Standard Model Effective Field Theory and Lepton Flavour Violation

Giovanni Marco Pruna

Laboratori Nazionali di Frascati
Frascati, Italia

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Charged Lepton flavour violation

Reaction	Present limit	C.L.	Experiment	Year	Reference
$\mu^+ \to e^+\gamma$	$< 4.2 \times 10^{-13}$	90%	MEG at PSI	2016	[49]
$\mu^+ \to e^+e^-e^+$	$< 1.0 \times 10^{-12}$	90%	SINDRUM	1988	[50]
$\mu^-\mathrm{Ti} \to e^-\mathrm{Ti}$ †	$< 6.1 \times 10^{-13}$	90%	SINDRUM II	1998	[51]
$\mu^-\mathrm{Pb} \to e^-\mathrm{Pb}$ †	$< 4.6 \times 10^{-11}$	90%	SINDRUM II	1996	[52]
$\mu^-\mathrm{Au} \to e^-\mathrm{Au}$ †	$< 7.0 \times 10^{-13}$	90%	SINDRUM II	2006	[54]
$\mu^-\mathrm{Ti} \to e^+\mathrm{Ca}^*$ †	$< 3.6 \times 10^{-11}$	90%	SINDRUM II	1998	[53]
$\mu^+e^- \to \mu^-e^+$	$< 8.3 \times 10^{-11}$	90%	SINDRUM	1999	[55]
$\tau \to e\gamma$	$< 3.3 \times 10^{-8}$	90%	BaBar	2010	[56]
$\tau \to \mu\gamma$	$< 4.4 \times 10^{-8}$	90%	BaBar	2010	[56]
$\tau \to eee$	$< 2.7 \times 10^{-8}$	90%	Belle	2010	[57]
$\tau \to \mu\mu\mu$	$< 2.1 \times 10^{-8}$	90%	Belle	2010	[57]
$\tau \to \pi^0 e$	$< 8.0 \times 10^{-8}$	90%	Belle	2007	[58]
$\tau \to \pi^0 \mu$	$< 1.1 \times 10^{-7}$	90%	BaBar	2007	[59]
$\tau \to \rho^0 e$	$< 1.8 \times 10^{-8}$	90%	Belle	2011	[60]
$\tau \to \rho^0 \mu$	$< 1.2 \times 10^{-8}$	90%	Belle	2011	[60]
$\pi^0 \to \mu e$	$< 3.6 \times 10^{-10}$	90%	KTeV	2008	[61]
$K_L^0 \to \mu e$	$< 4.7 \times 10^{-12}$	90%	BNL E871	1998	[62]
$K_L^0 \to \pi^0\mu^+e^-$	$< 7.6 \times 10^{-11}$	90%	KTeV	2008	[61]
$K^+ \to \pi^+\mu^+e^-$	$< 1.3 \times 10^{-11}$	90%	BNL E865	2005	[63]
$J/\psi \to \mu e$	$< 1.5 \times 10^{-7}$	90%	BESIII	2013	[64]
$J/\psi \to \tau e$	$< 8.3 \times 10^{-6}$	90%	BESII	2004	[65]
$J/\psi \to \tau\mu$	$< 2.0 \times 10^{-6}$	90%	BESII	2004	[65]
$B^0 \to \mu e$	$< 2.8 \times 10^{-9}$	90%	LHCb	2013	[68]
$B^0 \to \tau e$	$< 2.8 \times 10^{-5}$	90%	BaBar	2008	[69]
$B^0 \to \tau\mu$	$< 2.2 \times 10^{-5}$	90%	BaBar	2008	[69]
$B \to K\mu e$ ‡	$< 3.8 \times 10^{-8}$	90%	BaBar	2006	[66]
$B \to K^*\mu e$ ‡	$< 5.1 \times 10^{-7}$	90%	BaBar	2006	[66]
$B^+ \to K^+\tau\mu$	$< 4.8 \times 10^{-5}$	90%	BaBar	2012	[67]
$B^+ \to K^+\tau e$	$< 3.0 \times 10^{-5}$	90%	BaBar	2012	[67]
$B_s^0 \to \mu e$	$< 1.1 \times 10^{-8}$	90%	LHCb	2013	[68]
$\Upsilon(1s) \to \tau\mu$	$< 6.0 \times 10^{-6}$	95%	CLEO	2008	[70]
$Z \to \mu e$	$< 7.5 \times 10^{-7}$	95%	LHC ATLAS	2014	[71]
$Z \to \tau e$	$< 9.8 \times 10^{-6}$	95%	LEP OPAL	1995	[72]
$Z \to \tau\mu$	$< 1.2 \times 10^{-5}$	95%	LEP DELPHI	1997	[73]
$h \to e\mu$	$< 3.5 \times 10^{-4}$	95%	LHC CMS	2016	[74]
$h \to \tau\mu$	$< 2.5 \times 10^{-3}$	95%	LHC CMS	2017	[75]
$h \to \tau e$	$< 6.1 \times 10^{-3}$	95%	LHC CMS	2017	[75]

Testing LFV

LFV means BSM physics

No evidence so far

Many impressive limits

A consistent picture

Symmetries at work

LF is protected

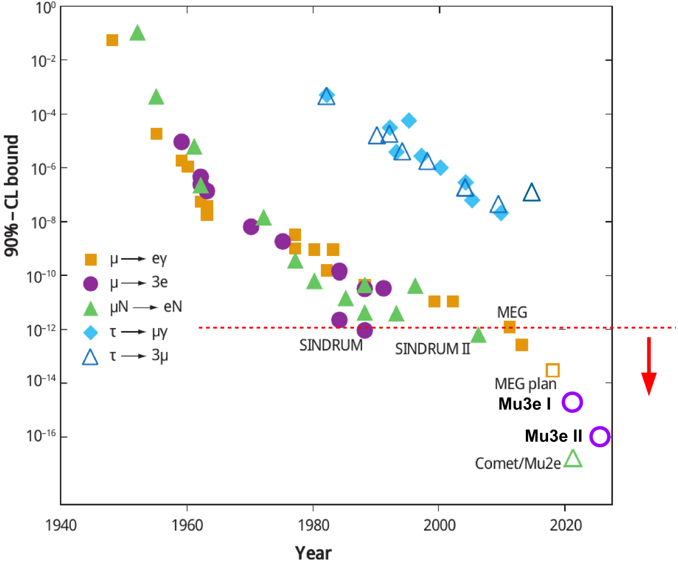
Experimental "observations"

CURRENT TRENDS IN MUONIC LEPTON FLAVOUR VIOLATION

- $\mathrm{BR}(\mu \to 3e) < 1.0 \times 10^{-12}$ at the 90% C.L.
  SINDRUM collaboration, Nucl. Phys. B **299** (1988) 1;
- $\sigma(\mu^- \to e^-)/\sigma(capt.)\big|_{\mathrm{Au}} < 7.0 \times 10^{-13}$ at the 90% C.L.
  SINDRUM II collaboration, Eur. Phys. J. C **47** (2006) 337;
- $\mathrm{BR}(\mu \to \gamma + e) < 4.2 \times 10^{-13}$ at the 90% C.L.
  MEG collaboration, Eur. Phys. J. C **76** (2016) 434;

- $\mathrm{BR}(\mu \to 3e) < 5.0 \times 10^{-15}$ at the 90% C.L.
  Mu3e collaboration;
- $\sigma(\mu^- \to e^-)/\sigma(capt.)\big|_{\mathrm{Al}} < 1.0 \times 10^{-16}$ at the 90% C.L.
  Mu2e and COMET collaborations;
- $\mathrm{BR}(\mu \to \gamma + e) < 4.0 \times 10^{-14}$ at the 90% C.L.
  MEG II collaboration.

Golden channels: Past, present and future



Extending the interactions of the SM

Assumptions: SM is merely an effective theory, valid up to some scale Λ. It can be extended to a field theory that satisfies the following requirements:

- its gauge group should contain $SU(3)_C \times SU(2)_L \times U(1)_Y$;
- all the SM degrees of freedom must be incorporated;
- at low energies (i.e. when $\Lambda \to \infty$), it should reduce to SM.

Assuming that such reduction proceeds via decoupling of New Physics (NP), the Appelquist-Carazzone theorem allows us to write such theory in the form:

$$\mathcal{L} = \mathcal{L}_{\mathrm{SM}} + \frac{1}{\Lambda} \sum_k C_k^{(5)} Q_k^{(5)} + \frac{1}{\Lambda^2} \sum_k C_k^{(6)} Q_k^{(6)} + \mathcal{O}\left(\frac{1}{\Lambda^3}\right).$$

Dimension-six operators

2-leptons

$$\boxed{Q_{eW}} = (\bar{l}_p \sigma^{\mu\nu} e_r)\tau^I \varphi W^I_{\mu\nu};$$
$$\boxed{Q_{eB}} = (\bar{l}_p \sigma^{\mu\nu} e_r)\varphi B_{\mu\nu}.$$
$$Q^{(1)}_{\varphi l} = (\varphi^\dagger i \overleftrightarrow{D}_\mu \varphi)(\bar{l}_p \gamma^\mu l_r)$$
$$Q^{(3)}_{\varphi l} = (\varphi^\dagger i \overleftrightarrow{D}^I_\mu \varphi)(\bar{l}_p \tau^I \gamma^\mu l_r)$$
$$Q_{\varphi e} = (\varphi^\dagger i \overleftrightarrow{D}_\mu \varphi)(\bar{e}_p \gamma^\mu e_r)$$
$$Q_{e\varphi} = (\varphi^\dagger \varphi)(\bar{l}_p e_r \varphi)$$

4-leptons

$$Q_{ll} = (\bar{l}_p \gamma_\mu l_r)(\bar{l}_s \gamma^\mu l_t)$$
$$Q_{ee} = (\bar{e}_p \gamma_\mu e_r)(\bar{e}_s \gamma^\mu e_t)$$
$$Q_{le} = (\bar{l}_p \gamma_\mu l_r)(\bar{e}_s \gamma^\mu e_t)$$

4-fermions

$$Q^{(1)}_{lq} = (\bar{l}_p \gamma_\mu l_r)(\bar{q}_s \gamma^\mu q_t)$$
$$Q^{(3)}_{lq} = (\bar{l}_p \gamma_\mu \tau^I l_r)(\bar{q}_s \gamma^\mu \tau^I q_t)$$
$$Q_{eu} = (\bar{e}_p \gamma_\mu e_r)(\bar{u}_s \gamma^\mu u_t)$$
$$Q_{ed} = (\bar{e}_p \gamma_\mu e_r)(\bar{d}_s \gamma^\mu d_t)$$
$$Q_{lu} = (\bar{l}_p \gamma_\mu l_r)(\bar{u}_s \gamma^\mu u_t)$$
$$Q_{ld} = (\bar{l}_p \gamma_\mu l_r)(\bar{d}_s \gamma^\mu d_t)$$
$$Q_{qe} = (\bar{q}_p \gamma_\mu q_r)(\bar{e}_s \gamma^\mu e_t)$$
$$\boxed{Q_{ledq}} = (\bar{l}^j_p e_r)(\bar{d}_s q^j_t)$$
$$\boxed{Q^{(1)}_{lequ}} = (\bar{l}^j_p e_r)\varepsilon_{jk}(\bar{q}^k_s u_t)$$
$$\boxed{Q^{(3)}_{lequ}} = (\bar{l}^j_p \sigma_{\mu\nu} e_r)\varepsilon_{jk}(\bar{q}^k_s \sigma^{\mu\nu} u_t)$$

Low-energy LFV observables

Neutrinoless radiative decay

$$\mathrm{Br}\left(\mu \to e\gamma\right) = \frac{\alpha_e m_\mu^5}{\Lambda^4 \Gamma_\mu} \left(\left| C_L^D \right|^2 + \left| C_R^D \right|^2 \right) .$$

Neutrinoless three-body decay

$$\begin{aligned} \mathrm{Br}(\mu \to 3e) \quad = \quad & \frac{\alpha_e^2 m_\mu^5}{12\pi \Lambda^4 \Gamma_\mu} \left(\left| C_L^D \right|^2 + \left| C_R^D \right|^2 \right) \left(8 \log\left[\frac{m_\mu}{m_e} \right] - 11 \right) \\ + \quad & \frac{m_\mu^5}{3(16\pi)^3 \Lambda^4 \Gamma_\mu} \left(\left| C_{ee}^{S\;LL} \right|^2 + 16 \left| C_{ee}^{V\;LL} \right|^2 + 8 \left| C_{ee}^{V\;LR} \right|^2 \right. \\ & \left. + \left| C_{ee}^{S\;RR} \right|^2 + 16 \left| C_{ee}^{V\;RR} \right|^2 + 8 \left| C_{ee}^{V\;RL} \right|^2 \right) . \end{aligned}$$

Coherent conversion in nuclei

$$\Gamma_{\mu\to e}^N = \frac{m_\mu^5}{4\Lambda^4} \left| e\, C_L^D \; D_N + 4 \left(G_F m_\mu m_p \tilde{C}_{(p)}^{SL} S_N^{(p)} + \tilde{C}_{(p)}^{VR} \; V_N^{(p)} + p \to n \right) \right|^2 + L \leftrightarrow R.$$

High-energy LFV observables

Flavour-violating Z decays can be parametrised at the tree level by means of the following four operators:

$$\Gamma(Z \to l_1^{\pm} l_2^{\mp}) = \frac{m_Z^3 v^2}{12\pi\Lambda^4} \left(\left|C_{eZ}^{12}\right|^2 + \left|C_{eZ}^{21}\right|^2 \right.$$
$$\left. + \left|C_{\varphi e}^{12}\right|^2 + \left|C_{\varphi l(1)}^{12}\right|^2 + \left|C_{\varphi l(3)}^{12}\right|^2 \right),$$

and all of their contributions occur at the same order. We have summed over the two possible final states, $l_1^+ l_2^-$ and $l_1^- l_2^+$.

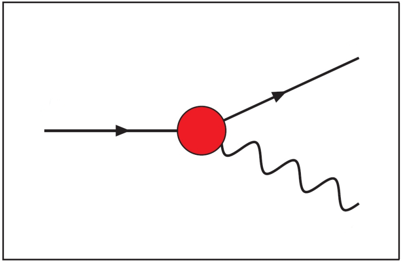
For the Higgs boson decay $H \to l_1^{\pm} l_2^{\mp}$, one has

$$\Gamma(H \to l_1^{\pm} l_2^{\mp}) = \frac{m_H v^4}{16\pi\Lambda^4} \left(\left|C_{e\varphi}^{12}\right|^2 + \left|C_{e\varphi}^{21}\right|^2 \right),$$

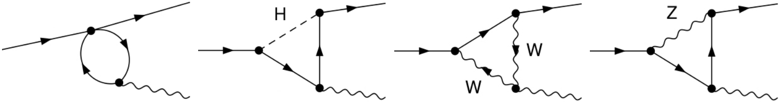
where only one operator contributes at tree level. Again, we have summed over the two possible decays $l_1^+ l_2^-$ and $l_1^- l_2^+$.

Dimension-six operators: lepton current at one loop

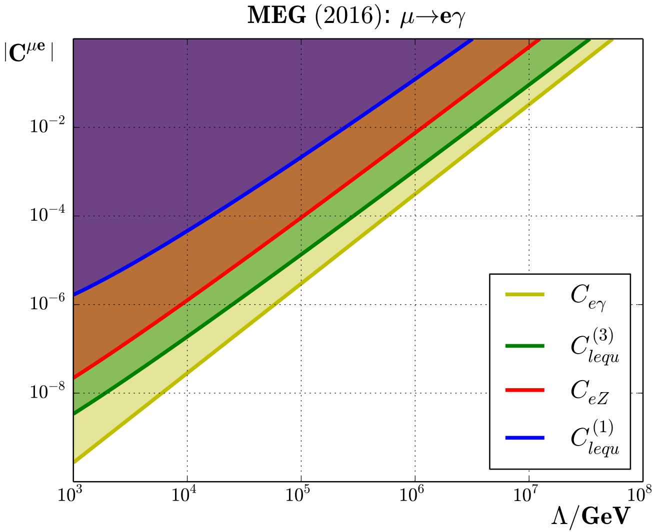
From a point-like interaction…



…to quantum fluctuations!



Experimental limits “reinterpreted” at the EW scale



No correlation: limits from muonic cLFV

GMP and A. Signer
JHEP **1410** (2014) 014

F. Feruglio,
arXiv:1509.08428

GMP and A. Signer
EPJWC **118** (2016) 01031

Coefficient	MEG ($\mu \to e\gamma$) $BR \leq 5.7 \cdot 10^{-13}$	ATLAS ($Z \to e\mu$) $BR \leq 7.5 \cdot 10^{-7}$	SINDRUM ($\mu \to 3e$) $BR \leq 1.0 \cdot 10^{-12}$
$C_{eZ}^{\mu e}(m_Z)$	$1.4 \cdot 10^{-13} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$5.5 \cdot 10^{-8} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$2.8 \cdot 10^{-8} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$
$C_{\varphi l}^{(1)}$	$2.5 \cdot 10^{-10} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$5.5 \cdot 10^{-8} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$2.5 \cdot 10^{-11} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$
$C_{\varphi l}^{(3)}$	$2.4 \cdot 10^{-10} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$5.5 \cdot 10^{-8} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$2.5 \cdot 10^{-11} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$
$C_{\varphi e}$	$2.4 \cdot 10^{-10} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$5.5 \cdot 10^{-8} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$2.6 \cdot 10^{-11} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$
$C_{e\varphi}^{\mu e}$	$2.7 \cdot 10^{-8} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$		$6.1 \cdot 10^{-6} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$
$C_{le}^{eee\mu}$	$\cancel{4.2 \cdot 10^{-8} \frac{\Lambda^2}{[\mathrm{GeV}]^2}}$		$2.2 \cdot 10^{-11} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$
$C_{le}^{e\mu\mu\mu}$	$\cancel{2.0 \cdot 10^{-10} \frac{\Lambda^2}{[\mathrm{GeV}]^2}}$		
$C_{le}^{e\tau\tau\mu}$	$\cancel{1.2 \cdot 10^{-11} \frac{\Lambda^2}{[\mathrm{GeV}]^2}}$		
$C_{ee}^{eee\mu}$			$7.7 \cdot 10^{-12} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$
$C_{ll}^{eee\mu}$			$7.7 \cdot 10^{-12} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$

No correlation: limits from tauonic cLFV

Coefficient	BaBar ($\tau \to \mu\gamma$) $BR \leq 4.4 \cdot 10^{-8}$	LEP ($Z \to \tau\mu$) $BR \leq 1.2 \cdot 10^{-5}$	BELL ($\tau \to 3\mu$) $BR \leq 2.1 \cdot 10^{-8}$	ATLAS&CMS ($H \to \tau\mu$) $BR \leq 1.85 \cdot 10^{-2}$
$C_{eZ}^{\tau\mu}(m_Z)$	$1.5 \cdot 10^{-9} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$2.2 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$6.1 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	
$C_{\varphi l}^{(1)}$	$1.6 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$2.2 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$9.0 \cdot 10^{-9} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	
$C_{\varphi l}^{(3)}$	$1.6 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$2.2 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$9.0 \cdot 10^{-9} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	
$C_{\varphi e}$	$1.6 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$2.2 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$9.5 \cdot 10^{-9} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	
$C_{e\varphi}^{\tau\mu}$	$1.9 \cdot 10^{-6} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$		$1.1 \cdot 10^{-5} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	$1.3 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$
$C_{le}^{\mu ee\tau}$	$\cancel{4.7 \cdot 10^{-4} \frac{\Lambda^2}{[\mathrm{GeV}]^2}}$			
$C_{le}^{\mu\mu\mu\tau}$	$\cancel{2.3 \cdot 10^{-6} \frac{\Lambda^2}{[\mathrm{GeV}]^2}}$		$8.0 \cdot 10^{-9} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	
$C_{le}^{\mu\tau\tau\tau}$	$\cancel{1.3 \cdot 10^{-7} \frac{\Lambda^2}{[\mathrm{GeV}]^2}}$			
$C_{ee}^{\mu\mu\mu\tau}$			$2.8 \cdot 10^{-9} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	
$C_{ll}^{\mu\mu\mu\tau}$			$2.8 \cdot 10^{-9} \frac{\Lambda^2}{[\mathrm{GeV}]^2}$	

Dipole evolution below the EWSB scale

At the two-loop level, in the tHV scheme:

$$
\begin{aligned}
\dot{C}_L^D &= 16\,\alpha_e\,Q_l^2 \boxed{C_L^D} - \frac{Q_l}{(4\pi)}\frac{m_e}{m_\mu}\boxed{C_{ee}^{S\,LL}} - \frac{Q_l}{(4\pi)}\boxed{C_{\mu\mu}^{S\,LL}} \\
&+ \sum_h \frac{8Q_h}{(4\pi)}\frac{m_h}{m_\mu} N_{c,h}\boxed{C_{hh}^{T\,LL}}\Theta(\mu - m_h) \\
&- \frac{\alpha_e Q_l^3}{(4\pi)^2}\left(\frac{116}{9}\boxed{C_{ee}^{V\,RR}} + \frac{116}{9}\boxed{C_{\mu\mu}^{V\,RR}} - \frac{122}{9}\boxed{C_{\mu\mu}^{V\,RL}} - \left(\frac{50}{9} + 8\,\frac{m_e}{m_\mu}\right)\boxed{C_{ee}^{V\,RL}}\right) \\
&- \sum_h \frac{\alpha_e}{(4\pi)^2}\left(6Q_h^2 Q_l + \frac{4Q_h Q_l^2}{9}\right) N_{c,h}\boxed{C_{hh}^{V\,RR}}\Theta(\mu - m_h) \\
&- \sum_h \frac{\alpha_e}{(4\pi)^2}\left(-6Q_h^2 Q_l + \frac{4Q_h Q_l^2}{9}\right) N_{c,h}\boxed{C_{hh}^{V\,RL}}\Theta(\mu - m_h) \\
&- \sum_h \frac{\alpha_e}{(4\pi)^2} 4Q_h^2 Q_l N_{c,h}\frac{m_h}{m_\mu}\boxed{C_{hh}^{S\,LR}}\Theta(\mu - m_h) + [\ldots]\,.
\end{aligned}
$$

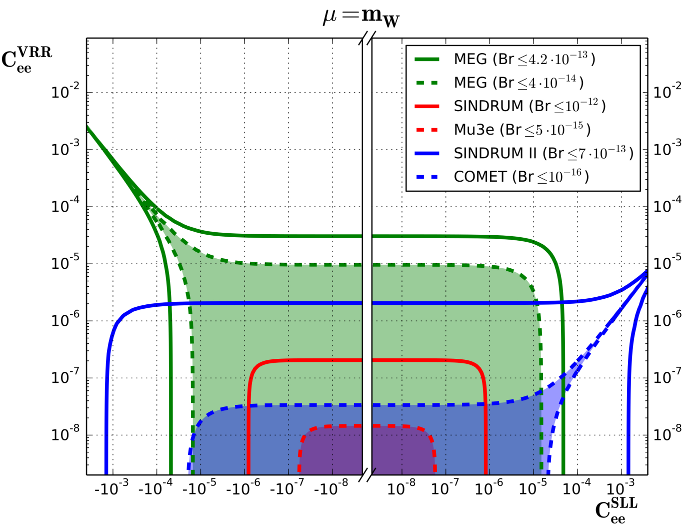
A. Crivellin, S. Davidson, GMP and A. Signer, JHEP **1705** (2017) 117.

In absence of interplay at the EWSB scale

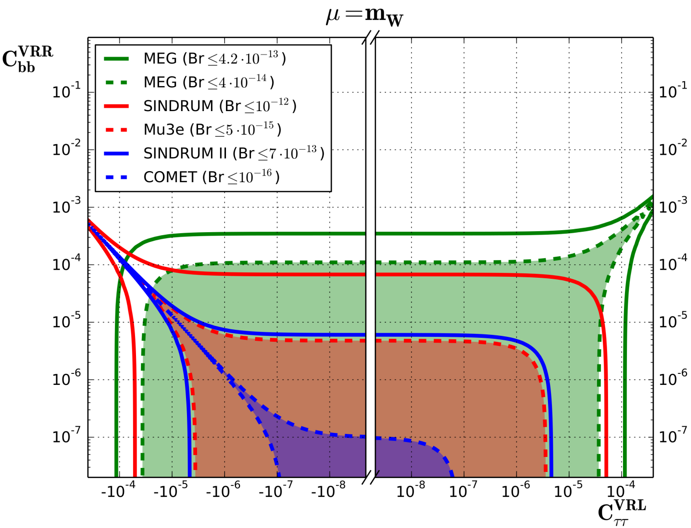
	$\mathrm{Br}(\mu^+ \to e^+\gamma)$		$\mathrm{Br}(\mu^+ \to e^+e^-e^+)$		$\mathrm{Br}^{\mathrm{Au/Al}}_{\mu\to e}$	
	$4.2 \cdot 10^{-13}$	$4.0 \cdot 10^{-14}$	$1.0 \cdot 10^{-12}$	$5.0 \cdot 10^{-15}$	$7.0 \cdot 10^{-13}$	$1.0 \cdot 10^{-16}$
C_L^D	$1.0 \cdot 10^{-8}$	$3.1 \cdot 10^{-9}$	$2.0 \cdot 10^{-7}$	$1.4 \cdot 10^{-8}$	$2.0 \cdot 10^{-7}$	$2.9 \cdot 10^{-9}$
$C_{ee}^{S\,LL}$	$4.8 \cdot 10^{-5}$	$1.5 \cdot 10^{-5}$	$8.1 \cdot 10^{-7}$	$5.8 \cdot 10^{-8}$	$1.4 \cdot 10^{-3}$	$2.1 \cdot 10^{-5}$
$C_{\mu\mu}^{S\,LL}$	$2.3 \cdot 10^{-7}$	$7.2 \cdot 10^{-8}$	$4.6 \cdot 10^{-6}$	$3.3 \cdot 10^{-7}$	$7.1 \cdot 10^{-6}$	$1.0 \cdot 10^{-7}$
$C_{\tau\tau}^{S\,LL}$	$1.2 \cdot 10^{-6}$	$3.7 \cdot 10^{-7}$	$2.4 \cdot 10^{-5}$	$1.7 \cdot 10^{-6}$	$2.4 \cdot 10^{-5}$	$3.5 \cdot 10^{-7}$
$C_{\tau\tau}^{T\,LL}$	$2.9 \cdot 10^{-9}$	$9.0 \cdot 10^{-10}$	$5.7 \cdot 10^{-8}$	$4.1 \cdot 10^{-9}$	$5.9 \cdot 10^{-8}$	$8.5 \cdot 10^{-10}$
$C_{bb}^{S\,LL}$	$2.8 \cdot 10^{-6}$	$8.6 \cdot 10^{-7}$	$5.4 \cdot 10^{-5}$	$3.8 \cdot 10^{-6}$	$9.0 \cdot 10^{-7}$	$1.2 \cdot 10^{-8}$
$C_{bb}^{T\,LL}$	$2.1 \cdot 10^{-9}$	$6.4 \cdot 10^{-10}$	$4.1 \cdot 10^{-8}$	$2.9 \cdot 10^{-9}$	$4.2 \cdot 10^{-8}$	$6.0 \cdot 10^{-10}$
$C_{ee}^{V\,RR}$	$3.0 \cdot 10^{-5}$	$9.4 \cdot 10^{-6}$	$2.1 \cdot 10^{-7}$	$1.5 \cdot 10^{-8}$	$2.1 \cdot 10^{-6}$	$3.5 \cdot 10^{-8}$
$C_{\mu\mu}^{V\,RR}$	$3.0 \cdot 10^{-5}$	$9.4 \cdot 10^{-6}$	$1.6 \cdot 10^{-5}$	$1.1 \cdot 10^{-6}$	$2.1 \cdot 10^{-6}$	$3.5 \cdot 10^{-8}$
$C_{\tau\tau}^{V\,RR}$	$1.0 \cdot 10^{-4}$	$3.2 \cdot 10^{-5}$	$5.3 \cdot 10^{-5}$	$3.8 \cdot 10^{-6}$	$4.8 \cdot 10^{-6}$	$7.9 \cdot 10^{-8}$
$C_{bb}^{V\,RR}$	$3.5 \cdot 10^{-4}$	$1.1 \cdot 10^{-4}$	$6.7 \cdot 10^{-5}$	$4.8 \cdot 10^{-6}$	$6.0 \cdot 10^{-6}$	$1.0 \cdot 10^{-7}$
C_{bb}^{RA}	$4.2 \cdot 10^{-4}$	$1.3 \cdot 10^{-4}$	$6.5 \cdot 10^{-3}$	$4.6 \cdot 10^{-4}$	$1.3 \cdot 10^{-3}$	$2.2 \cdot 10^{-5}$
C_{bb}^{RV}	$2.1 \cdot 10^{-3}$	$6.4 \cdot 10^{-4}$	$6.7 \cdot 10^{-5}$	$4.7 \cdot 10^{-6}$	$6.0 \cdot 10^{-6}$	$1.0 \cdot 10^{-7}$

Limits on the various coefficients $C_i(m_W)$ from current and future experimental constraints, assuming that (at the high scale m_W) only one coefficient at a time is non-vanishing and not including operator-dependent efficiency corrections.

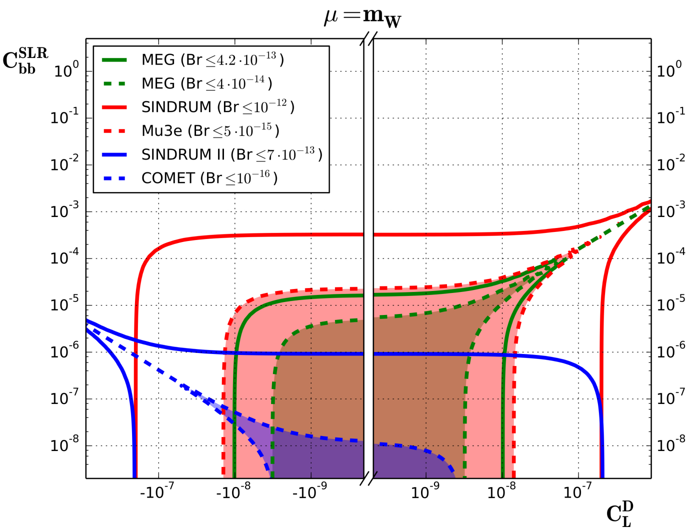
Interplay at the EWSB scale
Mu3e money plot



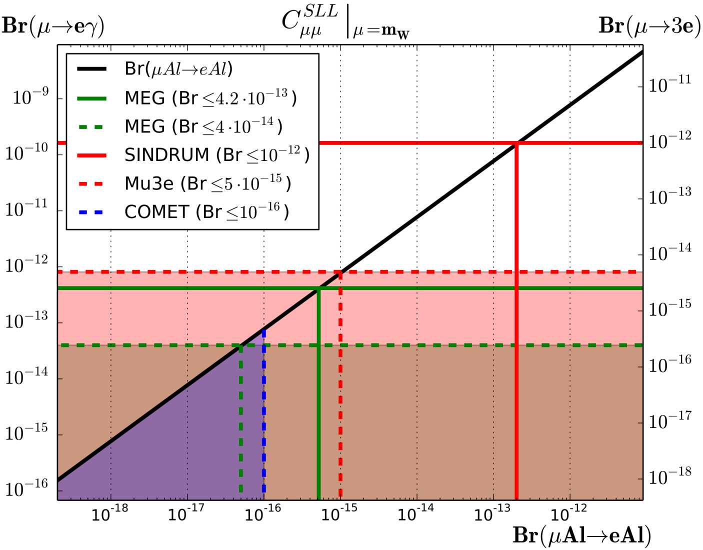
Interplay at the EWSB scale
COMET/Mu2e money plot (1)



Interplay at the EWSB scale
COMET/Mu2e money plot (2)



MEG/MEG-II money plot



Conclusion

- √ LFV phenomena are forbidden in the minimal SM
  - Neutrino sector seems to ignore this fact, calling for something more than the minimal “version”
  - Charged sector seems to take the job seriously
- √ If NP lives high energy scales, consistent EFT techniques can be adopted to extract information from low-energy observables
- √ From limits on LFV observables one can obtain information on the parameter space of possible UV-complete BSM theories
- √ Interplay among observables is crucial
- √ “MEG tests the dipole interaction, and Mu2e/Mu3e test the contact interaction” is a misleading statement