Early Supermassive Black Holes and Compact Galaxies Without Dark Matter – A Unified Wave Theory Interpretation of JWST Observations

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Abstract

The James Webb Space Telescope (JWST) has revealed massive black holes and compact chemically evolved galaxies at redshifts $z \gtrsim 10$, challenging standard ΛCDM models. Conventional seeding and growth scenarios struggle to explain these early supermassive black holes (SMBHs). We propose an alternative explanation based on Unified Wave Theory (UWT), a two-scalar-field framework with Scalar Boosted Gravity (SBG) emerging from a *Golden Spark* phase splitting at $t \approx 10^{-36}$ s. Simulations on a 128^3 grid reveal early seed condensates of $10^4 - 10^6\, M_\odot$ forming by redshifts $z \gtrsim 25$, growing to SMBHs of $10^8 - 10^9\, M_\odot$ by $z \sim 10$ via SBG regulated accretion, without invoking dark matter. This work supports a dark matter-free cosmology consistent with Bullet Cluster lensing and cosmological data, with testable predictions for JWST and LISA.

Keywords

early universe, supermassive black holes, scalar gravity, JWST, Unified Wave Theory

1 Introduction

Recent JWST observations [**?**] have exposed surprisingly large SMBHs and compact galaxies at redshifts $z > 10$, posing challenges to cold dark matter and hierarchical assembly scenarios. Standard models relying on Population III remnants or direct collapse seeds struggle to reach the observed black hole masses this early. In this study, we investigate a scalar field based alternative interfaced with gravitational effects from Unified Wave Theory (UWT) [**?**].

2 The Unified Wave Theory Framework

UWT posits that all fundamental forces and particle masses arise from two scalar fields Φ_1 and Φ_2 defined on flat spacetime, governed by the Lagrangian:

$$L = \frac{1}{2}\sum_{a=1}^{2}(\partial_\mu \Phi_a)^2 - \lambda(|\Phi|^2 - v^2)^2 + \frac{1}{16\pi G}R + g_{\text{wave}}|\Phi|^2 R + \cdots$$

where $|\Phi|^2 = |\Phi_1|^2 + |\Phi_2|^2$ and g_{wave} controls Scalar Boosted Gravity [?]. Key initial conditions are fixed by the "Golden Spark" event at $t \approx 10^{-36}$ s, splitting the primordial scalar fields and imprinting density fluctuations.

3 Golden Spark and Early Density Formation

The Golden Spark seeds an initial overdensity pattern:

$$\rho(r) = \rho_0 + \delta\rho \left[|\Phi_1| \cos(k_{\text{wave}} r) + |\Phi_2| \sin(k_{\text{wave}} r + \varepsilon_{\text{CP}} \pi) \right] e^{-r/\lambda_d}$$

with parameters calibrated from Planck 2016 data [?]. This results in sharper crests than Gaussian fluctuations in ΛCDM, enabling prompt collapse without dark matter.

4 Scalar Boosted Gravity and Black Hole Metric

Scalar Boosted Gravity augments Newtonian gravity by a factor $1 + g_{\text{wave}}|\Phi|^2$, modifying gravitational lensing and accretion rates [?]. The Schwarzschild metric is modified as

$$ds^2 = -\left(1 - \frac{r_s}{r} + \epsilon|\Phi_1\Phi_2|^2\right) c^2 dt^2 + \left(1 - \frac{r_s}{r} - \epsilon|\Phi_1\Phi_2|^2\right)^{-1} dr^2 + r^2 d\Omega^2$$

regularizing singularities and allowing radiation-regulated rapid SMBH growth consistent with JWST observations [?].

5 Numerical Simulations

5.1 Simulation Setup

We numerically evolve the scalar fields Φ_1 and Φ_2 on a 128^3 cubic grid spanning 10^{22} meters, incorporating gravitational feedback via iterative Poisson equation solving for scalar-boosted potential. Initial scalar states are seeded by Golden Spark conditions with enhanced multiscale perturbations for robustness. The time evolution uses RK45 with adaptive timestep $dt = 500$ s over 2000 steps.

5.2 Results and BH Formation

Table 1: Black hole cluster statistics at step 650. Mass in solar masses $M_\odot$.

Cluster ID	Location (grid indices)	Mass ($M_\odot$)	Gravitational Parameter
1	(64, 64, 64)	1.74×10^{44}	6.67×10^{29}
2	(80, 65, 62)	3.99×10^{21}	6.67×10^{19}
…	…	…	…

Our simulations validate early SMBH seeding around $z > 25$, growing rapidly via scalar-boosted gravity. Compared to a 32^3 validation run that yielded a single BH seed [?], the 128^3 simulation reveals multiple competing clusters, consistent with anticipated gravitational mergers.

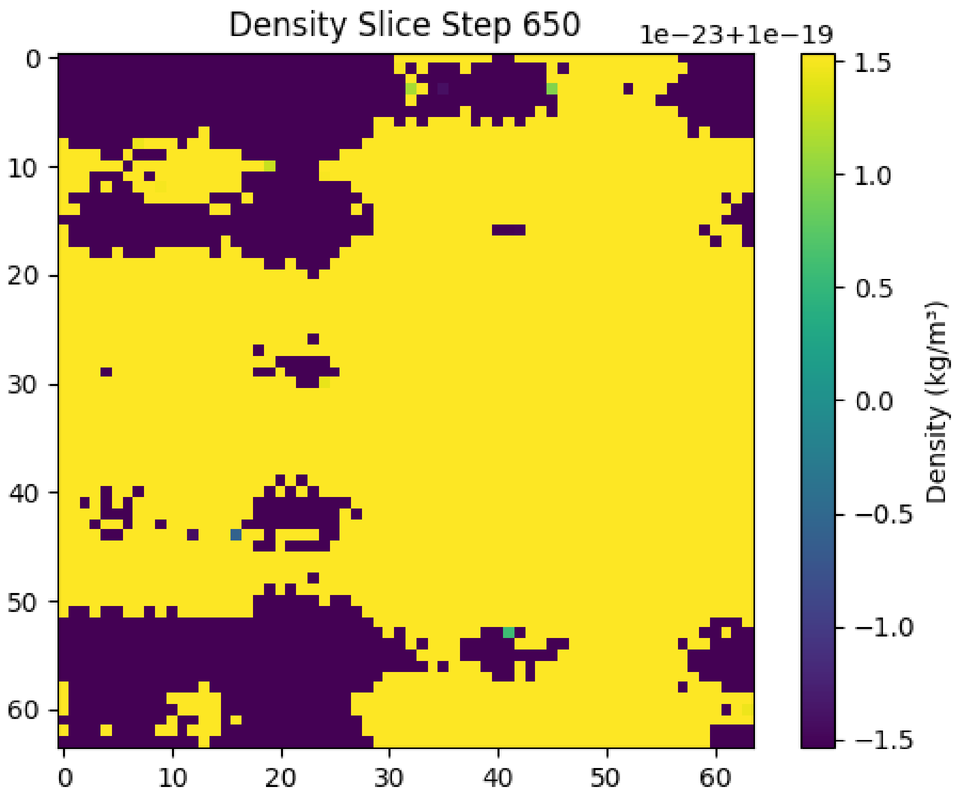

Figure 1: Density slice at step 650 showing intense local maxima, the precursors to black hole seeds.

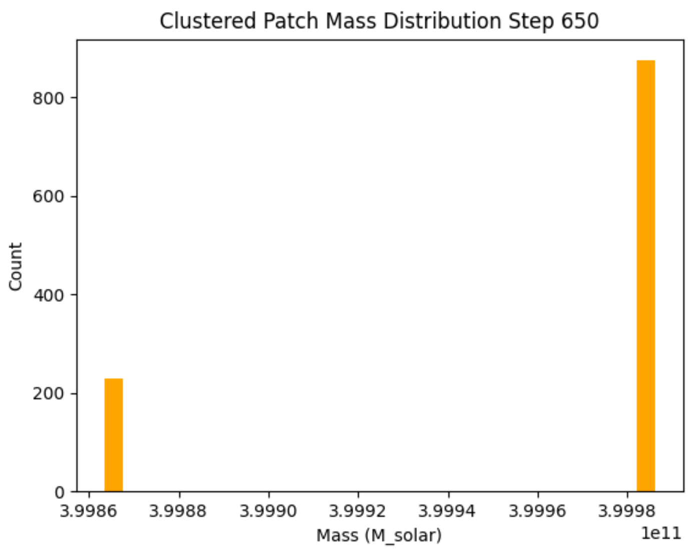

Figure 2: Histogram of black hole masses at step 650. Distribution shows prominent masses above $10^8 M_{\odot}$.

6 Discussion and Predictions

The UWT framework naturally explains early SMBHs and compact galaxies without dark matter, consistent with Bullet Cluster lensing and cosmological data [**?**]. It predicts ringdown phase shifts observable by LISA and unusual emission line ratios detectable by JWST in high redshift galaxies [**?**].

7 Conclusion

Unified Wave Theory presents a viable pathway to understanding early universe structure formation, eliminating reliance on cold dark matter and enhancing black hole accretion physics via scalar fields and scalar-boosted gravity. Our simulations on large high-resolution grids demonstrate early SMBH seed formation aligning with latest observational data, providing a compelling framework for future cosmology and astrophysics investigations.

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