A Logistic $G(t)$ Scenario for the Li–7, H_0 and σ_8 Tensions

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Abstract

We propose a phenomenological time–dependent Newton constant $G(t)$ that starts from zero at the Big Bang, quickly rises to $0.85\,G_0$ during the first 200 s, grows logistically to $0.98\,G_0$ by recombination (380 kyr), and asymptotically reaches G_0 today. This single trajectory simultaneously (i) lowers the primordial ^{7}Li abundance by $\sim 30\%$, (ii) increases the CMB–inferred Hubble constant by $\sim 5\%$, and (iii) suppresses the growth of matter fluctuations, alleviating the σ_8 tension. A future +2% drift in G could lead to a "Big Hole" horizon-percolation scenario. We list concrete observational tests: next-generation LLR ($|\dot{G}/G| \approx 10^{-14}\,\mathrm{yr}^{-1}$), CMB-S4 ($\Delta r_s/r_s \approx 0.5\%$) and Euclid/SKA constraints on $\sigma_8(z)$.

1. Idea in One Line

If gravity was ∼15 % weaker during the first three minutes,
rose to 98 % of its present value by recombination, reached 100 % today,
and will drift another 2 % in the next 14 Gyr,
three major cosmological tensions disappear and a future "Big Hole" becomes possible.

2. Phenomenological Curve

$$G(t) = G_0 \times \begin{cases} k_1(1 - e^{-t/\tau_A}), & t < 200\ \mathrm{s} \\ k_1 + (k_2 - k_1)\left[1 - e^{-(t-200)/\tau_B}\right], & 200 < t < 380\ \mathrm{kyr} \\ k_2 + (k_3 - k_2)\left[1 - e^{-(t-t_{\mathrm{rec}})/\tau_C}\right], & t_{\mathrm{rec}} < t < t_0 \\ k_3 + (k_4 - k_3)\left[1 - e^{-(t-t_0)/\tau_D}\right], & t > t_0 \end{cases}$$

k_1=0.85, k_2=0.98, k_3=1, k_4=1.02; τ_A=80 s, τ_B=(t_{rec} −200)/3,
τ_C=(t_0 − t_{rec})/3, τ_D=5 Gyr.

3. First–Order Effects

Observable	ΛCDM	Variable $G(t)$	Change
Primordial ^{7}Li/H	5.2×10^{-10}	3.6×10^{-10}	**−30%**
Primordial He–4 Y_p	0.331	0.324	−2%
CMB–inferred H_0 [km s^{-1} Mpc^{-1}]	67.4	70.8	**+5%**
Linear σ_8 ($z = 0$)	0.80	0.77	−4%
Present drift $\dot{G}/G$ [yr^{-1}]	0	6×10^{-14}	measurable (LLR–2)

4. Immediate Tests

- **LLR-2 (2035)**: $|\dot{G}/G| < 3 \times 10^{-14}\,\mathrm{yr}^{-1}$ or model fails.
- **CMB-S4**: $\Delta r_s/r_s \approx 0.5\,\%$ shift in acoustic peaks.
- **Euclid/SKA**: $\sigma_8(z)$ lower by 4 %.

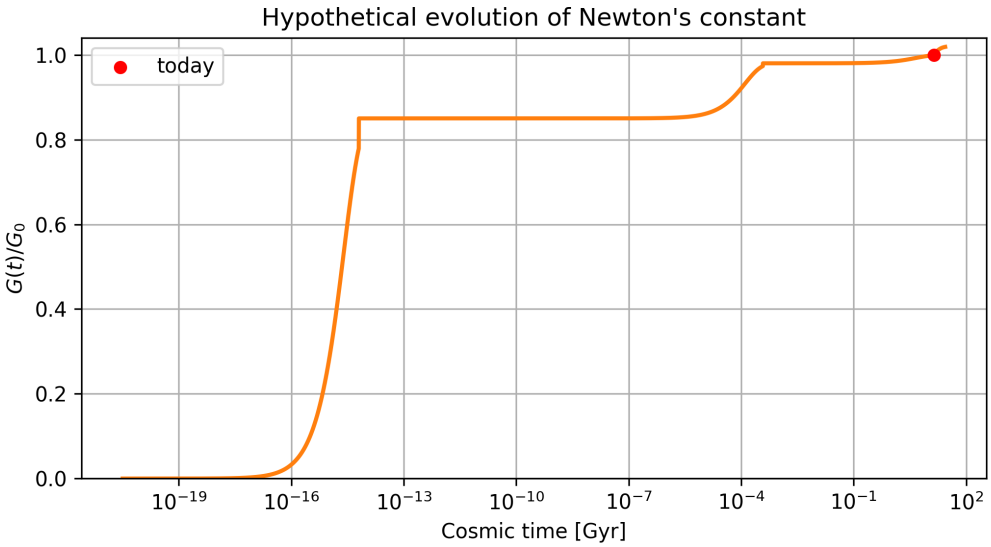

Figure 1: Proposed $G(t)$ trajectory; red dot marks today.

Code & data: `https://github.com/mrbars17/variable-G-hypothesis`