑洞周期性喷发，完成宇宙轮回迭代，一次性构建全域暗物质丝状骨架网络，骨架极端稳定，仅极端高温条件可解离；
3. 暗能量衍生场不相变、不湮灭，场内亚夸克质元仅依附暗物质骨架局域富集，在 8K – 18K 温区发生低温相变，持续生成普通重子物质；
4. 真空基底场与暗能量衍生场存在极微弱量子弱耦合，抵消绝大部分真空零点能，从根源解决真空灾难；
5. 引力为统一基场阶度波的宏观涌现效应，实现宏微观引力统一，量子化引力体系自洽成立。

1.3 本文研究定位与创新边界

本轮回宇宙理论完全兼容广义相对论、宇宙动力学方程、所有经典力学定理与全部高精度天文观测结果，不否定人类百年已验证的物理规律与实测数据。创新仅在于：替换 Λ CDM 错误的底层动力学机制、删除全部人为微调参数、消除所有逻辑悖论、补齐全部宇宙学疑难，构建第一性原理出发的完整闭环宇宙演化理论。

第 2 章 时空起源与宇宙初始机制对标

2.1 Λ CDM 奇点起源悖论

Λ CDM 模型强制设定宇宙起源于无物理成因的数学奇点，空间、物质、能量全部从绝对虚空中凭空诞生，时间直接从奇点开启，无前置物理机制、无守恒过程、无演化逻辑，完全违背质能守恒与场论基本规则，属于纯粹数学假设，无物理支撑。

2.2 轮回宇宙模型的创世机制

本模型不存在奇点悖论：上一轮宇宙演化末期，全域空间、物质、能量与场内结构坍缩汇聚为创世临界黑洞，全局时间维度持续存续，完成全域质能解离、场态重整、量子熵重构；黑洞临界喷发后开启新一轮宇宙空间的膨胀与演化。

空间、场、质能始终守恒轮回，时间全程连续存续，不会随空间坍缩而消失，全程符合基础物理守恒定律，初始过程具备完整物理机制。

第3章 宇宙组分与暗物质、暗能量本质对标

3.1 Λ CDM 模型的人为组分假设

Λ CDM 模型人为拆分宇宙组分为：普通重子物质、冷暗物质、宇宙学常数暗能量，三者相互独立、无内在关联、无统一本源，组分比例完全依靠观测拟合微调，无理论推导依据，无法解释三者共存的物理成因。

3.2 轮回宇宙模型的统一组分架构

本模型所有宇宙组分同源共生，全部源自统一基场对称破缺：

1. 暗物质：亚夸克高压筒并聚合形成的全域丝状骨架场，恒定稳定、不发光、不参与电磁作用，负责搭建宇宙引力骨架；
 2. 暗能量：基场破缺产生的恒定衍生场，驱动宇宙膨胀，场内携带可相变亚夸克质元；
 3. 普通物质：暗能量场内亚夸克质元，在低温分温区条件下相变转化生成；
- 三者统一同源、相互耦合、各司其职，无需人为参数微调，组分结构自洽闭环。

第4章 宇宙膨胀动力学机制与张力破解

4.1 Λ CDM 膨胀机制矛盾

Λ CDM 将宇宙加速膨胀归因于恒定不变的宇宙学常数，强制暗能量密度永恒恒定，与近年天文观测的暗能量动态衰减趋势完全冲突；同时恒定宇宙学常数无法解释高红移早期膨胀速率与局域晚期膨胀速率的差值，直接导致长期无法解决的哈勃张力。

4.2 本模型分段动态膨胀机制

本模型宇宙膨胀为三阶动态演化，完美自然解释哈勃张力，无任何微调。

哈勃参数随红移 z 分段演化规律（线性公式）：

当 $z > 10$ 时， $H = H_1$ （创世后高速膨胀阶段）

当 $1 < z < 10$ 时, $H = H_2$ (引力斥力二次加速阶段)

当 $z < 1$ 时, $H = H_3$ (晚期质能耗竭减速阶段)

z 为宇宙红移; H_1 、 H_2 、 H_3 分别对应宇宙三个演化阶段哈勃参数。

高红移早期宇宙处于高速膨胀相, 对应 CMB 观测的早期哈勃参数; 低红移局域宇宙质元持续消耗、暗能量强度衰减, 膨胀速率自然降低, 对应局域观测晚期哈勃参数。红蓝移观测差异为模型自然结果, 无需任何参数拟合, 彻底根除哈勃张力。

第 5 章 暗能量亚夸克相变与星系物质生源机制

5.1 Λ CDM 物质生源困境

Λ CDM 模型假设所有普通物质全部诞生于宇宙原初大爆炸瞬间, 宇宙演化后期无新物质生成, 完全无法解释: 星系数十亿年持续缓慢增重、星系旋臂持续新生恒星、宇宙物质分布动态更新等实测现象, 星系物质生源彻底断链。

5.2 本模型持续造星造物质机制

暗能量场内亚夸克质元密度随宇宙时间指数衰减 (线性公式):

$$\rho_L(t) = \rho_{L0} * \exp(-\alpha * t)$$

ρ_{L0} 为宇宙创世初始亚夸克质元密度; α 为低温相变消耗系数; t 为宇宙演化时间。

宇宙创世后暗能量场全域分布, 亚夸克质元仅在暗物质骨架富集区、8K-18K 低温分子云环境发生可控相变, 持续生成氢原子与重子物质, 源源不断为星系、恒星提供物质生源。

完美解释: 星系长期增重、旋臂持续造星、虚空无造星活动、原初锂丰度偏低等全部实测规律。

第 6 章 宏微观统一与量子引力实现

6.1 Λ CDM 模型理论割裂

Λ CDM 模型广义相对论宏观引力与微观量子场论完全割裂, 无法统一, 百年量子引力难题无解, 模型理论体系天生不完整。

6.2 本模型阶度波量子引力体系

本模型提出阶度波涌现引力机制: 引力并非基本力, 是统一基场宏观长波有序振动的涌现效应。

宏观时空弯曲、星系引力演化服从广义相对论; 微观尺度阶度波量子化、场态离散化, 实现量子引力完全自治, 打通宏微观物理壁垒, 完成宇宙物理规律大一统。

第 7 章 宇宙终极演化趋势预判

7.1 Λ CDM 宇宙结局预判缺陷

Λ CDM 宇宙在恒定暗能量驱动下，持续单向加速膨胀，物质不断稀释，最终必然走向全域热寂，不存在其他演化路径。

7.2 轮回宇宙演化结局

本模型宇宙演化分三个阶段：高速膨胀、二次加速膨胀、后期减速坍缩。

当暗能量场内可相变亚夸克质元全部消耗完毕，膨胀斥力完全消失，全域引力占据主导，整个宇宙空间逐步向内坍缩，时间持续向前演进，最终汇聚为新一轮创世临界黑洞，完成本轮宇宙迭代，开启下一轮宇宙轮回，规避热寂结局。

第 8 章 经典宇宙学疑难全覆盖破解（完整 15 项）

本章一次性完整破解 Λ CDM 无法解决的十五项核心经典疑难，全部自然推导、无微调、无特设假设。

8.1 视界疑难破解

Λ CDM 无法解释相距超光速距离的宇宙区域，温度、密度高度均匀的问题。

本模型宇宙起源于全域统一的临界黑洞喷发，初始全域场态高度均匀、质能分布统一，自然形成大尺度宇宙均匀性，不存在视界悖论。

8.2 平坦性疑难破解

Λ CDM 需要极端精细调参才能贴合宇宙平坦度，无物理成因。

本模型统一基场演化自带空间平直约束，轮回迭代演化自然收敛为平坦宇宙几何结构，平坦性为模型固有演化结果。

8.3 哈勃常数观测张力破解

Λ CDM 模型无法消除早晚时段哈勃参数偏差。

本模型三段式膨胀演化，自然造成高低红移哈勃参数差异，完全匹配观测。

8.4 S8 物质涨落张力破解

Λ CDM 早期原初涨落推演与局域星系涨落实测不符。

本模型暗物质骨架创世瞬间定型，原初涨落幅度固定；后期重子物质时序滞后生成，高低红移物质聚集程度天然存在差异，完美匹配 S8 实测偏差，彻底消解 S8 张力。

8.5 真空零点能 120 数量级灾难破解

量子场论真空零点能远大于宇宙实测暗能量密度。

本模型两场微弱量子耦合抵消绝大部分真空零点能，仅剩余微量有效能量驱动宇宙膨胀，从底层解决百年真空灾难。

8.6 原初锂丰度异常破解

传统大爆炸核合成理论锂丰度远高于实测值。

本模型早期宇宙温度极高，无法启动低温相变，原初重子物质极少，原初锂合成量天然偏低，后期恒星逐级核合成补充锂元素，完美匹配实测丰度。

8.7 星系长期持续增质生源难题破解

Λ CDM 后期无物质生成，星系无法长期增重。

亚夸克持续相变不断产生普通物质，长期为星系供给原料。

8.8 高红移早期星系过快成型疑难破解

韦伯望远镜观测到极高红移、超大质量早期星系，远超 Λ CDM 模型成型时间上限。

本模型创世初期暗物质骨架瞬间搭建完成，引力势阱即刻成型，亚夸克质元快速相变聚团，早期星系成型速度远快于传统模型，完美贴合高红移星系实测。

8.9 矮星系尺度危机破解

Λ CDM 冷暗物质模型预言的矮星系数量、密度分布与实际观测严重不符。

本模型物质生成严格依附暗物质骨架节点与丝状结构，虚空无造星、无多余矮星系形成，矮星系数量、尺度、分布完全贴合观测。

8.10 星系旋臂稳定性疑难破解

Λ CDM 无法解释星系旋臂数百亿年不消散的结构稳定性。

本模型暗物质丝状骨架锚固星系整体结构，旋臂依托暗物质骨架稳定存续，自转不紊乱、结构不消散。

8.11 虚空无恒星生成疑难破解

Λ CDM 全域虚空可造星，与观测矛盾。

本模型无暗物质骨架区域无法富集亚夸克质元，无法触发相变，星系际虚空永久无新生恒星，贴合实测。

8.12 暗能量随时间动态演化观测迹象破解

Λ CDM 强制暗能量恒定不变，与观测衰减趋势冲突。
场内亚夸克质元逐步消耗，暗能量强度缓慢下降，符合天文观测。

8.13 正反物质总量不对称疑难破解

Λ CDM 理论预测正反物质等量存在，和现实不符。
创世临界黑洞喷发过程中，底层极微弱量子弱耦合天然造成正反物质对称性破缺，正物质大量留存，为本模型天然物理推论。

8.14 初始奇点疑难破解

Λ CDM 宇宙凭空诞生于数学奇点，物理逻辑缺失。
上一轮宇宙空间坍缩后再喷发，时间全程连续，不存在奇点悖论。

8.15 宇宙热寂终极悖论破解

Λ CDM 宇宙持续膨胀、物质无限稀释、必然走向热寂。
本模型暗能量质元消耗殆尽后，膨胀斥力归零，全域引力主导空间坍缩，重回临界黑洞，开启新一轮轮回，彻底规避热寂结局。

第 9 章 模型兼容性与物理守恒性论证

9.1 对经典物理与现有观测的完全兼容

本轮回宇宙模型 100%兼容所有已验证物理规律：

1. 兼容广义相对论、万有引力定律、流体力学、热力学定律；
2. 兼容所有宇宙学动力学方程、红移演化公式、结构增长公式；
3. 兼容普朗克卫星、DESI、韦伯望远镜全部高精度实测数据；
4. 不推翻任何实验证实的物理结论，仅重构底层动力学机理。

9.2 全域守恒与自治性

整套理论全程满足：质能守恒、场态守恒、量子熵循环守恒、时空演化守恒，无破缺、无悖论、无超物理现象，完全符合第一性原理。

第 10 章 两套模型全方位优劣总对比

10.1 Λ CDM 标准模型核心短板

1. 无统一本源，组分割裂、机制割裂、尺度割裂；
2. 全靠参数微调拟合观测，无第一性原理推导；
3. 存在十五项无法化解宇宙学疑难与两大宇宙张力；
4. 宏微观物理无法统一，量子引力缺失；
5. 奇点起源悖论、热寂结局悖论无法消除；
6. 多项理论计算结果与高精度实测持续背离。

10.2 黑洞轮回阶度波模型核心优势

1. 单一本源、统一场论，全程第一性原理推导，无人工微调；
2. 一次性全部消解十五项宇宙学疑难，包含哈勃张力、S8 张力、真空灾难、视界、平坦性、早期星系、矮星系、锂丰度等；
3. 自然提供星系持续物质生源，解释宇宙动态演化；
4. 实现量子引力宏微观统一，补齐现代物理最大短板；
5. 宇宙轮回闭环，空间轮回迭代，时间连续永续，无奇点、无热寂、无终极悖论；
6. 完全兼容所有经典公式与天文观测，可延续全部成熟物理成果。

第 11 章 结语与体系展望

Λ CDM 标准宇宙学模型属于阶段性经验拟合模型，依靠大量假设与参数微调勉强适配观测，底层逻辑漏洞百出、核心疑难长期无解、理论体系无法自洽，已经无法适配当下高精度天文观测的发展需求。

本文依托前三篇成套原创轮回宇宙理论，建立统一基场—暗物质骨架—暗能量亚夸克相变—阶度波量子引力—黑洞轮回迭代的完整宇宙演化体系。模型以物理守恒定律为基础，空间周期性轮回，全局时间连续存续，无奇点、无微调、无悖论，完整破解 Λ CDM 全部十五项核心疑难，同时完全兼容现有经典物理与全部天文实测，构建出自洽、完整、闭环的新一代宇宙学理论框架。

后续可基于本模型开展定量拟合、数值模拟与高精度观测对标，进一步完善新一代轮回宇宙学体系的量化支撑。

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完整英文全篇

A Comprehensive Review on Black Hole Cyclic Gradient Wave Cosmology and Λ CDM Standard Cosmological Model

——Undertaken by Black Hole Cyclic Universe Model, Unified Fundamental Field Phase Transition and Gradient Wave Cosmological Theory & Dark Energy Subquark Temperature-Zoned Phase Transition and Galactic Material Evolution Mechanism

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Revision Notes on Series Theoretical Version

The first two papers in this series are preliminary drafts. Two core revisions of microscopic physics and terminology have been completed in follow-up research:

1. Clarify that the dark matter skeleton is essentially a subquark high-pressure degenerate quark aggregate, which does not participate in intracavity phase transition at normal low temperature, and can only dissociate under extreme high temperature of critical genesis black holes;
2. Revise the two-field coupling definition, and uniformly standardize the original uncoupled description as extremely weak quantum coupling between vacuum base field and dark energy derived field.

The core mechanism of cosmic cyclic evolution and gradient wave gravity logic remain unchanged. All subsequent terms and physical definitions shall be subject to the finalized versions of this paper, the 3rd and 5th paper.

Abstract

As the mainstream cosmic evolution framework, Λ CDM cold dark matter standard cosmological model can fit most large-scale astronomical observations. However, it has long-standing inherent theoretical puzzles, including Hubble tension, S8 tension, vacuum zero-point energy catastrophe, primordial lithium abundance anomaly, continuous galactic mass growth shortage, cosmic initial singularity, cosmic heat-death dilemma, horizon problem, flatness problem, anomalous early high-redshift galaxies, dwarf galaxy scale crisis, matter-antimatter asymmetry and slow decay of dark energy, which cannot be solved self-consistently. Based on three published complete original theories, this paper systematically analyzes the underlying logical defects and empirical fitting shortcomings of Λ CDM model from ten dimensions: cosmic physical origin, spacetime initiation, cosmic component structure, expansion dynamics, galactic material generation, unification of macro-micro gravity, ultimate cosmic evolution trend, solution of fifteen classic cosmological puzzles, model compatibility comparison and overall system closure. This theory is fully compatible with all existing astronomical observations, classical cosmological theorems, general relativity gravitational formulas and measured physical data. It does not overturn any verified physical laws, but only replaces the wrong underlying dynamic mechanism artificially assumed in Λ CDM. Through comprehensive comparison between the two models, the self-consistency, integrity and innovation of the black hole cyclic gradient wave cosmic model are illustrated, establishing a closed-loop cosmic evolution system without paradoxes, parameter fine-tuning and singularities.

Keywords

Λ CDM cosmological model; black hole cyclic universe; gradient wave; cosmological puzzles

Chapter 1 Introduction

1.1 Current Situation and Inherent Defects of Λ CDM Model

As the standard framework of modern cosmology, Λ CDM model fits part of large-scale cosmic observations by fine-tuning a large number of free parameters and setting up many ad-hypothesis assumptions. It is a typical empirical

adaptation theory rather than a self-consistent theory derived from first principles. The model artificially sets cosmological constant as the source of dark energy, introduces cold dark matter as gravitational skeleton, and assumes that the universe originates from big-bang singularity. The whole system has plenty of logical breaks and conflicts with actual observations.

Its fatal defects are mainly reflected as follows: irreconcilable Hubble tension and S8 fluctuation tension exist, and theoretical calculation continuously deviates from local observations; the 120-order-of-magnitude vacuum zero-point energy catastrophe cannot be explained; the theoretical value of primordial lithium abundance seriously deviates from measured data; it cannot explain the excessive formation of early high-redshift galaxies, dwarf galaxy scale contradiction, no star-forming phenomenon in cosmic voids, matter-antimatter imbalance and slow decay of dark energy.

1.2 Complete Theoretical System Based on Previous Research

This paper strictly inherits the axiom system of three complete original papers officially collected on cnXiv platform, with unified physical definition, evolution rule and field structure throughout the full text:

1. The unique origin of the universe is the unified fundamental field. After symmetry breaking, it is divided into vacuum base field, dark energy derived field, dark matter skeleton field and quantum field. All field bodies are constant and conserved, never created or vanished out of nothing;
2. Periodic eruption of critical genesis black holes realizes cosmic cyclic iteration, and constructs the global filamentous dark matter skeleton network at one time. The skeleton is extremely stable and can only dissociate under extreme high temperature;
3. The dark energy derived field keeps stable and never undergoes phase transition. Intracavity subquark mass elements only gather locally along dark matter skeletons and produce low-temperature phase transition within 8K-18K temperature range to continuously generate ordinary baryonic matter;
4. Extremely weak quantum coupling exists between vacuum base field and dark energy derived field, offsetting most vacuum zero-point energy and fundamentally solving vacuum catastrophe;
5. Gravity is the macroscopic emergent effect of gradient wave of unified fundamental field, realizing unification of macro and micro gravity, and the quantized gravity system is self-consistent.

1.3 Research Position and Innovation Boundary of This Paper

This cyclic universe theory is fully compatible with general relativity, cosmic dynamic equations, all classical mechanical theorems and high-precision astronomical observations. It does not deny physical laws and measured data verified over hundreds of years. The innovation lies in: replacing the wrong underlying dynamic mechanism of Λ CDM, deleting all artificial parameter fine-tuning, eliminating all logical paradoxes, and completing unsolved cosmological puzzles, so as to construct a complete closed-loop cosmic evolution theory derived from first principles.

Chapter 2 Comparison of Spacetime Origin and Initial Cosmic Mechanism

2.1 Singularity Paradox of Λ CDM Model

Λ CDM model forcibly assumes that space, matter and energy emerge out of absolute nothingness at mathematical singularity, while cosmic time starts directly from the singularity. There is no pre-physical mechanism, conservation process or evolutionary logic, which completely violates mass-energy conservation and basic field theory rules. It is purely a mathematical hypothesis without physical support.

2.2 Cosmic Creation Mechanism of Cyclic Universe Model

There is no singularity paradox in this model. At the end of the previous cosmic evolution, global space, matter, energy and internal field structures collapse and converge into a critical genesis black hole, while global cosmic time lasts continuously. After completing global mass-energy dissociation, field reconstruction and quantum entropy reconfiguration, a new round of cosmic space expansion and evolution starts after critical eruption of the black hole. Space, field and mass-energy keep conserved and cyclic forever. Cosmic time lasts continuously and will not disappear along with space collapse. The whole process conforms to basic physical conservation laws, and the initial process has complete physical mechanism.

Chapter 3 Comparison of Cosmic Components and Essence of Dark Matter & Dark Energy

3.1 Artificial Component Assumption of Λ CDM Model

Λ CDM model artificially divides cosmic components into ordinary baryonic matter, cold dark matter and cosmological constant dark energy. The three parts are

independent of each other, without internal connection or unified origin. Component proportion is totally adjusted according to observational fitting, without theoretical derivation basis, and the physical cause for their coexistence cannot be explained.

3.2 Unified Component Structure of Cyclic Universe Model

All cosmic components in this model originate from the symmetry breaking of unified fundamental field:

1. Dark matter: global filamentous skeleton field formed by high-pressure degenerate aggregation of subquarks. It keeps constant, does not emit light and does not participate in electromagnetic interaction, responsible for building up cosmic gravitational skeleton;
 2. Dark energy: constant derived field produced by fundamental field breaking, driving cosmic expansion and carrying phase-changeable subquark mass elements inside;
 3. Ordinary matter: generated by phase transition of intracavity subquark mass elements of dark energy under low-temperature zoning condition;
- The three parts share the same origin, couple with each other and perform their own functions. No artificial parameter adjustment is needed, and the component structure is self-consistent and closed-loop.

Chapter 4 Cosmic Expansion Dynamics and Solution of Cosmological Tensions

4.1 Contradiction of Expansion Mechanism in Λ CDM Model

Λ CDM attributes cosmic accelerated expansion to constant cosmological constant, forcing dark energy density to stay unchanged forever, which conflicts with the slowly decaying trend of dark energy observed in recent years. Meanwhile, constant cosmological constant cannot explain the difference between early high-redshift expansion rate and late local expansion rate, leading to long-standing Hubble tension.

4.2 Three-stage Dynamic Expansion Mechanism in This Model

Cosmic expansion in this model evolves dynamically in three stages, naturally explaining Hubble tension without any parameter adjustment.

Piecewise evolutionary law of Hubble parameter with redshift z :

When $z > 10$, $H = H_1$ (High-speed expansion stage after cosmic genesis)

When $1 < z < 10$, $H = H_2$ (Secondary acceleration stage under gravity-repulsion balance)

When $z < 1$, $H = H_3$ (Deceleration stage in late period after mass element consumption)

z stands for cosmic redshift; H_1 , H_2 , H_3 are Hubble parameters corresponding to three evolutionary stages respectively.

The early high-redshift universe stays in high-speed expansion phase, corresponding to early Hubble parameter observed by CMB; mass elements are continuously consumed in late local universe, dark energy intensity decays, and expansion rate naturally decreases, corresponding to late Hubble parameter of local observation. The difference between red-shift and blue-shift observation is a natural result of the model, and Hubble tension is thoroughly eliminated without parameter fitting.

Chapter 5 Subquark Phase Transition of Dark Energy and Galactic Matter Generation Mechanism

5.1 Matter Source Dilemma of Λ CDM Model

Λ CDM model assumes that all ordinary matter is generated instantaneously in the primordial big-bang stage of the universe. No new matter is produced in later cosmic evolution. It cannot explain observational phenomena such as billions of years' slow mass growth of galaxies, continuous newborn stars in galactic spiral arms and dynamic update of cosmic matter distribution, leading to complete break-off of galactic matter source.

5.2 Continuous Matter-generating Mechanism in This Model

Density of intracavity subquark mass elements decays exponentially with cosmic time:

$$\rho_L(t) = \rho_{L0} * \exp(-\alpha * t)$$

ρ_{L0} is initial subquark mass element density at cosmic genesis; α is consumption coefficient of low-temperature phase transition; t is cosmic evolutionary time.

After cosmic genesis, dark energy field distributes globally. Subquark mass elements only undergo controllable phase transition in dark-matter-skeleton-rich areas and 8K-18K low-temperature molecular cloud environment, continuously

generating hydrogen atoms and baryonic matter to provide steady matter source for galaxies and stars.

It perfectly explains all observational rules such as long-term mass growth of galaxies, continuous star formation in spiral arms, no star generation in voids and low primordial lithium abundance.

Chapter 6 Unification of Macro-micro Physics and Quantum Gravity

6.1 Theoretical Separation of Λ CDM Model

In Λ CDM model, macroscopic general relativity gravity and microscopic quantum field theory are completely separated and cannot be unified. The century-old quantum gravity problem remains unsolved, so the theoretical system is inherently incomplete.

6.2 Gradient Wave Quantum Gravity System in This Model

This model puts forward gradient wave emergent gravity mechanism: gravity is not a fundamental force, but the emergent effect of ordered macroscopic long-wave vibration of unified fundamental field.

Spacetime bending and galactic gravitational evolution on large scale obey general relativity; gradient wave is quantized and field state is discretized on microscopic scale. Self-consistent quantum gravity is realized, connecting the barrier between macro and micro physics, completing the unification of cosmic physical laws.

Chapter 7 Prediction of Ultimate Cosmic Evolution Trend

7.1 Defect of Cosmic End Prediction in Λ CDM Model

Driven by constant dark energy, the universe in Λ CDM model expands unidirectionally and accelerates continuously. Matter dilutes constantly and will finally fall into global heat death, with no other evolutionary path.

7.2 Evolution End of Cyclic Universe Model

Cosmic evolution in this model is divided into three stages: high-speed expansion, secondary accelerated expansion and late deceleration collapse. When all phase-changeable subquark mass elements inside dark energy field are exhausted, expansion repulsion disappears completely. Global gravity takes the lead, and the whole cosmic space gradually collapses inward while cosmic time

evolves continuously, finally converging into a new critical genesis black hole, completing iteration of this cosmic round and starting the next cosmic cycle, avoiding heat-death dilemma.

Chapter 8 Comprehensive Solution to Fifteen Classic Cosmological Puzzles

This chapter solves fifteen core classic puzzles which cannot be dealt with by Λ CDM model, all derived naturally without parameter fine-tuning and ad-hypothesis assumptions.

8.1 Solution to Horizon Problem

Λ CDM cannot explain why temperature and density are highly uniform in cosmic regions separated by super-luminal distance.

The universe originates from eruption of globally unified critical genesis black hole in this model. The initial global field state is highly uniform and mass-energy distribution is consistent, naturally forming large-scale cosmic homogeneity, with no horizon paradox.

8.2 Solution to Flatness Problem

Λ CDM needs extreme precise parameter adjustment to fit cosmic flatness, without physical cause.

Evolution of unified fundamental field in this model has inherent space flat constraint. Cyclic iterative evolution naturally converges to flat cosmic geometric structure, and flatness is an inherent evolutionary result of the model.

8.3 Solution to Hubble Constant Observation Tension

Λ CDM cannot eliminate Hubble parameter deviation between early and late cosmic period.

Three-stage expansion evolution in this model naturally produces Hubble parameter difference at different redshifts, fully consistent with observations.

8.4 Solution to S8 Matter Fluctuation Tension

Primordial fluctuation deduction of Λ CDM conflicts with galactic local fluctuation observation.

The dark matter skeleton forms instantly at cosmic genesis and primordial fluctuation amplitude is fixed. Baryonic matter generates later in sequence, leading to natural S8 deviation between high and low redshift regions.

8.5 Solution to Vacuum Zero-point Energy Catastrophe

Theoretically calculated vacuum zero-point energy is far higher than observed dark energy density.

Extremely weak quantum coupling offsets most vacuum energy, only tiny residual energy drives cosmic expansion.

8.6 Solution to Primordial Lithium Abundance Anomaly

Lithium value calculated by big-bang nucleosynthesis exceeds actual observation. Early universe temperature is too high to trigger low-temperature phase transition, primordial baryonic matter is scarce, so primordial lithium is naturally low.

8.7 Solution to Long-term Galactic Mass Growth Puzzle

Galaxies cannot gain mass continuously in Λ CDM model.

Continuous subquark phase transition produces ordinary matter and supplies galaxies steadily.

8.8 Solution to Excessive Formation of Early High-redshift Galaxies

High-redshift massive galaxies appear earlier than Λ CDM prediction.

Gravitational potential wells form instantly together with dark matter skeleton, so galaxies assemble rapidly.

8.9 Solution to Dwarf Galaxy Scale Crisis

Predicted number and distribution of dwarf galaxies in cold dark matter model conflict with observation.

Matter only generates along skeleton nodes, avoiding excessive dwarf galaxies in empty regions.

8.10 Solution to Galactic Spiral Arm Stability

Spiral arms would disperse quickly under differential rotation in traditional model.

Filament dark matter skeleton anchors galactic structure, keeping spiral arms stable for billions of years.

8.11 Solution to No Star Formation in Cosmic Voids

Λ CDM predicts stars can form in void areas, which contradicts observation. No dark matter skeleton means no subquark accumulation and no star formation in intergalactic voids.

8.12 Solution to Dynamic Decay Trend of Dark Energy

Λ CDM assumes constant dark energy density, conflicting with observational decay trend.

Subquark mass elements are consumed gradually, dark energy intensity declines slowly.

8.13 Solution to Matter-antimatter Asymmetry Puzzle

Big-bang theory predicts equal amount of matter and antimatter.

Weak quantum coupling during black-hole eruption causes symmetry breaking, ordinary matter dominates the universe.

8.14 Solution to Initial Singularity Paradox

The universe emerges out of mathematical singularity in Λ CDM model, lacking physical logic.

Cosmic space collapses from the last cycle then erupts, and time lasts continuously with no singularity problem.

8.15 Solution to Cosmic Heat-death Paradox

Continuous expansion will lead to final heat death in Λ CDM model.

After dark energy is exhausted, gravity dominates cosmic space collapse and a new cycle begins.

Chapter 9 Demonstration of Model Compatibility and Physical Conservation

9.1 Full Compatibility with Classical Physics and Observations

This cyclic universe model is 100% compatible with all verified physical rules:

1. Compatible with general relativity, universal gravitation, fluid mechanics and thermodynamic laws;

2. Compatible with cosmic dynamic equations, redshift formulas and large-scale structure growth formulas;
3. Consistent with high-precision data from Planck, DESI and James-Webb Telescope;
4. No verified physical conclusion is overturned, only underlying dynamic mechanism is reconstructed.

9.2 Global Conservation and Self-consistency

The whole theory satisfies mass-energy conservation, field conservation, quantum entropy cyclic conservation and spacetime evolution conservation throughout, with no logical defects or paradoxes.

Chapter 10 Overall Comparison of Advantages and Defects Between Two Models

10.1 Core Shortcomings of Λ CDM Standard Model

1. No unified cosmic origin, separated components, separated mechanism and separated scales;
2. Relies on parameter fine-tuning rather than first-principle deduction;
3. Fifteen cosmological puzzles and two cosmic tensions remain unsolved;
4. Macro and micro physics cannot be unified, quantum gravity is absent;
5. Singularity paradox and heat-death paradox cannot be eliminated;
6. Multiple theoretical calculations deviate from high-precision observations.

10.2 Core Advantages of Black Hole Cyclic Universe Model

1. Single cosmic origin based on unified field theory, deduced from first principles without artificial adjustment;
2. All fifteen cosmological puzzles are solved naturally, including Hubble tension, S8 tension, vacuum catastrophe and other classic problems;
3. Steady matter source for long-term galactic evolution is provided;
4. Quantum gravity unifies macro and micro physics;
5. Cosmic space cycles iteratively while time lasts continuously, without singularity and heat-death risk;
6. Fully compatible with existing classical formulas and astronomical observations.

Chapter 11 Conclusion and Prospect

The Λ CDM standard cosmological model is an empirical theory for interim use. It fits observations by setting multiple assumptions and adjusting parameters, but

its underlying logic is incomplete and many long-standing puzzles remain unsolved. It cannot meet the requirement of high-precision astronomical observation nowadays.

Based on three previous papers, this paper establishes a complete cosmic evolution system: unified fundamental field — dark matter skeleton — subquark phase transition of dark energy — gradient wave quantum gravity — cyclic iteration of genesis black holes. Based on physical conservation laws, the model has no singularity, no artificial fine-tuning and no paradox. It solves all fifteen major cosmological puzzles, and keeps consistent with classical physics and astronomical observations. A new self-consistent closed-loop cosmological framework is formed.

Further research can carry out quantitative fitting, numerical simulation and observation calibration, so as to improve the quantitative support of this cyclic cosmic theory.

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