Signals of Exotic Currents in Tritium Beta Decay

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Lagrangian

$$\mathcal{L}_{SM} = -\frac{G_F}{\sqrt{2}} V_{ud} U_{ei} (\overline{e}_s \gamma^\alpha (\mathbb{1} - \gamma^5) \nu_{i,s}) \left(\overline{{}^3He}_s \gamma_\alpha \left(g_V \mathbb{1} - g_A \gamma^5 \right) {}^3H_s \right),$$

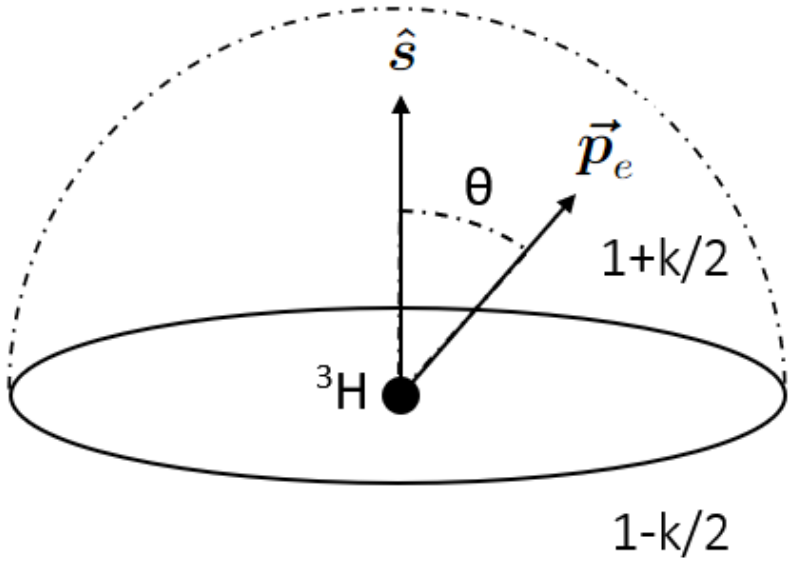
$$\mathcal{L}_{\text{exotic}} = -\frac{G_F}{\sqrt{2}} V_{ud} \left(\tilde{\epsilon}_L H^\mu_{V-A} j_{\mu,V+A} + \epsilon_R H^\mu_{V+A} j_{\mu,V-A} + \tilde{\epsilon}_R H^\mu_{V+A} j_{\mu,V+A} + \dots \right.$$

$$\mathcal{L}^N_{\text{exotic}} = -\frac{G_F}{\sqrt{2}} V_{ud} \left(\epsilon^N_L H^\mu_{V-A} J_{\mu,V-A} + \tilde{\epsilon}^N_L H^\mu_{V-A} J_{\mu,V+A} + \dots \right.$$

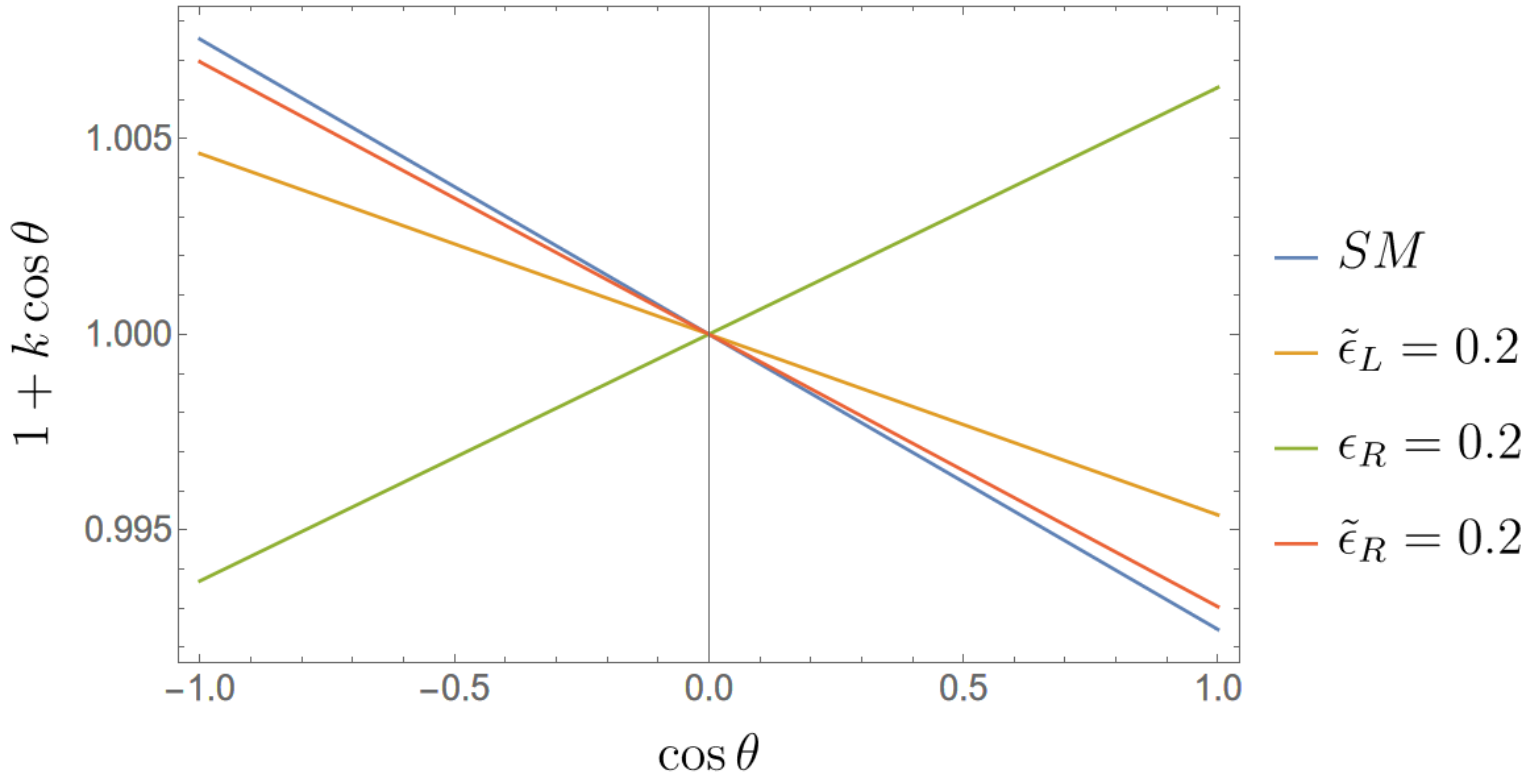
$$\frac{d\Gamma}{dE_e} = a_{\text{SM}}(E_e) + \text{Re}(\epsilon_Y) a_{LL,Y}(E_e) + |\epsilon_Y|^2 a_Y(E_e)$$

- Exotic currents produce active or sterile neutrinos.
- We want to constrain the ϵ.

Polarised Tritium



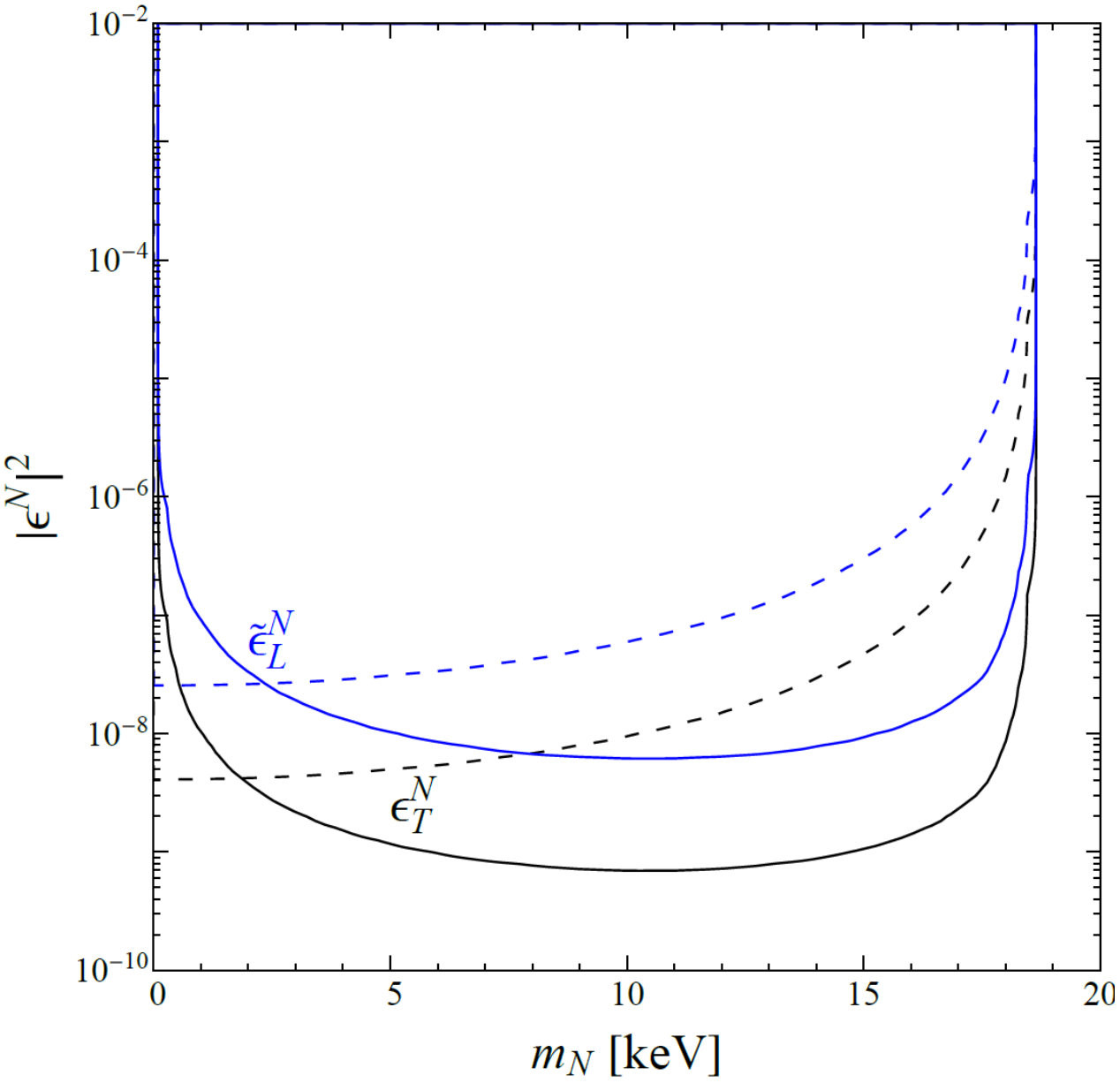
$$\frac{1}{\Gamma}\frac{d\Gamma}{d\cos\theta_e} = \frac{1}{2}(1 + k\cos\theta_e)$$



For polarised tritium, we use angular correlations as an additional probe.

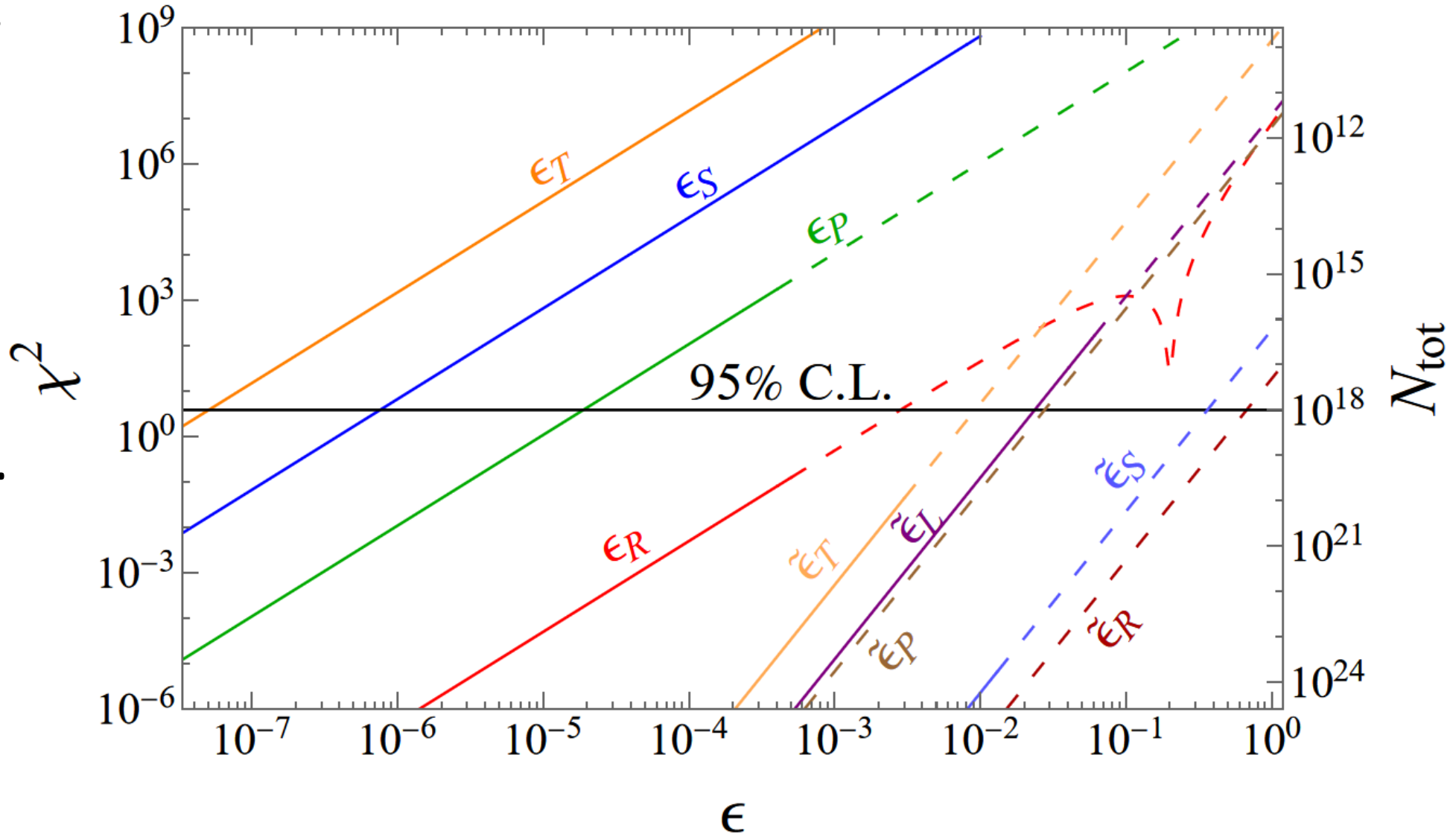
Exotic Limits

- The limits we place are sterile mass dependent.
- Measuring angular and energy distributions generate different, concurrent limits.



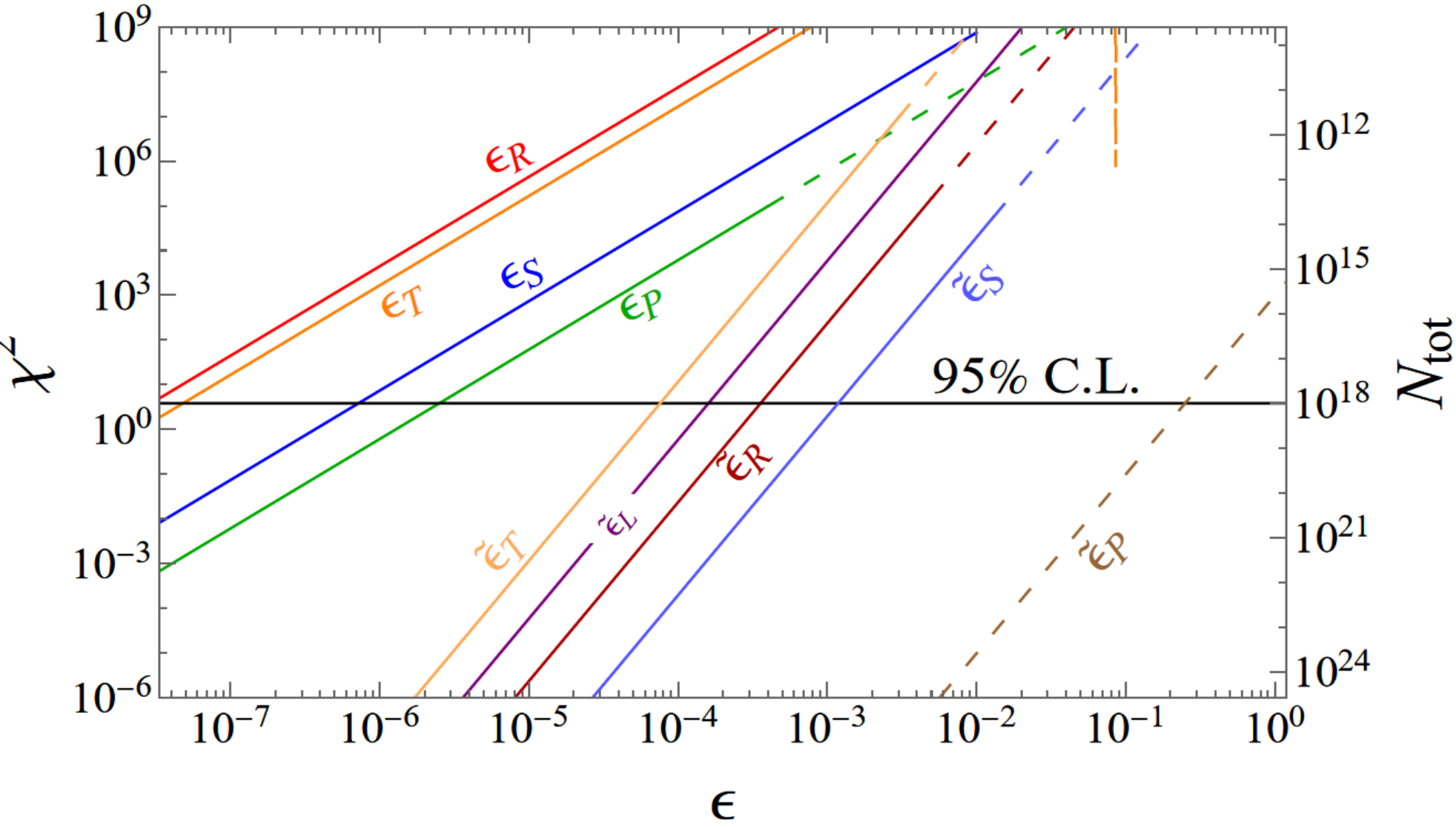
Energy Upper Bounds

- Considering currents individually gives upper bounds on the ϵ parameters.
- Pre-existing limits are shown by dashes.



Angular Upper Bounds

These results assume full polarisation but can be extended for partial.



Thank you!