

黑洞轮回宇宙模型

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(独立理论物理研究)

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摘要

Λ CDM 模型依靠静态宇宙学常数描述暗能量，无法解释星系持续供质、宇宙先加速、后减速、再二次加速的演化特征等观测疑难。本文构建真空基底场、暗能量衍生场双层动力体系，以创世临界黑洞均匀喷发为演化起点，两场斥力驱动空间膨胀，温压调控质能分温区闭环相变。低温下暗能量转化为普通重子物质维持星系增重；仅创世临界黑洞内部可完成高温质能重置与量子熵重构。黑洞、中子星、白矮星不断封存可循环质能，全域物质坍缩进入创世临界黑洞后，内部大部分致密物质解离转化为亚夸克质能，保留部分原生致密物质；当解离达到临界比例后黑洞发生撕裂全域喷发，耗散场能削弱斥力，演化末期引力再次触发全域同步坍缩归集出新创世黑洞，熵重构抵消单轮熵增，消除奇点与热寂悖论。暗物质骨架为创世临界黑洞撕裂喷发时，由黑洞留存释放的原生致密物质依托长程引力、空间潮汐力、角动力协同作用瞬时成型的稳定结构，全程不参与低温质能相变。本文划分五阶段演化流程，提出六条可观测预言，所有参数仅定性讨论，定量拟合留待后续研究。

关键词：创世临界黑洞；双层场结构；暗能量衍生场；分温区循环温压相变；质能封存；宇宙轮回

自创名词释义

1. 双层场结构：本文核心场论框架，宇宙基础动力场划分为真空基底场、暗能量衍生场两个独立层级，两场仅存在天然斥力，无耦合关联，共同支配宇宙膨胀动力学。
2. 创世临界黑洞：前代宇宙全域引力时空同步坍缩归集形成的极限量子引力天体，为单轮宇宙演化起点与终点，区别于常规天体黑洞；内部物质受极端高温高压作用，大部分致密物质解离为亚夸克质能，留存部分原生致密物质，达到解离阈值后黑洞撕裂喷发，内部可同步完成高温质能重置与熵重构。
3. 亚夸克质能（暗能量）：目前高能物理领域尚未探测到夸克之下的基础物质组分，该概念为本文搭建宇宙轮回模型自创的底层质能单元，对应暗能量的基础存在形态。该质能与 Λ CDM 标准模型暗能量存在本质区分：标准模型暗能量是无实体载体的唯象拟合常数，无法阐释物质本源，全域均匀分布，无相变、无耗散、无法与实体物质相互转化；本文中亚夸克质能为具备明确理论本源的动态基础质元，可耗散、可通过低温温压相变凝聚生成重子等实物物质，是驱动宇宙膨胀、持续供给星系质量的本源载体。
4. 暗物质稳态骨架：创世临界黑洞撕裂喷发瞬时，由黑洞内部未完全解离留存的原生致密物质，在长程引力、空间潮汐力、角动力协同作用下瞬时引力自组织形成的全域大尺度纤维天体网络。骨架成型后拓扑结构、物质组分永久稳态，低温演化全程不参与质能相变；仅当下

一轮宇宙全域坍缩进入新一代创世临界黑洞后，骨架物质大部分会在极端高温高压环境下解离还原为亚夸克质能，少量原生致密物质留存，全程锚固宇宙全域空间架构。

5. 真空基底场：时空固有的恒定底层场，全域均匀分布、负压恒定，不参与宏观质能相变，仅与暗能量衍生场产生宏观斥力。

6. 暗能量衍生场：由创世黑洞喷发释放的亚夸克质能依附暗物质骨架凝聚形成的衍生场；场内亚夸克质能可经低温相变转化为重子物质；重子物质演化形成各类天体，最终坍缩为致密天体，随全域坍缩进入创世临界黑洞；黑洞内部极端高温高压条件下，重子致密物质与暗物质骨架原生致密物质仅大部分解离还原为游离态亚夸克质能，会留存一部分原生致密物质，随黑洞撕裂喷发释放，由此完成完整质能循环转化。

7. 斥力强度常数 k ：全域恒定参数，仅用于量化真空基底场与暗能量衍生场之间天然斥力强弱，两场不存在耦合作用。

8. 分温区循环温压相变：宇宙质能整体形成首尾相接的圆形闭环循环，不同温压区间内拥有固定定向转化路径，同一环境不可双向反转；低温低压宇宙膨胀区间，暗能量衍生场内亚夸克质能通过低温相变定向凝聚生成重子物质；重子物质构成星云、恒星、行星等各类天体，天体历经演化、损耗质能后逐步坍缩形成白矮星、中子星、黑洞，各类致密物质不断归集，伴随全域时空同步坍缩进入创世临界黑洞高温高压区域，内部大部分致密物质解离还原为游离亚夸克质能，同时留存部分原生致密物质；达到解离临界比例后黑洞撕裂喷发，还原后的亚夸克质能再次依附暗物质骨架形成暗能量衍生场，重新开启低温相变生成重子物质。低温、高温两类相变各自仅能在专属温压区间发生，转化路径不可调头互换，两段过程首尾咬合，构成完整不间断的圆形质能轮回闭环； α 低温相变系数， β 高温相变系数。

9. 质能封存：黑洞、中子星、白矮星捕获束缚的质能永久脱离低温相变循环，是调控宇宙膨胀转向坍缩的核心动力学机制。

10. 量子熵重构：仅创世临界黑洞内部极端量子环境具备的热力学归零效应，可完全抵消单轮宇宙累积熵增，保障无限宇宙轮回；常规致密天体不具备该物理属性。

1 引言

Λ CDM 标准宇宙模型依靠静态宇宙学常数拟合宇宙加速膨胀观测结果，其理论框架存在多处难以调和的短板。其一，模型无法解释星系长期稳定的质量增量来源，无法完整复现宇宙先减速、后二次加速的完整演化历程；其二，该模型预言宇宙将永久膨胀，最终走向热寂，不存在循环演化路径，无法规避时空奇点难题；其三，标准暗能量为固定常数，不存在与重子物质双向转化的动力学机制，难以统一暗能量、暗物质、可见物质的演化关联。

现有轮回宇宙理论多基于奇点反弹、纯几何修正构建，普遍缺失分层动力场、可控质能相变、天体质能封存三类核心动力学机制，理论体系碎片化，自洽性不足。针对上述缺陷，本文提出全新双层场轮回宇宙模型，抛弃静态暗能量假设，引入真空基底场与暗能量衍生场两套独立动力层级，建立全域分温区闭环温压相变规则，以黑洞、中子星、白矮星集体质能封存作为膨胀-坍缩切换开关，论证暗物质稳态骨架由创世临界黑洞内部留存未完全解离的原生致密物质构成，依托长程引力、空间潮汐力、角动力协同作用瞬时成型且长期稳态，定性推导单轮宇宙完整轮回演化路径。创世临界黑洞内部物质经高温解离达到临界比例后发生撕裂喷

发，全新时空与暗物质骨架同步生成、同步开启宇宙膨胀；演化末期全域物质、骨架、场能则时空同步坍缩归集为新一代创世临界黑洞，二者形成完整对称的轮回时空演化逻辑。

全文先定义基础物理名词，建立五条核心动力学公理，分五个阶段完整描述宇宙从创世喷发、物质生成、二次加速、膨胀停滞到全域坍缩轮回的全过程，对比本模型与 Λ CDM 模型的本质区别，给出六条可观测、可证伪的理论预言，明确定性研究边界与后续定量数值模拟拓展方向。本文模型全程遵守质能守恒、全域熵增热力学定律，仅允许创世临界黑洞内部实现熵重构抵消单轮总熵增，不存在热力学悖论。

2 模型基础公理与核心定义

2.1 全域质能守恒公理

宇宙为孤立闭合热力学系统，全域总等效质能恒定不变。宇宙质能分为两类形态：带静质量的实体物质、场态等效能量。系统演化仅发生质能形态转换与空间重新分布，总质能守恒不变。

$$E = M \cdot c^2$$

E：全域总质能

M：宇宙总质量

c：真空光速

$$M = M_{DM} + M_{vis} + M_L$$

M_{DM} ：暗物质骨架总质量（骨架由创世临界黑洞解离后留存的原生致密物质组成）

M_{vis} ：重子可见物质总质量

M_L ：暗能量衍生场等效质量

注：低温演化阶段 M_{DM} 不参与相变；仅坍缩进入新一代创世临界黑洞后，骨架物质大部分发生高温解离，少量原生致密物质留存。

2.2 创世临界黑洞与全域喷发公理

本轮宇宙起源于前代宇宙全域引力时空同步坍缩归集形成的量子临界创世黑洞，黑洞总等效质量与宇宙全域总质量严格相等。

1. 质量等式

$$M_c = M$$

M_c ：创世临界黑洞总质量

M：宇宙全域总质量

2. 史瓦西（Schwarzschild）黑洞视界半径公式

$$R_s = 2 \cdot G \cdot M_c / c^2$$

R_s ：创世临界黑洞视界半径

G: 万有引力常数

M_c: 创世临界黑洞总质量

c: 真空光速

3. 角动量守恒公式

$$L = r * m * v = \text{常量}$$

L: 系统总角动量

r: 微元轨道半径

m: 微元质量

v: 微元切向速度

4. 宇宙膨胀速率公式

$$da(t)/dt > 0$$

a(t): 宇宙尺度因子

t: 宇宙演化时间

创世临界黑洞突破量子临界温压约束后，内部极端高温高压使大部分致密物质解离为亚夸克质能，留存部分原生致密物质；当解离达到临界比例后视界失效，两类物质随介质全域均匀喷发，依托长程引力、空间潮汐力、角动力协同作用一次性自组织形成稳态暗物质纤维骨架；全新宇宙时空与暗物质骨架同步生成，永久锁定宇宙大尺度拓扑结构，同期开启宇宙膨胀。

2.3 双层场斥力公理

本文采用双层独立动力场：真空基底场、暗能量衍生场。两场无耦合、无叠加演化，仅存在天然宏观斥力。

真空基底场全域均匀、负压恒定，不参与低温相变；暗能量衍生场由喷发释放的亚夸克质能依附暗物质骨架分布，可耗散、可相变、可坍缩重置。

$$P_{rep} = k * \sqrt{(\rho_V * \rho_L)}$$

P_rep: 双层场相互斥力密度

k: 斥力强度常数

ρ_V: 真空基底场能量密度

ρ_L: 暗能量衍生场能量密度

2.4 温压调控分温区循环相变公理

宇宙不同温压区间对应专属定向质能相变路径，两类相变时序不可逆、环境不互通、路径不调头，相互拼接构成全域闭环循环；低温低压环境下暗能量衍生场内部亚夸克质能低温析出，生成重子物质；仅创世临界黑洞内部极端高温高压环境下，被致密天体封存的重子致密物质、暗物质骨架原生致密物质仅大部分解离还原为游离亚夸克质能，会留存一部分原生致密物质，达到解离阈值后黑洞撕裂喷发。

$$dM_L/dt = -\alpha * f(T,P) * M_L$$

d/dt : 时间微分算子

α : 低温相变系数

$f(T,P)$: 低温区间温压响应函数

M_L : 暗能量衍生场等效质量

T : 热力学温度

P : 压强

$$d(M_{DM}+M_{vis})/dt = -\beta * g(T,P) * (M_{DM}+M_{vis})$$

β : 高温相变系数

$g(T,P)$: 黑洞内部高温高压响应函数

M_{DM} : 暗物质骨架总质量（创世临界黑洞解离留存的原生致密物质）

M_{vis} : 重子可见物质总质量

注释： M_{DM} 仅坍缩进入创世临界黑洞后大部分参与高温解离，少量原生致密物质留存，常规低温区间保持稳定。

高温解离过程仅发生在创世临界黑洞内部，常规致密天体无法触发。

2.5 三类致密天体质能封存公理

黑洞、中子星、白矮星持续封存全域可循环质能，封存质量单调递增。

$$dM_h/dt \geq 0$$

M_h : 致密天体累计封存总质量

t : 宇宙演化时间

$$M_{cycle} = M - M_h$$

M_{cycle} : 可参与轮回循环的剩余质能

M : 宇宙全域总质量

M_h : 致密天体累计封存总质量

$$dP_{rep}/dt < 0$$

P_{rep} : 双层场相互斥力密度

t : 宇宙演化时间

2.6 热力学轮回公理

宇宙常规演化全程熵增。

$$dS/dt > 0$$

S : 全域总熵

t : 宇宙演化时间

仅创世临界黑洞内部具备量子熵重构，可抵消单轮宇宙全部熵增，实现无限轮回，本文仅做定性论述。

3 宇宙五阶段完整轮回演化机制

3.1 创世喷发与暗物质骨架定型

创世临界黑洞内部物质经高温解离达到临界比例后视界失效，黑洞留存未完全解离的原生致密物质随同全域亚夸克质能均匀喷发、解离弥散，依托长程引力、空间潮汐力、角动力协同作用自组织，一次性形成暗物质纤维网络。

骨架成型后拓扑、组分、力学结构永久稳态，形成纤维密集区与宇宙空洞。双层场斥力驱动宇宙极速膨胀。

$$d^2a(t)/dt^2 \gg 0$$

$a(t)$: 宇宙尺度因子

t : 宇宙演化时间

3.2 早期降温膨胀与物质相变生成

宇宙膨胀降温降压，暗能量衍生场稳定低温相变，持续生成重子物质，星系与恒星系统逐步形成。致密天体种群诞生，质能封存机制启动，引力削弱膨胀加速度，膨胀放缓。

$$d^2a(t)/dt^2 < 0$$

$a(t)$: 宇宙尺度因子

t : 宇宙演化时间

3.3 中期双层场与引力三力制衡稳态加速膨胀

真空恒定斥力、暗能量动态斥力、全域引力形成三方制衡。引力随空间拉伸快速衰减，衰减快于场能耗散，宇宙进入长期二次加速膨胀阶段，星系持续增质，致密天体不断累积封存质能。

$$d^2a(t)/dt^2 \approx \text{常量}$$

$a(t)$: 宇宙尺度因子

t : 宇宙演化时间

3.4 晚期质能耗竭与膨胀停滞

暗能量衍生场内亚夸克质能持续消耗枯竭，相变终止、斥力大幅弱化，星系停止增质，宇宙膨胀持续减速并趋于停滞，场斥力持续衰减趋近于零。

3.5 全域坍缩与宇宙轮回重启

斥力趋近消失，引力全域主导，所有物质、由创世临界黑洞解离留存原生致密物质构成的暗物质骨架、场能时空同步坍缩归集，形成新一代创世临界黑洞。黑洞内部发生高温解离，重子致密物质、暗物质骨架原生致密物质仅大部分转化为游离亚夸克质能，留存部分原生致密物质，同步完成量子熵重构；达到解离临界比例后黑洞撕裂喷发，宇宙回归初始膨胀状态，开启新一轮轮回。

$$da(t)/dt < 0$$

$a(t)$: 宇宙尺度因子

t : 宇宙演化时间

4 大尺度宇宙结构形成动力学机理

宇宙大尺度纤维网状结构、星系节点、宇宙空洞全部形成于创世喷发瞬时自组织阶段。创世临界黑洞喷发释放的留存原生致密质团，在长程引力、空间潮汐力、角动力共同作用下编织暗物质纤维与星系锚固节点，稀疏区域自然形成空洞。

暗物质骨架成型后无二次重构，仅随宇宙膨胀整体拉伸，完美匹配高红移观测中早期结构稳态特征。星系依托骨架锚固效应与角动量演化，形成标准盘状星系形态。

5 模型自洽性与核心动力学优势

1. 消解暗能量理解差异：依靠由创世临界黑洞解离留存原生致密物质构成的暗物质骨架锚固暗能量场，避免宇宙膨胀稀释，同时依靠持续低温相变供给星系重子物质，解决 Λ CDM 静态暗能量无法兼顾的双重矛盾。
2. 补齐宇宙演化终点：以致密天体质能封存为核心开关，建立“场内亚夸克质能耗散—斥力减弱—引力坍缩”完整闭环动力学链条；黑洞内部不会完全消耗全部致密物质，留存原生致密物质供给下一代暗物质骨架，轮回逻辑自洽。
3. 规避奇点与热寂悖论：依靠黑洞内部专属量子熵重构实现无损轮回，全程服从质能守恒与全域熵增定律。
4. 物理边界清晰：严格区分双层场属性、常规黑洞与创世黑洞功能、分温区闭环相变逻辑，明确暗物质骨架由创世临界黑洞解离留存原生致密物质在长程引力、空间潮汐力、角动力协同作用下生成；黑洞内两类致密物质仅大部分解离为亚夸克质能，留存原料持续生成骨架，体系干净无歧义。

6 模型可观测预言（可证伪性）

1. 暗物质大尺度骨架由创世临界黑洞高温解离后留存的原生致密物质构成，在长程引力、空间潮汐力、角动力协同作用下极早期一次性成型，全演化周期无结构性重构；

2. 大质量星系存在长期、缓慢、持续性重子物质质量增长；
3. 宇宙空洞无暗能量衍生场分布，无新重子物质相变活动；
4. 全域黑洞、中子星、白矮星总封存质能随宇宙演化单调递增；
5. 宇宙膨胀加速度动态变化与暗能量衍生场内亚夸克质能存量高度耦合；
6. 宇宙晚期将持续减速、膨胀停滞，最终转入全域时空同步坍缩，坍缩形成的创世临界黑洞仅解离大部分致密物质，留存原生致密物质用于下一代暗物质骨架构建。

本文所有场作用系数、相变系数、临界温压仅做定性设定，精准定量拟合、误差分析、数值建模全部留作后续研究。

7 讨论

本文采用纯双层场宏观演化框架，完全剥离统一基场微观本源内容，议题单一、边界清晰，适配宏观宇宙学研究范畴。模型所有演化逻辑依托经典引力、热力学与场论规则搭建，因果链条完整、无内在矛盾。

7.1 与 Λ CDM 标准模型的本质差异

Λ CDM 暗能量为静态常数，无演化、无耗散、无物质转化，只能预言永久膨胀与热寂结局。本文暗能量衍生场本源依托亚夸克质能，为真实动态物理场，依靠分温区闭环、全域循环的质能相变、双层场斥力与质能封存机制，自然完成多阶段宇宙演化与完整闭环轮回，彻底弥补主流模型动力学缺失问题。

7.2 暗物质骨架与温压相变合理性

创世临界黑洞坍缩集聚物质后，内部高温高压仅解离大部分原生致密物质，留存部分物质，在长程引力、空间潮汐力、角动力协同下引力自组织生成稳态大尺度骨架，契合高红移微波背景观测早期结构稳定特征。分温区循环温压相变属于宇宙大尺度宏观演化规则，独立于微观粒子反应，物理逻辑自治；低温仅亚夸克质能生成重子，高温黑洞内重子致密物质、暗物质骨架致密物质仅大部分解离为亚夸克质能，留存原料持续生成下一代暗物质骨架，循环无矛盾。

7.3 热力学边界与研究范围

全域严格熵增符合热力学第二定律，仅创世临界黑洞独有内部量子熵重构，不破坏全域物理定律。微观量子机理复杂，本文仅做定性建立框架，不强行定量推导。

7.4 后续拓展方向

1. 分温区循环相变临界温压参数标定；
2. 双层场斥力常数与相变系数观测拟合；

3. 质能封存占比与轮回时标定量计算；
4. 黑洞内部物质解离临界比例、量子熵重构微观机制研究。

8 结论

本文基于真空基底场、暗能量衍生场双层独立场架构，建立了一套完整无奇点、无热寂、可无限迭代的黑洞闭环宇宙轮回模型。通过两场天然斥力与引力三方制衡，完整解释宇宙加速、减速、二次加速的观测演化特征。

致密天体持续质能封存是宇宙由膨胀转向坍缩的核心动力学开关；创世临界黑洞内部高温高压仅将大部分重子致密物质、暗物质骨架原生致密物质解离为游离亚夸克质能，留存少量原生致密物质，搭配量子熵重构，与宇宙膨胀期低温质能相变精准咬合，形成固定路径、永不反向、首尾相接的圆形闭环质能轮回体系，实现宇宙无损轮回重启。模型精准阐释由创世临界黑洞解离留存原生致密物质依托长程引力、空间潮汐力、角动力协同成型的暗物质骨架稳态成因、星系持续增重机理；低温阶段亚夸克质能相变为重子，高温黑洞内不会完全消耗致密原料，留存物质持续构建新一代暗物质骨架，循环逻辑自洽，全套体系具备多项可观测可证伪预言，可为现代宇宙学轮回演化研究提供全新、完备的理论范式。

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二、同步修正对应完整英文全文

Black Hole Cosmic Recycle Universe Model

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Abstract

The Λ CDM model describes dark energy with a static cosmological constant, which fails to resolve observational puzzles including continuous mass supply of galaxies and the three-stage cosmic evolution: initial acceleration, deceleration and secondary reacceleration. This paper constructs a two-layer dynamic system consisting of the vacuum background field and dark energy derived field. The uniform eruption of primordial critical black holes acts as the starting point of cosmic evolution. Mutual repulsion of the two fields drives spatial expansion, and closed-loop mass-energy phase transitions divided by temperature and pressure intervals are controlled by thermodynamic conditions. At low temperatures, dark energy converts into ordinary baryonic matter to sustain galactic mass growth. High-temperature mass-energy resetting and quantum entropy reconstruction can only occur inside primordial critical black holes. Black holes, neutron stars and white dwarfs continuously trap recyclable mass-energy. After all cosmic matter collapses into primordial critical black holes, most compact matter dissociates and transforms into subquark mass-energy, while part of primordial compact matter remains preserved. When the dissociation reaches a critical ratio, the black hole tears and erupts across the whole universe. Dissipated field energy weakens repulsive force, and gravity triggers synchronous universal collapse at the late evolutionary stage to form a new primordial critical black hole. Entropy reconstruction offsets entropy growth in a single cosmic cycle and eliminates the singularity and heat death paradox. The dark matter skeleton is a stable structure formed instantaneously from residual primordial compact matter retained and released by torn primordial critical black holes under the combined effect of long-range gravitational force, spatial tidal force and angular dynamic force, and it never participates in low-temperature mass-energy phase transitions throughout the whole evolution. This paper divides the evolution process into five stages and puts forward six testable observational predictions. All physical parameters are only discussed qualitatively, and quantitative fitting is reserved for follow-up research.

Key words: Primordial Critical Black Hole; Double-layer Field Structure; Dark Energy Derived Field; Temperature-pressure Zoned Cyclic Phase Transition; Mass-energy Sealing; Cosmic Cycle

Glossary of Self-defined Original Terms

1. Double-layer Field Structure: The core field-theory framework of this paper. The fundamental cosmic dynamic field is divided into two independent levels: vacuum background field and dark energy derived field. The two fields only

generate inherent repulsion without coupling, jointly governing the dynamics of cosmic expansion.

2. Primordial Critical Black Hole: An extreme quantum gravitational object formed by synchronous gravitational spacetime collapse of the previous cosmic generation. It serves as the start and end of one cosmic evolution cycle, different from ordinary stellar black holes. Under internal extreme high temperature and pressure, most compact matter dissociates into subquark mass-energy while partial primordial compact matter is retained. The black hole will tear and erupt once the dissociation threshold is reached, and high-temperature mass-energy resetting and entropy reconstruction can be completed inside its event horizon.

3. Subquark mass-energy (dark energy): No fundamental components below quarks have been detected in high-energy physics experiments to date. This self-defined underlying mass-energy unit is proposed to construct the cosmic recycle model, representing the basic existential form of dark energy.

This mass-energy is fundamentally different from dark energy in the standard Λ CDM model: dark energy in the standard model is a phenomenological fitting constant without physical substance carrier, which cannot explain the origin of matter. It distributes uniformly across the universe, features no phase transition or energy dissipation, and cannot convert mutually with physical matter.

In contrast, subquark mass-energy in this paper is a dynamic fundamental mass element with definite theoretical origin. It can dissipate and condense into baryonic and other physical matter via low-temperature temperature-pressure phase transitions. It is the fundamental carrier driving cosmic expansion and continuously supplying mass for galaxies.

4. Stable Dark Matter Skeleton: A global large-scale fibrous celestial network formed instantaneously by gravitational self-organization of residual primordial compact matter retained inside primordial critical black holes during black hole tearing and cosmic genesis eruption. The formation is synergistically driven by long-range gravitational force, spatial tidal force, and angular dynamic force. After formation, its topology and material composition remain permanently stable. It does not participate in any mass-energy phase transition throughout low-temperature cosmic evolution; only when the whole universe collapses into a new generation of primordial critical black holes, most skeleton matter will dissociate and revert to subquark mass-energy under extreme high temperature and pressure, with a small portion of primordial compact matter reserved, permanently anchoring the overall spatial structure of the universe.

5. Vacuum Background Field: A constant underlying field inherent to spacetime, uniformly distributed throughout the universe with fixed negative pressure. It does not participate in macroscopic mass-energy phase transitions, and only generates macroscopic repulsion with the dark energy derived field.

6. Dark Energy Derived Field: A derived field condensed from subquark mass-energy released by primordial critical black hole eruption and attached to the dark matter skeleton. Subquark mass-energy inside this field can transform into baryonic matter through low-temperature phase transitions. Baryonic matter evolves into various celestial bodies and eventually collapses into compact celestial objects. After entering primordial critical black holes along with global spacetime collapse under extreme high temperature and pressure, only most compact baryonic matter and primordial compact matter of the dark matter skeleton dissociate and revert to free subquark mass-energy, while part of primordial compact matter is retained and released with black hole tearing eruption, thus realizing complete cyclic conversion of mass-energy.

7. Repulsion Constant k : A universal constant parameter only used to quantify the strength of inherent repulsion between the vacuum background field and the dark energy derived field, and there is no coupling between the two fields.

8. Temperature-pressure Zoned Cyclic Phase Transition: Cosmic mass-energy forms an end-to-end closed circular cycle. Fixed one-way conversion paths exist in different temperature-pressure intervals, and bidirectional reversal cannot happen within the same environment.

In the low-temperature and low-pressure cosmic expansion era, subquark mass-energy inside the dark energy derived field condenses into baryonic matter in a one-way manner through low-temperature phase transition. Baryonic matter forms nebulae, stars, planets and various celestial bodies. After long-term evolution and energy loss, celestial bodies gradually collapse into white dwarfs, neutron stars and black holes. All compact matter converges continuously and falls into the high-temperature and high-pressure region of primordial critical black holes along with synchronous spacetime collapse of the whole universe. Inside the black hole, only most compact matter dissociates and reverts to free subquark mass-energy, while partial primordial compact matter is retained. Once the critical dissociation ratio is reached, the black hole tears and erupts. The regenerated subquark mass-energy reattaches to the dark matter skeleton to reform the dark energy derived field, and restarts the low-temperature phase transition to generate baryonic matter.

Low-temperature and high-temperature phase transitions can only occur within their exclusive temperature-pressure intervals, and their conversion paths cannot be swapped or reversed. The two processes connect end to end to form a complete uninterrupted closed circular cycle of mass-energy circulation. α denotes the low-temperature phase transition coefficient, and β denotes the high-temperature phase transition coefficient.

9. Mass-energy Sealing: Mass-energy captured and bound by black holes, neutron stars and white dwarfs permanently breaks away from the low-temperature

phase transition cycle. It is the core dynamic mechanism regulating the transition from cosmic expansion to collapse.

10. Quantum Entropy Reconstruction: A thermodynamic zero-resetting effect unique to the extreme quantum environment inside primordial critical black holes. It can completely offset the accumulated entropy growth of a single cosmic cycle and support infinite cosmic circulation. Ordinary compact celestial bodies do not possess this physical property.

1 Introduction

The standard Λ CDM cosmological model relies on a static cosmological constant to fit observational results of cosmic accelerated expansion, and its theoretical framework has many irreconcilable defects. First, the model cannot explain the long-term stable mass increment source of galaxies, nor fully reproduce the complete evolutionary process of initial deceleration followed by secondary acceleration. Second, the model predicts permanent cosmic expansion and an ultimate heat death without cyclic evolution paths, failing to resolve the spacetime singularity problem. Third, standard dark energy is a fixed constant lacking dynamic mechanisms for bidirectional conversion with baryonic matter, making it difficult to unify the evolutionary correlations among dark energy, dark matter and visible matter.

Existing cyclic cosmic theories are mostly constructed based on singularity bounce and pure geometric revision, generally lacking three core dynamic mechanisms: layered dynamic fields, controllable mass-energy phase transitions, and mass-energy sealing by compact celestial bodies, resulting in fragmented theoretical systems with insufficient self-consistency. To address the above defects, this paper proposes a brand-new two-layer-field cyclic cosmic model, abandons the static dark energy hypothesis, introduces two independent dynamic layers of vacuum background field and dark energy derived field, and establishes global closed-loop temperature-pressure phase transition rules divided by temperature zones. Taking collective mass-energy sealing by black holes, neutron stars and white dwarfs as the switching trigger between expansion and collapse, this paper demonstrates that the stable dark matter skeleton is composed of residual primordial compact matter retained after dissociation inside primordial critical black holes, forms instantaneously under the joint action of long-range gravitational force, spatial tidal force and angular dynamic force and maintains long-term stability, and qualitatively deduces the complete cyclic evolution path of a single cosmic generation. After internal matter of primordial critical black holes reaches the critical dissociation ratio via high-temperature decomposition, the black hole tears and erupts; new spacetime and

the dark matter skeleton generate synchronously and initiate cosmic expansion at the same time; at the late evolutionary stage, all cosmic matter, skeleton and field energy collapse synchronously with spacetime to converge into a new generation of primordial critical black holes, forming a fully symmetric cyclic spacetime evolution logic.

This paper first defines fundamental physical terms and establishes five core dynamic axioms, then comprehensively describes the whole cosmic cycle from cosmic genesis eruption, matter generation, secondary acceleration, expansion stagnation to global collapse in five successive stages. It compares the essential differences between this model and the Λ CDM model, presents six testable and falsifiable theoretical predictions, clarifies the boundary of qualitative research and the expansion direction of subsequent quantitative numerical simulation. The model strictly abides by mass-energy conservation and the thermodynamic law of global entropy increase; only entropy reconstruction inside primordial critical black holes can offset the total entropy growth of a single cycle without thermodynamic paradoxes.

2 Fundamental Axioms and Core Definitions of the Model

2.1 Axiom of Global Mass-energy Conservation

The universe forms an isolated closed thermodynamic system, and the total equivalent mass-energy of the whole cosmos remains constant. Cosmic mass-energy exists in two forms: physical matter with rest mass and equivalent field energy. System evolution only brings about transformation of mass-energy forms and spatial redistribution, while the total mass-energy stays invariant.

$$E = M * c^2$$

E: Total global mass-energy

M: Total cosmic mass

c: Speed of light in vacuum

$$M = M_{DM} + M_{vis} + M_L$$

M_{DM} : Total mass of the dark matter skeleton (the skeleton is composed of residual primordial compact matter retained after dissociation inside primordial critical black holes)

M_{vis} : Total mass of baryonic visible matter

M_L : Equivalent mass of the dark energy derived field

Note: M_{DM} does not participate in phase transitions during low-temperature evolution; only after collapsing into a new primordial critical black hole, most

skeleton matter undergoes high-temperature dissociation while a small amount of primordial compact matter is reserved.

2.2 Axiom of Primordial Critical Black Hole and Global Eruption

The current universe originates from a quantum critical primordial black hole formed by synchronous gravitational spacetime collapse of the previous cosmic generation. The total equivalent mass of this black hole is strictly equal to the total mass of the whole universe.

1. Mass equation

$$M_c = M$$

M_c : Total mass of the primordial critical black hole

M : Total mass of the universe

2. Schwarzschild event horizon radius formula

$$R_s = 2 * G * M_c / c^2$$

R_s : Event horizon radius of the primordial critical black hole

G : Gravitational constant

M_c : Total mass of the primordial critical black hole

c : Speed of light in vacuum

3. Angular momentum conservation formula

$$L = r * m * v = \text{constant}$$

L : Total angular momentum of the system

r : Orbital radius of mass elements

m : Mass of the element

v : Tangential velocity of the element

4. Cosmic expansion rate formula

$$da(t)/dt > 0$$

$a(t)$: Cosmic scale factor

t : Cosmic evolution time

After the primordial critical black hole breaks through the constraint of quantum critical temperature and pressure, internal extreme high temperature and pressure dissociate most compact matter into subquark mass-energy while partial primordial compact matter is retained. Once the dissociation reaches the critical ratio, its event horizon fails. The two types of matter erupt uniformly across the whole space together with compact mass-energy medium. Driven by the combined effect of long-range gravitational force, spatial tidal force and angular dynamic force, it spontaneously forms a stable dark matter fiber skeleton in one go. New cosmic spacetime and the dark matter skeleton generate synchronously,

permanently locking the large-scale topological structure of the universe and triggering cosmic expansion simultaneously.

2.3 Axiom of Repulsion from Double-layer Fields

This paper adopts two independent dynamic fields: vacuum background field and dark energy derived field. The two fields evolve without coupling or superposition and only generate inherent macroscopic repulsion.

The vacuum background field distributes uniformly with constant negative pressure and does not participate in low-temperature phase transitions; the dark energy derived field is formed by subquark mass-energy released via eruption attached to the dark matter skeleton, with properties of energy dissipation, phase transition and reset after collapse.

$$P_{\text{rep}} = k * \sqrt{(\rho_V * \rho_L)}$$

P_{rep} : Mutual repulsion density between the two layers of fields

k : Repulsion constant

ρ_V : Energy density of the vacuum background field

ρ_L : Energy density of the dark energy derived field

2.4 Axiom of Zoned Cyclic Phase Transition Controlled by Temperature and Pressure

Different temperature-pressure intervals of the universe correspond to exclusive one-way mass-energy phase transition paths. The two types of phase transitions are irreversible in time sequence, isolated in environmental conditions and non-reversible in transformation paths, connecting end to end to form a global closed cycle. Under low-temperature and low-pressure conditions, subquark mass-energy inside the dark energy derived field precipitates at low temperature to generate baryonic matter; only inside primordial critical black holes with extreme high temperature and pressure can most compact baryonic matter trapped by compact celestial bodies and primordial compact matter of dark matter skeleton dissociate and revert to free subquark mass-energy, while part of primordial compact matter is retained, and the black hole tears and erupts after reaching the dissociation threshold.

$$dM_L/dt = -\alpha * f(T,P) * M_L$$

d/dt : Time differential operator

α : Low-temperature phase transition coefficient

$f(T,P)$: Temperature-pressure response function for low-temperature zones

M_L : Equivalent mass of the dark energy derived field

T: Thermodynamic temperature

P: Pressure

$$d(M_{DM}+M_{vis})/dt = -\beta * g(T,P) * (M_{DM}+M_{vis})$$

β : High-temperature phase transition coefficient

$g(T,P)$: High-temperature response function inside black holes

M_{DM} : Total mass of the dark matter skeleton (residual primordial compact matter retained after dissociation inside primordial critical black holes)

M_{vis} : Total mass of baryonic visible matter

Remark: Only after collapsing into primordial critical black holes does most M_{DM} participate in high-temperature dissociation with partial primordial compact matter reserved; it remains stable under ordinary low-temperature conditions.

High-temperature dissociation can only occur inside primordial critical black holes, and ordinary compact celestial bodies cannot trigger such reactions.

2.5 Axiom of Mass-energy Sealing by Three Types of Compact Celestial Bodies

Black holes, neutron stars and white dwarfs continuously trap recyclable mass-energy of the whole universe, and the total sealed mass increases monotonically.

$$dM_h/dt \geq 0$$

M_h : Total mass accumulated and sealed by compact celestial bodies

t: Cosmic evolution time

$$M_{cycle} = M - M_h$$

M_{cycle} : Residual mass-energy available for cyclic circulation

M: Total mass-energy of the whole universe

M_h : Total mass sealed by compact celestial bodies

$$dP_{rep}/dt < 0$$

P_{rep} : Mutual repulsion density between the two layers of fields

t: Cosmic evolution time

2.6 Axiom of Thermodynamic Circulation

Entropy increases continuously throughout the ordinary evolution of the universe.

$$dS/dt > 0$$

S: Total entropy of the whole universe

t: Cosmic evolution time

Only the interior of primordial critical black holes supports quantum entropy reconstruction, which can offset all entropy growth of a single cosmic cycle to realize infinite circulation. This paper only carries out qualitative discussion on this effect.

3 Five-stage Complete Cyclic Evolution Mechanism of the Universe

3.1 Cosmic Genesis Eruption and Formation of Dark Matter Skeleton

After internal matter of the primordial critical black hole reaches the critical dissociation ratio via high-temperature decomposition, its event horizon disappears. Residual primordial compact matter retained inside the black hole erupts uniformly and disperses together with all subquark mass-energy of the universe. Driven by the combined effect of long-range gravitational force, spatial tidal force and angular dynamic force, gravitational self-organization instantly forms a dark matter fiber network.

After formation, the topology, composition and mechanical structure of the skeleton stay permanently stable, dividing space into dense fiber regions and cosmic voids. Repulsion from the double-layer fields drives ultra-fast cosmic expansion.

$$d^2a(t)/dt^2 \gg 0$$

a(t): Cosmic scale factor

t: Cosmic evolution time

3.2 Early Cooling Expansion and Matter Generation via Phase Transition

The universe cools down with expansion and pressure decreases. Stable low-temperature phase transitions continuously occur in the dark energy derived field to generate baryonic matter, and galaxies and stellar systems gradually take shape. Populations of compact celestial bodies emerge, the mass-energy sealing mechanism activates, gravity weakens the expansion acceleration, and cosmic expansion slows down.

$$d^2a(t)/dt^2 < 0$$

a(t): Cosmic scale factor

t: Cosmic evolution time

3.3 Steady Accelerated Expansion with Three-way Balance of Double-layer Field Repulsion and Gravity

Three forces reach equilibrium: constant repulsion from vacuum field, dynamic repulsion from dark energy, and global gravitational pull. Gravity decays faster than field energy dissipation as space stretches, and the universe enters a long-term phase of secondary accelerated expansion. Galaxies keep accumulating mass, and compact celestial bodies continuously stockpile sealed mass-energy.

$$d^2a(t)/dt^2 \approx \text{a constant}$$

$a(t)$: Cosmic scale factor

t : Cosmic evolution time

3.4 Late-stage Mass-energy Exhaustion and Expansion Stagnation

Subquark mass-energy inside the dark energy derived field is gradually depleted, phase transitions terminate, repulsive force drops sharply, galaxies stop mass accretion, cosmic expansion decelerates continuously and tends to stagnate, and field repulsion decays to nearly zero.

3.5 Global Collapse and Restart of Cosmic Circulation

When repulsion approaches zero, gravity dominates the entire universe. All matter, dark matter skeleton composed of residual primordial compact matter retained after dissociation inside primordial critical black holes and field energy collapse synchronously with spacetime and converge to form a new generation of primordial critical black holes. High-temperature dissociation takes place inside the black hole, converting most compact baryonic matter and primordial compact matter of dark matter skeleton into free subquark mass-energy while partial primordial compact matter is reserved, together with quantum entropy reconstruction. After reaching the critical dissociation ratio, the black hole tears and erupts, the universe returns to the initial expansion state and starts a new cycle.

$$da(t)/dt < 0$$

$a(t)$: Cosmic scale factor

t : Cosmic evolution time

4 Dynamic Mechanism of Large-scale Cosmic Structure Formation

The large-scale cosmic fiber network, galactic nodes and cosmic voids all form in the instantaneous self-organization stage of cosmic genesis eruption. High-density residual primordial compact mass clumps released by the eruption of primordial critical black holes weave dark matter fibers and galactic anchoring nodes under the joint action of long-range gravitational force, spatial tidal force and angular dynamic force, while sparse regions naturally form voids.

No secondary reconstruction occurs to the dark matter skeleton after formation; it only stretches passively along with cosmic expansion, perfectly matching the stable structural characteristics of early epochs revealed by high-redshift observations. Galaxies evolve into standard disk morphologies relying on the anchoring effect of the skeleton and angular momentum evolution.

5 Self-consistency and Core Dynamic Advantages of the Model

1. Resolve the cognitive conflict of dark energy: The dark matter skeleton composed of residual primordial compact matter retained after dissociation inside primordial critical black holes anchors the dark energy field to avoid dilution by cosmic expansion, and continuous low-temperature phase transitions supply baryonic matter for galaxy growth, solving two contradictory problems that static dark energy in the Λ CDM model cannot address simultaneously.
2. Complete the ending of cosmic evolution: Taking mass-energy sealing by compact celestial bodies as the core switch, a complete closed-loop dynamic chain is established: dissipation of subquark mass-energy in the field $\rightarrow$ weakening of repulsion $\rightarrow$ gravitational collapse. The black hole does not consume all compact matter completely, and residual primordial compact matter supplies raw materials for the next generation of dark matter skeleton, making the circulation logic self-consistent.
3. Avoid singularity and heat death paradox: Exclusive quantum entropy reconstruction inside primordial black holes enables lossless cosmic circulation, while mass-energy conservation and global entropy increase are always satisfied.
4. Clear physical boundaries: Strictly distinguish the properties of double-layer fields, functions of ordinary black holes and primordial critical black holes, and the logic of closed zoned phase transitions. The definition that dark matter skeleton is generated from residual primordial compact matter retained after dissociation inside primordial critical black holes under long-range gravitational force, spatial tidal force and angular dynamic force makes the theoretical system unambiguous and concise; only most baryonic compact matter and dark matter skeleton compact matter dissociate into subquark mass-energy inside primordial critical black holes, and reserved raw materials continuously generate new skeletons without logical contradiction.

6 Testable Predictions of the Model (Falsifiability)

1. The large-scale dark matter skeleton is composed of residual primordial compact matter retained after high-temperature dissociation inside primordial critical black holes, forms once in the extremely early universe under the combined effect of long-range gravitational force, spatial tidal force and angular dynamic force, and undergoes no structural reconstruction throughout the whole evolution cycle;
2. Massive galaxies experience long-term, slow and continuous baryonic mass growth;
3. No dark energy derived field distributes inside cosmic voids, and no new baryonic matter is generated via phase transitions there;
4. The total mass-energy sealed by black holes, neutron stars and white dwarfs of the whole universe increases monotonically with cosmic time;
5. The dynamic variation of cosmic expansion acceleration is strongly coupled with the remaining stock of subquark mass-energy in the dark energy derived field;
6. The late universe will decelerate continuously, expansion will stagnate, and the whole spacetime will eventually fall into synchronous global collapse. The primordial critical black hole formed by collapse only dissociates most compact matter, and residual primordial compact matter is used to construct the dark matter skeleton of the next generation.

All field interaction coefficients, phase transition coefficients and critical temperature-pressure values are only qualitatively assigned in this paper. Precise quantitative fitting, error analysis and numerical modeling are reserved for follow-up research.

7 Discussion

This paper adopts a purely macroscopic evolutionary framework of double-layer fields, completely stripping the microscopic origin of the unified fundamental field. The research topic is single-focused with clear boundaries, fitting the scope of macroscopic cosmology. All evolutionary logic is built based on classical gravity, thermodynamics and field theory, with complete causal chains and no internal contradictions.

7.1 Essential Differences from the Standard Λ CDM Model

Dark energy in the Λ CDM model is a static constant without evolution, dissipation or material conversion, which only predicts permanent expansion and heat death as the final outcome. The dark energy derived field in this paper originates from subquark mass-energy and acts as a real dynamic physical field. Supported by closed zoned mass-energy phase transitions, double-layer repulsion and mass-energy sealing mechanisms, it naturally reproduces multi-stage cosmic evolution and a complete closed circulation, thoroughly filling the gap of dynamic mechanisms in mainstream cosmology.

7.2 Rationality of Dark Matter Skeleton and Zoned Phase Transition

After primordial critical black holes aggregate matter via collapse, internal extreme high temperature and pressure only dissociate most primordial compact matter while partial matter is reserved. Stable large-scale structures form via gravitational self-organization under long-range gravitational force, spatial tidal force and angular dynamic force, conforming to the stable early structural features shown by high-redshift CMB observations. The temperature-pressure zoned cyclic phase transition is a macroscopic evolutionary rule of the universe independent of microscopic particle reactions, with logically self-consistent physical mechanisms. At low temperature, only subquark mass-energy transforms into baryonic matter; at high temperature inside primordial critical black holes, only most baryonic compact matter and dark matter skeleton compact matter dissociate into free subquark mass-energy, and reserved raw materials continuously generate dark matter skeletons for the next generation, forming a consistent mass-energy cycle without conflict.

7.3 Thermodynamic Boundary and Research Scope

Global entropy increase strictly complies with the second law of thermodynamics. Exclusive quantum entropy reconstruction only exists inside primordial critical black holes without breaking universal physical laws. The microscopic quantum mechanism remains complex, so this paper only establishes a qualitative framework without forced quantitative derivation.

7.4 Directions for Further Research

1. Calibration of critical temperature and pressure for zoned cyclic phase transitions;
2. Observational fitting of double-layer repulsion constant and phase transition coefficients;

3. Quantitative calculation of mass-energy sealing ratio and cosmic circulation timescale;
4. Research on critical dissociation ratio of internal matter inside black holes and the microscopic mechanism of quantum entropy reconstruction.

8 Conclusions

Based on the two independent field architectures of vacuum background field and dark energy derived field, this paper constructs a complete closed-loop black hole cosmic recycle model free of spacetime singularity and heat death, supporting infinite cosmic iteration. Through the three-way balance of inherent repulsion between the two fields and global gravity, the observed evolutionary characteristics of cosmic acceleration, deceleration and secondary acceleration are fully explained.

Continuous mass-energy sealing by compact celestial bodies serves as the core dynamic switch driving the transition from cosmic expansion to collapse. The high-temperature mass-energy phase transition and quantum entropy reconstruction inside primordial critical black holes precisely match the low-temperature mass-energy phase transition during the expansion era. Only most compact baryonic matter and primordial compact matter of dark matter skeleton dissociate into free subquark mass-energy under high temperature and pressure inside black holes, with a small amount of primordial compact matter reserved. This forms a fixed, irreversible, end-to-end closed circular mass-energy circulation system that realizes lossless restart of cosmic cycles. The model reasonably interprets the formation mechanism of stable dark matter skeleton which is formed from residual primordial compact matter retained after dissociation inside primordial critical black holes under long-range gravitational force, spatial tidal force and angular dynamic force, and the principle of continuous mass accretion of galaxies. In low-temperature environment, subquark mass-energy transforms into baryonic matter; under high temperature and pressure inside primordial critical black holes, compact raw materials are not completely consumed, and reserved matter continuously constructs dark matter skeletons for the next generation, eliminating internal logical conflict. The whole theoretical system is logically self-consistent and provides multiple falsifiable observational predictions, offering a brand-new and complete theoretical paradigm for research on cyclic cosmology.

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