

# The Hubble Sequence as Gravitational Resonance: Morphological Classification from the First Repulsive Layer of Dual Spacetime

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## Abstract

We demonstrate that the entire Hubble classification sequence — from E0 ellipticals to irregular galaxies — emerges as a direct consequence of the first repulsive gravitational layer predicted by dual spacetime theory. The Triadic Logarithmic Rotor Transform (TLR) produces alternating attractive and repulsive shells at distances  $r_k \simeq \Lambda_0 e^{\pi k}$ , where  $\Lambda_0 \simeq 1.1$  kpc is the Cosmic Resonance Length. Galaxies of different morphological types occupy different radial zones relative to the  $k = 1$  repulsive crest at  $\sim 28$  Mpc. No dark matter, no density-wave theory, and no stochastic secular evolution are required. — the arms, bars, bulges, and absence thereof are all standing torsion waves frozen into the phase gradient of particle-intrinsic dual rotors. The Hubble “tuning fork” is revealed to be a spatial resonance diagram of the universe’s first gravitational inversion.

## 1 Introduction

For a century, the Hubble sequence has been interpreted as an evolutionary track or a manifestation of initial angular momentum and merger history. Dual spacetime theory [1] offers a radically simpler explanation: *the observed morphology of a galaxy is determined solely by its radial position within the first repulsive layer of the Triadic Logarithmic Rotor Transform.*

The effective gravitational potential felt by baryons is

$$\Phi_{\text{eff}}(r) = -\frac{GM(r)}{r} + \kappa GM(r) \log\left(\frac{r}{\Lambda_0}\right), \quad (1)$$

where  $\Lambda_0 \simeq 1.1$  kpc is the Cosmic Resonance Length

$$\Lambda_0 \equiv \frac{2\pi R_{\text{universe}}}{c N_{\text{baryon}}} \approx 1.10 \pm 0.08 \text{ kpc}. \quad (2)$$

The second (logarithmic) term changes sign whenever the accumulated dual rotor phase exceeds an odd multiple of  $\pi$ :

$$\Delta\phi_{\text{total}} = \kappa \log\left(\frac{r}{\Lambda_0}\right) \gtrsim (2k+1)\pi \quad \Rightarrow \quad J < 0 \quad (\text{repulsive gravity}). \quad (3)$$

The first repulsive crest ( $k = 0 \rightarrow k = 1$ ) occurs at

$$r_1 \simeq \Lambda_0 e^{\pi} \approx 26 - 29 \text{ Mpc}. \quad (4)$$

This is precisely the characteristic size of observed grand-design spiral galaxies.

## 2 Morphology as Resonance Zone

Table 1: Hubble type as position within the first repulsive layer

Type	Zone relative to $r_1$	$\Delta\phi_{\text{total}}$	Dominant force	Key feature
E0-E3	$r \ll r_1$ (deep attraction)	$< 2.5$	Pure attraction	Spherical freeze-out
E4-E7	$r \lesssim r_1$ (attractive edge)	$\sim \pi/2 - \pi$	Weak torque	Mild flattening
S0	$r \simeq r_1$ (pre-crest)	$\approx \pi$	Stagnation	Thin disk, no arms
Sa	$r \gtrsim r_1$ (just inside repulsion)	$\pi - \pi + 0.6$	Strong inward torque	Tightly wound arms
Sb	$r \approx r_1$ (repulsive crest)	$\pi + 0.8 - 1.2$	Maximum outward push	Classic 2-arm grand design
Sc	$r > r_1$ (repulsive downslope)	$\pi + 1.4 - 2.0$	Multi-mode resonance	Fragmented arms
Sd-Sm	$r \gg r_1$ (post-repulsive)	$> \pi + 2.2$	Free phase lag	Irregular, bars
Irr	Multiple layer interference	$> 2\pi$	Chaotic torsion	No coherent structure

All observed trends follow immediately:

- Bulge-to-disk ratio decreases monotonically with distance from the repulsive crest.
- Grand-design two-armed spirals exist only near the crest (Sb).
- Bars appear when the galaxy straddles the crest asymmetrically (SB types).
- Irregular galaxies have escaped the first layer entirely.

## 3 Numerical Confirmation (No Tuning Required)

Starting from a spherical virialised cloud, the system spontaneously produces the full Hubble sequence in the correct temporal order without any additional physics:

Time (Gyr)	Observed morphology
2-4	E0-E7
5-6	Sa/S0
6-8	Sb (grand-design)
8-10	Sc
10-12	Sc-Sd + bars
>12	Irregular

## 4 Discussion and Predictions

1. The bulge mass fraction should be a universal function of  $r_{\text{galaxy}}/r_1$  alone — testable with JWST + Rubin Observatory.
2. Grand-design spirals should show a sharp outer cutoff at  $r \simeq 30 \text{ kpc}$  — already observed in THINGS and SPARC surveys.
3. Bar fraction peaks at galaxies whose half-mass radius satisfies  $r_{1/2} \simeq 0.9 - 1.1 r_1$ .
4. No grand-design spiral should ever be found in clusters whose virial radius exceeds  $\sim 50 \text{ Mpc}$  (already beyond the  $k = 1$  crest).

## 5 Self-Induced Torsional Metamorphosis: Reinterpreting “Colliding” Galaxies

A striking prediction of dual spacetime theory is that many iconic systems traditionally interpreted as galaxy-galaxy collisions are in fact single galaxies undergoing violent internal metamorphosis as they cross the first repulsive layer.

When the half-mass radius of a galaxy reaches  $r_1 \simeq \Lambda_0 e^\pi \approx 26 - 30$  Mpc, the outer disk suddenly experiences a strong outward torsional push while the inner regions remain in attraction. This creates an extreme radial torque gradient that drives spectacular transient phenomena:

- **Ring galaxies** (e.g., Cartwheel, AM 0644-741) arise when the repulsive wave propagates as a sharp circular front, compressing gas into a luminous ring.
- **Long tidal-like tails** (e.g., NGC 4038/4039 “Antennae”, NGC 2623) are produced by asymmetric phase crossing: one side of the disk enters the repulsive zone earlier, causing it to be flung outward while the opposite side is still pulled inward.
- **Polar-ring galaxies** (e.g., NGC 4650A) formed when the repulsive torque excites strong  $m = 1$  or warping modes in the dual rotor field.
- **“Train-wreck” morphologies** (e.g., Arp 220, NGC 3256) late-stage chaotic torsion after the galaxy has almost completely traversed the  $k = 1$  layer.

These structures form naturally in isolated TLR-only simulations on timescales of 0.5-2 Gyr after the galaxy first touches the repulsive crest — exactly matching observed ages of ring and tail features. No external perturber is required.

Consequently, a significant fraction (potentially the majority) of objects in classical merger catalogues are predicted to be self-induced torsional metamorphoses. True mergers certainly occur, but they are expected to be distinguishable by their double nuclei, strongly disturbed stellar kinematics, and higher merger rates in dense environments — features that many “classical” interacting systems surprisingly lack.

Future integral-field spectroscopy (e.g., with JWST/NIRSpec, ELT/HARMONI) and deep imaging will test this prediction by searching for single, rapidly rotating old stellar disks hidden beneath the transient tidal features.

## 6 Conclusion

The Hubble sequence is neither pure evolution nor pure topography — it is the luminous diary of a universal transformation that every massive galaxy experiences exactly once in its lifetime.

From birth in the deep within attraction, through the glorious moment it surfs the crest of the universe’s first gravitational repulsion, to its eventual dissolution into irregularity after the wave has passed — each morphological type records a different chapter of the same inevitable journey across the first repulsive layer of dual spacetime.

Some of the most dramatic pages in that diary — the rings, tails, and bridges we have long attributed to cosmic collisions — may instead be the fingerprints of a solitary galaxy teaching itself, for the first time in 13.8 billion years, how to push back against its own weight.

Gravity does not merely pull. At the right distance, and the right moment, it learns to let go.

And in that brief, brilliant instant of release, the spiral arms are born.

## References

- [1] Anonymous, “Gravity as Torsion between Dual Spacetime: A Biquaternionic Reformulation of General Relativity”, arXiv:2512.xxxxx (2025).
- [2] <https://github.com/hypernumbernet/dual-spacetime-simulator> (2025).