# HEAVY NEW PHYSICS IN $b \to s\nu\nu$


W. Altmannshofer, S.A.G, K. Toner



arXiv: 2406.xxxxx



Aditya Gadam


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**Theoretical**

- GIM and CKM suppression makes these decays of $b$ quarks rare
- Sensitive probes of New Physics (NP)
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**Experimental**

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  - Polarization can be measured - passes to fermionic children

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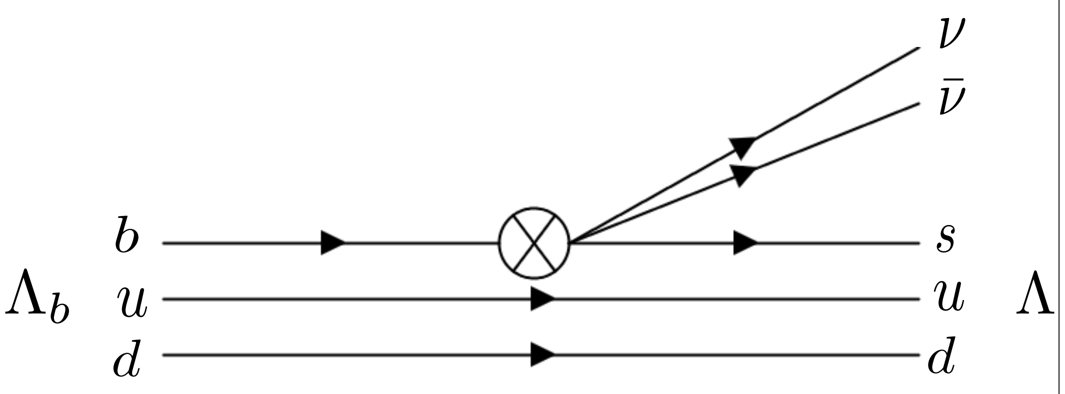
$$\Lambda_b \to \Lambda \nu \bar{\nu}$$




# Conclusion: Soap from Friend!

*bud* to *sud*

| | |
|---|---|
| Polarized: probes chiral NP structure | • Polarization measurements have been made[1] and will improve |
| Predicted[2] to be measured at future colliders | • No current bounds |
| Additional observable: $A_{FB}$ | • Conditioned on $\cos\theta = \hat{p}_\Lambda \cdot \hat{s}_{\Lambda_b}$ |

[1]Buskulic et al.: 10.1016/0370-2693(95)01433-0

[2]Amhis, Kenzie, Reboud, Wiederhold: 2309.11353

# The Framework: $\Lambda_b \to \Lambda \nu \bar{\nu}$

- Compute double differential decay rate of the Standard Model process
  - Polarized initial state (sample fraction)
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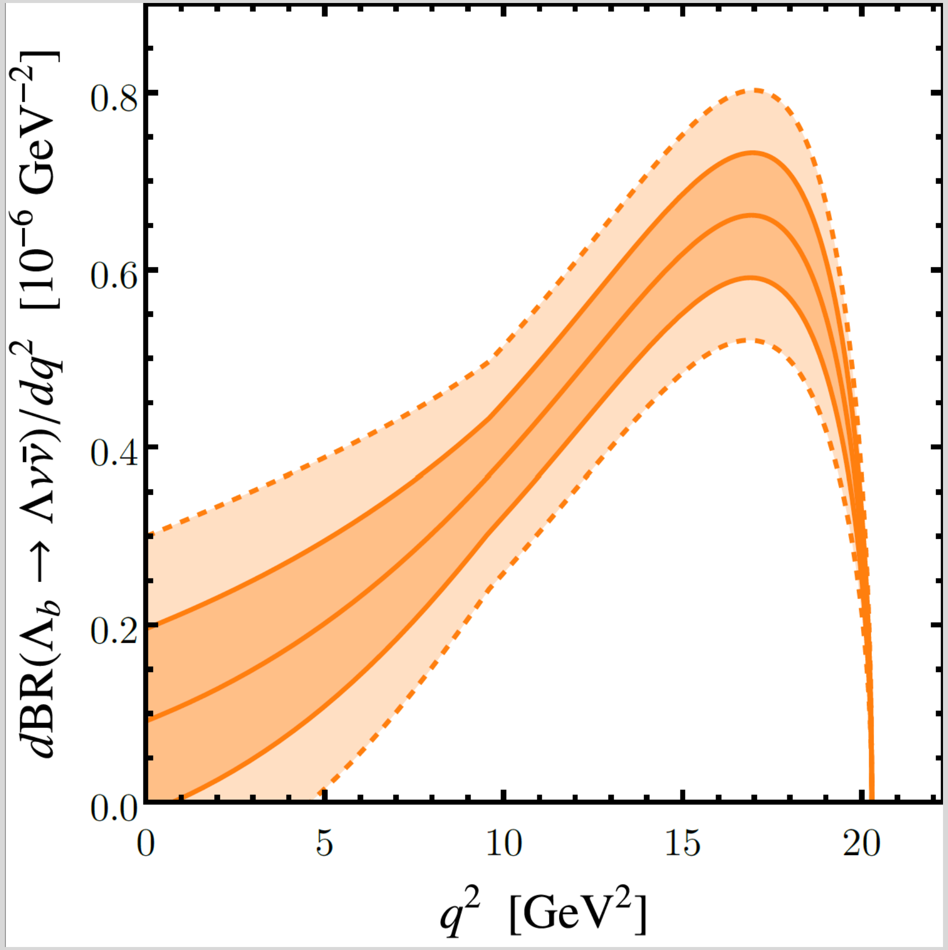
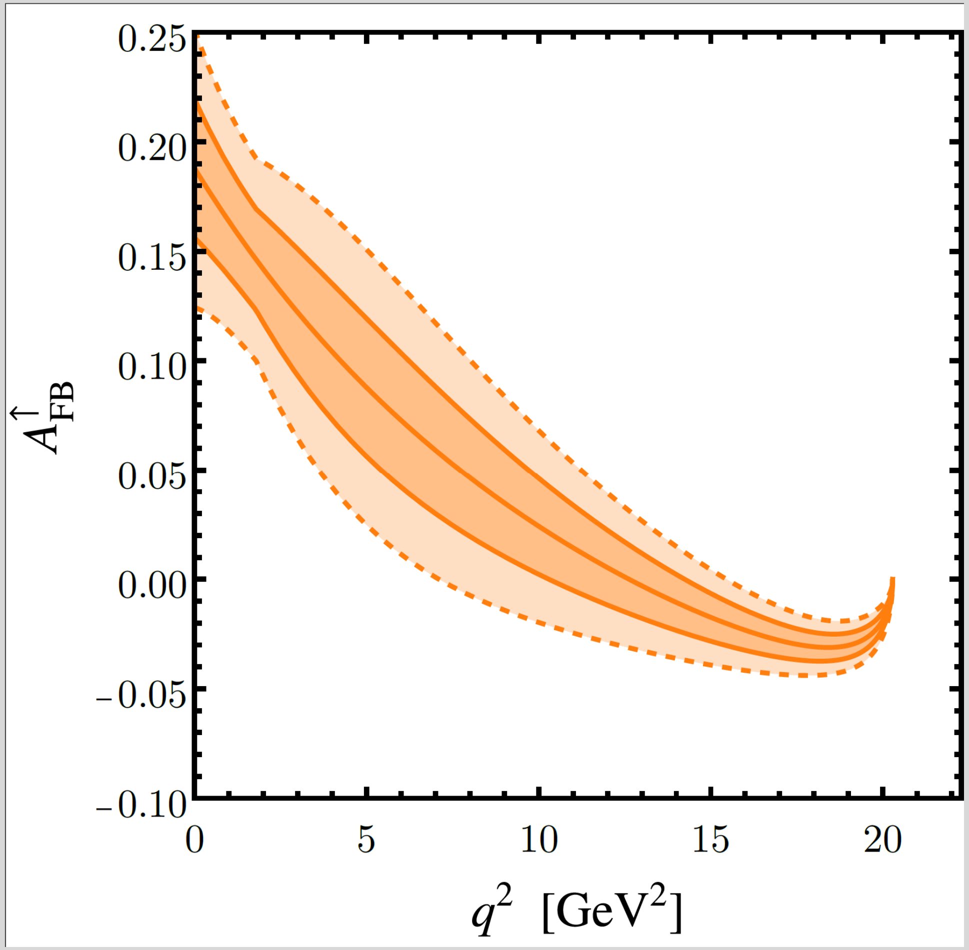
- Evaluate the bound on $C_{R,L}$

# Observables



# The Particles were Framed

**Lab Frame**

$\Lambda_b$ **Rest Frame**

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$$\langle\Lambda|\bar{s}\gamma^\mu b|\Lambda_b\rangle = \bar{u}_\Lambda\Bigg[f_t^V(q^2)(m_{\Lambda_b}-m_\Lambda)\frac{q^\mu}{q^2} + f_\perp^V(q^2)\left(\gamma^\mu - \frac{2(m_\Lambda P^\mu + m_{\Lambda_b}p^\mu)}{(m_{\Lambda_b}+m_\Lambda)^2-q^2}\right)$$
$$+ f_0^V(q^2)\frac{m_{\Lambda_b}+m_\Lambda}{(m_{\Lambda_b}+m_\Lambda)^2-q^2}\left(P^\mu + p^\mu - (m_{\Lambda_b}^2 - m_\Lambda^2)\frac{q^\mu}{q^2}\right)\Bigg]u_{\Lambda_b}$$

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- Only vector and axial elements used
  - Couples to neutrinos – scalar and tensor elements ignored

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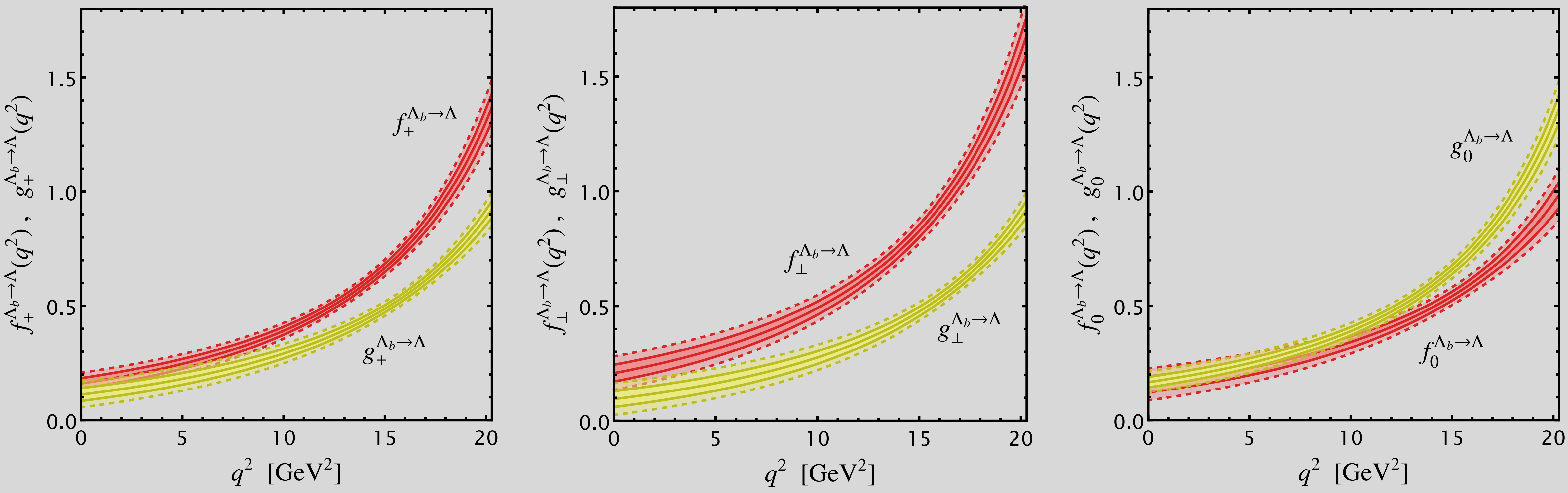
# *FORMING* A PICTURE



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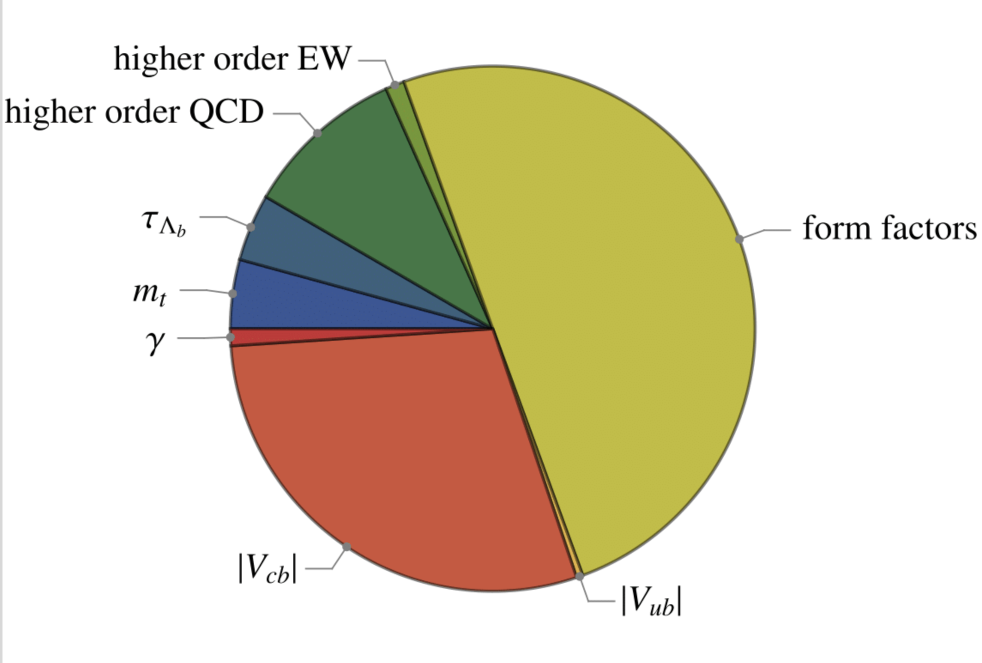

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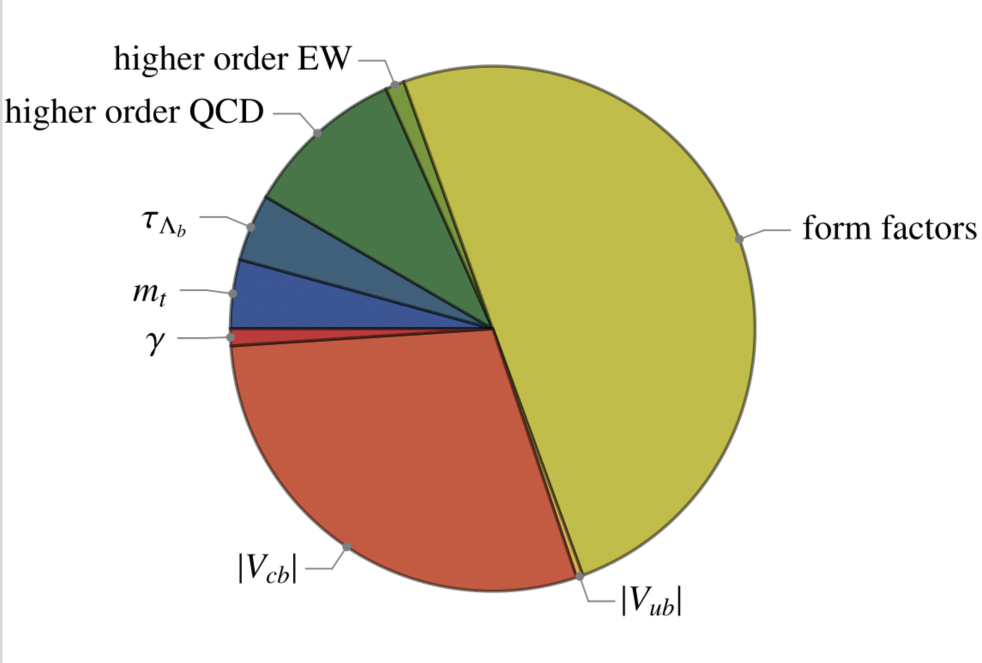

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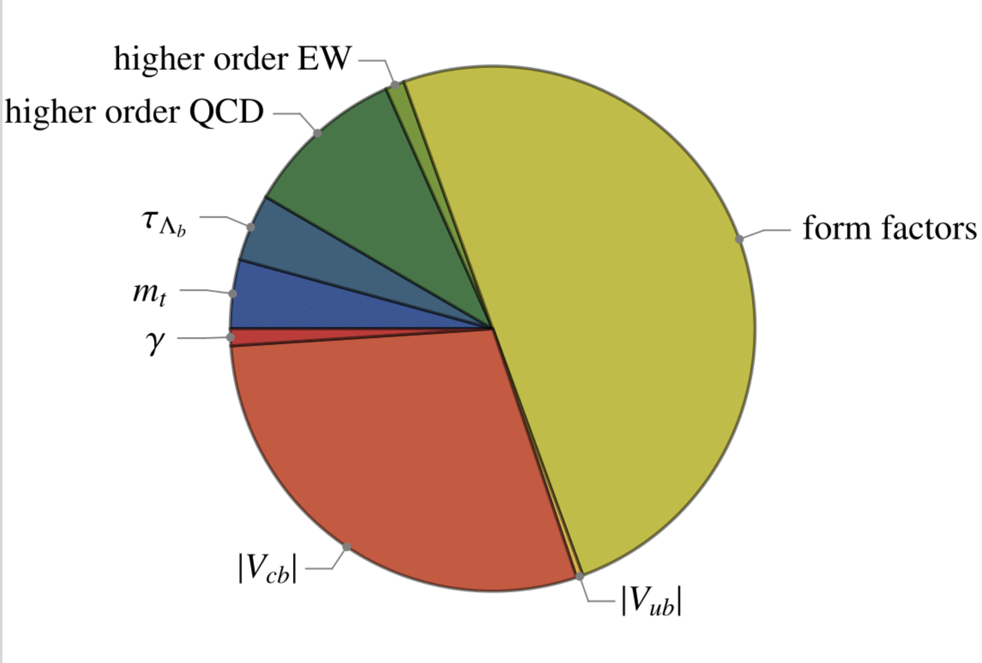

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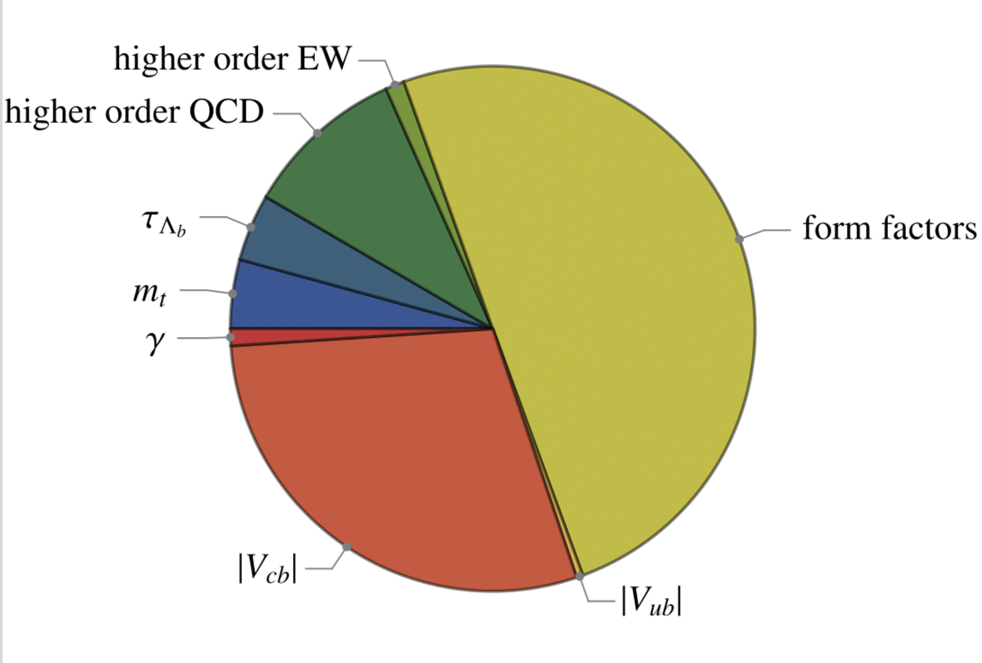


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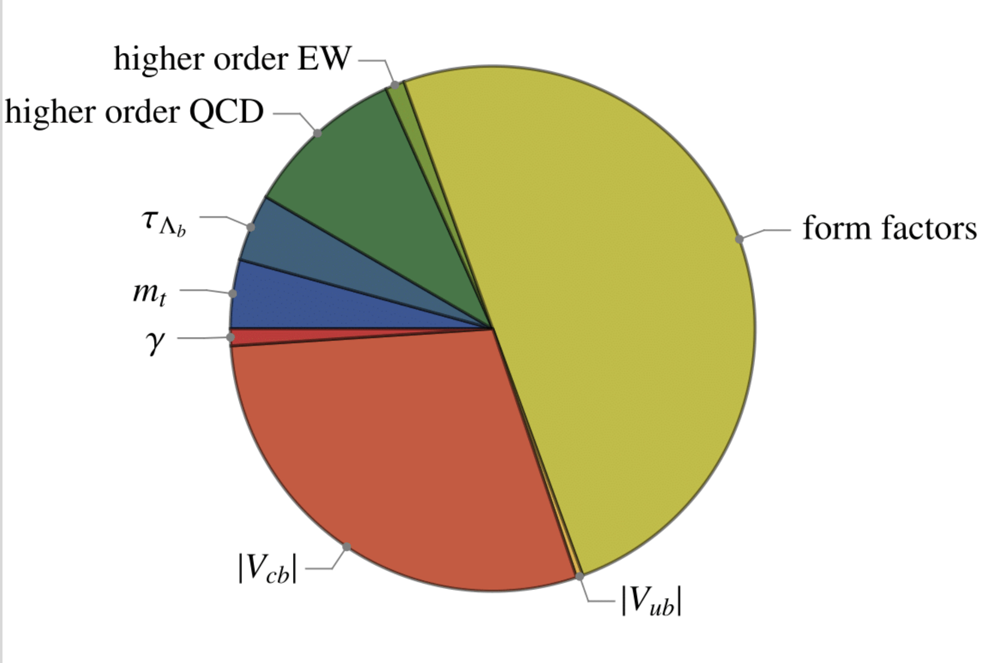


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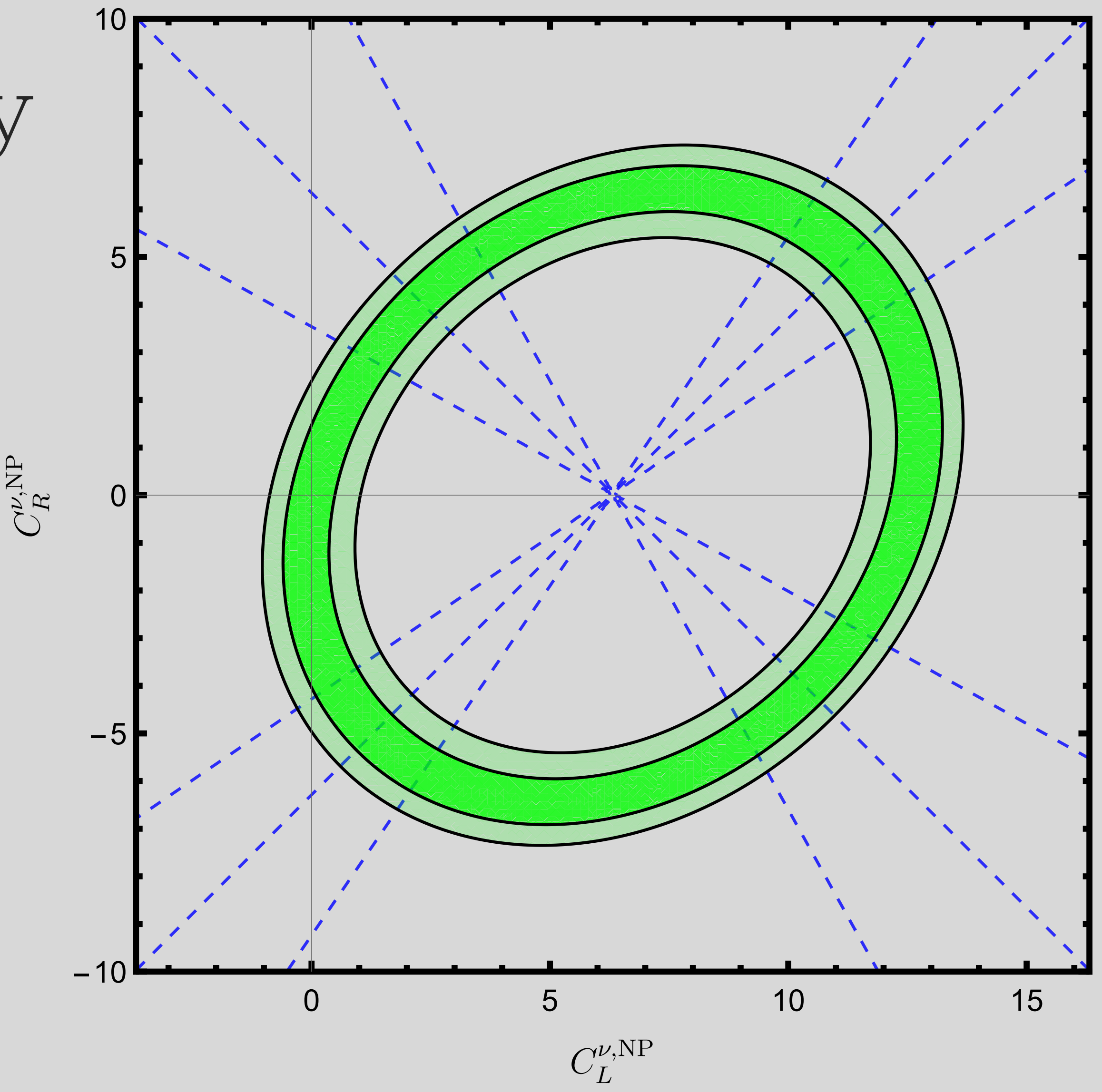

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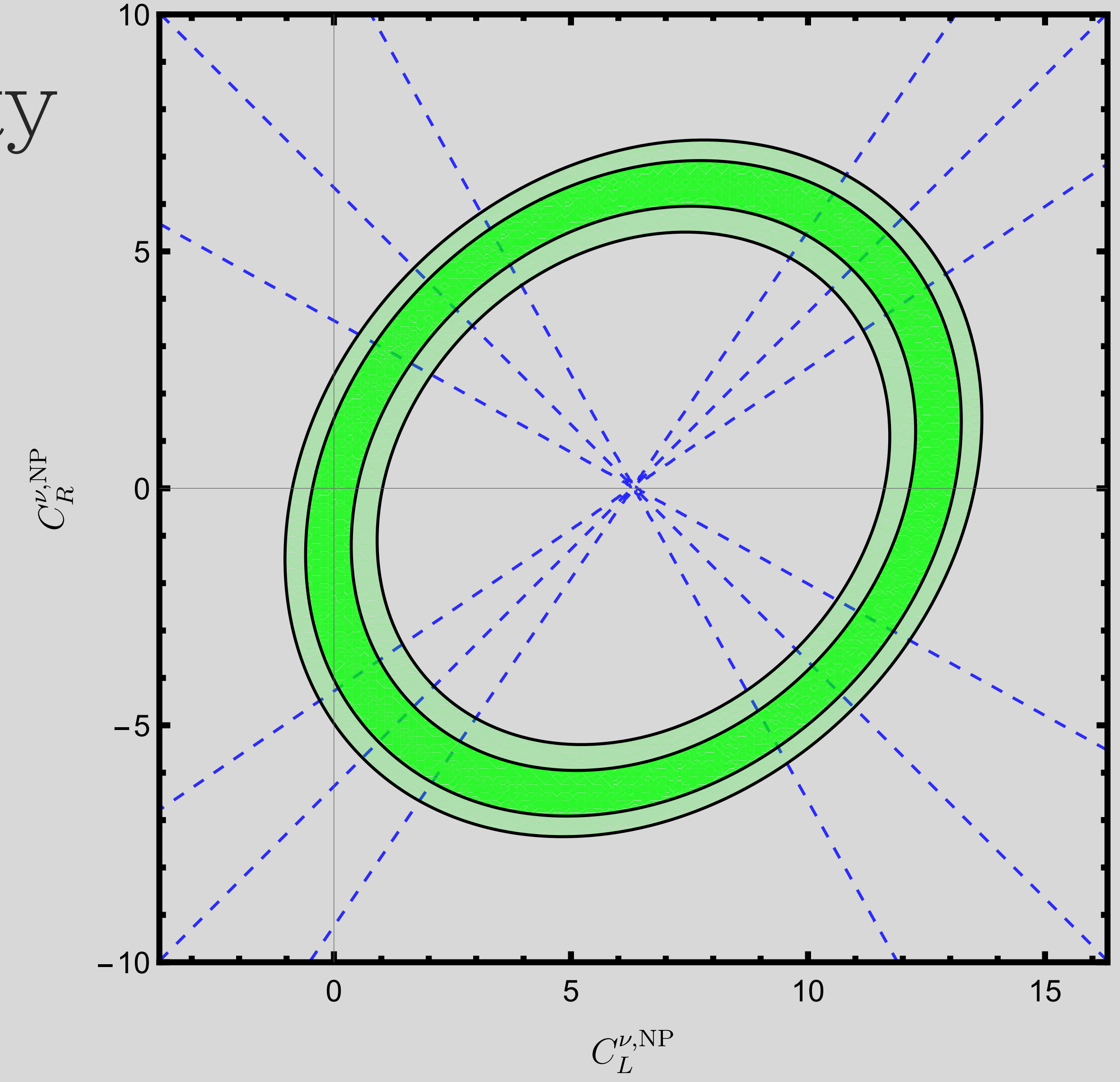

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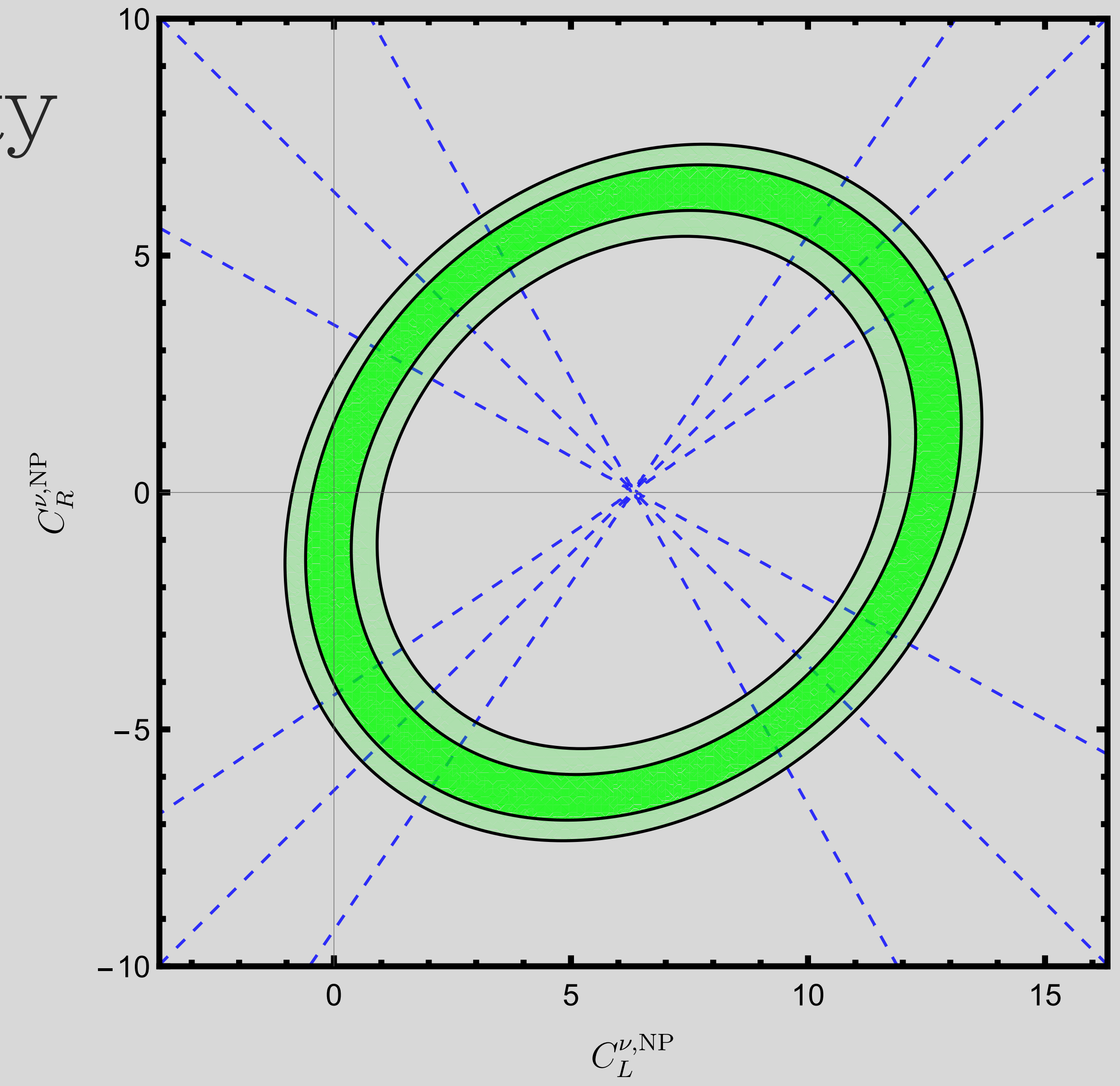

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- Meson decays: current/future data
  - $B \to K^{(*)}\,\nu\,\nu,\;\; B_s \to \phi\,\nu\,\nu$

# QUESTIONS?

Thanks for attending!