What can we learn from Charged Leptons vs. Neutrinos?

David McKeen
University of Victoria

work with Batell, Pospelov, Ritz
& many others' work...

Outline

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- High-scale SUSY

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- Muon anomalies

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- Leptonic Higgs Portal

Arkani-Hamed, Kaplan, Weiner, Giudice, Strumia, Kane, Hall, Nomura, etc. etc....

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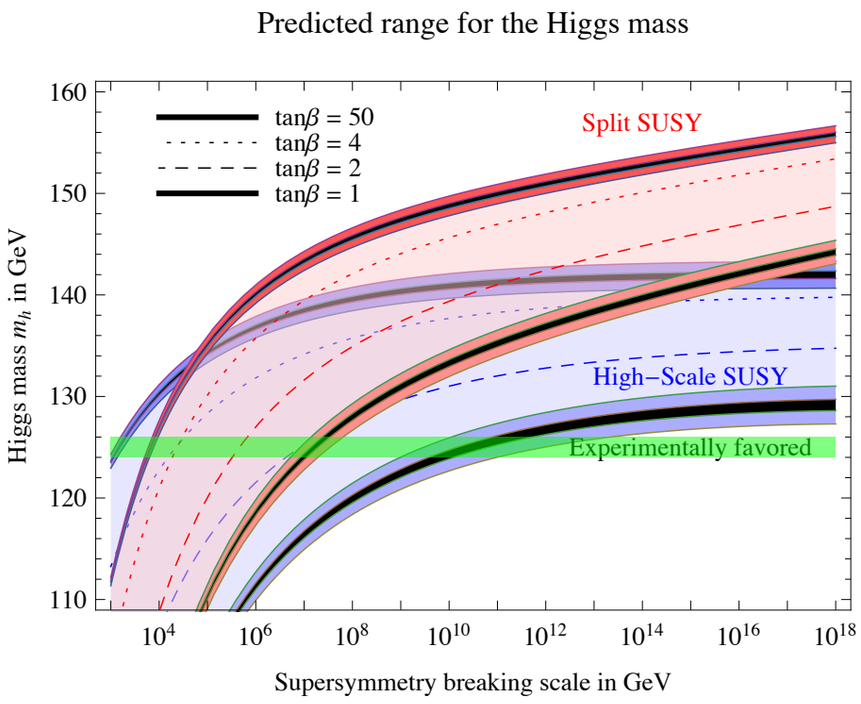

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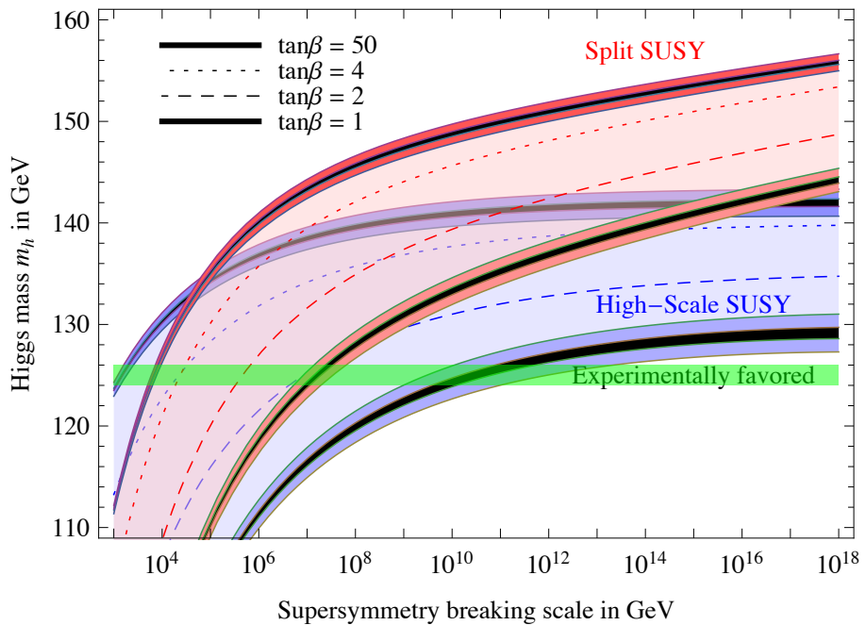
Predicted range for the Higgs mass



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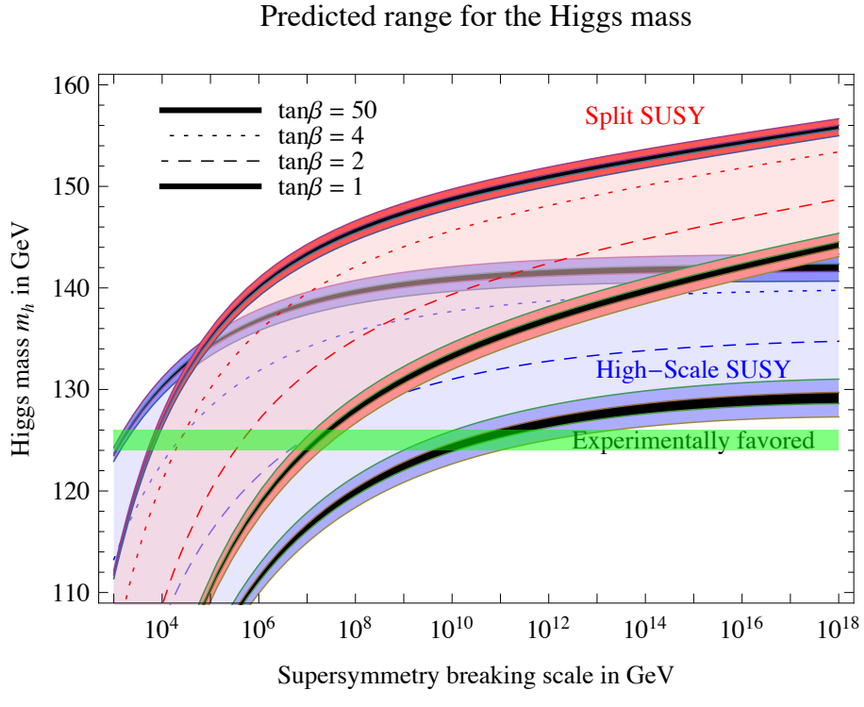

- Flavor constraints satisfied for soft masses with "anarchic" flavor structure

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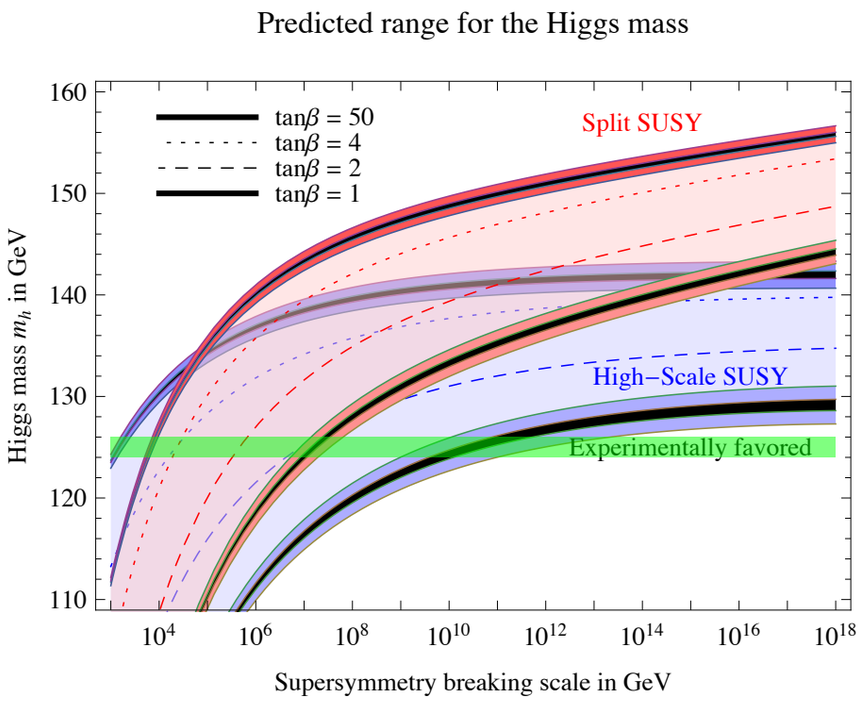

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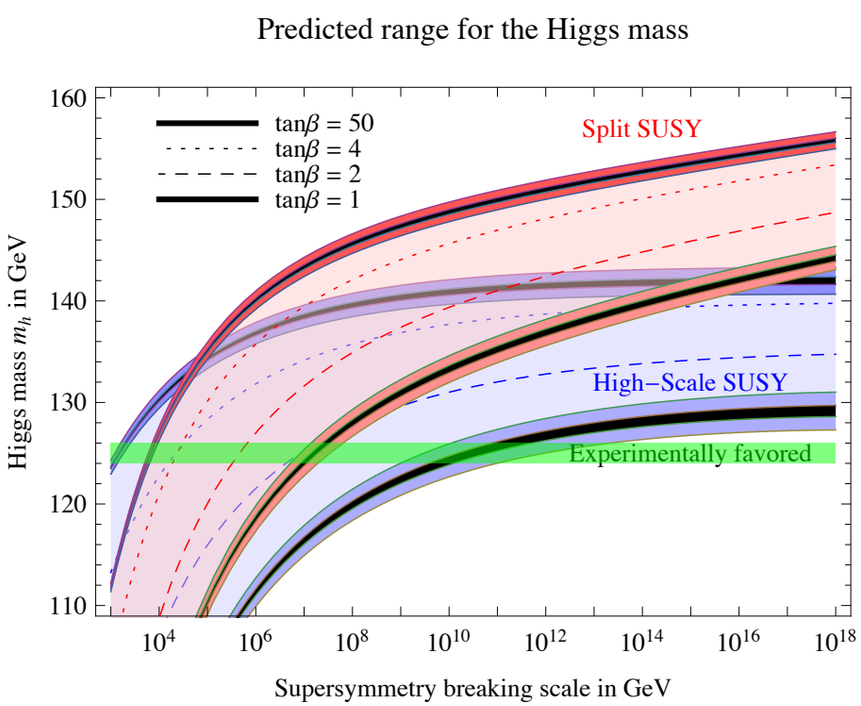

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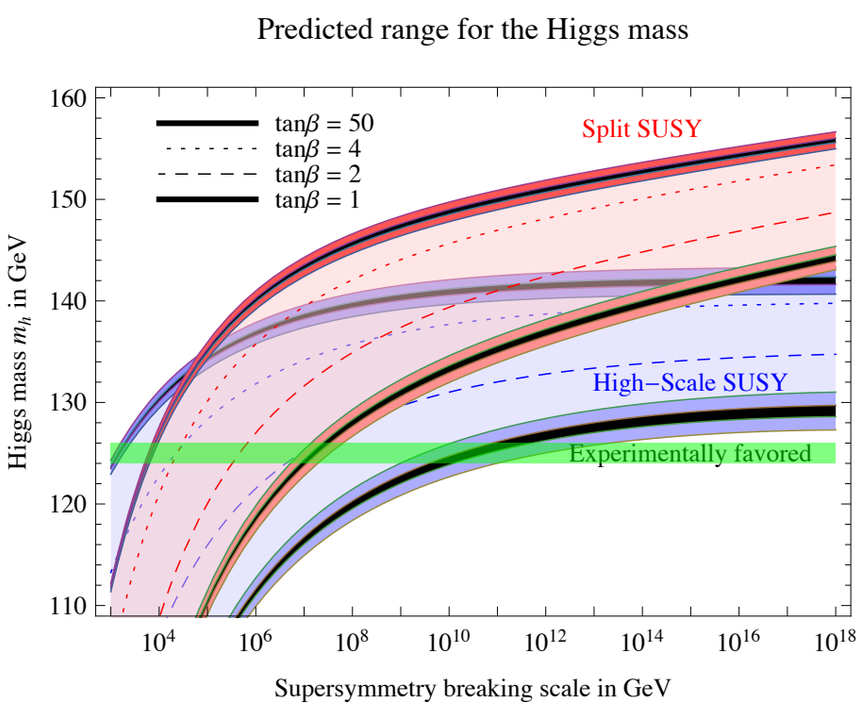

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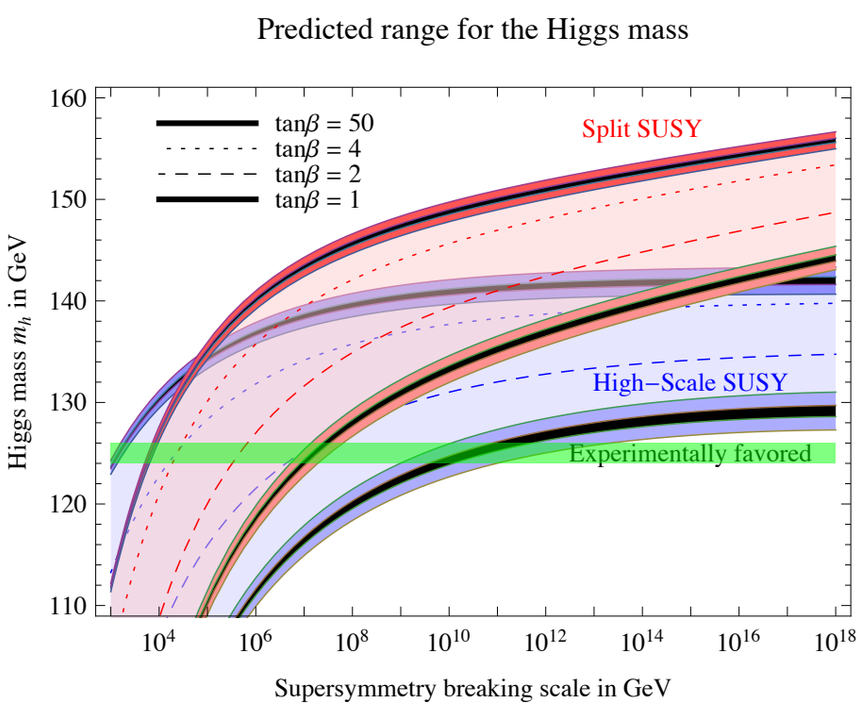

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- Increased importance of LR observables

from Giudice & Strumia

DM, Pospelov, Ritz
See also Moroi & Nagai, Harnik & Altmannshofer, ...

What can charged leptons say about this?

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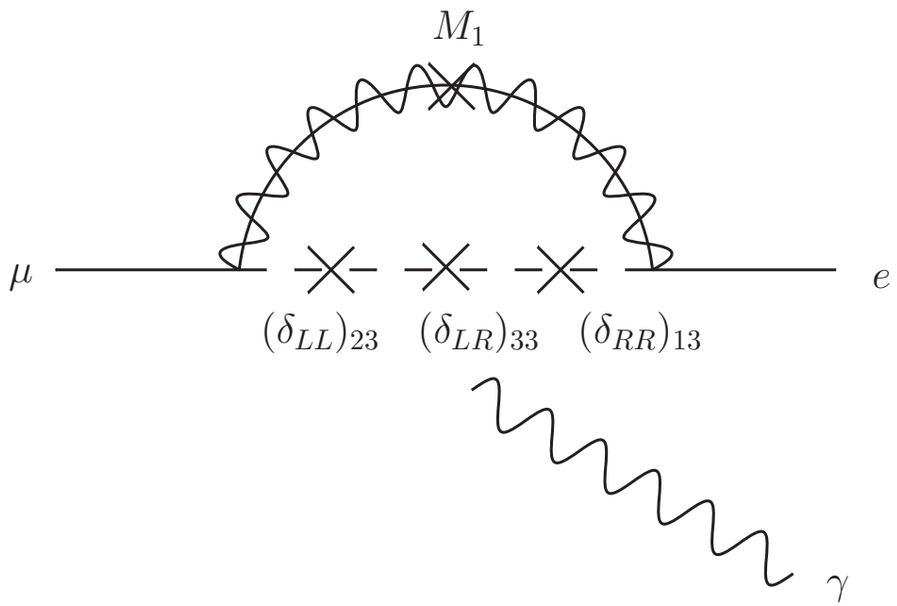

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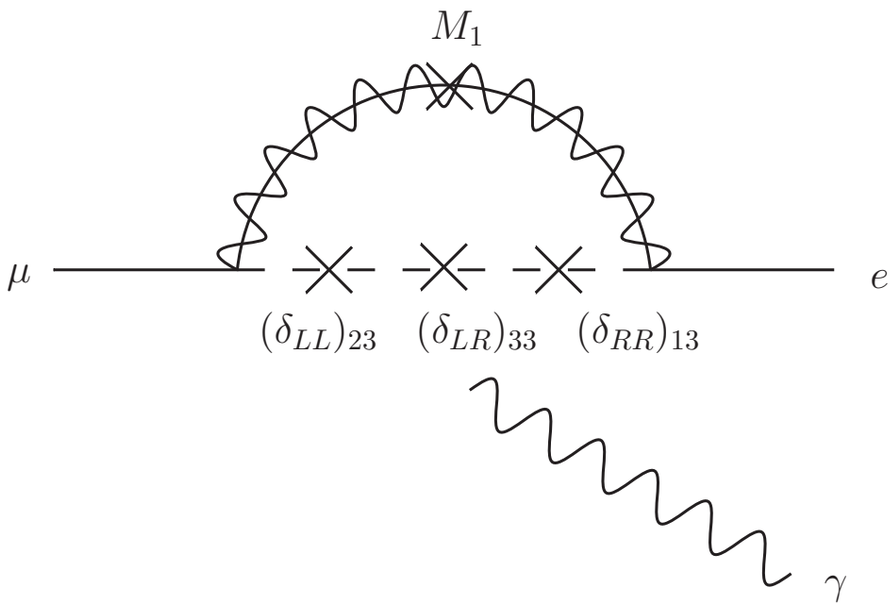

$$(\delta_{LR})_{33} \sim \frac{m_\tau \mu \tan\beta}{M_{\rm sl}^2} \sim \frac{m_\tau \tan\beta}{\Lambda_{\rm SUSY}}$$

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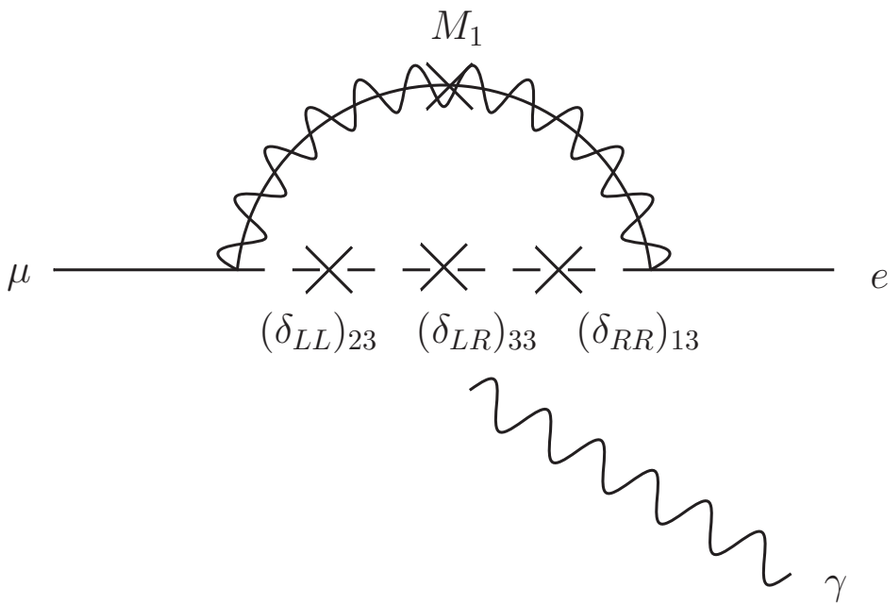

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$$\Rightarrow \mathcal{B}(\mu \to e)_{\text{Ti, dip.}} \sim \text{few} \times 10^{-20}$$

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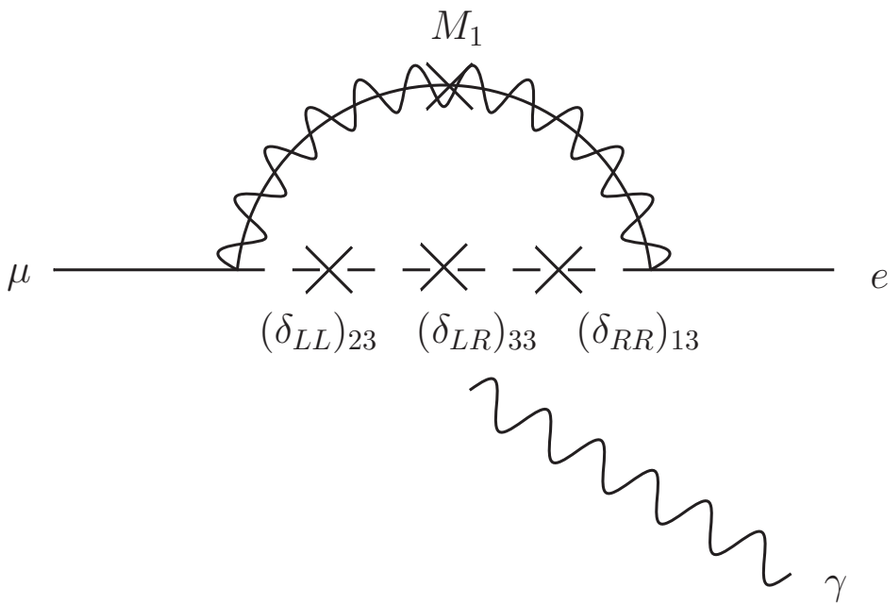

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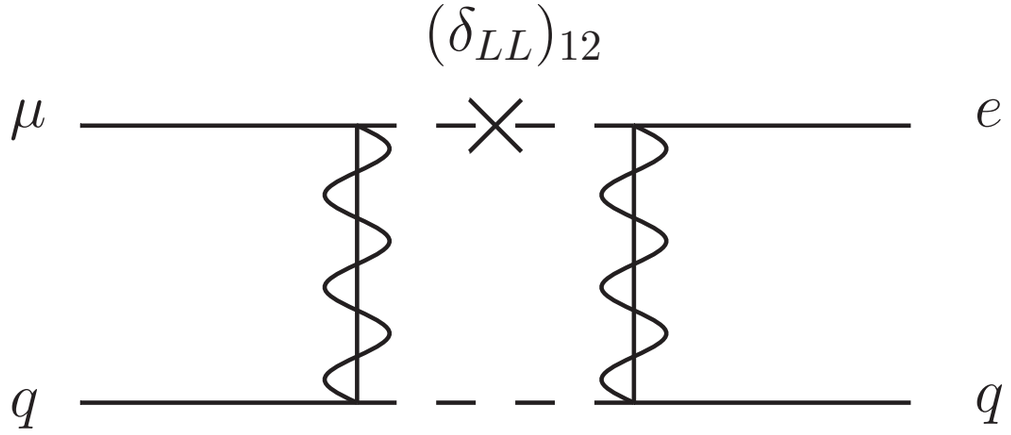

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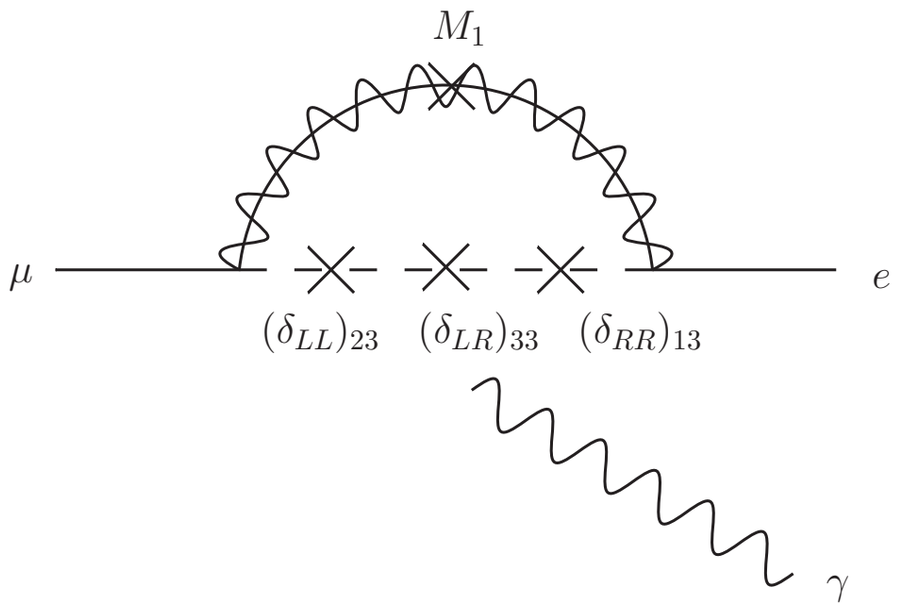

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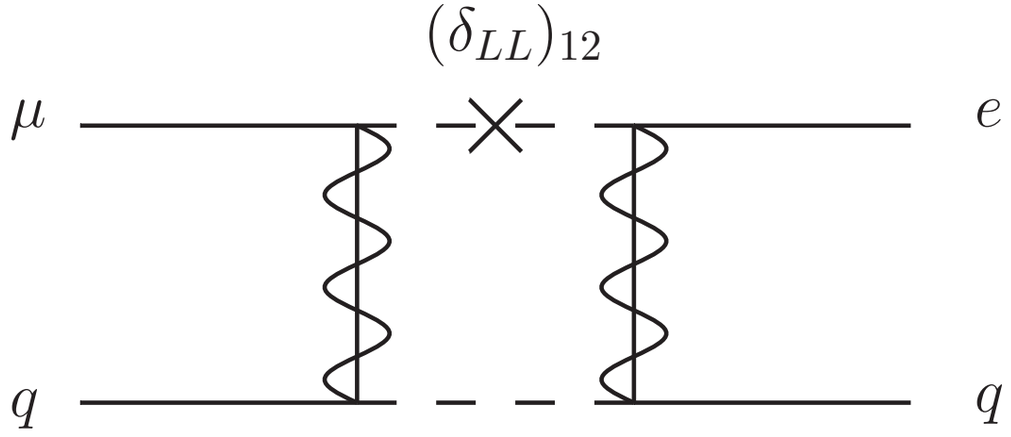

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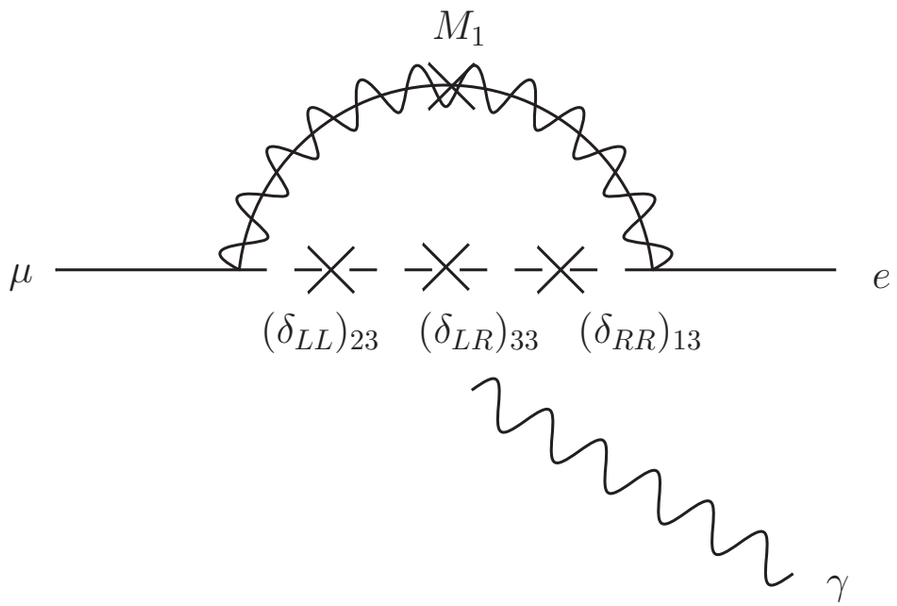

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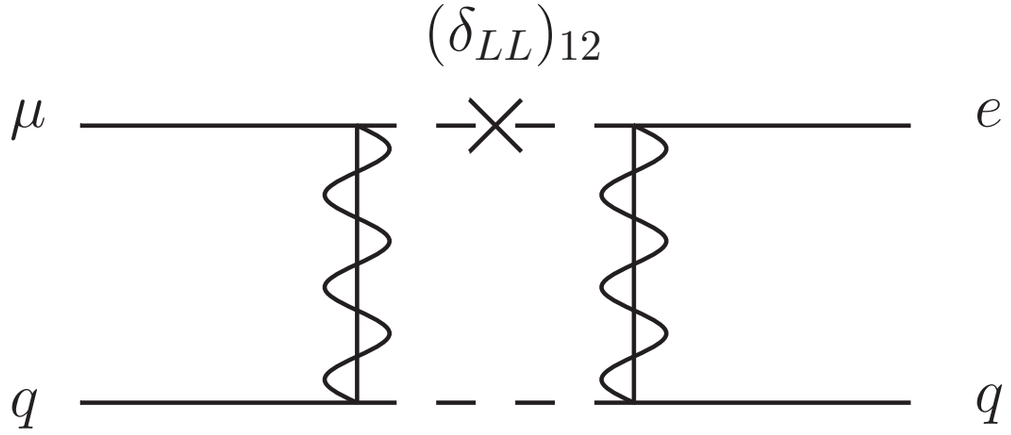

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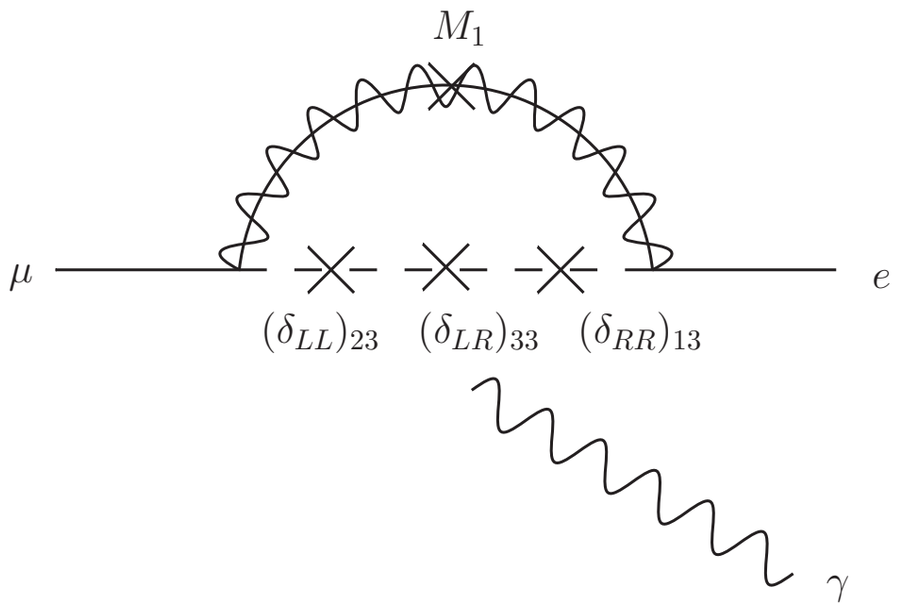

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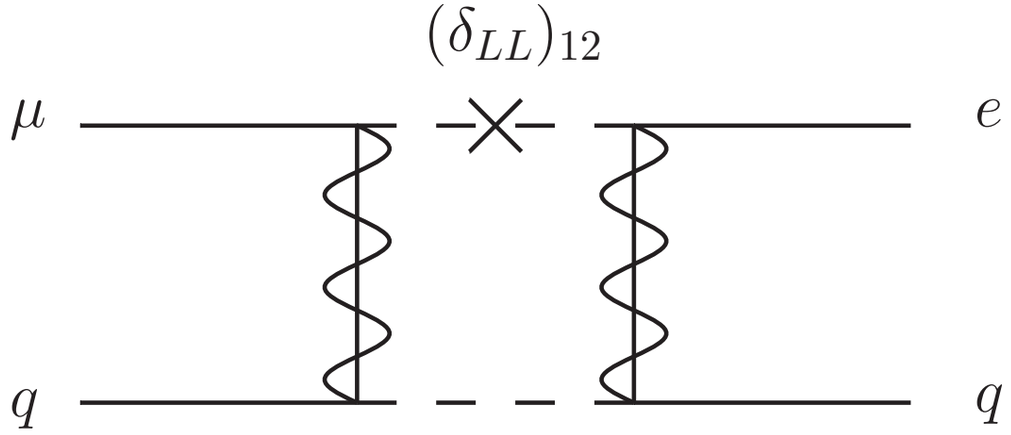

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Neutrinos...?

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We'll talk a bit about this

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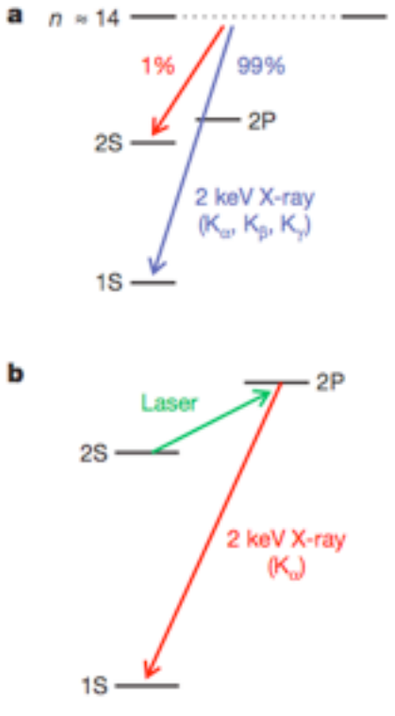

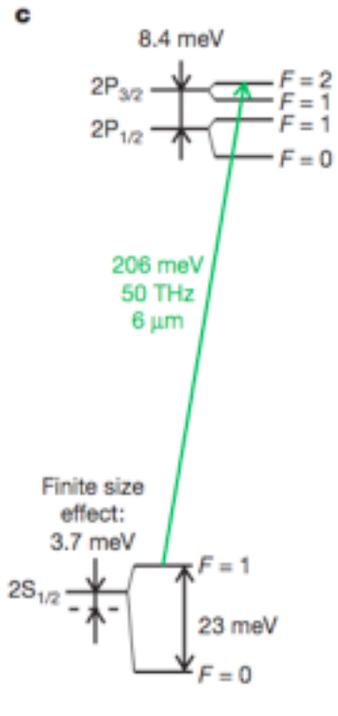

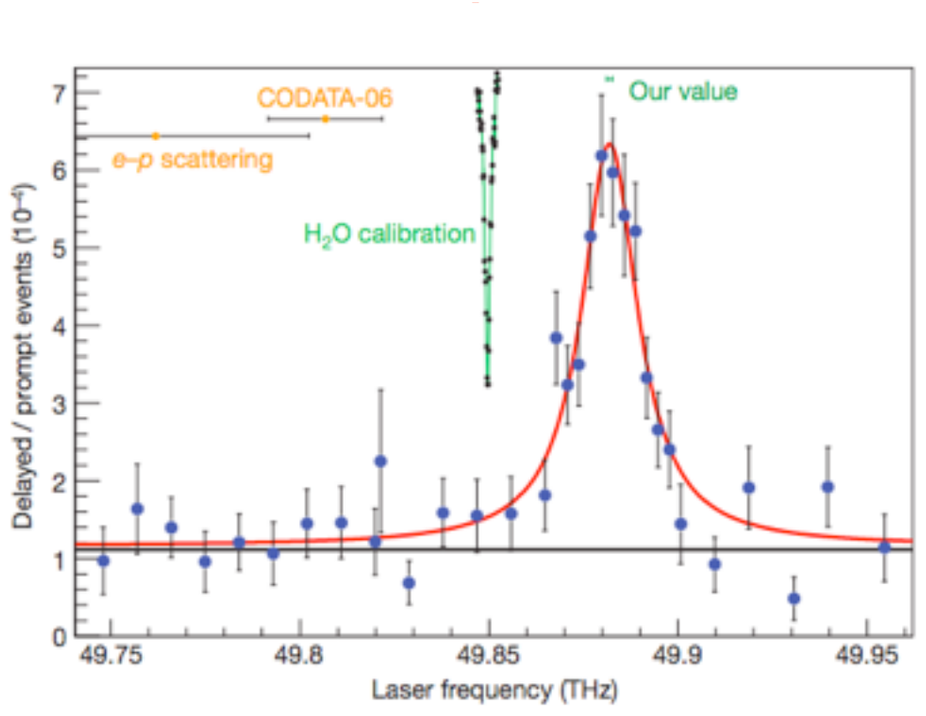

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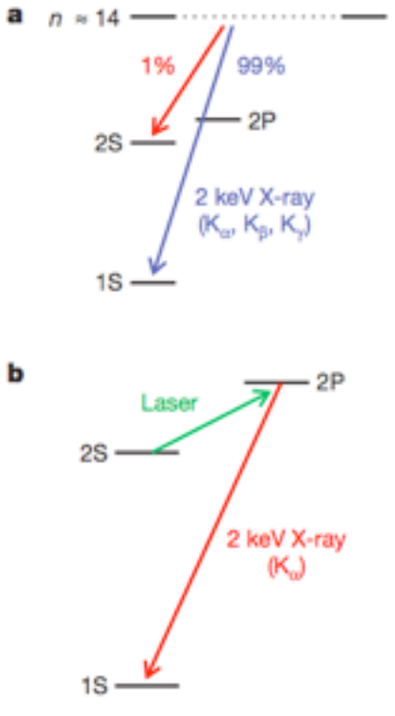
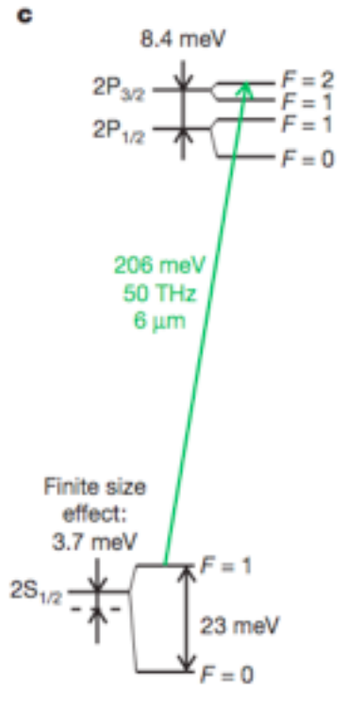
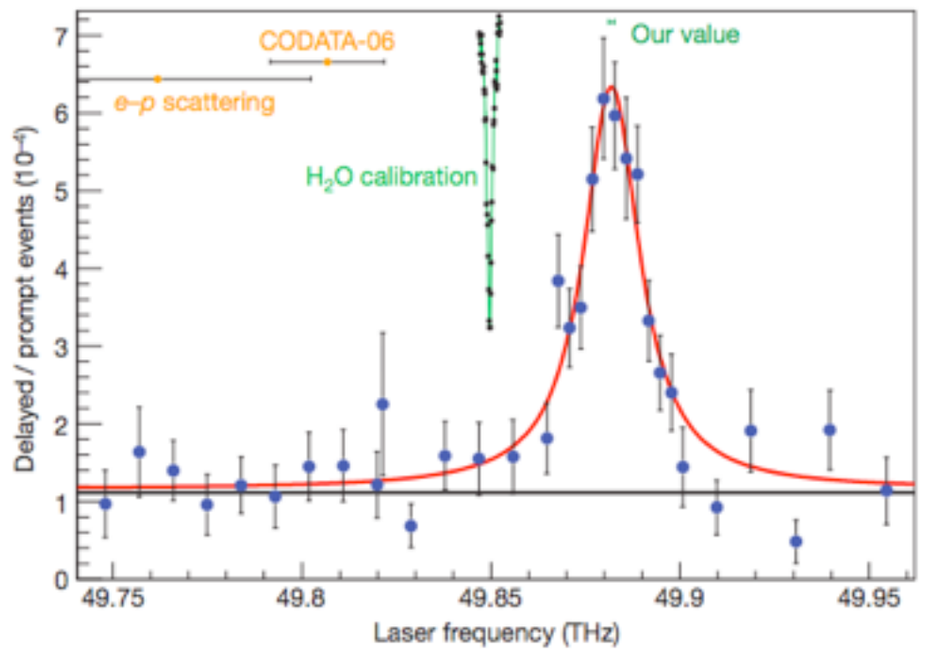
Recent update: $r_p = 0.84087(39)\ \text{fm}$







Tucker-Smith & Yavin
Barger, Chiang, Keung, Marfatia

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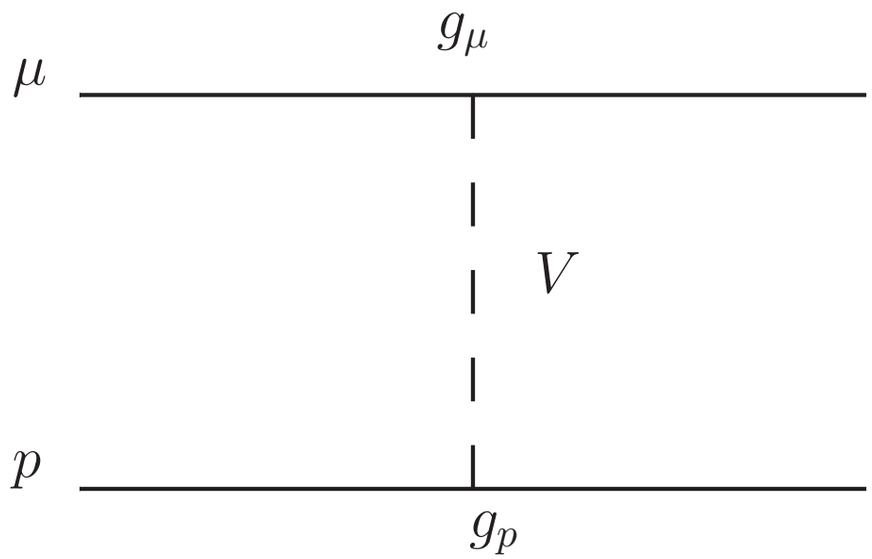

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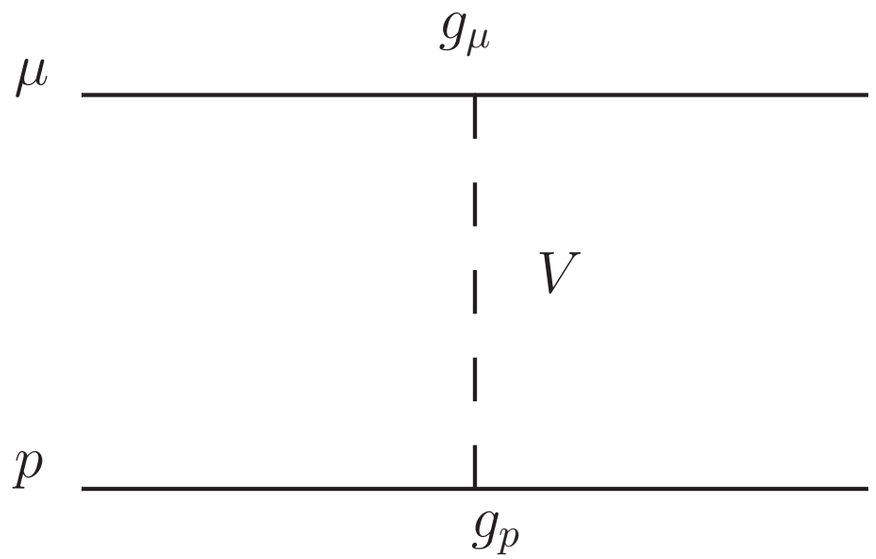

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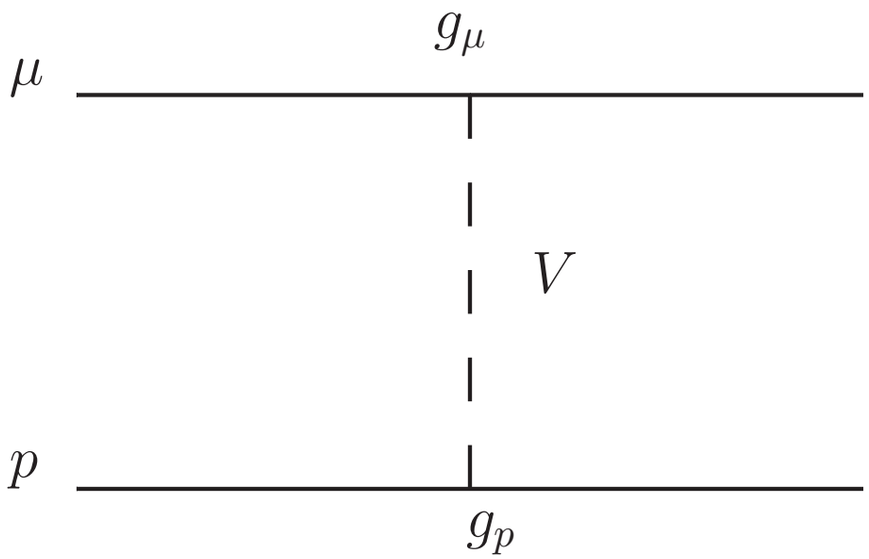

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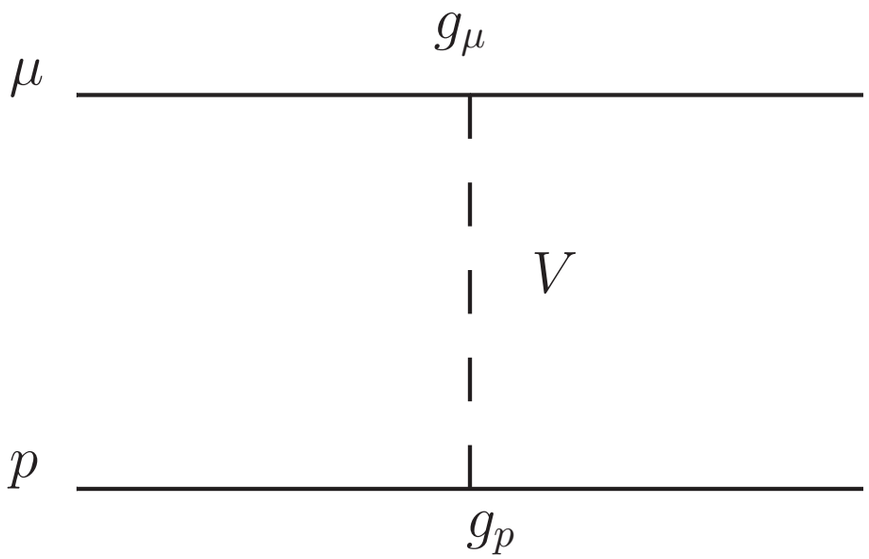

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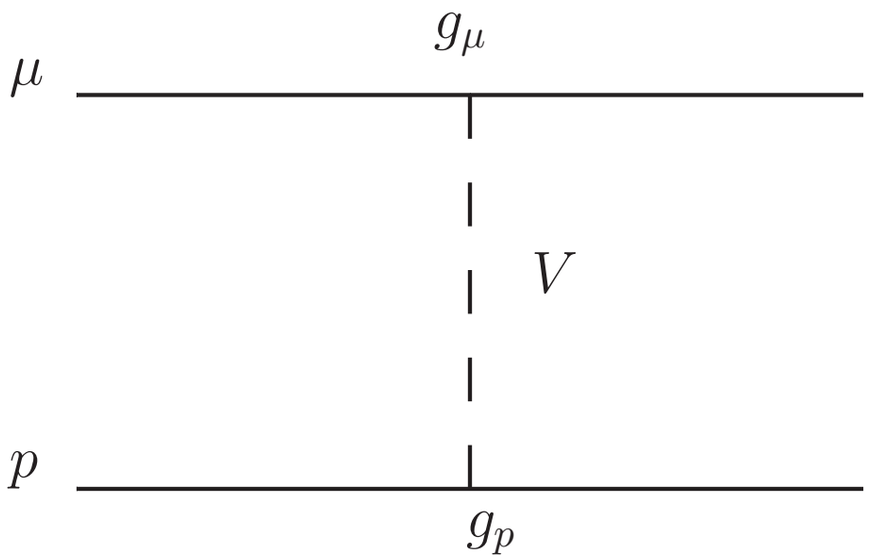

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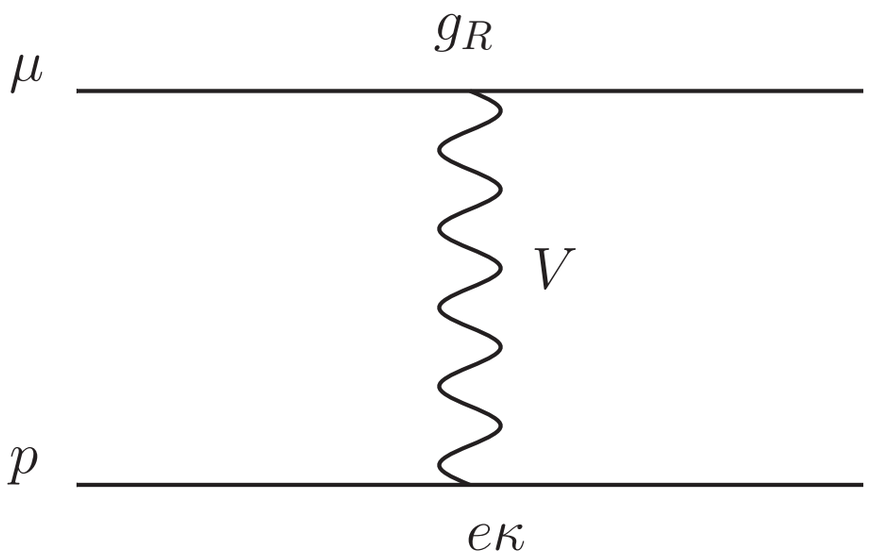

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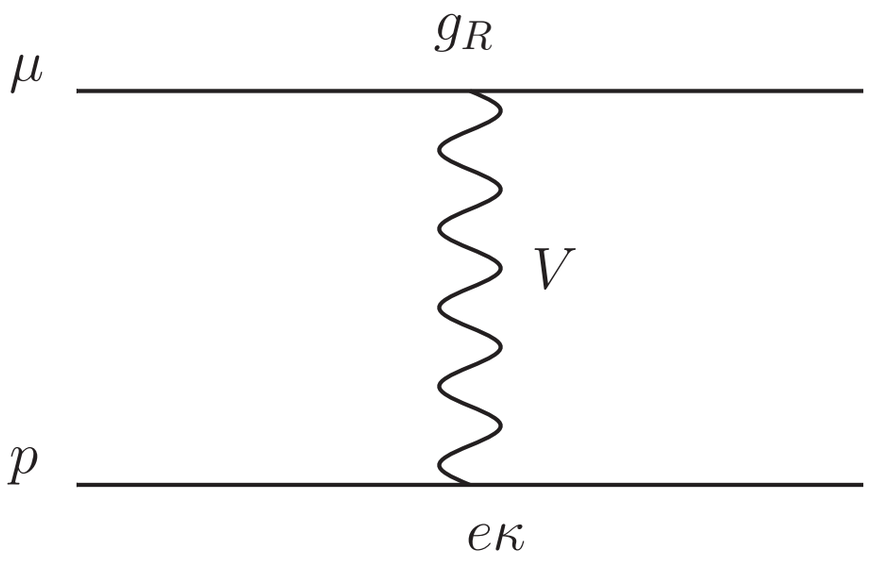

$$\mathcal{L} \supset -g_R V_\alpha \bar{\mu}_R \gamma^\alpha \mu_R - \frac{\kappa}{2} V_{\alpha\beta} F^{\alpha\beta} + |D_\alpha \phi|^2 - \left(\bar{L} \mu_R H_{SM} \frac{\phi}{\Lambda} + \text{h.c.} \right)$$

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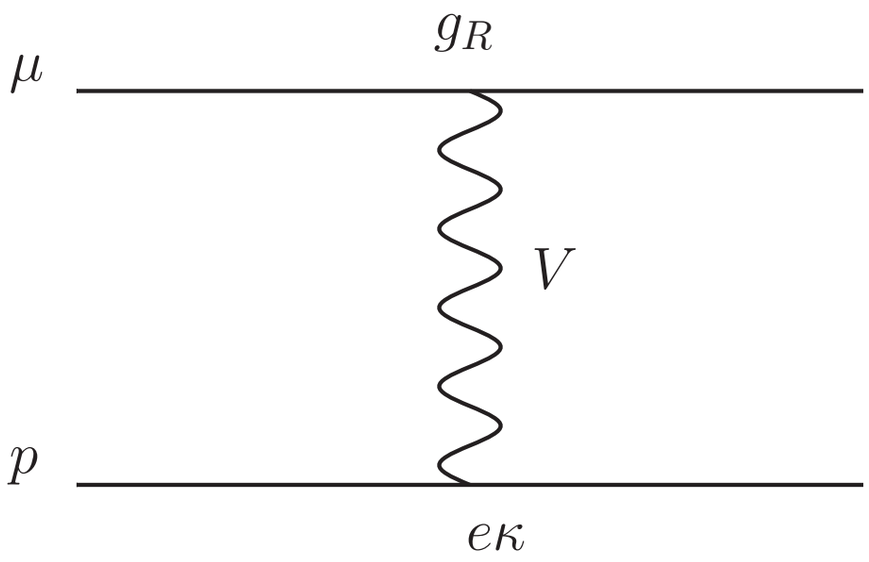

$$\mathcal{L} \supset -g_R V_\alpha \bar{\mu}_R \gamma^\alpha \mu_R - \frac{\kappa}{2} V_{\alpha\beta} F^{\alpha\beta} + |D_\alpha \phi|^2 - \left(\bar{L} \mu_R H_{SM} \frac{\phi}{\Lambda} + \text{h.c.} \right)$$

$$\Delta r_p^2 \propto \frac{g_R \kappa}{e m_V^2} \qquad m_V \sim 50 \text{ MeV} \qquad \kappa \simeq 10^{-3} - 10^{-2}$$

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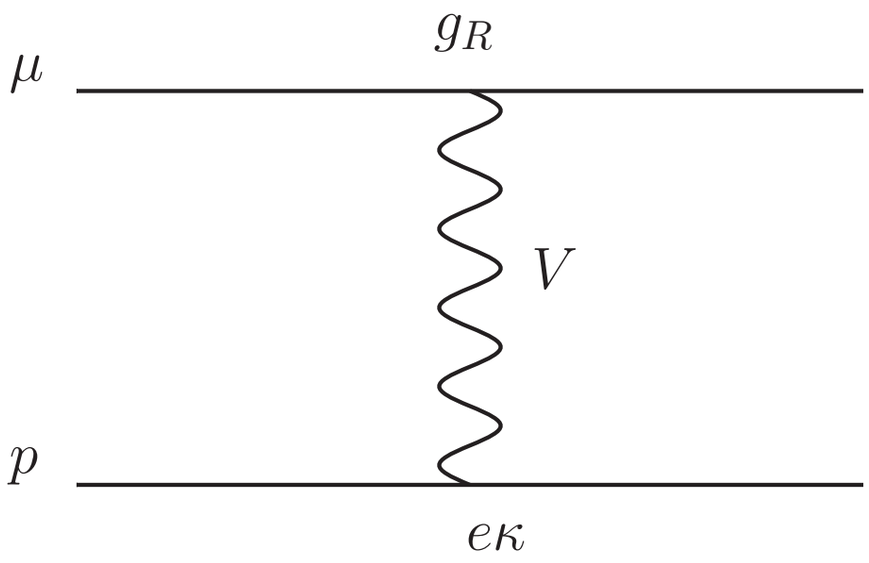

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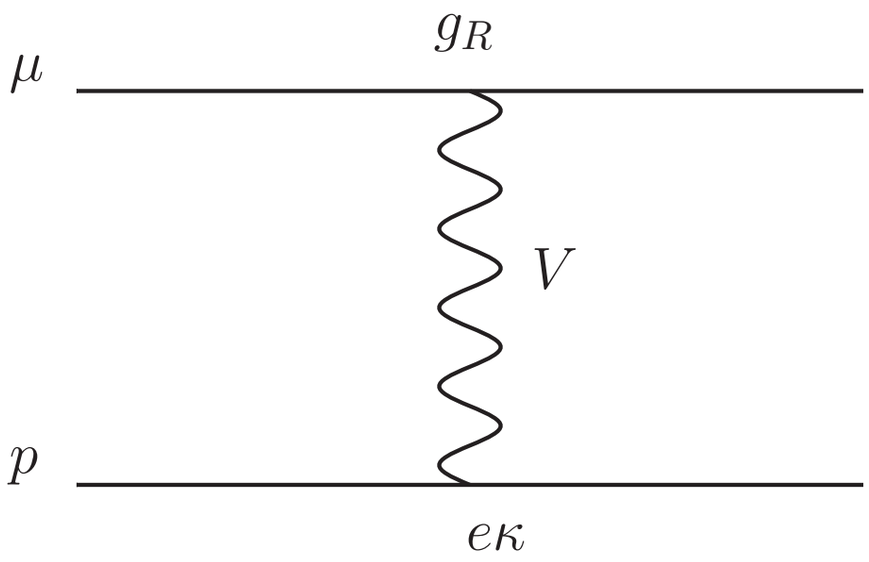

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Noted by Barger et al.

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Higher-dim. operators for lepton masses: see Roni's talk tomorrow for effects on Higgs' properties

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The light scalar's interaction is:

$$-\mathcal{L}_{\rm Y,h_\ell} \to \xi_{\ell\ell} \frac{m_\ell}{v} h_\ell \bar{\ell}\ell + \xi_{qq} \frac{m_q}{v} h_\ell \bar{q} q, \quad \xi_{qq} \sim \xi_{\ell\ell} \cot^2\beta \quad \Rightarrow \tan\beta \text{ is large}$$

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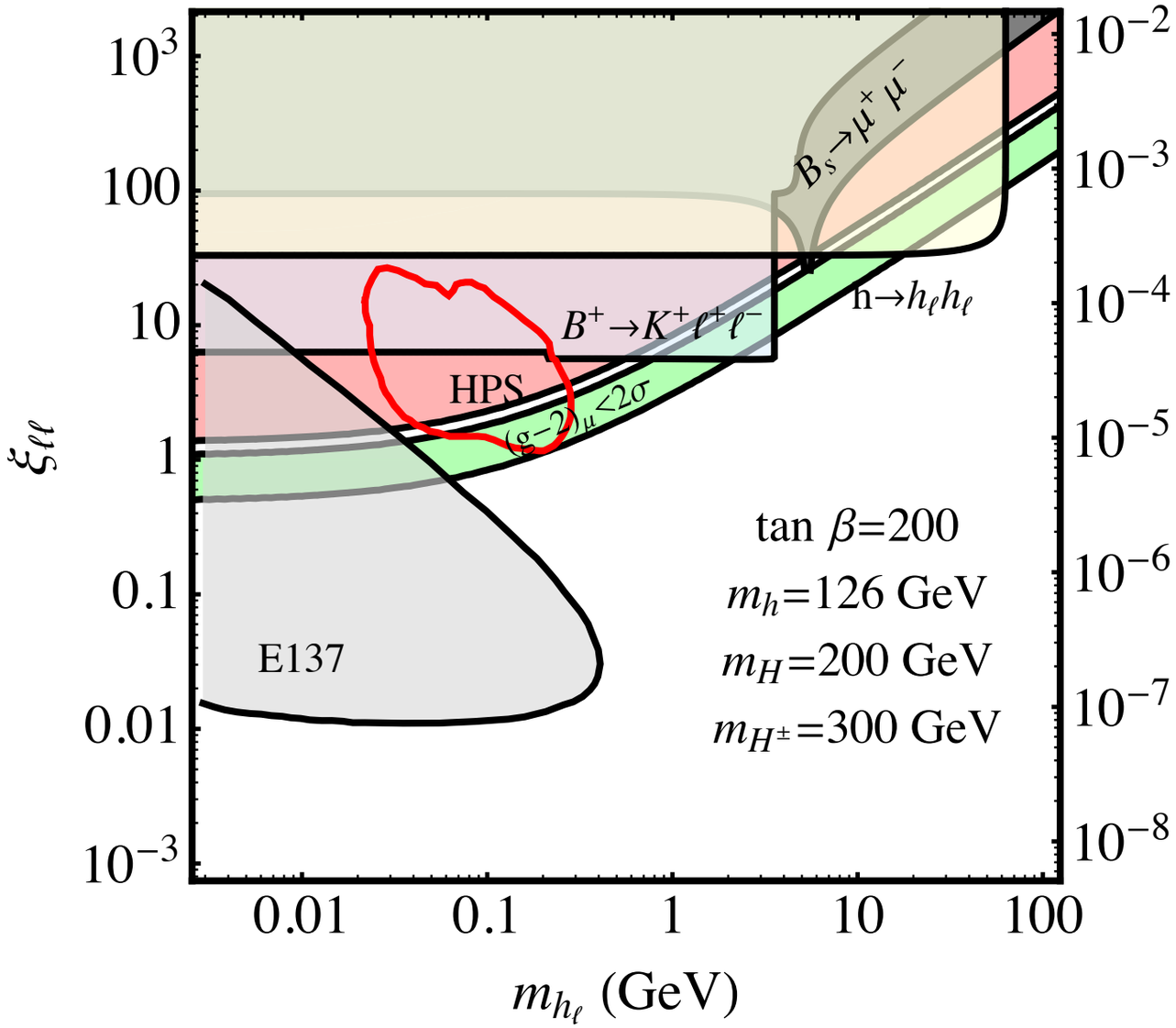
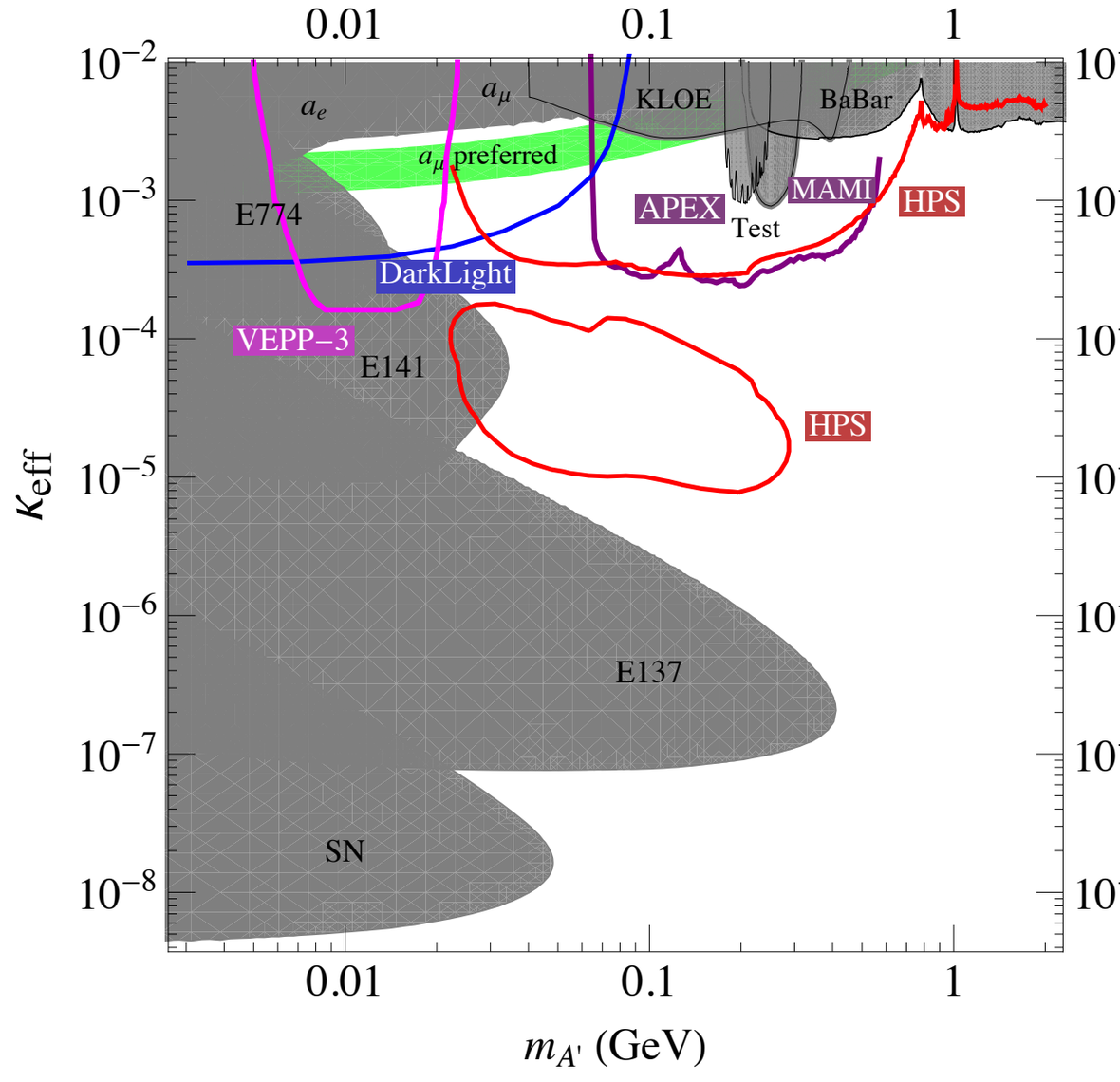
Comparison with Vector





$$e\kappa_{\rm eff} \equiv \xi_{\ell\ell}\frac{m_e}{v}$$

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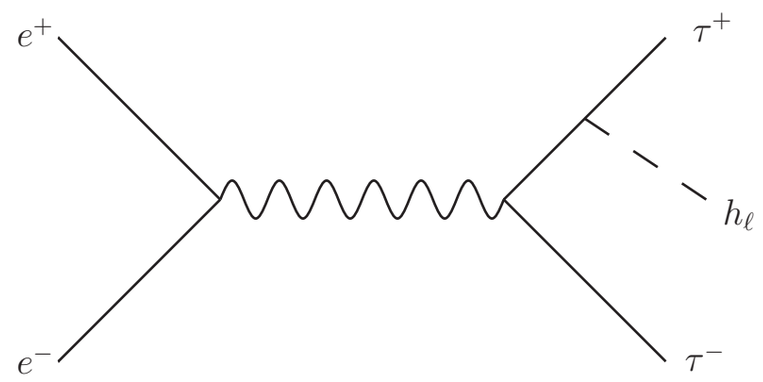

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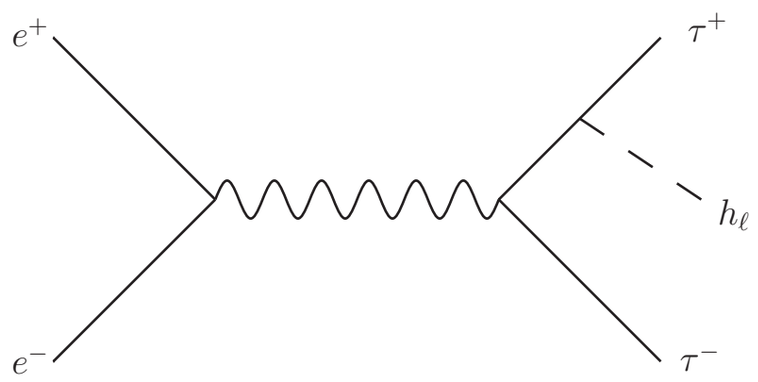

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$$N\left(e^+e^- \to \tau^+\tau^- h_\ell\right) \sim 2 \times 10^4 \left(\frac{\xi_{\ell\ell}}{2}\right)^2 \left(\frac{\int \mathcal{L} dt}{10 \text{ ab}^{-1}}\right)$$

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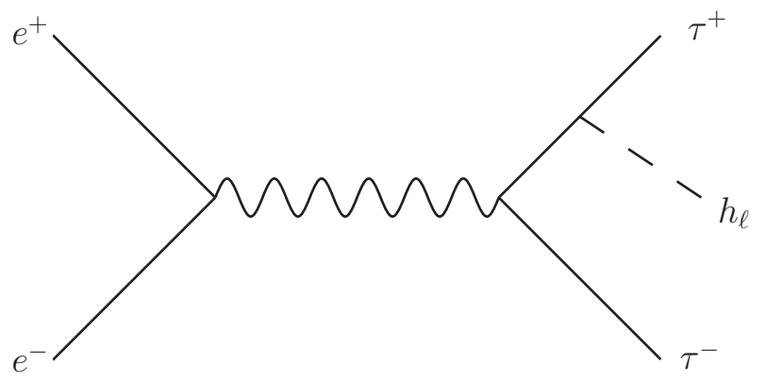

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What else??

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- New ideas, thoughts, etc. welcome!