Low-Energy Tests of Leptogenesis Scenarios within the Type-I Seesaw Extension

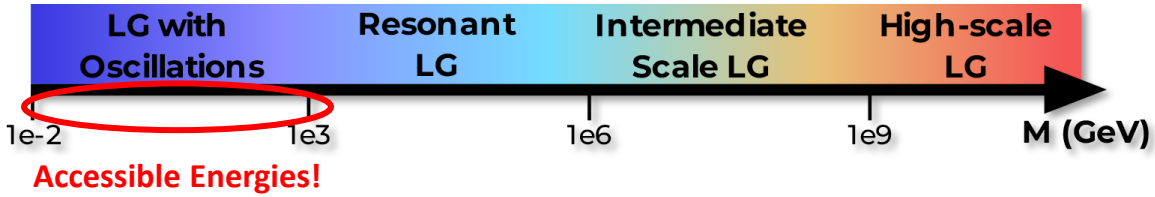
Type-I seesaw mechanism for neutrino mass generation

$$\mathcal{L}_{Y,M}(x) = -\left(Y_{\alpha j}\overline{\psi_{\alpha L}}(x)\, i\sigma_2\, \Phi^*(x)\, N_{jR}(x) + h.c.\right) - \frac{1}{2} M_j\, \overline{N_j}(x)\, N_j(x) \quad \xrightarrow{\text{EWSSB}} \quad m_\nu \simeq -(v^2/2) Y \widehat{M}^{-1} Y^T$$

Leptogenesis (LG) within the type-I seesaw extension

L-, C- and CP-violating, out-of-equilibrium processes involving the **RHNs**, the **Higgs** and **leptons generate** an early **lepton asymmetry**, translated into the present **BAU** by **sphalerons**

LG scales

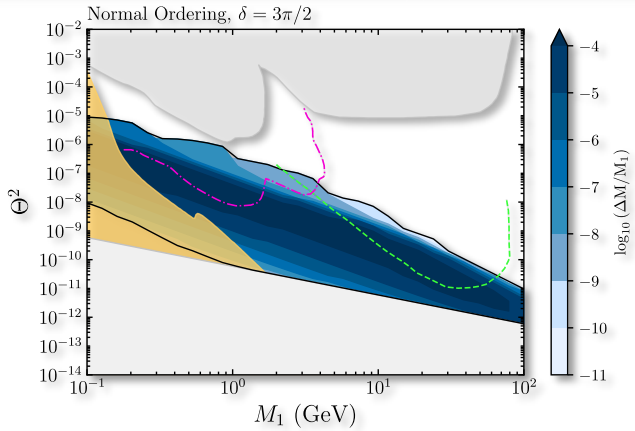


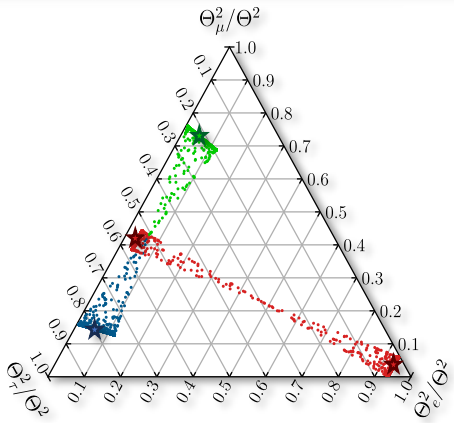
Low-energy leptonic CP-violation

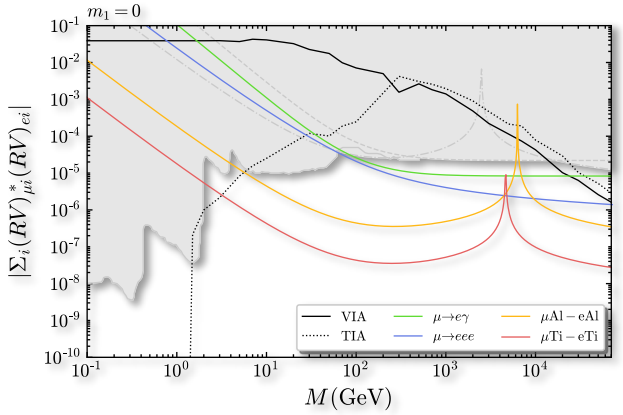
The **PMNS phases** as **the only source of CP-violation**.
LG via oscillations works with **CPV** only **from** the **Dirac phase**, with connections to HNL searches and neutrino oscillations.

Charged lepton flavour violating processes

Planned and upcoming **experiments on cLFV** with μ± (MEG II,Mu3e Mu2e, COMET and PRISM/PRIME) can **probe leptogenesis** with **three quasi-degenerate** in mass **RHNs**.







A.G., S. Pascoli, S. T. Petcov, arXiv:2307.07476

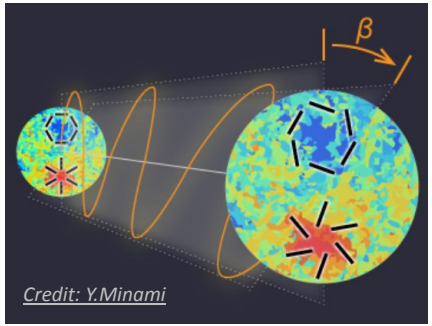
A.G., J. Klarić, S. T. Petcov, arXiv:2206.04342

Searching for signatures of new physics in the CMB: constraints on Cosmic Birefringence

What is Cosmic Birefringence?

Frequency independent rotation of the polarization plane of linearly polarized radiation.

Most promising target: *Cosmic Microwave Background (CMB)*



- Study of the *optical properties* of our Universe
- Insights on the physics of the *Early Universe*

Our method

Harmonic estimator for the Cosmic Birefringence field

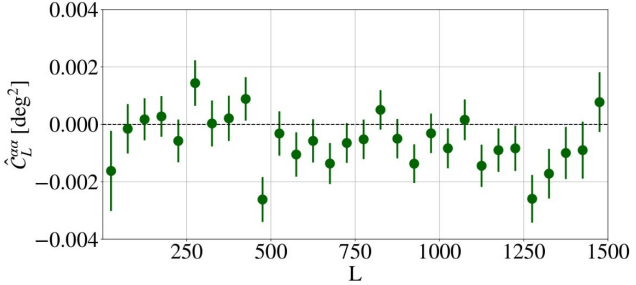
$$\hat{\alpha}_{LM} \propto \frac{1}{\sigma_L^{-2}} \sum_{\ell\ell' mm'} a_{\ell m}^{E,map} a_{\ell' m'}^{B,map,*} K_{\ell\ell' mm'}^{LM}$$

De-biasing procedure to end up with an estimate of the Cosmic Birefringence *power spectrum*

$$\hat{C}_L^{\alpha\alpha}$$

Results

Estimate of the Cosmic Birefringence power spectrum from *Planck PR3* CMB polarization maps



Forecasts: Planck *vs.* forthcoming CMB experiments

Improvements *wrt* Planck	
LiteBIRD	~ 5
Simons Observatory LAT	~ 9
CMB-S4	~ 10

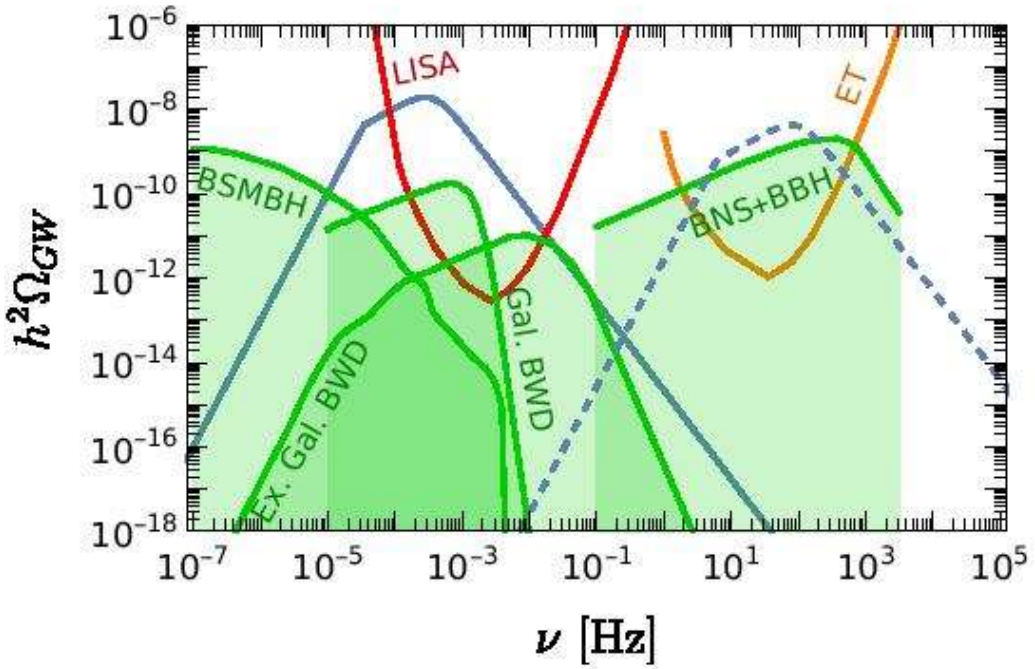
Baryogenesis from Supercooled Confinement

Key message: new framework for Baryon asymmetry from TeV to much higher scales

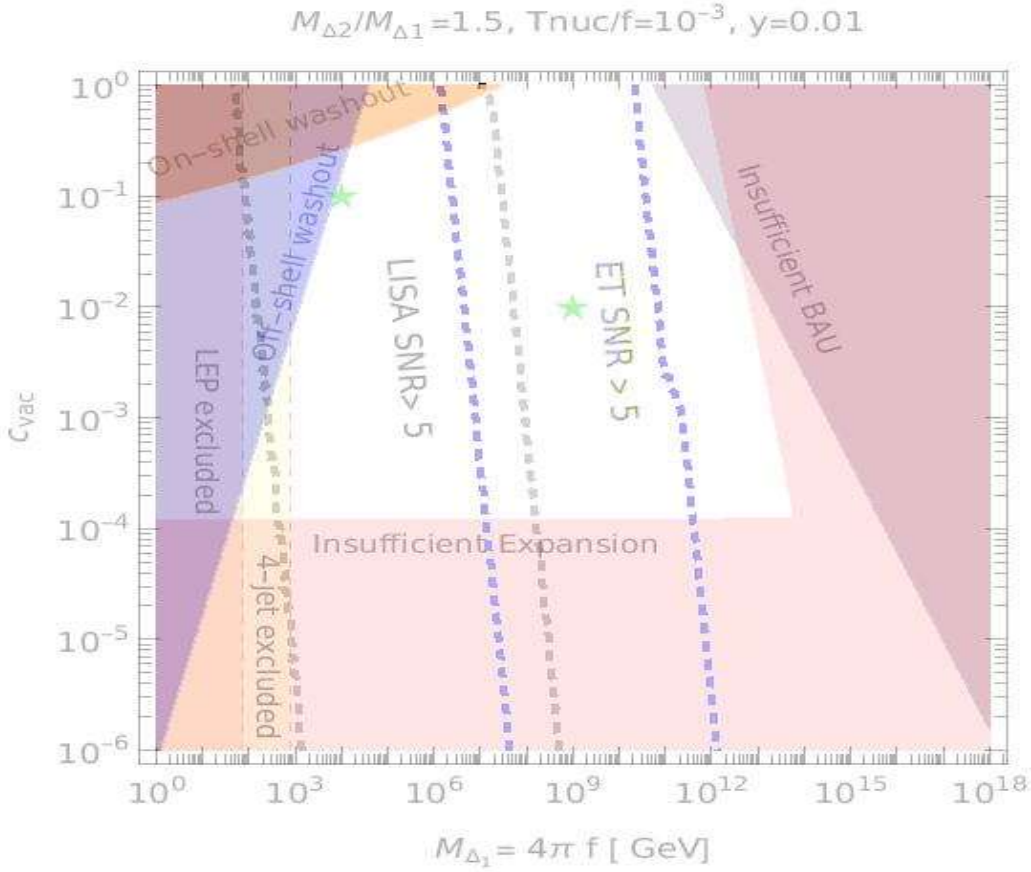
M.Dichtl, J.Nava, S.Pascoli, F.Sala
arXiv: 2310.xxxxx

- 1st order phase transition, VEV f
- Supercooling, bubbles nucleate at T<<f
- Extended parameter space as $M_{hadr} = 4\pi f$, washout suppressed

Gravitational Waves signal expected



Δ heavy scalar, testable at colliders+GW: no EDMS



Sterile fermion is also fine!