Impact of beyond the Standard Model physics in the detection of the Cosmic Neutrino Background

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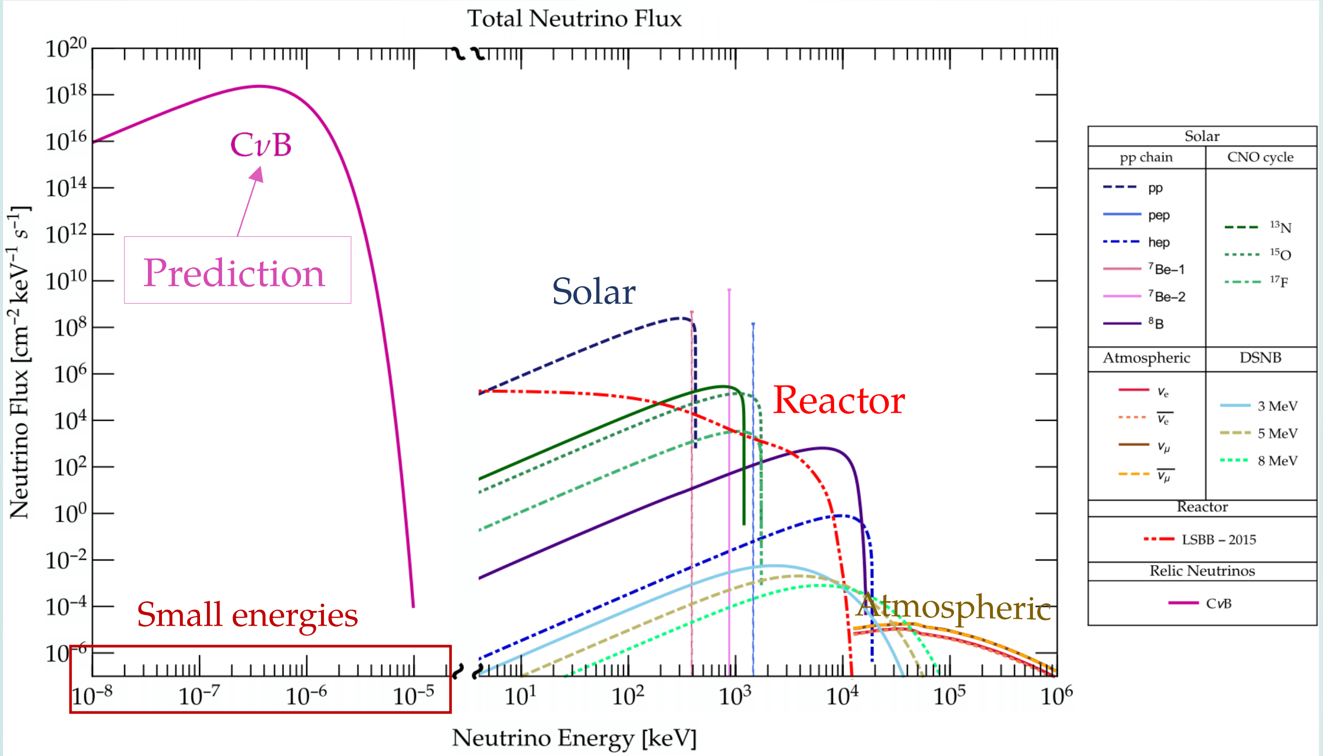
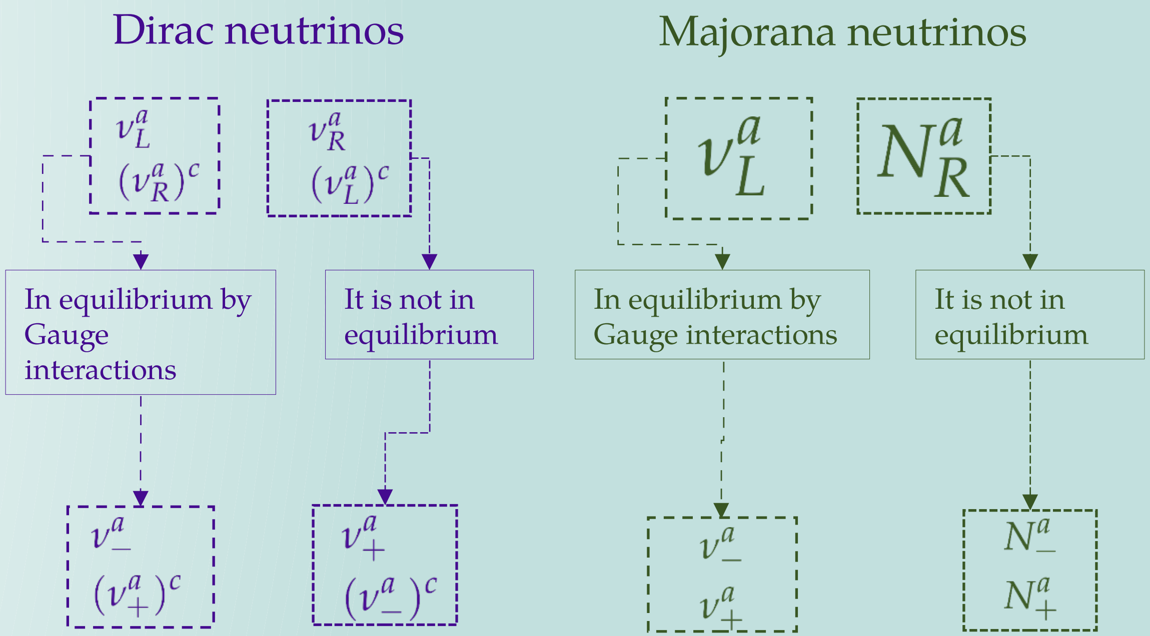
Cosmic neutrino background (CνB)

$$\frac{\Gamma_W}{H} \approx \frac{G_F^2 T_\nu^5}{T_\nu^2/M_{Pl}} = \left(\frac{T_\nu}{1\ \mathrm{MeV}}\right)^3$$



Neutrino temperature today

$$T_\nu = 1.945\ \mathrm{K}(0.168\ \mathrm{meV})$$



$$\nu_a + n \longrightarrow p + e^-$$

Weinberg, 1962

$$\Gamma^{\mathrm{M}}_{C\nu B} = 85.73\ [\mathrm{kg\ yr}]^{-1}, \qquad \Gamma^{\mathrm{D}}_{C\nu B} = 42.87\ [\mathrm{kg\ yr}]^{-1}$$

Number of targets

Number density

$$\Gamma_{C\nu B} = N_T \sum_{a=1}^{3} \left[\sigma_a(+1/2) v_a n_{\nu_+^a} + \sigma_a(-1/2) v_a n_{\nu_-^a}\right]$$

Capture cross section times velocity

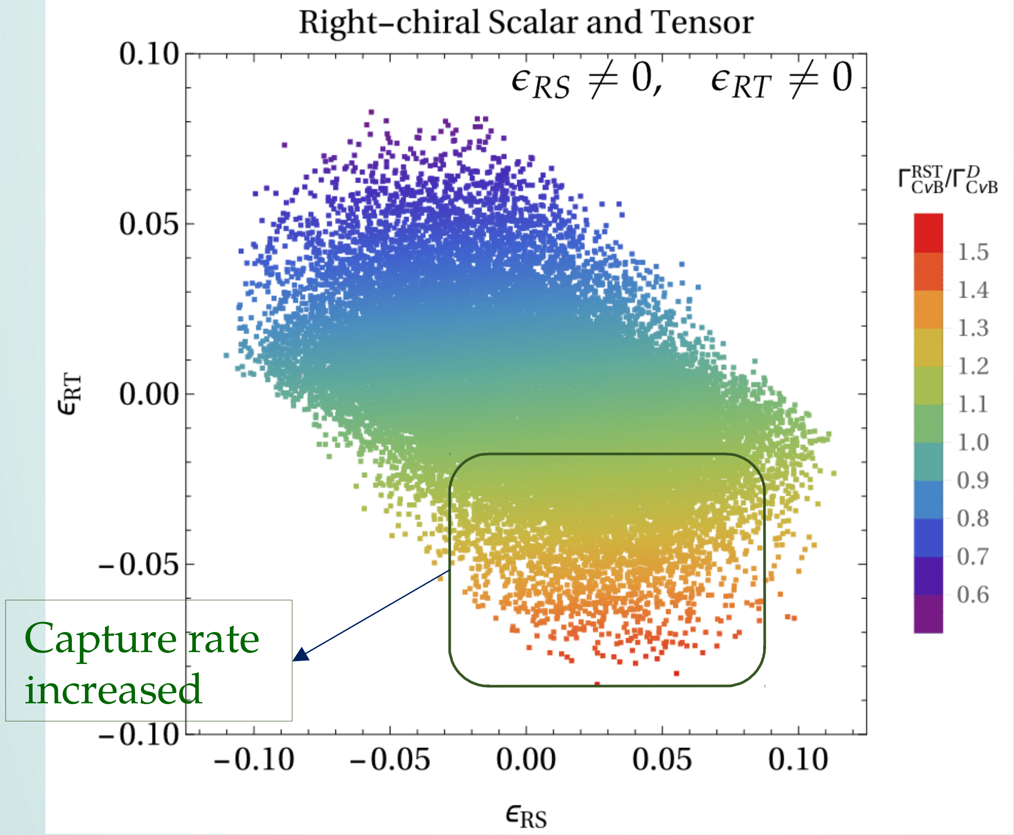
$$\Gamma^{\mathrm{M}}_{C\nu B} = 2\Gamma^{\mathrm{D}}_{C\nu B}$$

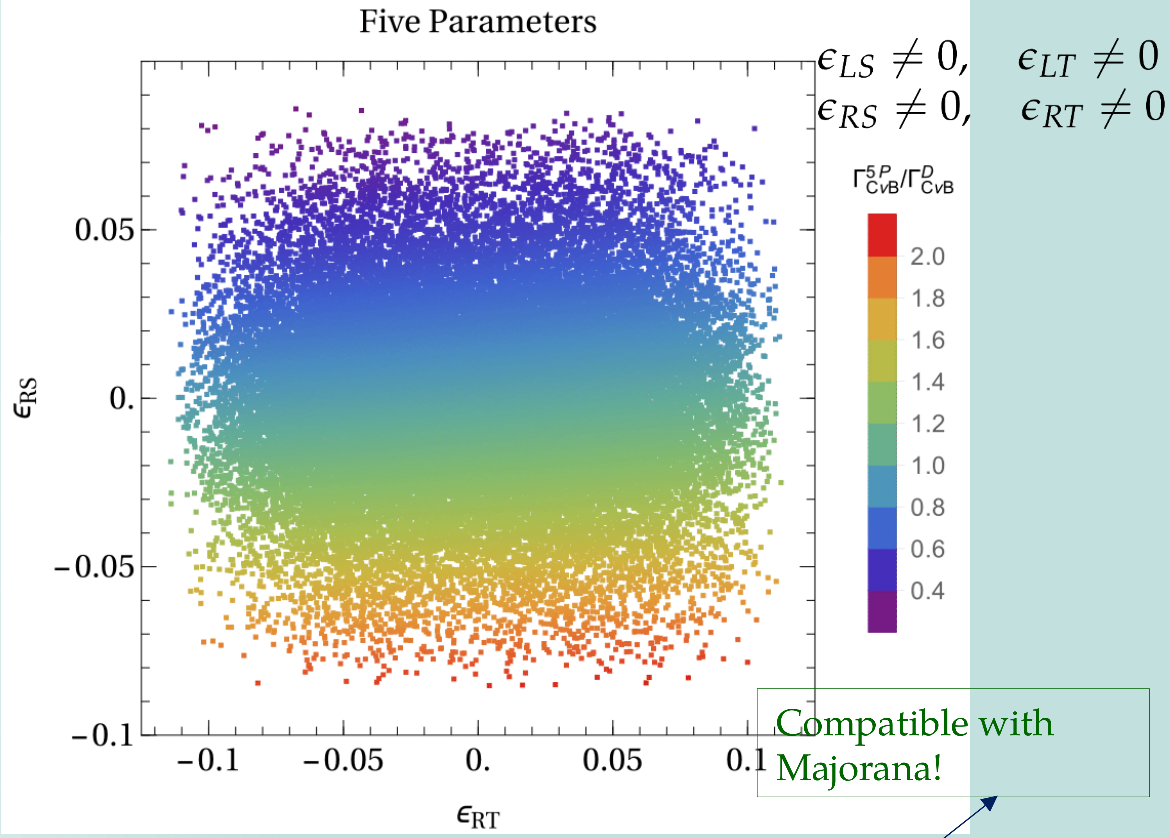
It could be possible to distinguish between Majorana and Dirac neutrinos!

Introducing physics BSM

What happens if there is physics BSM?

$$\mathscr{L}_{\rm eff}^{C\nu B} = -\frac{G_F}{\sqrt{2}} V_{ud}\widetilde{U}_{ea}\left\{\underbrace{[\bar{e}\gamma^{\mu}(1-\gamma^5)\nu_a][\bar{u}\gamma_{\mu}(1-\gamma^5)d]}_{\text{SM}} + \sum_{l,q}\underbrace{\epsilon_{lq}[\bar{e}\mathscr{O}_l\nu][\bar{u}\mathscr{O}_q d]}_{\text{BSM}}\right\} + \text{h.c.}$$





$$0.3\,\Gamma^{\rm D}_{C\nu B} \lesssim \Gamma^{\rm BSM}_{C\nu B} \lesssim 2.2\,\Gamma^{\rm D}_{C\nu B}$$

Martín Arteaga, Enrico Bertuzzo, YFPG and Renata Zukanovich Funchal, JHEP09 (2017) 160, arXiv:1708.07841 [hep-ph]