Closing in on TCNH-EWBG from Heavy Higgs

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March 27, HPNP Special (Virtual) Edition 2021

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Closing in on TCNH-EWBG w/ Heavy Higgs

$H, A, H^\pm$

I. Intro

II. Framework & Parameter Space

III. Charged Higgs Production

IV. Neutral Higgs Production

V. Discussion

VI. Outlook

~~Z_2~~ g2HDM
general

B.A.U. ~~Z_2~~

Electroweak baryogenesis in a two-Higgs doublet model is a well-motivated and testable scenario for physics beyond the Standard Model. One attractive way of providing CP violation is through flavor-changing Higgs couplings, where a link between top and charm quarks is hardly affected by flavor and CP-violation constraints. This scenario can be tested by searching for heavy charged and neutral Higgs bosons at the LHC.

WSH, Modak, Plehn (HMP'20), 2012.03572

I. Intro

Beyond CKM **CPV**

EW BaryoGenesis (EWBG)
- more testable -

tension

LHC
- *N*o *N*ew *P*hysics -

tension

competition

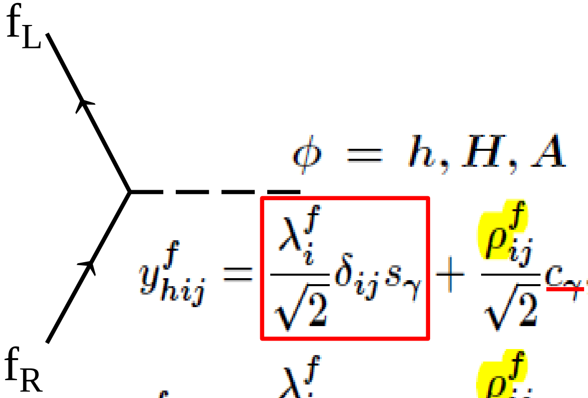
eEDM: ACME14 → ACME18
- L.E. Precision Frontier -

$|d_e| < 1.1 \times 10^{-29}\ e$ cm

Render small? Or evade?

~~Z_2~~ g2HDM (general)

f = u, d, e

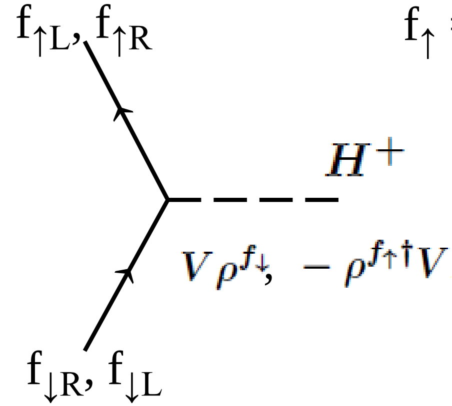


$$y^f_{hij} = \boxed{\frac{\lambda^f_i}{\sqrt{2}}\delta_{ij}s_\gamma} + \frac{\rho^f_{ij}}{\sqrt{2}}c_\gamma,$$

$$y^f_{Hij} = \frac{\lambda^f_i}{\sqrt{2}}\delta_{ij}c_\gamma - \frac{\rho^f_{ij}}{\sqrt{2}}s_\gamma,$$

$$y^{f_\uparrow}_{Aij} = -i\frac{\rho^{f_\uparrow}_{ij}}{\sqrt{2}}, \quad y^{f_\downarrow}_{Aij} = i\frac{\rho^{f_\downarrow}_{ij}}{\sqrt{2}}$$

$f_\uparrow$ = u, ν; $f_\downarrow$ = d, e



ρ^f are ~~3 × 3 Yukawa~~ Extra 3 × 3 Yukawa — complex — **Flav/CPV**

ρ_{tt}, ρ_{tc} — Largest

Emergent

- mass hierarchy: $m_1^2 \ll m_2^2 \ll m_3^2$; $m_b^2 \ll m_t^2$
- mixing hierarchy: $|V_{ub}|^2 \ll |V_{cb}|^2 \ll |V_{us}|^2 \ll 1$
- alignment: $|\cos\gamma|^2 \ll 1$ (small h-H mixing)

→ Control FCNH (Flavor Changing Neutral Higgs)

~~Glashow-Weinberg '77~~

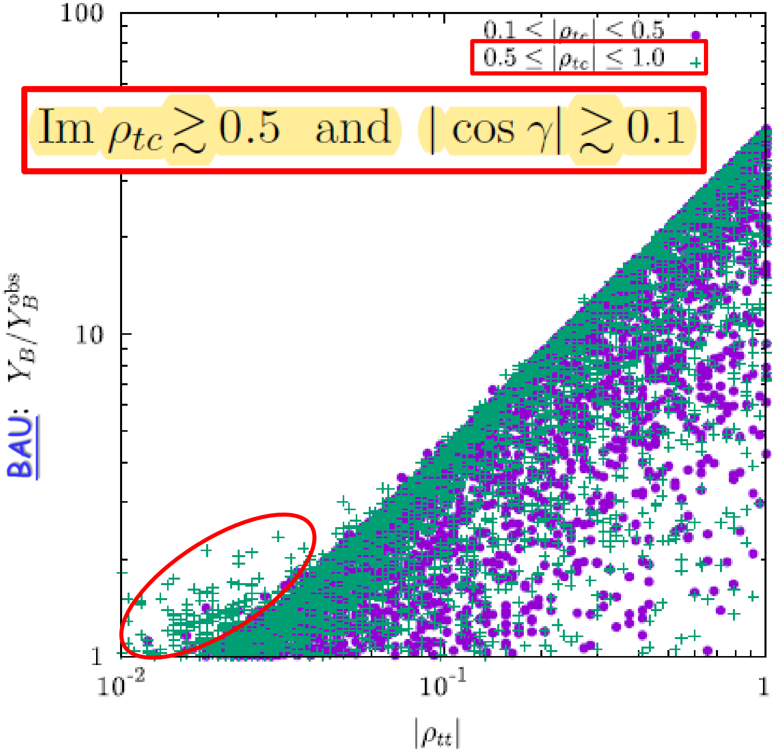
NFC Not Needed

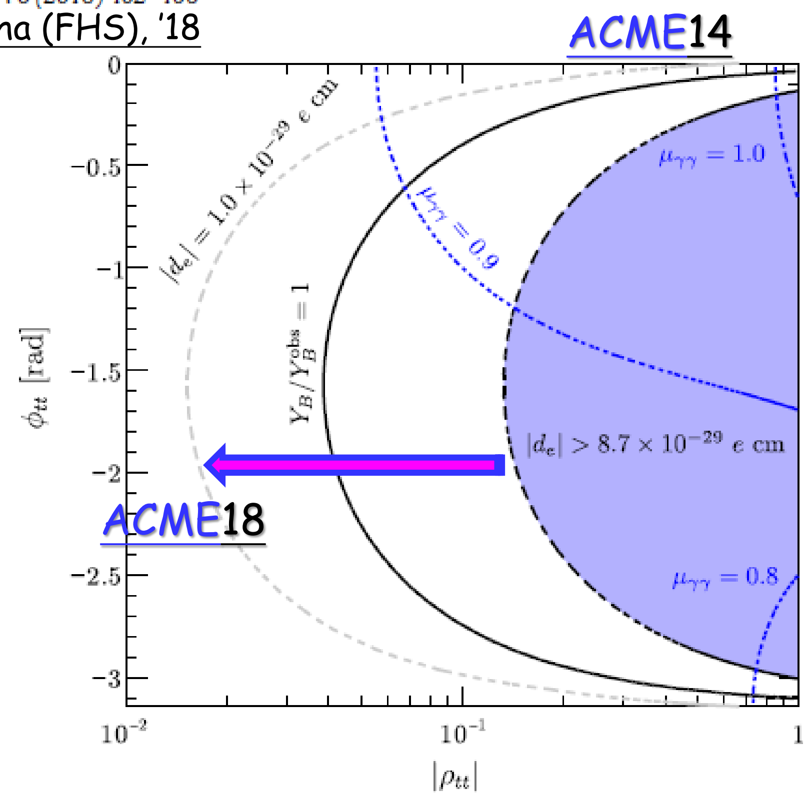
WSH, Kikuchi, PLB'18

TCNH-EWBG, ThO EDM

K. Fuyuto et al. / Physics Letters B 776 (2018) 402–406

Fuyuto, WSH, Senaha (FHS), '18





EWBG ⇐ $\lambda_t \mathrm{Im}\rho_{tt}$ robust driver ⊕ eEDM: $\lambda_e \mathrm{Im}\rho_{tt}$

$\mathcal{O}(\lambda_t) \approx 1$

[ρ_{tc} as backup

Immune! →

Ruled Out by ACME18!

TCNH-EWBG Scenario

ρ_{tc}-driven (ρ_{tt} accidentally small)

$\mathrm{Im}\,\rho_{tc} \gtrsim 0.5$ and $|\cos\gamma| \gtrsim 0.1$

N.B. ρ_{ct} constrained small by B_q mixing.
Altunkaynak, WSH, Kao, Kohda, McCoy PLB'15

LHC Probes of ρ_{tc}:

- $t \xrightarrow{\rho_{tc} c_\gamma} ch$

WSH, PLB'92
Chen, WSH, Kao, Kohda, PLB'13
CMS/ATLAS (PDG), ATLAS JHEP'19

- $cg \xrightarrow{\rho_{tc}} tA/H \xrightarrow{\rho_{tc}} t\,(t\bar{c})$

WSH, Lin, Ma, Yuan, PLB'97
Altmanshoffer et al., PRD'16
Altmanshoffer, Maddock, Tucker, PRD'19
Kohda, Modak, WSH, PLB'18
WSH, Kohda, Modak, PLB'18 [300 GeV allowed!]
WSH, Hsu, Modak, PRD'20 …

- $cg \xrightarrow{\rho_{tc} V_{tb}} bH^+ \xrightarrow{g c_\gamma} b\,(W^+ h)$

Gori, Grojean, Juste, Paul, JHEP'18
HMP'20 (2012.03572)

II. Framework & Parameter Space

g2HDM: Φ "mass giver", Φ' exotic

~~Z_2~~

General CP-conserving 2HDM potential (Higgs basis)

$$m_{H^\pm}^2 = \mu_{22}^2 + \frac{1}{2}\eta_3 v^2,$$

$$m_A^2 = \mu_{22}^2 + \frac{1}{2}(\eta_3 + \eta_4 - \eta_5)v^2$$

$$\mu_{11}^2 = -\eta_1 v^2/2 \qquad > 0 \qquad \mu_{12}^2 = \eta_6 v^2/2$$

$$V(\Phi,\Phi') = \mu_{11}^2|\Phi|^2 + \mu_{22}^2|\Phi'|^2 - \left(\mu_{12}^2\Phi^\dagger\Phi' + \text{h.c.}\right) + \frac{\eta_1}{2}|\Phi|^4 + \frac{\eta_2}{2}|\Phi'|^4 + \eta_3|\Phi|^2|\Phi'|^2$$
$$+ \eta_4|\Phi^\dagger\Phi'|^2 + \left[\frac{\eta_5}{2}(\Phi^\dagger\Phi')^2 + \left(\eta_6|\Phi|^2 + \eta_7|\Phi'|^2\right)\Phi^\dagger\Phi' + \text{h.c.}\right]$$

Davidson & Haber, PRD'05 WSH, Kikuchi, EPL'18

$$M_{\rm even}^2 = \begin{bmatrix} \eta_1 v^2 & \eta_6 v^2 \\ \eta_6 v^2 & m_A^2 + \eta_5 v^2 \end{bmatrix}$$

$$c_\gamma^2 = \cos^2\gamma = \frac{\eta_1 v^2 - m_h^2}{m_H^2 - m_h^2} \quad \text{and} \quad s_{2\gamma} = \sin(2\gamma) = \frac{2\eta_6 v^2}{m_H^2 - m_h^2}$$

alignment: c_γ small

$$c_\gamma \cong \frac{\eta_6 v^2}{m_H^2 - m_h^2}$$

CPV (mostly) from 2nd Yukawa matrices:

$$-\frac{1}{\sqrt{2}}\sum_{f=u,d,\ell}\bar f_i\left[\left(-\lambda_i^f\delta_{ij}s_\gamma + \rho_{ij}^f c_\gamma\right)h + \left(\lambda_i^f\delta_{ij}c_\gamma + \rho_{ij}^f s_\gamma\right)H - i\,\text{sgn}(Q_f)\rho_{ij}^f A\right]Rf_j$$
$$- \bar u_i\left[(V\rho^d)_{ij}R - (\rho^{u\dagger}V)_{ij}L\right]d_j H^+ - \bar\nu_i\rho_{ij}^\ell R\ell_j H^+ + \text{h.c.}$$

complex

Davidson & Haber, PRD'05 Altunkaynak, WSH, Kao, Kohda, McCoy PLB'15

$\mathbf{H, A, H^+}$ Spectrum Fit for the LHC

$V(\Phi) \sim -\mu^2|\Phi|^2 + \lambda|\Phi|^4$

$v^2 \sim \mu^2/\lambda$

$$V(\Phi,\Phi') = \mu_{11}^2|\Phi|^2 + \mu_{22}^2|\Phi'|^2 - (\mu_{12}^2\Phi^\dagger\Phi' + \text{h.c.}) + \frac{\eta_1}{2}|\Phi|^4 + \frac{\eta_2}{2}|\Phi'|^4 + \eta_3|\Phi|^2|\Phi'|^2 + \eta_4|\Phi^\dagger\Phi'|^2 + \left\{\frac{\eta_5}{2}(\Phi^\dagger\Phi')^2 + \left[\eta_6|\Phi|^2 + \eta_7|\Phi'|^2\right]\Phi^\dagger\Phi' + \text{h.c.}\right\}$$

$\mu_{11}^2 = -\eta_1 v^2/2$

$\mu_{12}^2 = \frac{1}{2}\eta_6 v^2$

2nd min. cond.

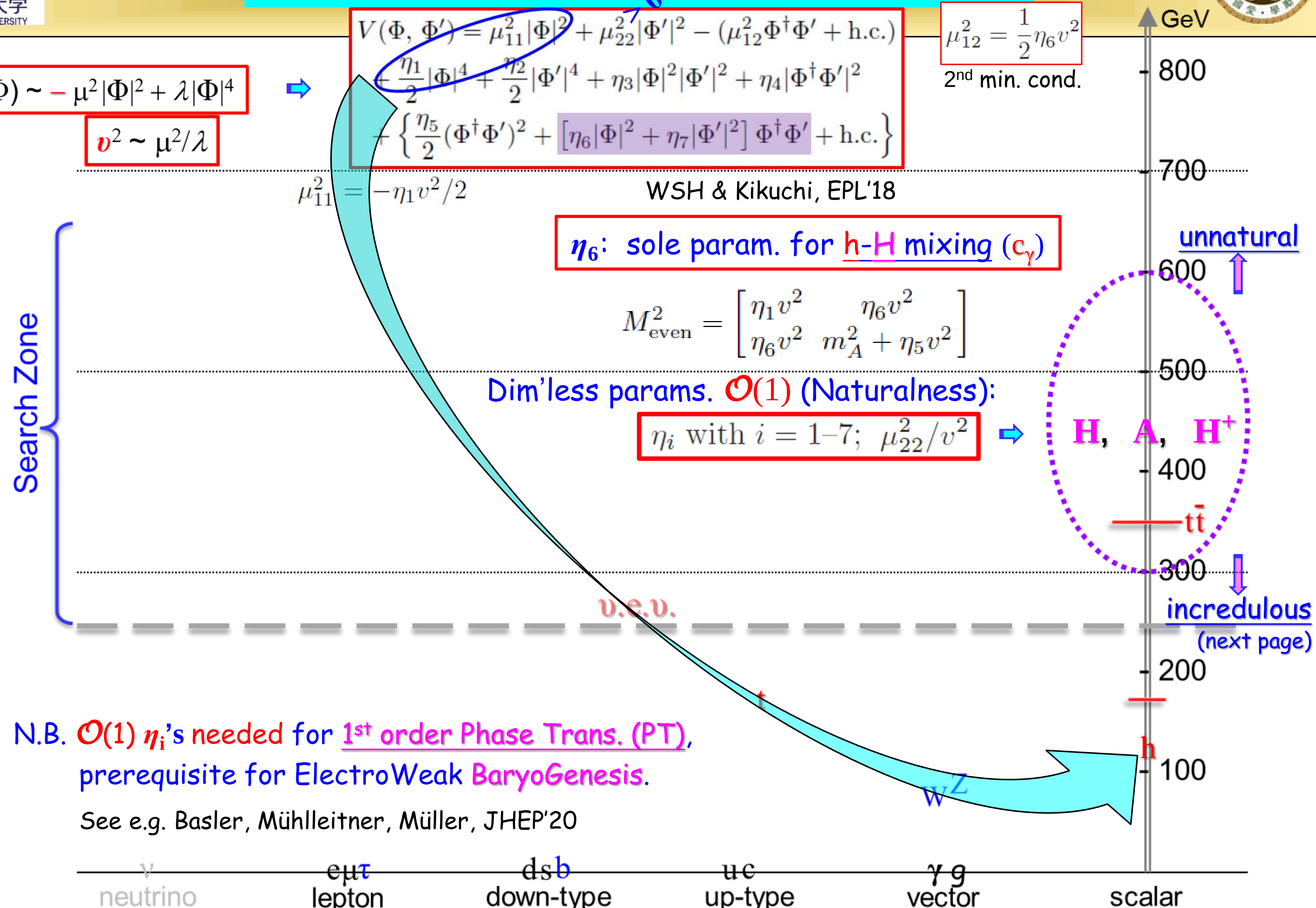
WSH & Kikuchi, EPL'18

η_6: sole param. for h-H mixing (c_γ)

$$M_{\text{even}}^2 = \begin{bmatrix} \eta_1 v^2 & \eta_6 v^2 \\ \eta_6 v^2 & m_A^2 + \eta_5 v^2 \end{bmatrix}$$

Dim'less params. $\mathcal{O}(1)$ (Naturalness):

η_i with $i = 1$–7; μ_{22}^2/v^2 ⇨ $\mathbf{H, A, H^+}$



N.B. $\mathcal{O}(1)$ η_i's needed for 1st order Phase Trans. (PT), prerequisite for ElectroWeak BaryoGenesis.

See e.g. Basler, Mühlleitner, Müller, JHEP'20

Flavor Design: replace (Un)*Natural* Flavor Conserv.

Where Are They? What hides H, A, H^+ effects from our view?

1. *Mass-Mixing Hierarchy*: Yuk. matrices ρ^f trickle off off-diagonal

2. ***Alignment***: Expt. find h rather close to SM Higgs → **c_γ small!** ⇨ controls $\left\{ \begin{array}{l} t \to ch \\ h \to \tau\mu \end{array} \right.$

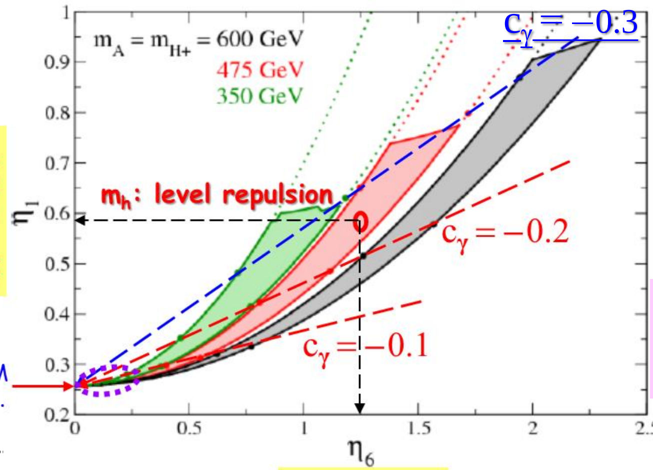
h-H mixing

Search Zone

$$M^2_{\text{even}} = \begin{bmatrix} \eta_1 v^2 & \eta_6 v^2 \\ \eta_6 v^2 & m_A^2 + \eta_5 v^2 \end{bmatrix}$$

$$c_\gamma \cong \frac{\eta_6 v^2}{m_H^2 - m_h^2}$$

$\eta_1 = \mathcal{O}(1)$



$\eta_6 = \mathcal{O}(1)$

NOT in conflict w/ $\mathcal{O}(1)$ η_i's!

WSH&Kikuchi, EPL'18

H, A, H^+

($\mathit{alignment}$) incredulous

3. Small/Near-diagonal ρ^d matrix! *Nature* has her *mysterious* ways!

[K^0, B^0 and B_s meson mixings our most sensitive probes!]

GeV: 800, 700, 600, 500, 400, 300, 200, 100

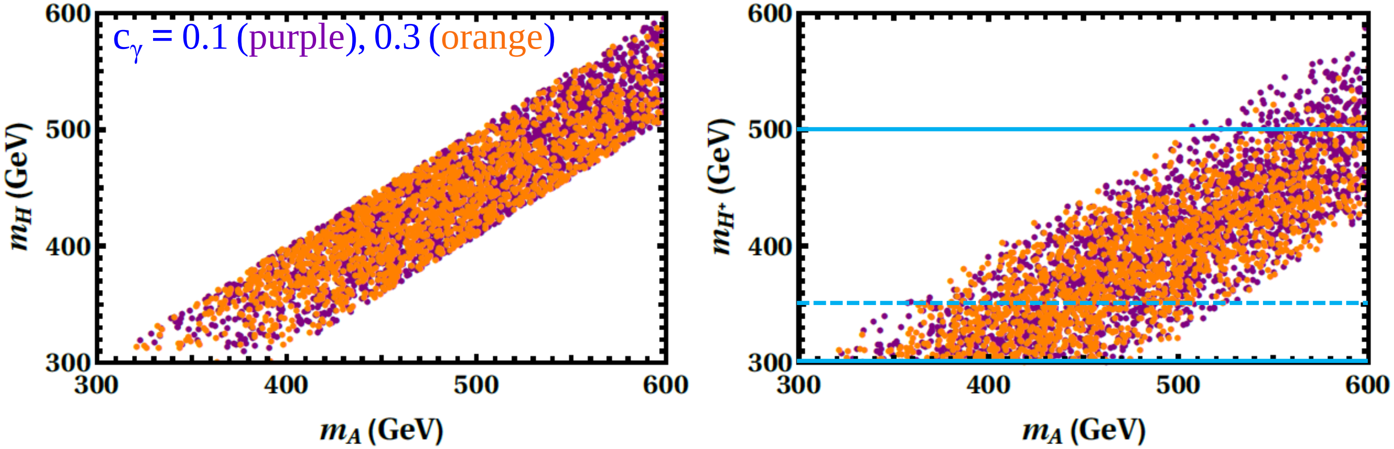
$t\bar{t}$, t, h, W Z

ν neutrino | eμτ lepton | dsb down-type | uc up-type | γ g vector | scalar

Parameter Space

ρ_{tt} small

HMP'20

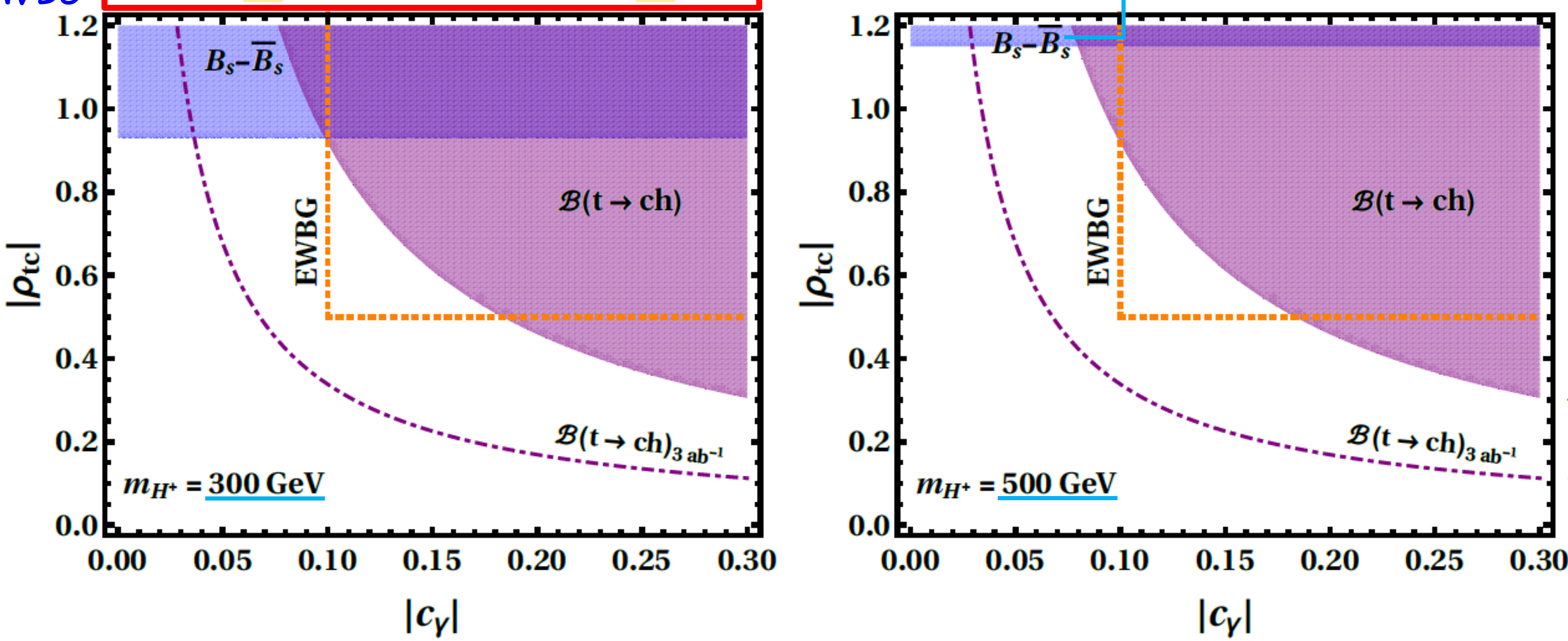


2HDMC scan for
- perturbativity,
- positivity,
- unitarity,
- EW prec. measur.

TCNH -EWBG

$\text{Im}\,\rho_{tc} \gtrsim 0.5$ and $|\cos\gamma| \gtrsim 0.1$

e.g. Crivellin, Kokulu, Greub, PRD'13



$< 1.1 \times 10^{-3}$

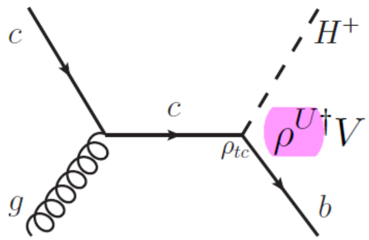
$< 1.0 \times 10^{-4}$

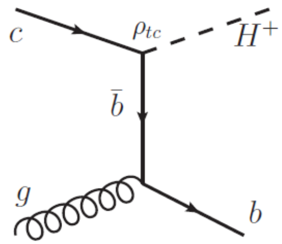
ATL-PHYS-PUB -2016-019

III. Charged Higgs Production

$\rho_{tt} = 0$

HMP'20





$\rho_{tc} V_{tb}$ $\qquad g c_\gamma$

$$cg \to bH^+ \to b\,(W_\ell^+ h) \to b\,W_\ell^+ W_\ell^+ W_\ell^-$$

$\geq 3\ell; \geq 1j_b$

- Generator: MadGraph5_aMC@NLO
- Shower/hadronize: PYTHIA6.4
- Detector Sim.: Delphes 3.4.2 (ATLAS)
- anti-k_T jets ($R = 0.6$)
- extra jets: MLM matching

$$p_{T,\ell} > 20\ \text{GeV}, \qquad |\eta_\ell| < 2.5 \qquad (\ell = e, \mu)$$
$$p_{T,b} > 20\ \text{GeV}, \qquad |\eta_b| < 2.5$$
$$\Delta R_{ij} > 0.4, \qquad (i, j = \ell, b)$$
$$\not{E}_T > 35\ \text{GeV}, \qquad m_{\ell^+\ell^-} \not\subset [76, 110]\ \text{GeV}$$

Z-veto

$\rho_{tc} = 0.35$, $c_\gamma = 0.25$ $\qquad b\,W_\ell^+ W_\ell^+ W_\ell^-$

m_{H^+} [GeV]	Γ_{H^+} [GeV]	$\mathcal{B}(H^+ \to c\bar{b})$	$\mathcal{B}(H^+ \to W^+ h)$	$\sigma(cg \to bH^+)$ [fb]
350	2.2	0.85	0.15	0.126
500	3.9	0.66	0.34	0.113

≤ 2 extra jets

jet as ℓ mis-id

	$t\bar{t}W$	$t\bar{t}Z$	WZ + jets	$4t$	$t\bar{t}h$	tZ + jets	tWZ	ZZ+jets	$t\bar{t}$+jets	sum bkg
merged jets	1	1	1	0	0	1	0	1	1	
K-factor	NLO	NLO	NNLO	NLO	NLO	NLO	LO	LO	NNLO	
$\sigma_{\rm bkg}$ [fb]	0.685	0.279	0.101	0.074	0.026	0.017	0.02	0.001	0.304	1.504

$$cg \to bH^+ \to b\,(W_\ell^+ h) \to b\,W_\ell^+ W_\ell^+ W_\ell^-$$

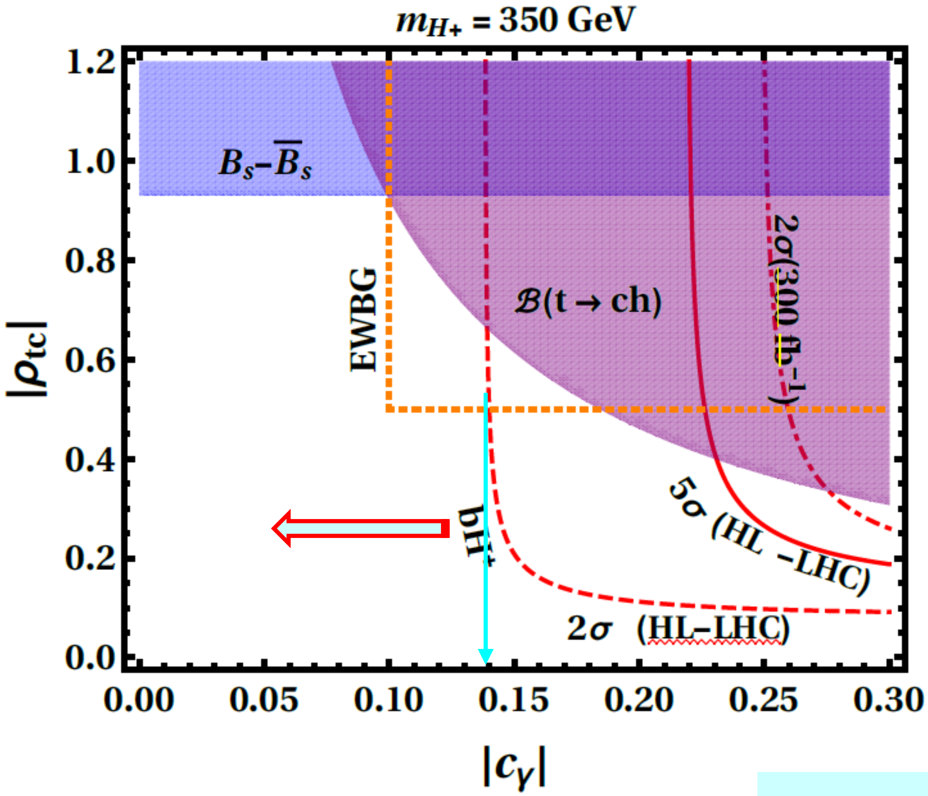
$\rho_{tc} V_{tb}$ $\quad$ $g c_\gamma$

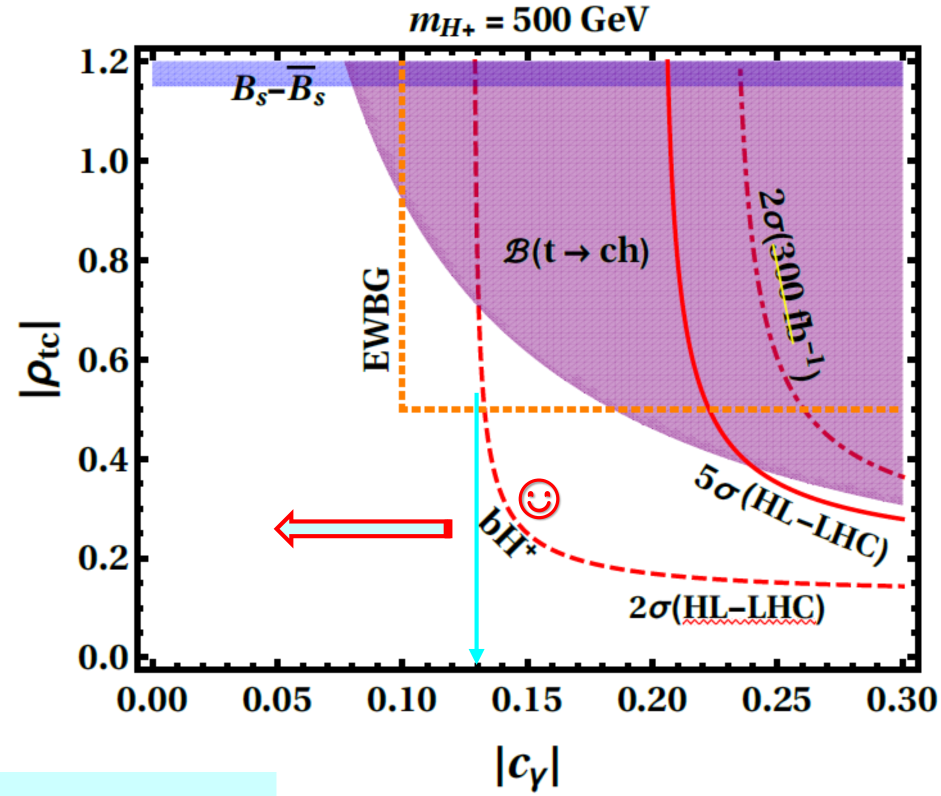
simple counting

HMP'20

$$Z(n|n_{\rm pred}) = \sqrt{-2\ln\frac{L(n|n_{\rm pred})}{L(n|n)}}, \qquad \text{with} \qquad L(n|\bar{n}) = \frac{e^{-\bar{n}}\bar{n}^n}{n!}$$

Exclusion: $Z(b|s+b) > 2$ $\qquad$ Observation: $Z(s+b|b) > 5$

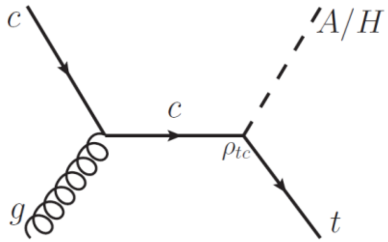


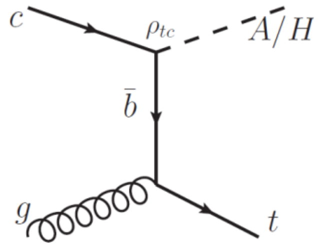


Cover small c_γ?

IV. Neutral Higgs Production

HMP'20





$$cg \xrightarrow{\rho_{tc}} \cancel{tH}/tA \xrightarrow{\rho_{tc}} t\,(t\bar{c})$$

very slight c_γ-dependence

feeds CMS CRW$_{4t}$

WSH, Kohda, Modak, PLB'19

$t\bar{t}W$ Control Region of CMS $4t$ search (ATLAS CRttW2ℓ less constraining)

CMS EPJC'20

- Same-sign dilepton (w/ Drell-Yan veto)
- 2–5 jets (w/ 2 j_b)
- Sum over jets

137 fb^{-1}

$p_{T,\ell} > 25, 20$ GeV, $\quad |\eta_e| < 2.5, \quad |\eta_\mu| < 2.4$

$|\eta_j| < 2.4$, satisfying one of

(i) $p_{T,b_1} > 40$ GeV, $p_{T,b_2} > 40$ GeV,

(ii) $p_{T,b_1} > 20$ GeV, $p_{T,b_2} = 20$–40 GeV, $p_{T,j_3} > 40$ GeV

(iii) $p_{T,b_{1,2}} = 20$–40 GeV, $p_{T,j_{3,4}} > 40$ GeV.

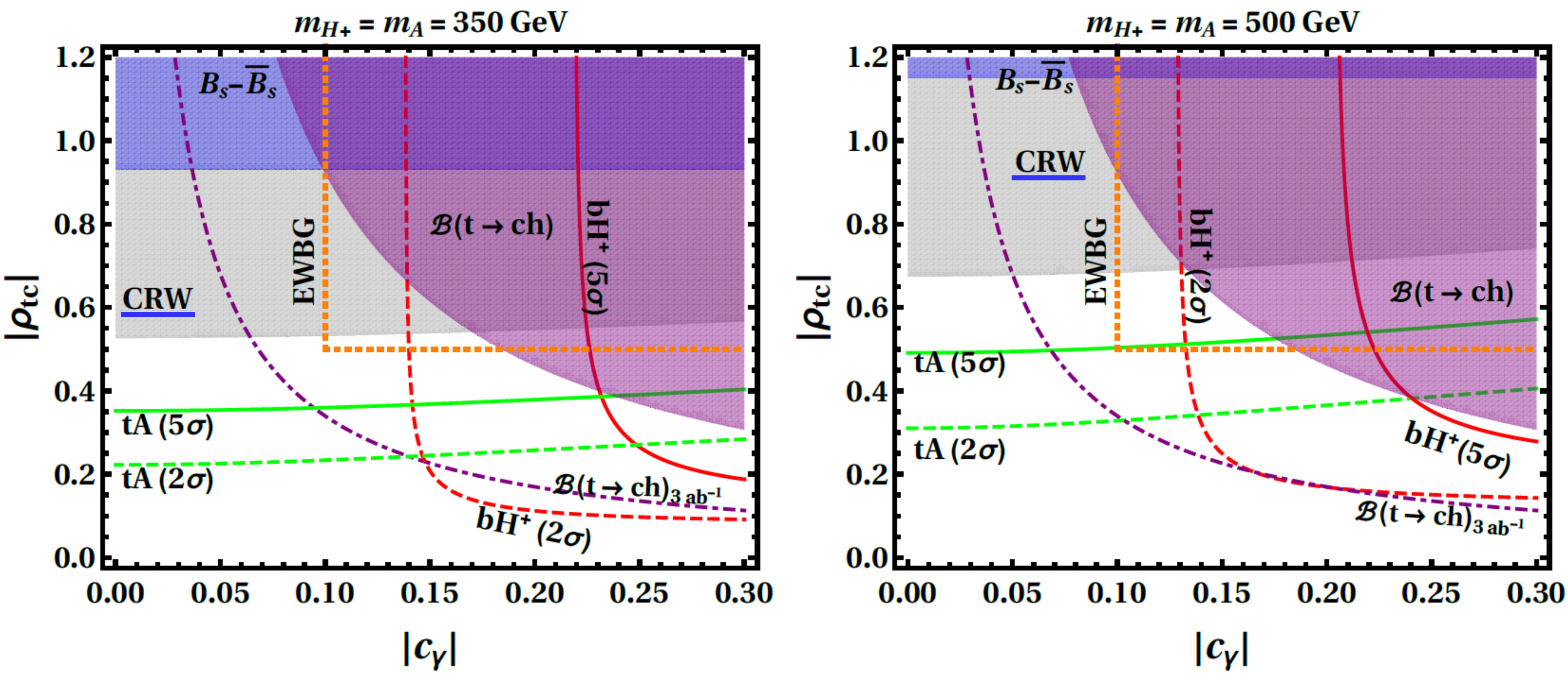
$$H_T = \sum_{\text{jets}} p_{T,j} > 300\ \text{GeV, and}\ \not{E}_T > 50\ \text{GeV}$$

→ CMS observes 338 evts, expect 335 ± 18 evts

assume $m_A \approx m_{H^\pm} = 350, 500$ GeV, and ~~heavy H~~ within 2σ

HMP'20

CRW control region of CMS Run 2 $tt\bar{t}\bar{t}$ analysis (137 fb^{-1}) *powerful*!



But can optimize with **dedicated same-sign top** + jet search. (PTO)

as seen above (HL-LHC)

HMP'20

Same-Sign Top + jet Signature:

- Same-sign dilepton (ee, eμ, μμ)
- $\geq 3j$ ($\geq 2j_b$; ≥ 1 non-j_b)
- Sum over jets *and* leptons

$p_T^{\ell_1(\ell_2)} > 25\,(20)$ GeV $\quad |\eta| < 2.5$

all jets $p_T > 20$ GeV and $|\eta| < 2.5$

all jets/leptons sep. by $\Delta R_{ij} > 0.4$

$H_T > 300$ GeV, $\not{E}_T > 35$ GeV

Dedicated same-sign top search after selection cuts (Signal scaled)

Background	σ [fb]	background	σ [fb]	background	σ [fb]
$t\bar{t}W$	1.31	$t\bar{t}Z$	1.97	tZ + jets	0.007
$4t$	0.092	$3t + W$	0.001	$3t + j$	0.0004
$t\bar{t}h$	0.058	charge-flip	0.024	non-prompt	$1.5\times\ t\bar{t}W$

$t\bar{t}$ + jets & Z/γ^* + jets

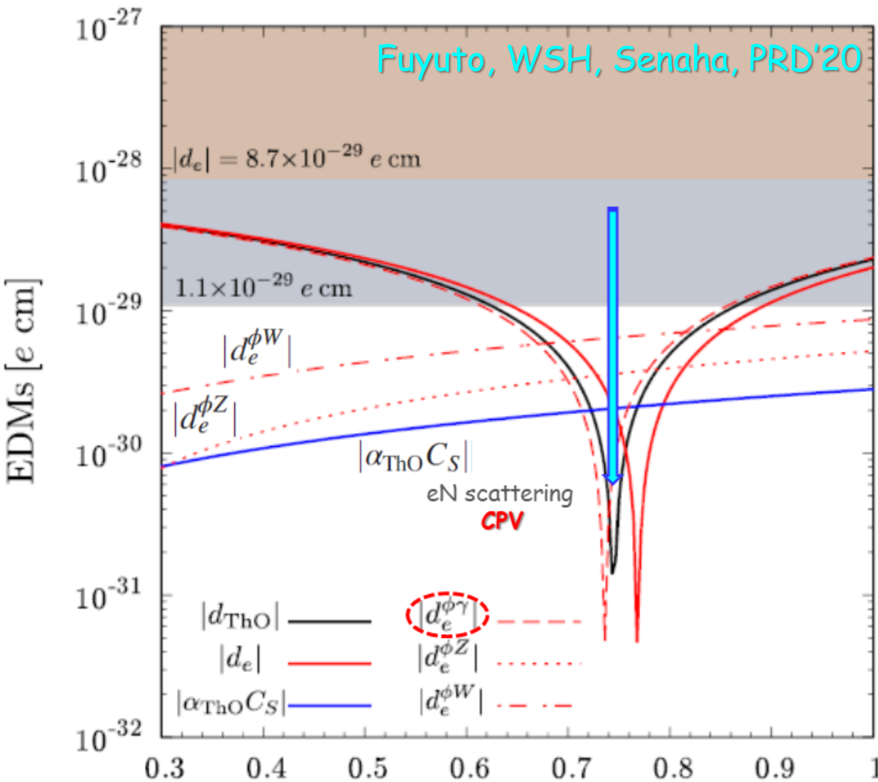
CMS SS2ℓ, EPJC'17

N.B. Checked that "tuned" cancellation btwn A-H degeneracy not quite effective.

V. Discussion

- In general, ρ_{tt} is a robust driver for B.A.U.: no good reason to "just vanish".

  Mechanism to render $d_{\rm ThO}$ small ? *Yes!* $\lambda_e \mathrm{Im}\rho_{tt} \oplus \rho_{ee}$



r (depend on loop functions)

simplified "Ansatz" ρ_{ee}

$$\frac{\mathrm{Im}\,\rho_{ff}}{\mathrm{Im}\,\rho_{tt}} = r\,\frac{\lambda_f}{\lambda_t}$$
$$\frac{\mathrm{Re}\,\rho_{ff}}{\mathrm{Re}\,\rho_{tt}} = -r\,\frac{\lambda_f}{\lambda_t}$$

Splendor in **the Heavens**

Follow SM Hierarchy!

Extra *electron* Yukawa that works in concert to give ***exquisite*** **cancellation** among various dangerous diagrams

Beautiful on **Earth**

- Allowing ρ_{tt} (even ρ_{bb}, which can also drive B.A.U.) opens up new processes, such as $cg \to tA/tH \to tt\bar{t}$ and $cg \to bH^+ \to bt\bar{b}$, and dilutes previous processes.

$cg \xrightarrow{\rho_{tc}} tA/tH \xrightarrow{\rho_{tt}} tt\bar{t}$

$\sigma_{3t} < \sigma_{4t}$ in SM

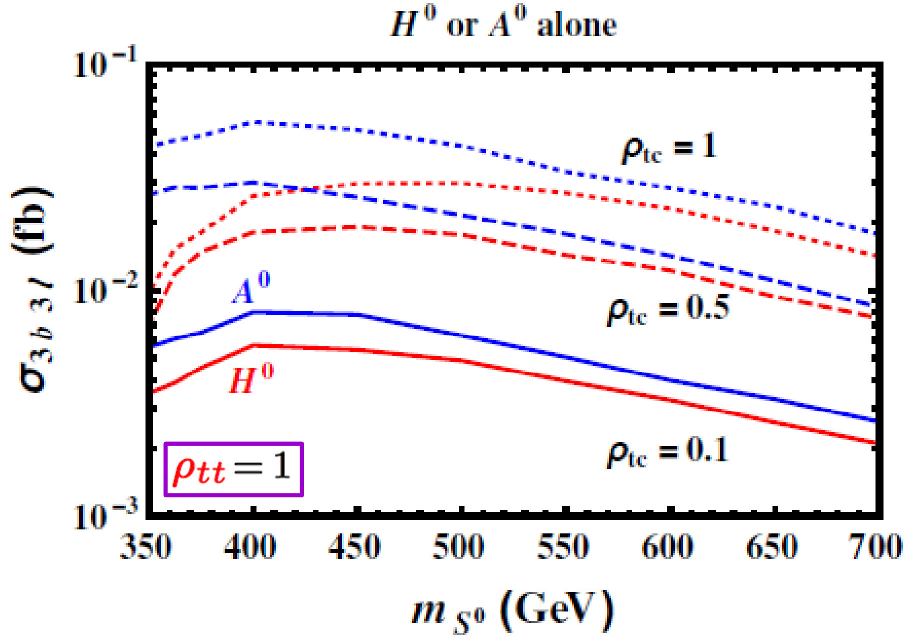
$3\ell 3b$ process

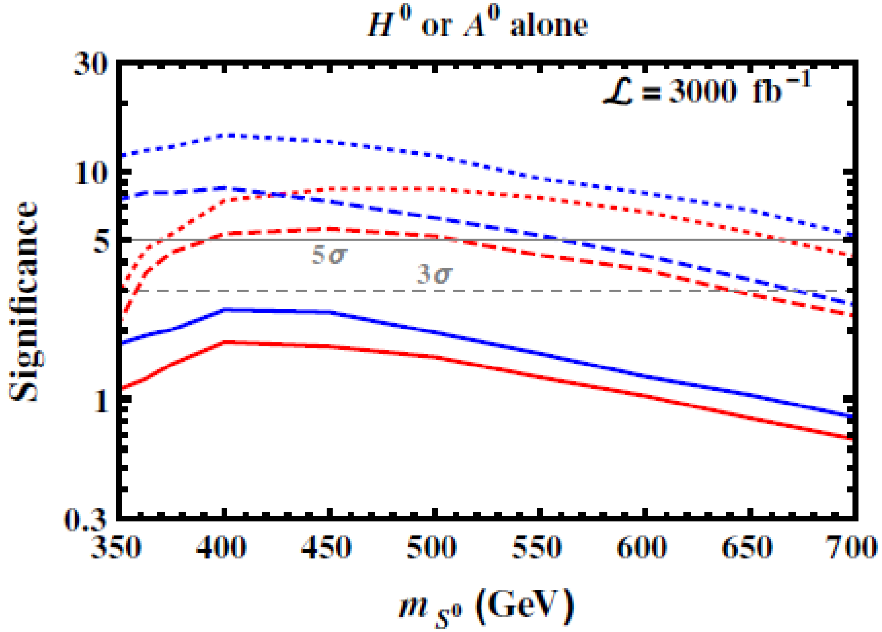
Table 2. Backgrounds for $3\ell 3b$ process at 14 TeV, where LO to NLO K-factors (cross sections with Z-pole veto) are given in the left (right) parentheses.

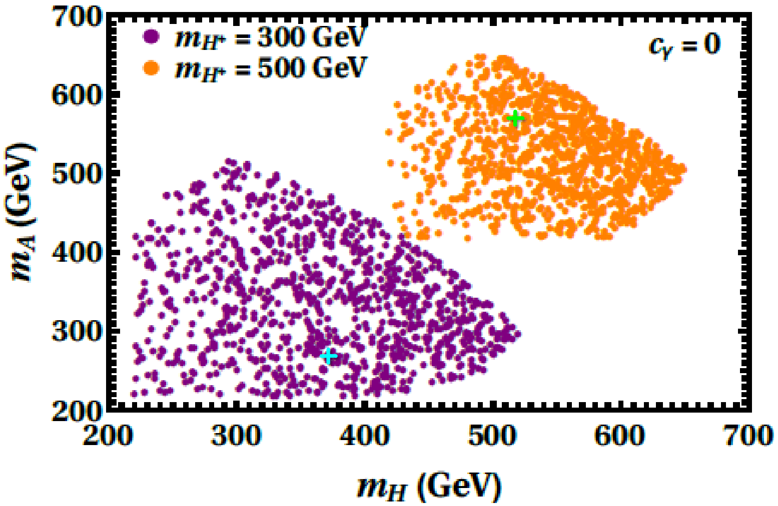
$t\bar{t}Z$ + jets (1.56)	0.0205 (0.0026)
$4t$ (2.04)	0.0232 (0.0209)
$t\bar{t}W$ + jets (1.35)	0.0017 (0.0015)
$t\bar{t}h$ (1.27)	0.0015 (0.0013)
tZj + jets (1.44)	0.0002 —
$t\bar{t}$ + jets (fake)	0.0026 (0.0025)

Excellent Reach @ HL-LHC

Should revisit.







Two BenchmarkPoints

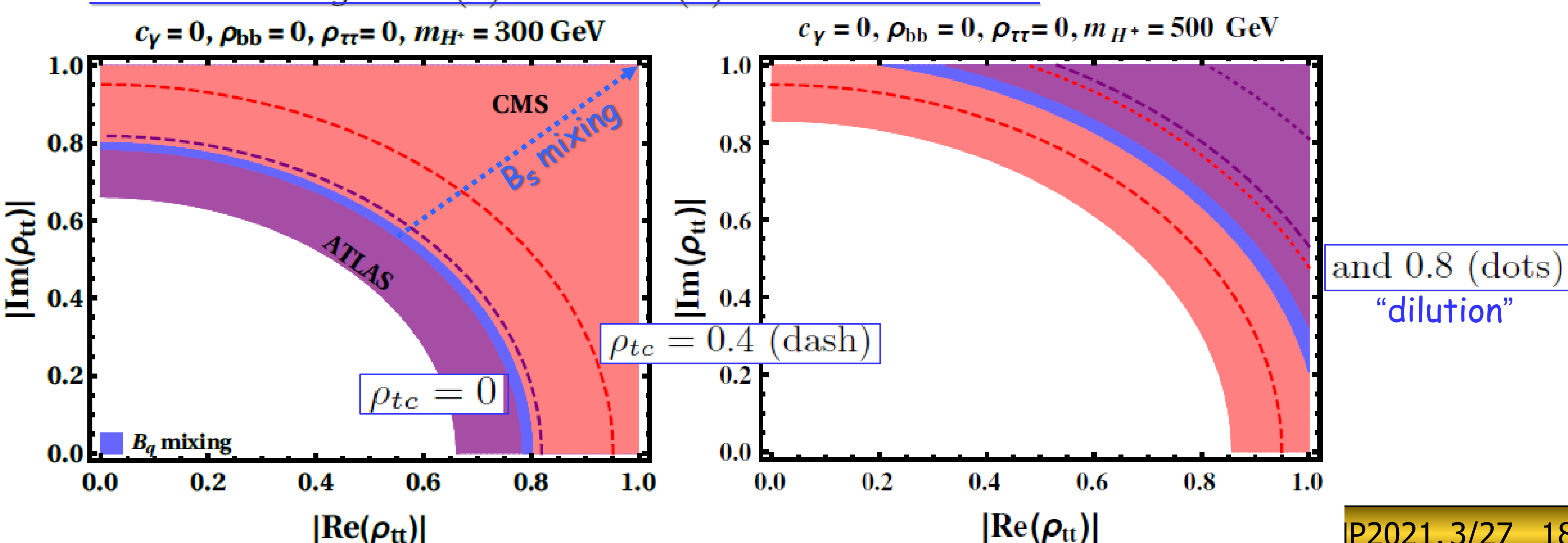
	η_2	η_3	η_4	η_5	η_7	$\frac{\mu_{22}^2}{v^2}$	m_{H^+}	m_A	m_H
BP1	1.40	0.62	0.53	1.06	−0.79	1.18	300	272	372
BP2	0.71	0.69	1.52	−0.93	0.24	3.78	500	569	517

	$t\bar{t}js$	tj	$Wtjs$	$t\bar{t}h$	$t\bar{t}Z$	other	B_{tot}	Sig
BP1	1546	42	27	4.2	1.5	3.1	1627	11.4
BP2	1000	27	16	2.9	1.2	1.9	1049	9.3

(fb)

- Hint possible for BP1 w/ $\rho_{tt} \sim \rho_{tc} \sim 0.5$
- Need expt'l study (*larger* param. space)!

ATLAS & CMS $bg \to \bar{t}(b)H^+ \to \bar{t}(b)t\bar{b}$



Revenge of *Flavor* (& CPV?) in g2HDM

e.g. **$B \to \mu\nu$**

1903.03016 [PLB'20]

Enhanced $B \to \mu\bar{\nu}$ Decay at Tree Level as Probe of Extra Yukawa Couplings

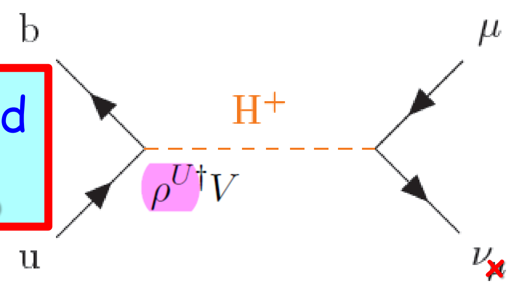
Wei-Shu Hou, Masaya Kohda, Tanmoy Modak and Gwo-Guang Wong
Department of Physics, National Taiwan University, Taipei 10617, Taiwan
(Dated: April 26, 2019)

With no New Physics seen at the LHC, a second Higgs doublet remains attractive and plausible. The ratio $\mathcal{R}_B^{\mu/\tau} = \mathcal{B}(B \to \mu\bar{\nu})/\mathcal{B}(B \to \tau\bar{\nu})$ is predicted at 0.0045 in both the Standard Model and the type II two Higgs doublet model, but it can differ if extra Yukawa couplings exist in Nature, which we deem an experimental issue. Considering recent Belle update on $B \to \mu\bar{\nu}$, we show that in the general two Higgs doublet model, the ratio could be up by a factor of two, which can be probed by the Belle II experiment with just a few ab^{-1}.

Competitive with ATLAS/CMS: probe $\rho_{tu}\rho_{\tau\mu}$

$$\mathcal{B}(B \to \ell\bar{\nu}_\ell)\big|^{\rm 2HDM\,II} = r_H\, \mathcal{B}(B \to \ell\bar{\nu}_\ell)\big|^{\rm SM}$$

WSH, PRD'93 [$B \to \tau\nu$]



ρ_{tu} enhanced by V_{tb}/V_{ub}

$\rho_{\tau\mu}$ enters!

Conclusion.— With a second Higgs doublet quite plausible, the existence of extra Yukawa couplings is an experimental issue. The SM and 2HDM II predict the ratio $\mathcal{R}_B^{\mu/\tau} = \mathcal{B}(B \to \mu\bar{\nu})/\mathcal{B}(B \to \tau\bar{\nu})$ to be 0.0045, which offers a unique test. Through $\bar{\nu}_\tau$ flavor, the $\rho_{\tau\mu}$ coupling can enhance $B \to \mu\bar{\nu}$, while $B \to \tau\bar{\nu}$ is SM-like. If enhancement of $\mathcal{R}_B^{\mu/\tau}$ is uncovered by Belle II with just a few ab^{-1}, then the many extra Yukawa couplings — fundamental flavor parameters associated with a second Higgs doublet — would need to be unraveled.

VI. Conclusion

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H, **A**, $\mathbf{H}^{\pm}$: well hidden so far (fermion mass-mixing ⊕ alignment)

- One extra doublet: 4 exotic Higgs/No holds barred (except *Nature herself*)

  ➔ 1 ⊕ 3 sets of extra *dim-4* couplings (Not EFT)

  Quartics Yukawas — Needed for 1st order EWPT and Flav/**CP V**, resp.

- Intriguingly: The *largest* diagonal ***extra*** Yukawa ρ_{tt} drives B.A.U., works in concert w/ *smallest* diagonal ***extra*** Yukawa ρ_{ee} to cover eEDM (?).

- Limit focus here: the ρ_{tc}-driven B.A.U (i.e. turn off ρ_{tt}) → fully evades eEDM.
  - $cg \to bH^+ \to b\,(W_\ell^+ h) \to b\, W_\ell^+ W_\ell^+ W_\ell^-$ efficiently probes to low ρ_{tc} for $c_\gamma > 0.14$;
  - complemented by $cg \to tH/tA \to t\,(t\bar{c})$ almost indep. of c_γ; and $t \to ch$ (c_γ-dep.).

- Advocate 3 type of searches: param. space much *larger*
  - Same-sign Top + j: $cg \to tH/tA \to tt\bar{c}$
  - Triple-Top: $cg \to tH/A \to tt\bar{t}$
  - Charged H^+: $cg \to bH^+ \to bt\bar{b}$

  } Sub-TeV **H**, **A**, $\mathbf{H}^+$ a long way to go.

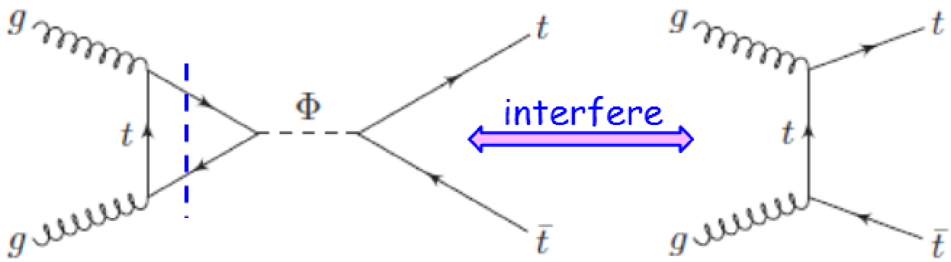
Let's Find these extra H, A, $\mathbf{H}^+$ bosons and crack the *Flavor* code!

Thank you!

CMS "A → tt(bar)" hint

CMS JHEP'20 — 35.6 fb^{-1} (2016 data)

"a signal-like excess for the pseudoscalar hypotheses (largest) at 400 GeV, Γ_{tot} = 4%, 3.5σ local (1.9σ LEE)"

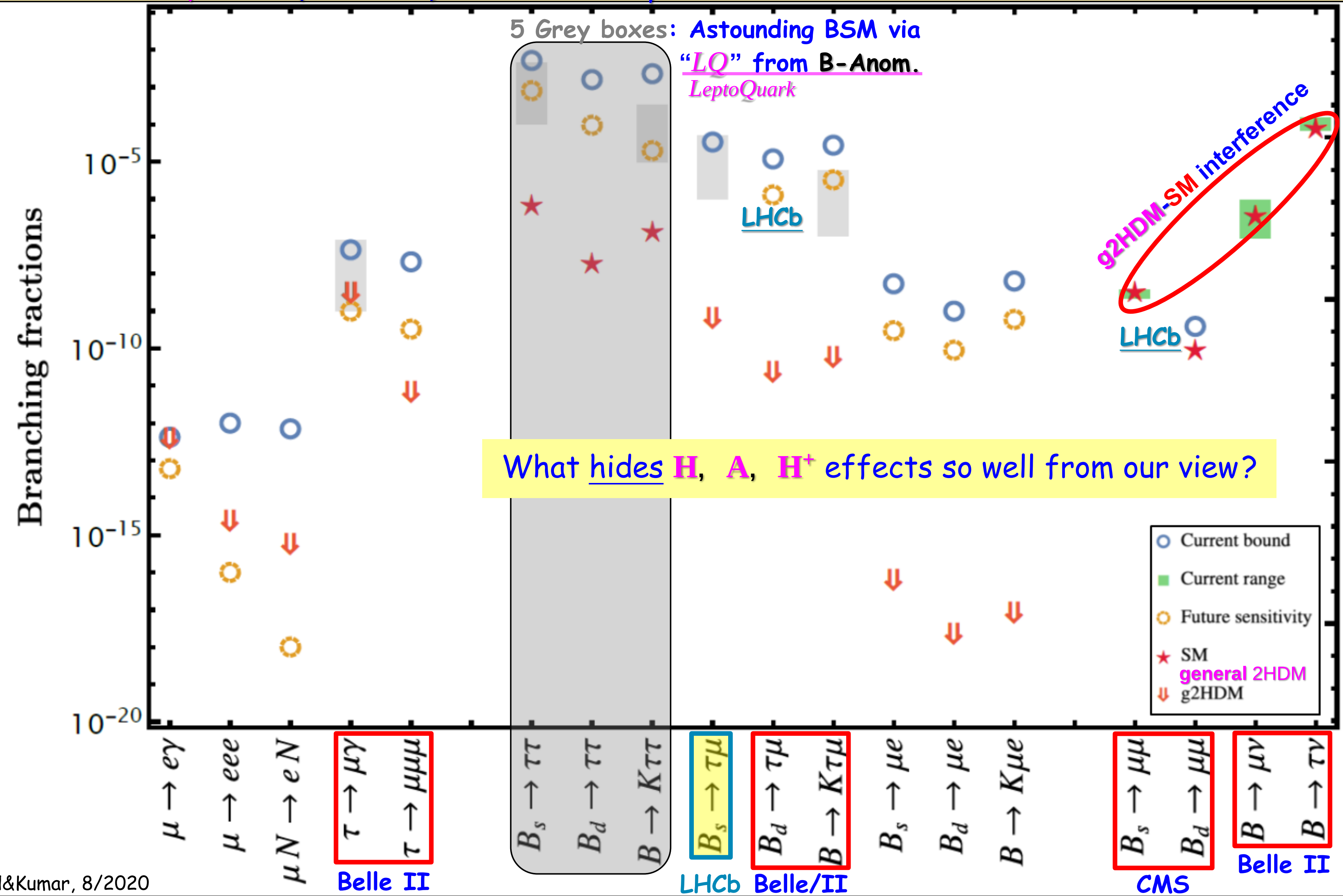


- *Intriguing !*
- Needs large ρ_{tt}
  Cannot make it work* easily …
- To be Watched (Full Run 2, both expts)

* See e.g. 2103.13082.

Glimpse of coming New *Flavor* Era

μ & τFV (Flav.Viol.) in B decay



WSH&Kumar, 8/2020