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We discuss direct and indirect probes of chirality-flipping couplings of the top quark to Higgs and gauge bosons, considering both CP-conserving and CP-violating observables, in the framework of the Standard Model effective field theory. In our analysis we include current and prospective constraints from collider physics, precision electroweak tests, flavor physics, and electric dipole moments (EDMs). We find that low-energy indirect probes are very competitive, even after accounting for long-distance uncertainties. In particular, EDMs put constraints on the electroweak CP-violating dipole moments of the top that are two to three orders of magnitude stronger than existing limits. The new indirect constraint on the top EDM is given by $|d_t| < 5 \cdot 10^{-20}$ e cm at 90% C.L.

Introduction: The top quark might offer a first gateway to physics beyond the Standard Model (BSM), due to its large coupling to the Higgs and hence to the electroweak symmetry breaking sector. In several scenarios, ranging from partial compositeness [1] to supersymmetric models with light stops [2], enhanced deviations from the SM are expected in the top sector which can be relevant for electroweak baryogenesis [2, 3]. Experiments at the Large Hadron Collider (LHC) offer a great opportunity to directly probe non-standard top quark couplings. On the other hand, these same couplings also affect via quantum corrections processes that do not involve a top quark. Such "indirect probes" give very valuable complementary information and in several cases constrain non-standard top couplings more strongly than direct searches.

In this letter we discuss direct and indirect probes of chirality-flipping top-Higgs couplings, including both CP-conserving (CPC) and CP-violating (CPV) interactions, the latter being of great interest in light of Sakharov's conditions for baryogenesis [4]. Despite the vast literature on top-gluon [5–16], top-photon [17–21], top-W [22–28], top Yukawa [29–36] couplings, and global analyses [37–42], the impact of electric dipole moments (EDMs) has received comparatively little attention [17, 29, 37, 43, 44]. The central new element of our work is the systematic inclusion of EDM constraints. Even after properly taking into account the hadronic and nuclear uncertainties [44], EDMs dominate the bounds on all the CPV top couplings. Our major finding is that bounds on the top EDM (weak EDM) are improved by three (two) orders of magnitude over the previous literature. As part of our analysis, we also update indirect constraints from Higgs production and decay.

We work in the linear SM Effective Field Theory (SM-EFT) framework [45–49]. We assume that a gap exists between the scale of new physics Λ and the electroweak scale $v = 246$ GeV and keep only the leading terms in $(v/\Lambda)^2$, corresponding to dimension-six operators. We assume that at the high-scale Λ the largest non-standard effects appear in the top sector, and hence set to zero all

other couplings. We then evolve the non-standard top couplings to lower scales through renormalization group flow and heavy SM particle thresholds. The evolution induces operators that impact various high- and low-energy phenomena, thus leading to constraints on non-standard top-Higgs couplings at the scale Λ.

Operator structure and mixing pattern: In this letter we study chirality-flipping couplings of the top quark to Higgs and gauge bosons. At dimension six, five structures arise: non-standard Yukawa and Gluon, Electric, and Weak dipoles. The hierarchical flavor structure considered here naturally arises [50] in models obeying minimal flavor violation (MFV) [51]. The starting effective Lagrangian encoding new physics at the high scale $\Lambda \gg v$ in the quark mass basis is

$$\mathcal{L}_{\text{eff}}^{\text{BSM}} = \sum_{\alpha \in \{Y, g, \gamma, Wt, Wb\}} C_\alpha O_\alpha + \text{h.c.} \tag{1}$$

with complex couplings $C_\alpha = c_\alpha + i\, \tilde{c}_\alpha$ and

$$O_Y = -m_t \bar{t}_L t_R \left(vh + \frac{3}{2}h^2 + \frac{1}{2}\frac{h^3}{v} \right) \tag{2a}$$

$$O_\gamma = -\frac{eQ_t}{2} m_t \, \bar{t}_L \sigma_{\mu\nu} (F^{\mu\nu} - t_W Z^{\mu\nu}) t_R \left(1 + \frac{h}{v} \right) \tag{2b}$$

$$O_g = -\frac{g_s}{2} m_t \, \bar{t}_L \sigma_{\mu\nu} G^{\mu\nu} t_R \left(1 + \frac{h}{v} \right) \tag{2c}$$

$$O_{Wt} = -gm_t \Bigg[\frac{1}{\sqrt{2}} \bar{b}'_L \sigma^{\mu\nu} t_R W^-_{\mu\nu} $$
$$+ \bar{t}_L \sigma^{\mu\nu} t_R \left(\frac{1}{2c_W} Z_{\mu\nu} + igW^-_\mu W^+_\nu \right) \Bigg] \left(1 + \frac{h}{v} \right) \tag{2d}$$

$$O_{Wb} = -gm_b \Bigg[\frac{1}{\sqrt{2}} \bar{t}'_L \sigma^{\mu\nu} b_R W^+_{\mu\nu} $$
$$- \bar{b}_L \sigma^{\mu\nu} b_R \left(\frac{1}{2c_W} Z_{\mu\nu} + igW^-_\mu W^+_\nu \right) \Bigg] \left(1 + \frac{h}{v} \right), \tag{2e}$$

where $Q_t = 2/3$, $t_W = \tan\theta_W$, $c_W = \cos\theta_W$, $b' = V_{tb}b + V_{ts}s + V_{td}d$, $t' = V_{tb}^*t + V_{cb}^*c + V_{ub}^*u$, and h denotes the physical scalar boson. Our operators retain

Operator		Coupling
$-\sqrt{2}\varphi^\dagger\varphi\ \bar{q}_L\,Y'_u\,u_R\,\tilde\varphi$	O_Y	$y_t C_Y = [Y'_u]_{33}$
$-\frac{g_s}{\sqrt{2}}\ \bar{q}_L\sigma\cdot G\,\Gamma^u_g\,u_R\,\tilde\varphi$	O_g	$y_t C_g = [\Gamma^u_g]_{33}$
$-\frac{g'}{\sqrt{2}}\ \bar{q}_L\sigma\cdot B\,\Gamma^u_B\,u_R\,\tilde\varphi$	$O_{\gamma,Wt}$	$y_t Q_t C_\gamma = -[\Gamma^u_B+\Gamma^u_W]_{33}$
$-\frac{g}{\sqrt{2}}\ \bar{q}_L\sigma\cdot W^a\tau^a\,\Gamma^u_W\,u_R\,\tilde\varphi$		$y_t C_{Wt} = [\Gamma^u_W]_{33}$
$-\frac{g}{\sqrt{2}}\ \bar{q}_L\sigma\cdot W^a\tau^a\,\Gamma^d_W\,d_R\,\varphi$	O_{Wb}	$y_b C_{Wb} = [\Gamma^d_W]_{33}$

TABLE I: High-scale operators in $SU(2)\times U(1)$ invariant form [45, 46] (left column) and mapping to the operators and couplings used in this letter (center and right column). q_L represents the L-handed quark doublet, φ is the Higgs doublet, and $\tilde\varphi = i\sigma_2\varphi^*$. g_s, g, g' denote the $SU(3)$, $SU(2)$, and $U(1)$ gauge couplings, $y_{t,b} = m_{t,b}/v$, and $\sigma\cdot X = \sigma_{\mu\nu}X^{\mu\nu}$. The couplings C_α are related to the 33 components of the matrices Y'_u and $\Gamma^{u,d}_{g,B,W}$ in the quark mass basis.

FIG. 1: Representative diagrams contributing to the mixing of C_γ into $C_{\varphi\tilde{W},\varphi\tilde{B},\varphi\tilde{W}B,quqd,lequ}$ (top panel), and the mixing of the latter into light fermion electroweak dipoles (bottom panel). The square (circle) represents an operator (quark mass) insertion. Solid, wavy, and dotted lines represent fermions, electroweak gauge bosons, and the Higgs, respectively.

the full constraints of gauge invariance as they are linear combinations of the explicitly $SU(2)\times U(1)$-invariant operators of Refs. [45, 46], expressed in the unitary gauge. The correspondence to the standard basis is provided in Table I. The couplings C_α have mass dimension $[-2]$ and are related to properties of the top quark, such as electric and magnetic dipole moments ($d_t = (em_t Q_t)\tilde{c}_\gamma$ and $\mu_t = (em_t Q_t)c_\gamma$).

To constrain c_α and $\tilde{c}_\alpha$ we use direct and indirect probes. Direct probes involve top quark production (single top, $t\bar{t}$, and $t\bar{t}h$) and decay (W-helicity fractions, lepton angular distributions) at colliders. We include CPV effects in the angular distributions of the decay products of a single top [52], while we neglect CPV observables in $t\bar{t}$ and $t\bar{t}h$ production/decay [53–61] as these are not yet competitive. Indirect probes involve top quarks in quantum loops, affecting both high-energy (Higgs production and decay, precision electroweak tests) and low-energy observables ($b\to s\gamma$ and EDMs).

Indirect constraints rely on operator-mixing via renormalization group (RG) flow and on threshold corrections arising from integrating out heavy SM particles (t, h, W, Z). In Table II we summarize the operators that are generated from Eq. (1) to leading order in the strong, electroweak, and Yukawa couplings. These include the light quark electromagnetic and gluonic dipoles (flavor diagonal and off-diagonal entries relevant to $b\to s\gamma$), the Weinberg three-gluon operator, and operators involving Higgs and gauge bosons. To a good approximation, these operators close under RG evolution, and in particular the top dipoles mix into and from chirality-conserving top-Higgs-gauge couplings at three-loops [46–49].

There are several paths to connect the high-scale Wilson coefficients in (1) to the operators in Table II and low-energy observables. These paths are determined by the RG equations

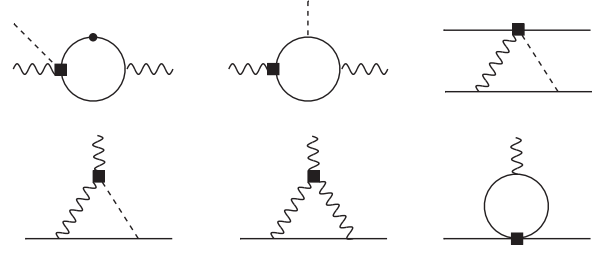$$\frac{dC_i}{d\ln\mu} = \sum_j \gamma_{j\to i}\,C_j\ , \qquad (3)$$

and possibly threshold corrections. In Table III we provide a synopsis of the induced low-scale couplings (left column) and the observables they contribute to (right column). Several of these paths have already been analyzed in the literature. Here we briefly recall the dominant paths for each operator, paying special attention to a novel two-step path that connects the top EDM and W-EDMs ($\tilde{c}_\gamma$ and $\tilde{c}_{Wt}$) to low energy. A detailed analysis is presented in Ref. [50].

There are three paths that constrain the top electromagnetic dipole coupling C_γ through indirect measurements. First, C_γ induces down-type EDMs ($C_\gamma \to C_\gamma^{(d,s)}$) via a flavor-changing W loop, suppressed by the CKM factor $|V_{td,ts}|^2$. Similar one-loop diagrams induce $b\to s\gamma$ dipole operators [62, 63]. Next, at one loop C_γ induces the top gluonic dipole C_g, which in turn at the top threshold generates the three-gluon Weinberg coupling $C_{\tilde{G}}$. Finally, there is a new two-step path: first C_γ induces the anomalous couplings of the Higgs to electroweak bosons, as well as anomalous couplings of the top quark to light fermions, namely $C_{\varphi W,\varphi B,\varphi WB}$, $C_{\varphi\tilde{W},\varphi\tilde{B},\varphi\tilde{W}B}$, and $C_{lequ,quqd}$ (see top diagrams in Fig. 1). These couplings in turn mix at one loop (see bottom diagrams in Fig. 1) into the electromagnetic dipoles $C_\gamma^{(f)}$ ($f = e, u, d, s$) [64, 65]. Focusing on the electron, the relevant anomalous dimensions are

$$\gamma_{\tilde{c}_\gamma\to C_{\{\varphi\tilde{B},\varphi\tilde{W}B,lequ\}}} = \frac{N_c Q_t}{16\pi^2}y_t^2\left\{1-4Q_t, 1, \frac{3g'^2 y_e}{2N_c y_t}\right\}\ , \quad (4)$$

$$\gamma_{\{C_{\varphi\tilde{B}},C_{\varphi\tilde{W}B},C^{(3)}_{lequ}\}\to\tilde{c}^{(e)}_\gamma} = -\frac{\alpha}{\pi\,Q_e\,s_W^2}\ \times$$

$$\left\{-3t_W^2,\ \frac{3}{2}(1+t_W^2), 4Q_t N_c\frac{1}{g^2}\frac{y_t}{y_e}\right\}\ . \qquad (5)$$

This new "two-step" path leads to light fermion EDMs.

$O_{\varphi G} = g_s^2 \varphi^\dagger \varphi G_{\mu\nu} G^{\mu\nu}$	$O_{\varphi\tilde{G}} = g_s^2 \varphi^\dagger \varphi G_{\mu\nu} \tilde{G}^{\mu\nu}$
$O_{\varphi W} = g^2 \varphi^\dagger \varphi W_{\mu\nu}^i W^{i\mu\nu}$	$O_{\varphi\tilde{W}} = g^2 \varphi^\dagger \varphi \tilde{W}_{\mu\nu}^i W^{i\mu\nu}$
$O_{\varphi B} = g'^2 \varphi^\dagger \varphi B_{\mu\nu} B^{\mu\nu}$	$O_{\varphi\tilde{B}} = g'^2 \varphi^\dagger \varphi \tilde{B}_{\mu\nu} B^{\mu\nu}$
$O_{\varphi WB} = gg' \varphi^\dagger \tau^i \varphi W_{\mu\nu}^i B^{\mu\nu}$	$O_{\varphi\tilde{W}B} = gg' \varphi^\dagger \tau^i \varphi \tilde{W}_{\mu\nu}^i B^{\mu\nu}$
$O_{lequ}^{(3)} = (\bar{l}_L^I \sigma^{\mu\nu} e_R) \epsilon_{IJ} (\bar{q}_L^J \sigma_{\mu\nu} u_R)$	
$O_{quqd}^{(1)} = (\bar{q}_L^I u_R) \epsilon_{IJ} (\bar{q}_L^J d_R)$, $\quad O_{quqd}^{(8)} = (\bar{q}_L^I t^a u_R) \epsilon_{IJ} (\bar{q}_L^J t^a d_R)$	
$O_{\tilde{G}} = (1/6) g_s f_{abc} \epsilon^{\mu\nu\alpha\beta} G_{\alpha\beta}^a G_{\mu\rho}^b G_\nu^{c\ \rho}$	
$O_g^{(q)} = O_g\big|_{t\to q} \qquad q = u, d, s$	
$O_g^{(bs)} = -(g_s/2)\, m_b\, \bar{s}_L \sigma_{\mu\nu} G^{\mu\nu} b_R$	
$O_\gamma^{(f)} = O_\gamma\big|_{t\to f} \qquad f = e, u, d, s$	
$O_\gamma^{(bs)} = -(e/2) m_b\, \bar{s}_L \sigma_{\mu\nu} F^{\mu\nu} b_R$	

TABLE II: Dimension-six operators induced by the top-Higgs interactions in Eq. (1) via RG flow and threshold corrections. We write $\tilde{X}_{\mu\nu} \equiv \epsilon_{\mu\nu\alpha\beta} X^{\alpha\beta}$.

Coupling	Observables
C_g	$\sigma(t\bar{t})$; $\sigma(t\bar{t}h)$
C_{Wt}	$\sigma(t)$; $t \to W b$
C_{Wb}	$\sigma(t)$; $t \to W b$; $Z \to b\bar{b}$
C_Y	$\sigma(t\bar{t}h)$
$C_{\varphi W, \varphi B, \varphi WB} \leftarrow C_\gamma, C_{Wt,Wb}, C_Y$	$h \to \gamma\gamma$; S
$C_{\varphi\tilde{W}, \varphi\tilde{B}, \varphi\tilde{W}B} \leftarrow C_\gamma, C_{Wt,Wb}, C_Y$	$h \to \gamma\gamma$
$C_{\varphi G, \varphi\tilde{G}} \leftarrow C_g, C_Y$	$h \leftrightarrow gg$
$C_{\tilde{G}} \leftarrow C_g, C_Y$	EDMs
$C_g^{(q)} \leftarrow C_\alpha, C_{\varphi G,\varphi\tilde{G}}, C_{quqd}^{(1,8)}$	EDMs; $b \to s\gamma$
$C_\gamma^{(f)} \leftarrow C_{\alpha\neq g}, C_{lequ}^{(3)}, C_{quqd}^{(1),(8)},$ $C_{\varphi W, \varphi B, \varphi WB}, C_{\varphi\tilde{W}, \varphi\tilde{B}, \varphi\tilde{W}B}$	EDMs; $b \to s\gamma$

TABLE III: Left column: effective couplings in the extended basis. The first four entries are in the original basis of Eq. (1). The remaining entries are induced via RG flow, as indicated by the arrows. Right column: observables to which couplings in the extended basis contribute.

For the electron, the approximate solution of (3) reads

$$\frac{\tilde{c}_\gamma^{(e)}}{\tilde{c}_\gamma} \simeq \frac{3N_c Q_t \alpha}{64\pi^3 s_W^2} \frac{m_t^2}{v^2} \left[1 + (12Q_t - 1)t_W^2\right] \left(\log \frac{\Lambda}{m_t}\right)^2,$$

(6)

implying $\tilde{c}_\gamma^{(e)}/\tilde{c}_\gamma \sim 4 \times 10^{-4}$ for $\Lambda = 1$ TeV and thus $|d_e| \sim |v^2 \tilde{c}_\gamma| \cdot 6 \cdot 10^{-26} e\,$cm. While this simple estimate already shows the power of this new path ($|d_e| < 8.7 \cdot 10^{-29} e\,$cm [66]), in our analysis we employ the full numerical solution of (3).

The weak dipole C_{Wt} has a mixing pattern similar to C_γ. The strongest constraints arise again from the two-step path: $C_{Wt} \to C_{\varphi\tilde{W},\varphi\tilde{B},\varphi\tilde{W}B,lequ,quqd} \to C_\gamma^{(f)}$ ($f = e, u, d, s$). For C_{Wb} this path is suppressed by the bottom Yukawa. So the main contribution of C_{Wb} to EDMs arises from mixing with the b chromo-EDM, which induces $O_{\tilde{G}}$ [67, 68] at the m_b threshold.

The gluonic dipole coupling C_g mixes at one loop with the top electromagnetic dipole C_γ, the non-standard Yukawa C_Y, and non-standard Higgs-gluon couplings $C_{\varphi G,\varphi\tilde{G}}$ [44, 49, 65, 69, 70]. Moreover, C_g generates the light chromo-EDMs through the two-step mechanism, $C_g \to C_{quqd}^{(1),(8)} \to C_g^{(q)}$, and induces $O_{\tilde{G}}$ at the top threshold.

Finally, the non-standard top Yukawa coupling C_Y has no anomalous mixing but it contributes to all the couplings of the extended effective Lagrangian at lower scale through finite threshold corrections from one-loop and two-loop Barr-Zee diagrams [71–77].

Current and prospective bounds: As becomes clear from Table III, the high-scale top-Higgs couplings can be constrained by various CP-even and CP-odd observables. A detailed description of the experimental and theoretical input, the chi-squared function, and the treatment of theoretical uncertainties are presented in Ref. [50]. Here we highlight the main features of our analysis: (i) For each observable, we include only contributions linear in the new physics couplings C_α, neglecting higher-order terms in the SM-EFT expansion. We express all bounds in terms of $C_\alpha(\Lambda = 1\,\text{TeV})$. (ii) For low-energy probes ($b \to s\gamma$ [78–81] and EDMs [44, 82, 83]) we treat the significant hadronic and nuclear theoretical uncertainties according to the "range-fit" method [84], in which the total chi-squared is minimized with respect to the matrix elements (varied in their allowed theoretical range). This procedure allows for cancellations between different contributions to a given observable and thus gives the most conservative bounds on BSM couplings [44]. (iii) We use experimental input on top processes at Tevatron [85, 86] and the LHC [52, 87–94]; on Higgs production/decay signal strengths [95, 96]; on $Z \to b\bar{b}$ and S [97, 98]; on $b \to s\gamma$ [98, 99]; and on neutron, ^{199}Hg, ^{129}Xe, ^{225}Ra, and electron EDMs [66, 100–104].

We first focus on the case in which a single operator structure dominates at the high scale, keeping both real (c_α) and imaginary ($\tilde{c}_\alpha$) parts. In Figs. 2 and 3 we present the 90% CL bounds on the planes $v^2 c_\alpha - v^2 \tilde{c}_\alpha$, for the five couplings of Eq. (1). We show the individual most constraining bounds and the combined allowed region. For $\tilde{c}_\gamma$, $\tilde{c}_{Wt}$, $\tilde{c}_{Wb}$, and c_g, our bounds are considerably stronger than the existing literature. For the remaining couplings, we agree with previous findings. The following features emerge from the plots: (i) Indirect probes are currently more constraining than direct ones, with the exception of c_{Wt}, for which the bound from W helicity fractions in $t \to Wb$ competes with $b \to s\gamma$. In particular, the bound on c_g from Higgs production is a factor of 5 stronger than the direct bound from $t\bar{t}$. (ii) EDMs, despite the conservative nature of the range-fit procedure, strongly constrain the CPV couplings, with the electron EDM dominating the bound on $\tilde{c}_\gamma$, $\tilde{c}_{Wt}$, $\tilde{c}_Y$, and $\tilde{c}_g$ and the neutron EDM leading to the best bound
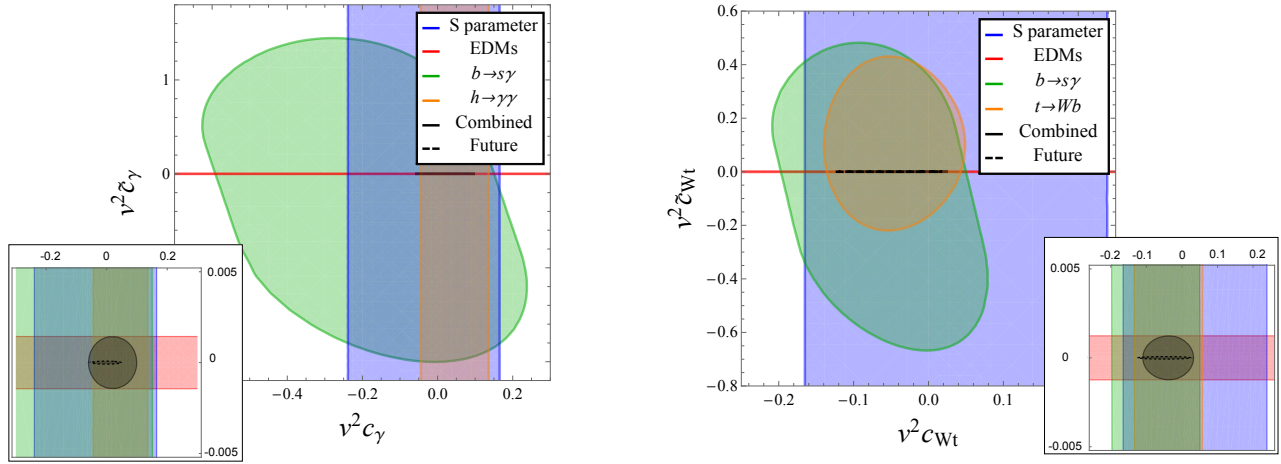
FIG. 2: 90% CL allowed regions in the $v^2c_\gamma - v^2\tilde{c}_\gamma$ (left panel) and $v^2c_{Wt} - v^2\tilde{c}_{Wt}$ planes (right panel), with couplings evaluated at $\Lambda = 1$ TeV. In both cases, the inset zooms into the current combined allowed region and shows projected future sensitivities. Future EDM searches will probe $v^2\tilde{c}_\gamma \sim 8 \cdot 10^{-5}$ and $v^2\tilde{c}_{Wt} \sim 7 \cdot 10^{-5}$.
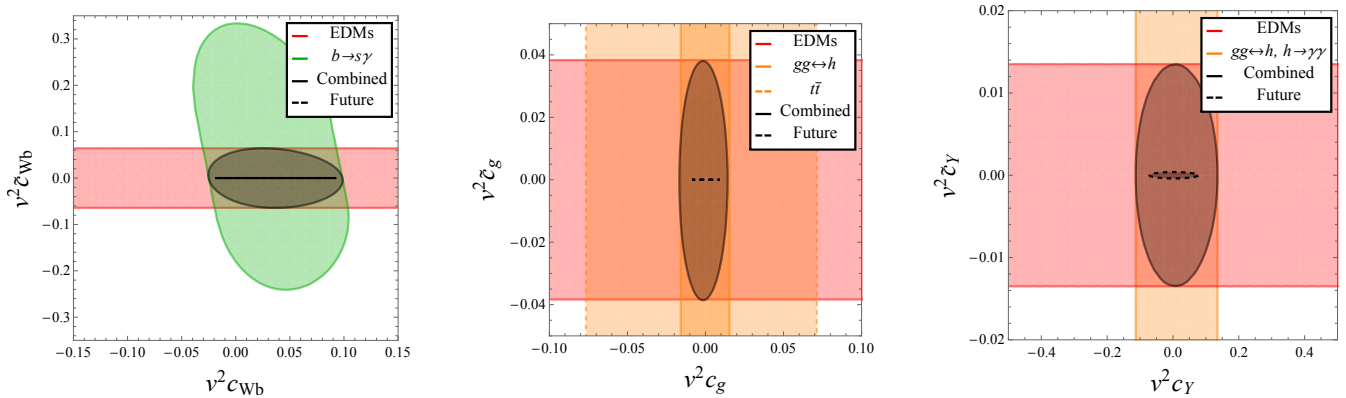

FIG. 3: 90% CL allowed regions in the $v^2c_{Wb} - v^2\tilde{c}_{Wb}$ (left panel) and $v^2c_g - v^2\tilde{c}_g$ (center panel) and $v^2c_Y - v^2\tilde{c}_Y$ planes (right panel). with couplings evaluated at $\Lambda = 1$ TeV. Future EDM searches will probe $v^2\tilde{c}_{Wb} \sim 2 \cdot 10^{-4}$, $v^2\tilde{c}_g \sim 2 \cdot 10^{-3}$, and $v^2\tilde{c}_Y \sim 3 \cdot 10^{-4}$.

on $\tilde{c}_{Wb}$. The neutron EDM could put a much stronger constraint on $\tilde{c}_g$ ($v^2\tilde{c}_g < 2 \cdot 10^{-3}$) with better control of the hadronic matrix elements. In particular EDMs lead to a three (two) orders of magnitude improvement in the bounds on $\tilde{c}_\gamma$ ($\tilde{c}_{Wt}$), see Fig. 2, and a significant one (factor of 5) in $\tilde{c}_{Wb}$, see Fig. 3. The new bounds on $\tilde{c}_\gamma$ and $\tilde{c}_{Wt}$ lie well below the prospected sensitivities of the LHC [18, 21, 27] and envisioned [20, 21] collider experiments.

In Figs. 2 and 3 we also present projected combined bounds for the new physics couplings, based on expected improvements in collider [105, 106], super-B factory [107, 108], and EDM sensitivities [109] (one (two) order(s) of magnitude for the electron (neutron)).

Discussion: The overarching message emerging from our single-operator analysis is that the CPV couplings are very tightly constrained, and out of reach of direct collider searches. If new physics simultaneously generates several operators at the scale Λ, not necessarily in-

volving top and Higgs fields, our results enforce strong correlation between the various couplings. For example, a large top EDM ($\tilde{c}_\gamma$) is compatible with non-observation of ThO EDM if an electron EDM (d_e) is also generated at the scale Λ, with the right size to cancel the RG effect from $\tilde{c}_\gamma$, at the level of a few parts in a thousand. This puts powerful constraints on the underlying dynamics, providing non-trivial input to model building [64]. This point can also be illustrated by studying the case in which new physics generates all the couplings of Eq. (1) at the matching scale Λ. Performing a global analysis with five free CPV couplings $\tilde{c}_\alpha(\Lambda)$ (fixing the hadronic and nuclear matrix elements to their central values) we find the bounds: $-0.2 < v^2\tilde{c}_\gamma < 0.4$, $-0.02 < v^2\tilde{c}_g < 0.04$, $-0.2 < v^2\tilde{c}_{Wt} < 0.4$, $-0.1 < v^2\tilde{c}_{Wb} < 0.3$, $-0.2 < v^2\tilde{c}_Y < 0.5$. While weaker than the single-operator EDM constraints, in most cases these bounds are still stronger than individual flavor and collider bounds, and certain
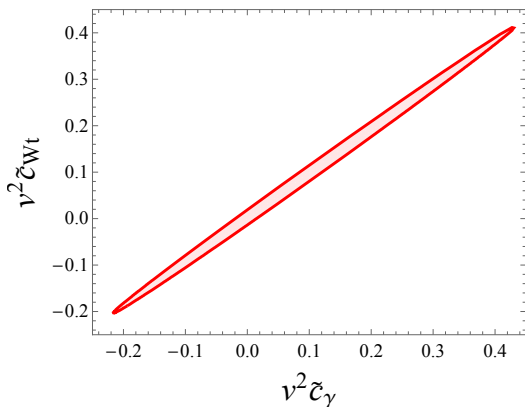
FIG. 4: 90% CL allowed region in the $v^2\tilde{c}_\gamma - v^2\tilde{c}_{Wt}$ plane in a global analysis.

directions in parameter space remain very strongly constrained, as shown in Fig. 4. Even if one allows for additional CP violation in chirality-conserving top couplings, under broad assumptions such as MFV this strong constraint is not significantly affected.

Conclusions: In this letter we have highlighted the impact of indirect probes on chirality-flipping top-Higgs couplings, uncovering the dramatic effect of neutron and atomic/molecular EDMs – they improve the bounds on the top EDM by three orders of magnitude ($|d_t| < 5 \cdot 10^{-20}$ e cm at 90% C.L.). Our results have implications for baryogenesis mechanisms, collider searches, and flavor physics. They motivate more sensitive EDM searches and improved lattice QCD and nuclear structure calculations of the effect of CPV operators in nucleons and nuclei.

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