LEPTOPHILIC Z' MODEL: HUBBLE TENSION AND CMB CONSTRAINTS

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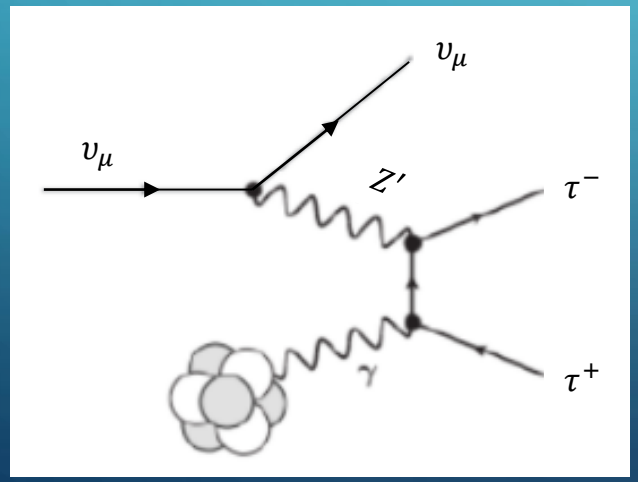
CoCo 2020

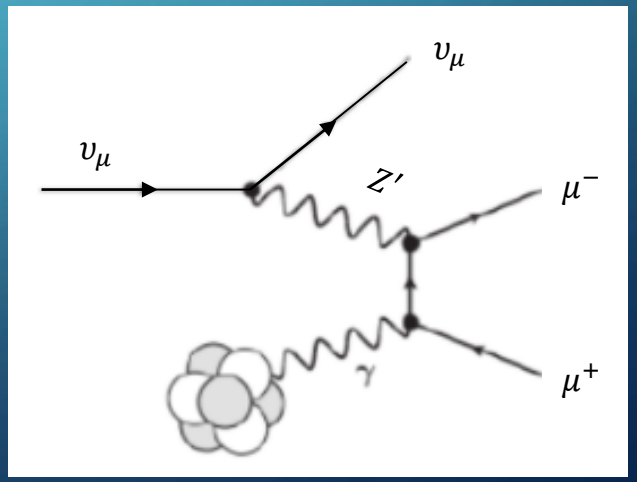
MOTIVATION AND MODEL BUILDING

Particle	SM	$U(1)_{L_\mu - L_\tau}$
(L_e, L_μ, L_τ)	$(1,2)_{-\frac{1}{2}}$	$(0, +1, -1)$
(e_R, μ_R, τ_R)	$(1,1)_{-1}$	$(0, +1, -1)$

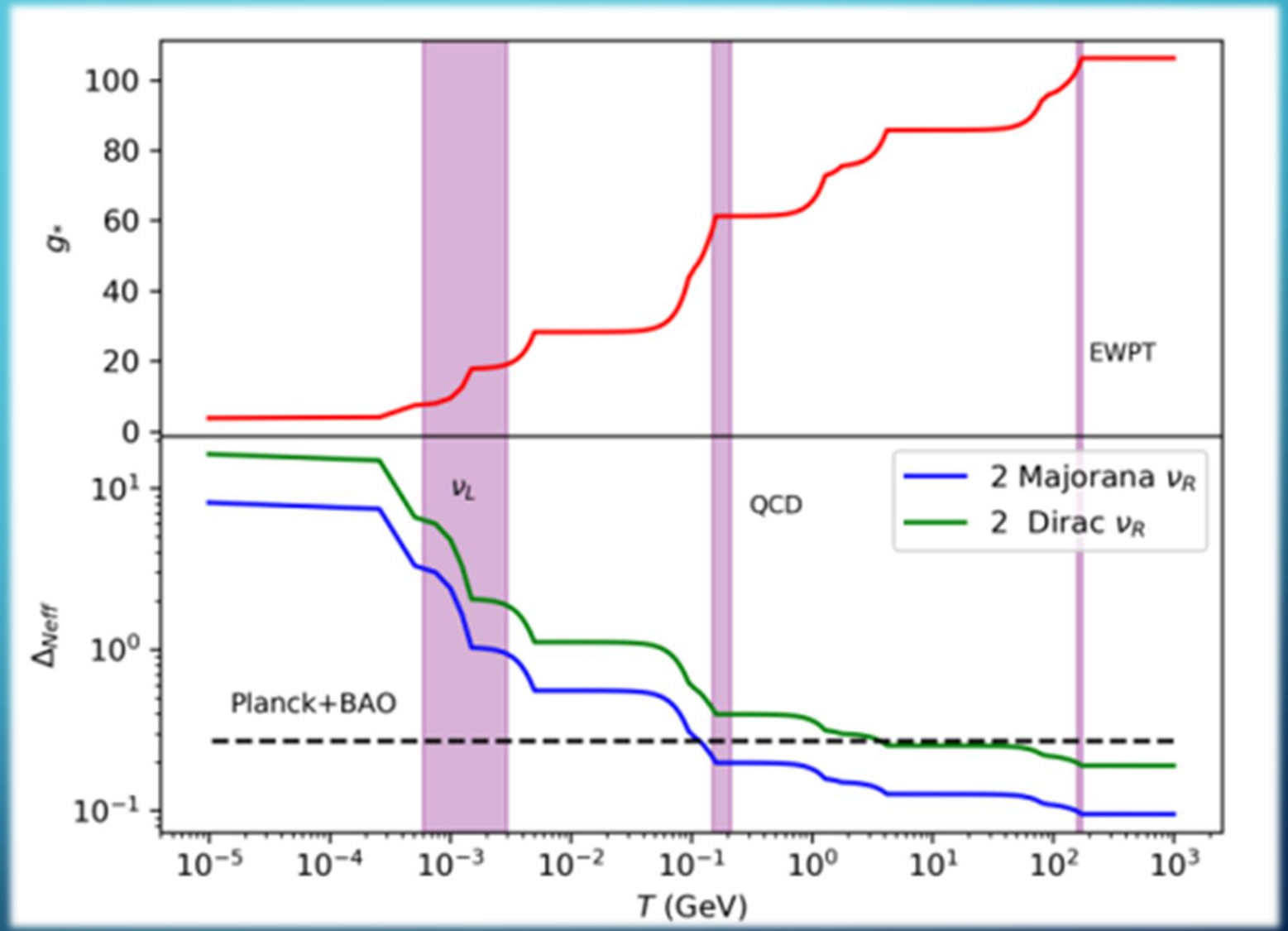
$U(1)_{Z'}^3$,

$$\sum_\alpha [2(Q_\alpha^L)^3 - (Q_\alpha^R)^3] - \sum_N Q_N^3 = 0$$





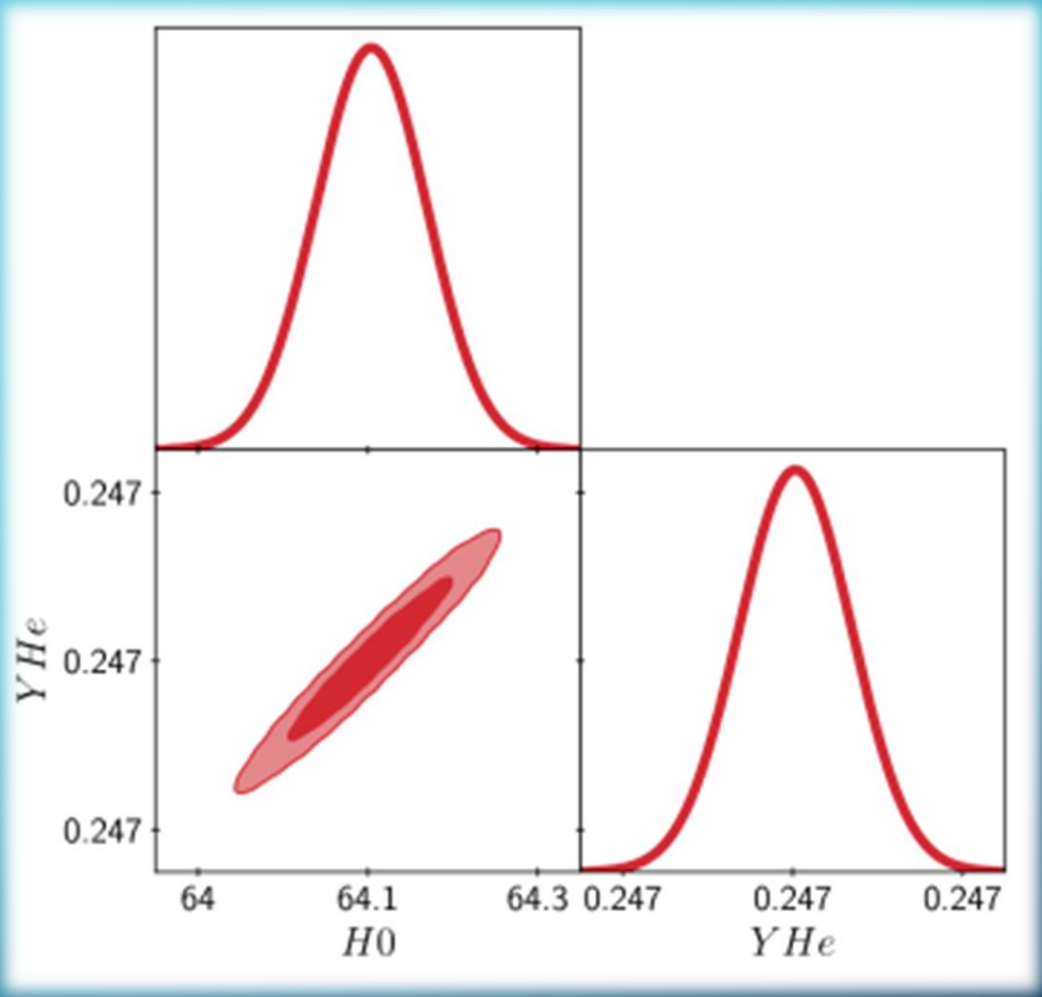
ΔN_{eff} induced by Right-handed neutrinos



[1]

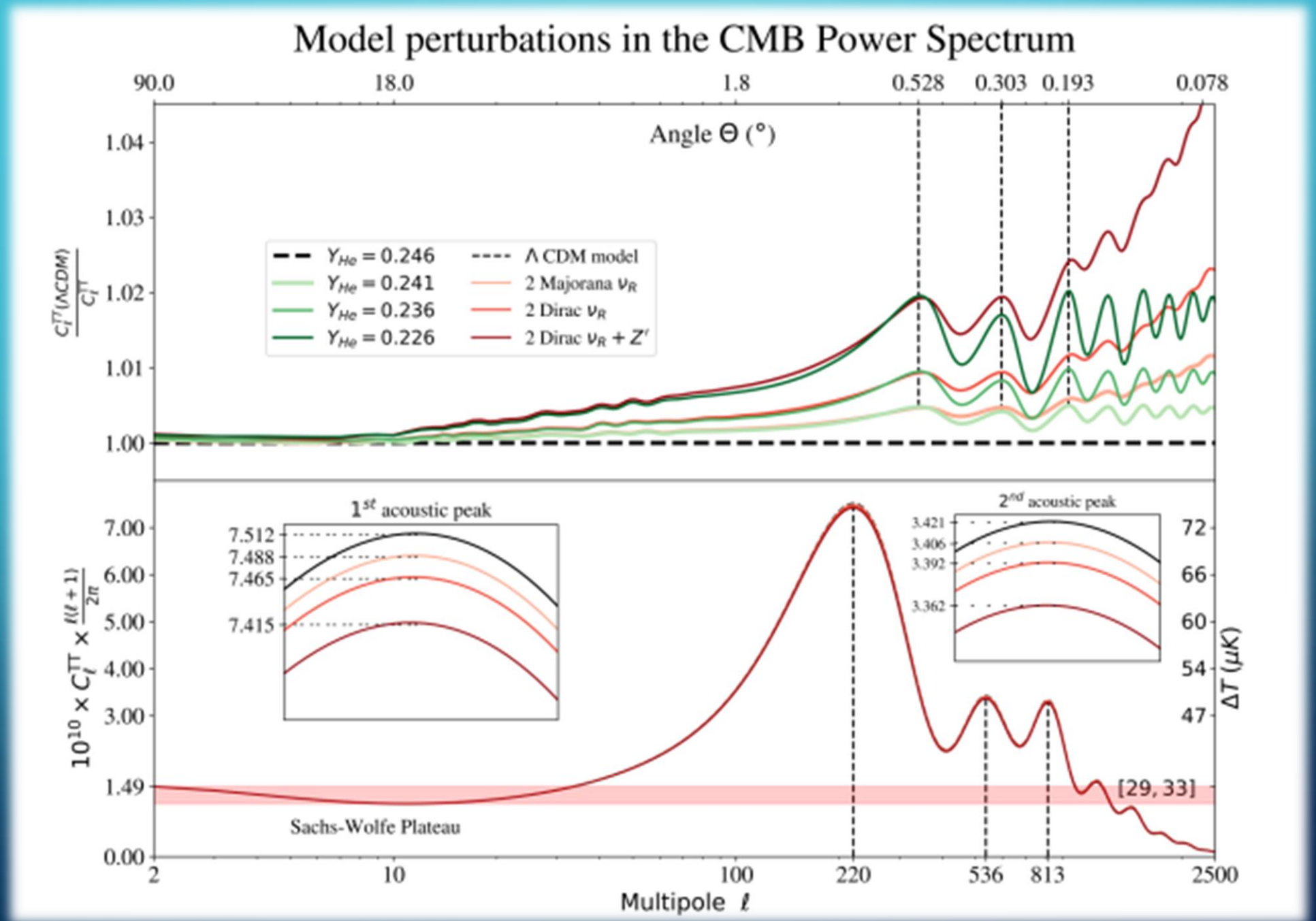
[2]

EFFECTS OF THE MODEL ON THE HUBBLE PARAMETER



[3]

Parameter	ΛCDM	$\nu_{s1,s2}$+ΛCDM	$\nu_{s1,s2}$+Z'+ΛCDM
$H0$	$64.138^{+0.088}_{-0.090}$	$64.911^{+0.082}_{-0.092}$	$65.091^{+0.086}_{-0.087}$
YHe	$0.246667^{+0.000027}_{-0.000028}$	$0.249503^{+0.000026}_{-0.000029}$	$0.250177^{+0.000027}_{-0.000028}$


Model perturbations in the CMB Power Spectrum
90.0
18.0
1.8
0.528
0.303
0.193
0.078
Angle Θ (°)
$\frac{C_l^{TT}(\Lambda CDM)}{C_l^{TT}}$
$Y_{He} = 0.246$
$Y_{He} = 0.241$
$Y_{He} = 0.236$
$Y_{He} = 0.226$
Λ CDM model
2 Majorana ν_R
2 Dirac ν_R
2 Dirac $\nu_R + Z'$
1st acoustic peak
2nd acoustic peak
$10^{10} \times C_l^{TT} \times \frac{l(l+1)}{2\pi}$
$\Delta T\ (\mu K)$
[29, 33]
Sachs-Wolfe Plateau
Multipole ℓ

[5]

[4]

CONCLUSIONS

Deviations up to 2% from ΛCDM in the angular scales of approximately 0193°, 0.303°, 0.528°

Even number of Dirac neutrinos ruled out due to the experimental uncertainty reported for N_{eff}

H_0 parameter is modified by up to approximately 1.5%, getting closer to local astrophysics measurements

REMARKS AND FUTURE WORK

- How the massive regime of ν_R impacts the Hubble parameter and the CMB matter-power spectrum?
- The contribution of Z' to ΔN_{eff} has to be extended to other accessible regions in the parameters' space
- It is expected that the effects of these model can be observed in LSST measurements, such as weak-lensing

REFERENCES

1. Heeck J, Phys. Lett. B739 (2014) 256-262
2. N. Aghnaim et al. (Planck Collaboration), Planck 2018 Results. VI. Cosmological Parameters, arXiv: 1807.06209.
3. Audren, B., Lesgourgues, J., Benabed, K., & Prunet, S. (2013). J. Cosmol. Astropart. Phys, 2(001), 1210-7183
4. Diego Blas, Julien Lesgourgues, and Thomas Tram. Journal of Cosmology and Astroparticle Physics, 2011(07):034, 2011.
5. Sergei Bashinsky and Uros Seljak. Physical Review D, 69(8):083002, 2004

THANK YOU FOR YOUR TIME