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We make the observation that **baryon asymmetry**, as observed in the universe, **can be generated thanks to the metric perturbations** originated during cosmological inflation, with no need to introduce new phenomenology. We analyse the inflationary and reheating scenarios in which the produced asymmetry is enhanced.

MOTIVATION

Baryon asymmetry

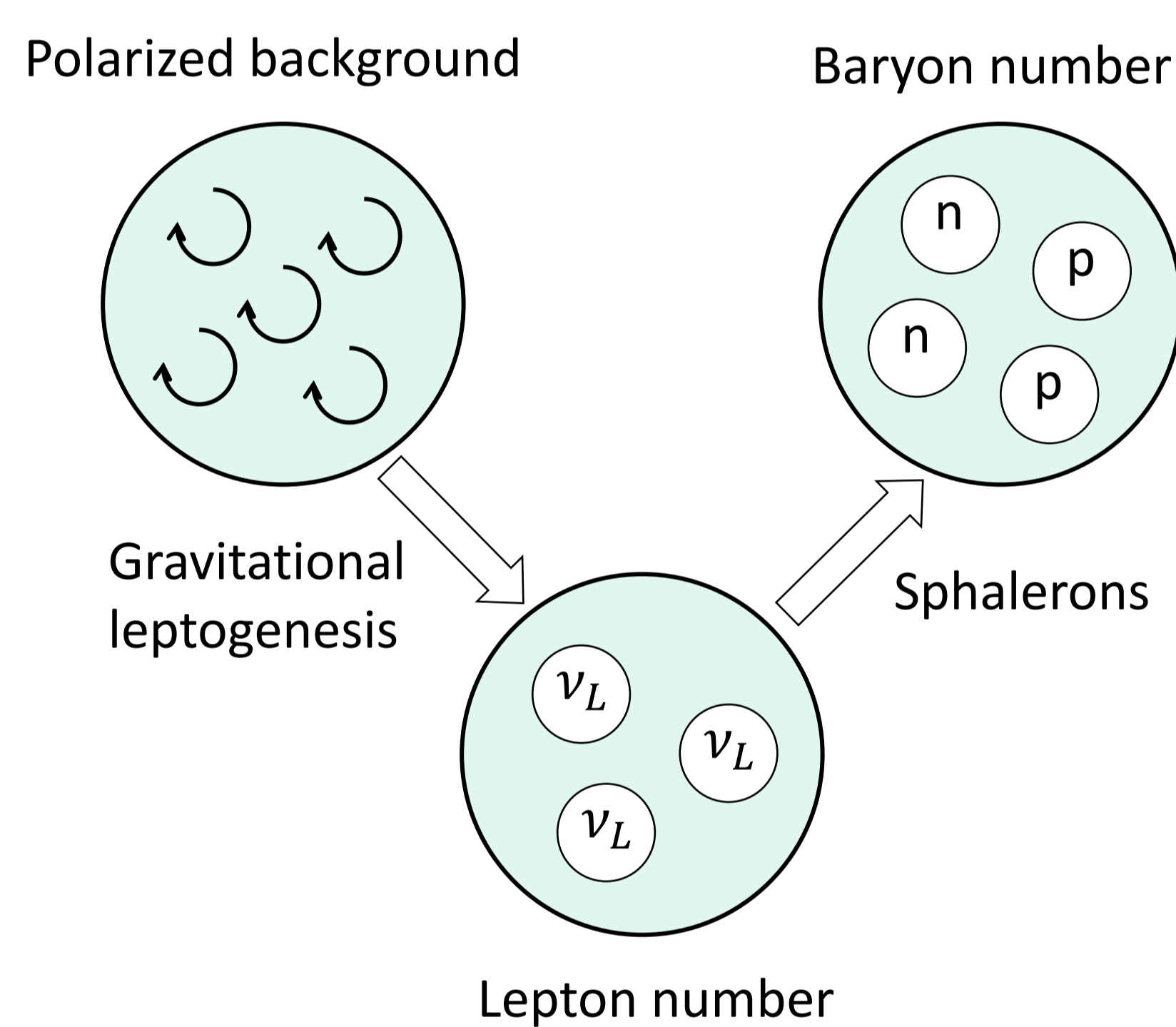
The excess of matter over antimatter is one of the long-standing problems in cosmology. The latest Planck measurements put this asymmetry at

$$\frac{n_B - n_{\bar{B}}}{s} = (8.718 \pm 0.004) \times 10^{-11}$$

This amount that **cannot be originated** only with processes **within the Standard Model**.

Gravitational leptogenesis

Leptogenesis is one of the most interesting proposals to generate baryon asymmetry. If **lepton number violation** is achieved by some mechanism, this **can be translated into baryon number** through electroweak *sphaleron* processes.



The *gravitational leptogenesis* proposal relies on a spacetime with a **gravitational-wave background with a preferred handedness**. This chirality triggers the generation of leptons through the **chiral gravitational anomaly**, which can occur because there are **no right-handed neutrinos** in the Standard Model.

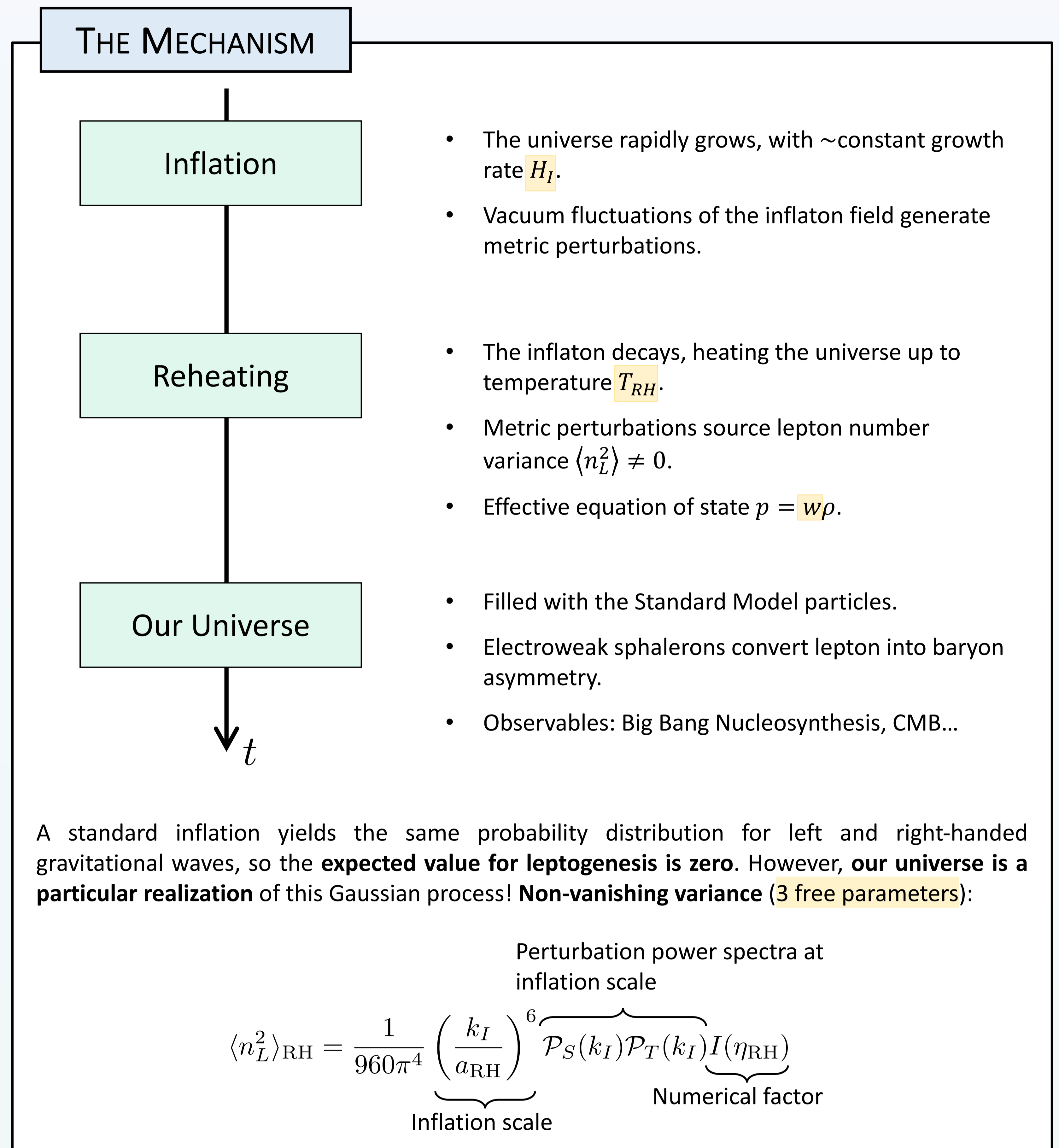
"Right" minus "left" particles (-3 in the SM)

$$\nabla_\mu J_L^\mu = \frac{N_{R-L}}{24(4\pi)^2} R\tilde{R}$$

Lepton number divergence

Topological source

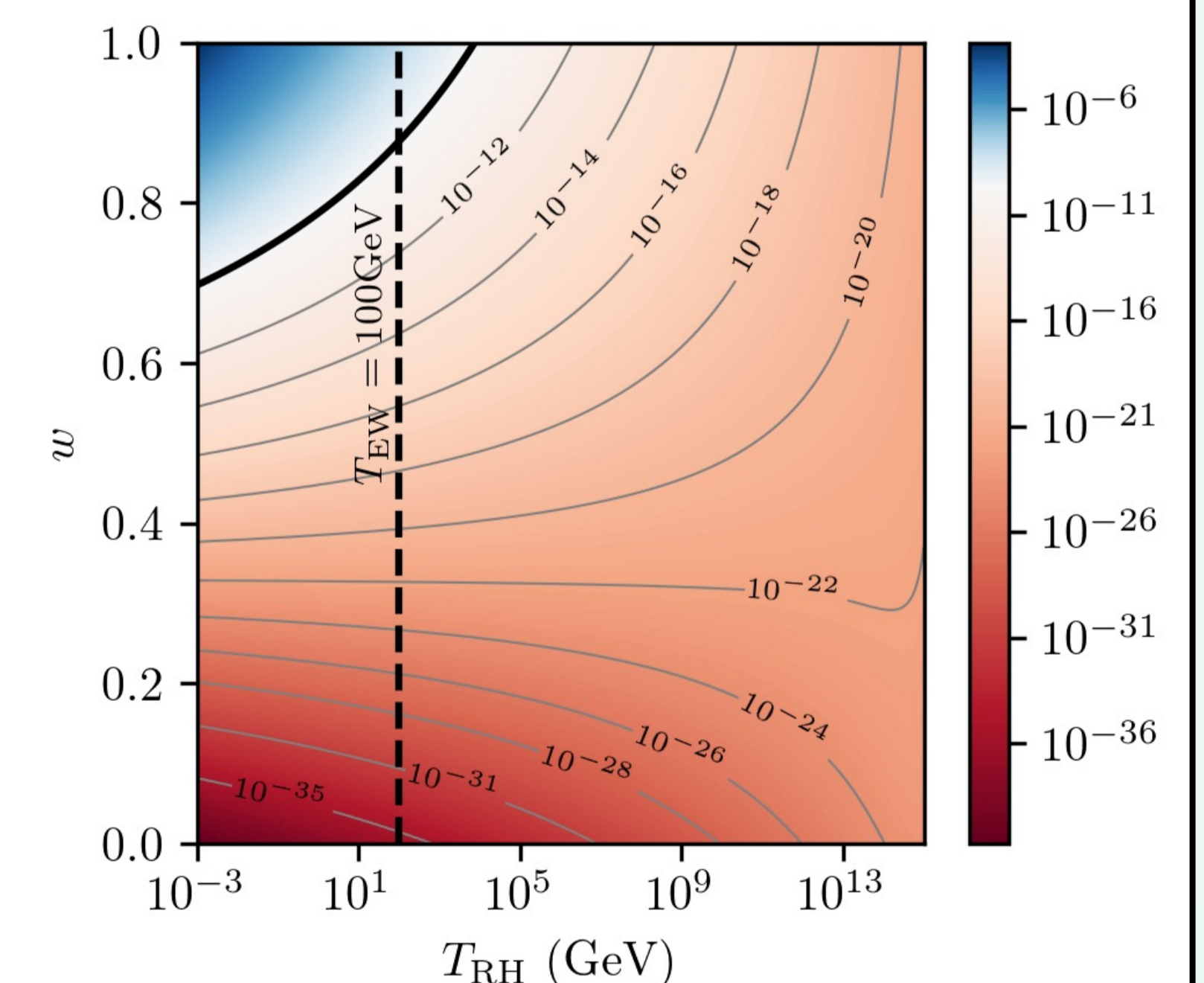
THE MECHANISM



$$\langle n_L^2 \rangle_{RH} = \frac{1}{960\pi^4} \underbrace{\left(\frac{k_I}{a_{RH}}\right)^6}_{\text{Inflation scale}} \underbrace{\mathcal{P}_S(k_I)\mathcal{P}_T(k_I)}_{\text{Perturbation power spectra at inflation scale}} \underbrace{I(\eta_{RH})}_{\text{Numerical factor}}$$

RESULTS

- The figure shows the predicted baryon asymmetry rms for different reheating temperatures T_{RH} and equations of state w , at fixed inflation scale $H_I = 10^{13}$ GeV.
- The solid black line corresponds to the **observed abundance**, whereas red and blue regions depict under and overproduction, respectively.
- Production is enhanced for **low reheating temperatures** and **stiff ($w > 1/3$) equations of state**.



CONCLUSIONS

- Gravitational leptogenesis is a suitable mechanism for generating baryon asymmetry even without new couplings.**
- High inflation energy scales, and low-temperature stiff reheating** scenarios enhance this mechanism.
- Stiff reheating increases small-scale gravitational-wave amplitude: Possibility to test with future gravitational-wave detectors (ongoing work).

REFERENCES

- Antonio L. Maroto, Alfredo D. Miravet, 2207.00465.
- S. H.-S. Alexander, M. E. Peskin, and M. M. Sheikh-Jabbari, Phys. Rev. Lett. 96, 081301 (2006), hep-th/0403069.
- A. Papageorgiou and M. Peloso, JCAP 12, 007 (2017), 1708.08007.