Progress on
Global Analysis of CP Odd EFT Operators

2025.10.31

• Introduction

3 CP-odd dim-6 EFT operators (gauge boson sector)

$$\mathcal{O}_{H\tilde{B}} = H^\dagger H B^{\mu\nu} \tilde{B}_{\mu\nu}$$

$$\mathcal{O}_{H\tilde{W}} = H^\dagger H W^{a\mu\nu} \tilde{W}^a_{\mu\nu}$$

$$\mathcal{O}_{HW\tilde{B}} = H^\dagger \sigma^a H W^{a\mu\nu} \tilde{B}_{\mu\nu}$$

global fitting
from electron EDM, neutron EDM, ATLAS data

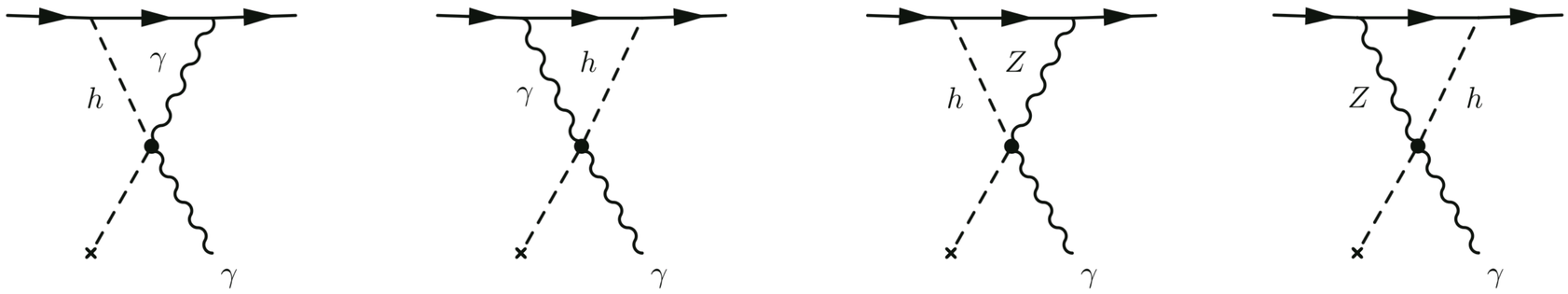
- EDM limits

$$\Lambda \to m_h \to m_e$$

electron EDM

$$\mathcal{O}_{H\tilde{B}} = H^\dagger H B^{\mu\nu} \tilde{B}_{\mu\nu}$$

$$d_e = \frac{e}{16\pi^2}\frac{m_e}{\Lambda^2} C_{H\tilde{B}} \left[-\frac{9}{2} + 6\ln\left(\frac{\Lambda}{m_h}\right) + \frac{2m_Z^2}{m_Z^2 - m_h^2}\left(-1 + 4\sin^2\theta_W\right)\ln\left(\frac{m_h}{m_Z}\right)\right].$$



$$\frac{d}{d\ln\mu}\text{Im } C_{eB} = -\frac{y_e g}{16\pi^2} 2t_W (Y_L + Y_e) C_{H\tilde{B}}$$

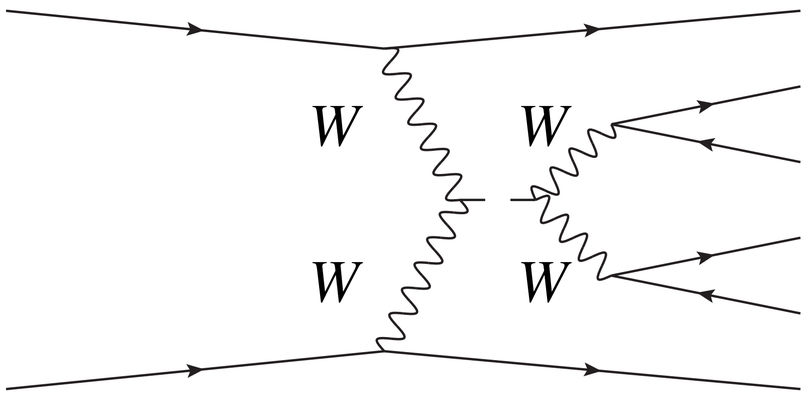
$$\mathcal{O}_{eB} = \bar{L}_L \sigma^{\mu\nu} e_R H B_{\mu\nu} + \text{h.c.}$$

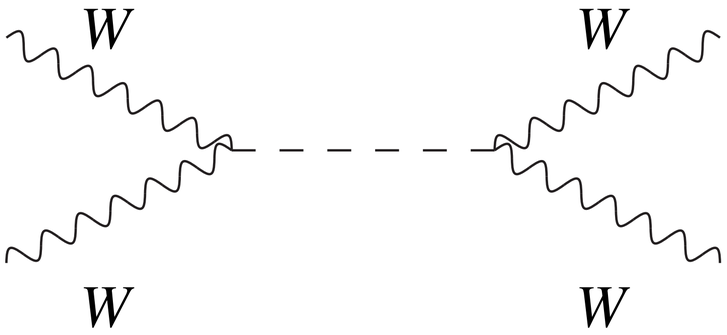
$$\text{Im } C_{e\gamma}(m_h) = -\frac{v}{\sqrt{2}\Lambda} c_W \text{Im } C_{eB}(m_h)$$

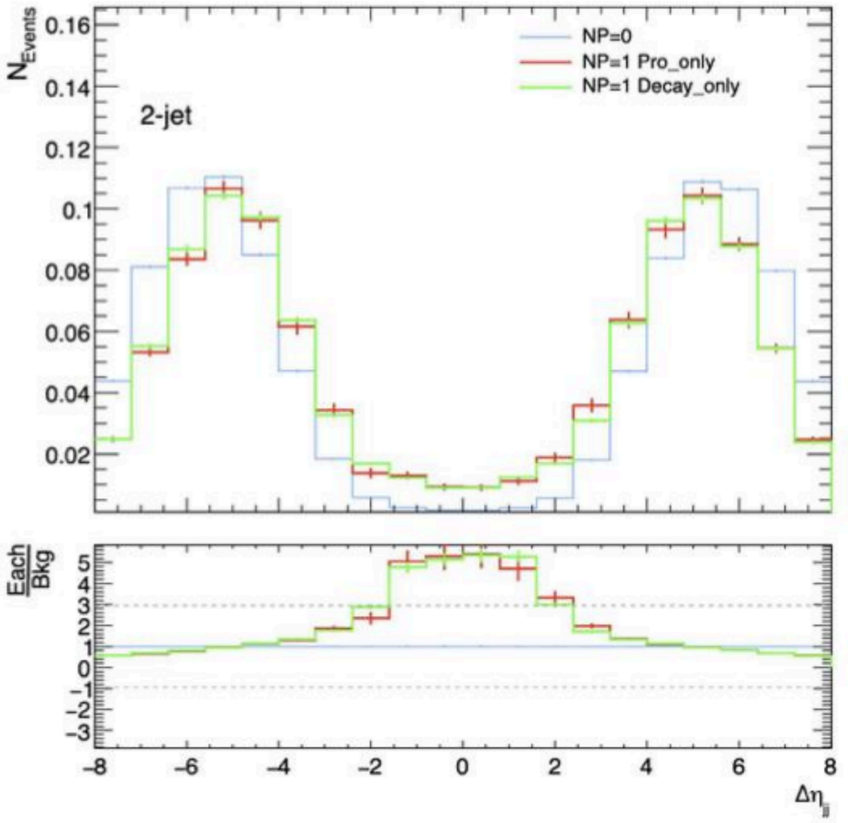
$$= -\frac{3e}{16\pi^2}\frac{m_e}{\Lambda} C_{H\tilde{B}}(\Lambda)\ln\left(\frac{m_h}{\Lambda}\right)$$

$$d_f = -2\frac{\text{Im}\left[C_{f\gamma}\right]}{\Lambda}$$

- Decouple of Production and Decay

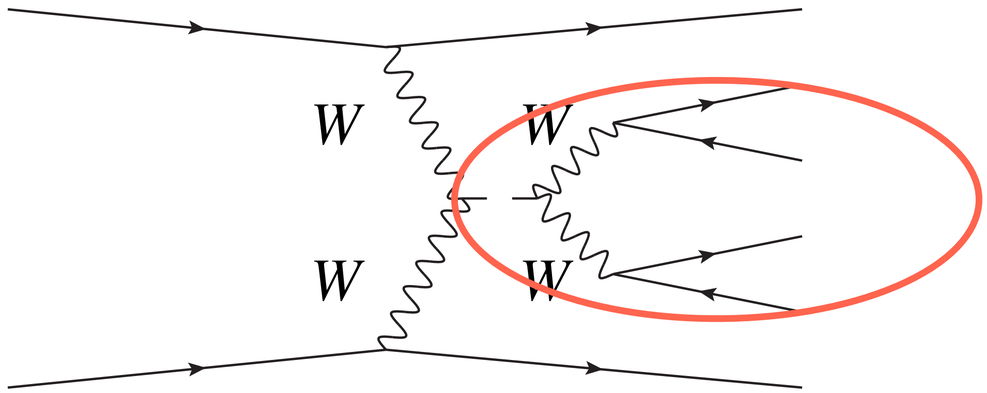






$$\mathscr{M} = -g^2 m_W^2 (\epsilon_1 \cdot \epsilon_2)(\epsilon_3 \cdot \epsilon_4) - 8 v C_{H\tilde{W}} g m_W (\epsilon_1 \cdot \epsilon_2) \epsilon_{\rho\sigma mn} k_3^\rho k_4^\sigma \epsilon_3^m \epsilon_4^n$$

• Observable based on lepton information



$$h(p) \to l(q_1)\bar{\nu}(q_2)\bar{l}(q_3)\nu(q_4)$$

higgs rest frame

narrow width approximation: W onshell

phase space integral

$$d\Pi_{\mathrm{LIPS}} = (2\pi)^4\delta^4(p - q_1 - q_2 - q_3 - q_4)\prod_j \frac{d^3q_j}{(2\pi)^3 2E_j}$$

integrate out the components that cannot measure

$$q_{1x} + q_{2y} = q_x$$

$$q_{1y} + q_{2y} = q_y$$