Dark Genesis Theory Summary

Dark Genesis Theory: Cosmological and Theoretical Evidence

Dark Genesis posits that the Dark Sector (dark matter + dark energy) preceded normal matter, with a fraction converting into baryons at the Big Bang. This theory explores whether baryons emerged from an early dark fluid via a vacuum instability.

1. Dark Sector Conversion to Baryons

Dark Genesis suggests baryons originated from the dark substrate. Standard models achieve baryogenesis via other means (e.g., leptogenesis). The baryon density today is ~4.9% [Planck 2018](https://arxiv.org/abs/1807.06209). Some models propose asymmetric dark matter decay to baryons [Borah et al. 2023](https://arxiv.org/abs/2305.18572), [Alexander et al. 2018](https://arxiv.org/abs/1807.08192), [Buchmüller et al. 2010](https://arxiv.org/abs/1007.2378), and [Durrani 2025](https://vixra.org/abs/2405.0119).

2. Expansion History and Dark Substrate Depletion

Dark Genesis predicts cosmic acceleration should slow as dark substrate converts. Yet all current data favor constant dark energy (Lambda) [Planck 2018](https://arxiv.org/abs/1807.06209). Some decaying vacuum models (e.g., [Chander & Singh 2025](https://arxiv.org/abs/2405.10568), [Tong & Noh 2011](https://arxiv.org/abs/1106.0061)) mimic LambdaCDM but do not show definitive slowdown.

3. Vacuum Energy and Instability

Vacuum decay could explain baryon emergence. False vacuum decay scenarios are discussed by

[Buchmüller et al. 2010](https://arxiv.org/abs/1007.2378). Laboratory analogs have simulated vacuum decay [Polozov et al. 2022](https://www.scientificamerican.com/article/the-quantum-vacuum-is-real-and-has-been-seen-in-the-lab/). No direct evidence of such a cosmological transition exists.

4. Cosmic Voids as Unconverted Regions

Voids are underdense but not empty. Simulations show voids contain 20% of baryons [Haider et al. 2016](https://arxiv.org/abs/1605.01409). Observations match LambdaCDM predictions [Cautun et al. 2014](https://arxiv.org/abs/1405.5885). No evidence for unconverted dark substrate exists in voids.

5. Summary

Dark Genesis remains speculative. Models show it's theoretically possible, but there's no observational necessity. Current data from Planck, BAO, SN, voids, and particle physics experiments align with LambdaCDM, not Dark Genesis.

References include:

- [Planck Collaboration 2018](https://arxiv.org/abs/1807.06209)
- [Alexander et al. 2018](https://arxiv.org/abs/1807.08192)
- [Buchmüller et al. 2010](https://arxiv.org/abs/1007.2378)
- [Durrani 2025](https://vixra.org/abs/2405.0119)
- [Chander & Singh 2025](https://arxiv.org/abs/2405.10568)
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