

Radiative Charged Seesaw Mechanism and Implications to ILC

Kei Yagyu (Osaka U.)



Kai-Feng Chen, Cheng-Wei Chiang, KY, 2006.07929 [hep-ph] (JHEP)

Cheng-Wei Chiang, KY, 2104.00890 [hep-ph]

71st general meeting of ILC physics subgroup

12th May, KEK (Online)

Last participated Gen. ILC Meeting

Testing Higgs models via the $H^\pm W^\mp Z$ vertex by a recoil method at the ILC

Kei Yagyu (Univ. of Toyama)

Collaborators

Shinya Kanemura, Kazuya Yanase

Physical Review D83, 075018

KEK, 14th May, 2011

Last participated Gen. ILC Meeting

Testing Higgs models via the $H^\pm W^\mp Z$ vertex by a recoil method at the ILC

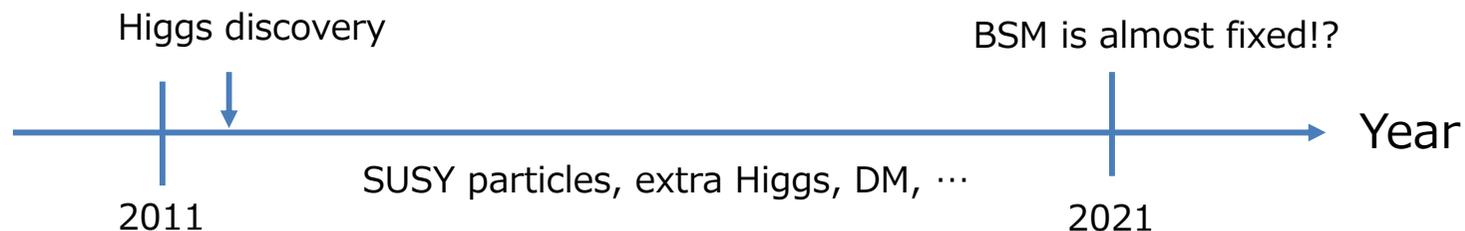
Kei Yagyu (Univ. of Toyama)

Collaborators

Shinya Kanemura, Kazuya Yanase

Physical Review D83, 075018

KEK, 14th May, 2011



Actual current situation

ATLAS Exotics Searches* - 95% CL Upper Exclusion Limits

Status: May 2020

ATLAS Preliminary

$\int \mathcal{L} dt = (3.2 - 139) \text{ fb}^{-1}$ $\sqrt{s} = 8, 13 \text{ TeV}$

Model	ℓ, γ	Jets [†]	E^{miss}	$\int \mathcal{L} dt [\text{fb}^{-1}]$	Limit	Reference	
Extra dimensions	ADD $G_{KK} + g/q$	$0, e, \mu$	1-4 J	Yes	36.1	M_0 7.7 TeV	$n = 2$ 1711.03301
	ADD non-resonant $\gamma\gamma$	$2, \gamma$	2 J	-	36.7	M_0 6.5 TeV	$n = 3$ HLZ NLO 1707.04147
	ADD OBH	-	-	-	37.0	M_0 8.9 TeV	$n = 6$ 1703.09127
	ADD BH high Σp_T	$\geq 1, e, \mu$	≥ 2 J	-	3.2	M_0 8.2 TeV	$n = 6, M_0 = 3 \text{ TeV}$, rot BH 1606.02265
	ADD BH multijet	-	≥ 3 J	-	3.6	M_0 9.55 TeV	$n = 6, M_0 = 3 \text{ TeV}$, rot BH 1512.02586
	RS1 $G_{KK} \rightarrow \gamma\gamma$	$2, \gamma$	-	-	36.7	G_{KK} mass 4.1 TeV	$k/M_0 = 0.1$ 1707.04147
	Bulk RS $G_{KK} \rightarrow WW/ZZ$	multi-channel	-	-	36.1	G_{KK} mass 2.3 TeV	$k/M_0 = 1.0$ 1608.02280
	Bulk RS $G_{KK} \rightarrow WV \rightarrow \nu\bar{\nu}qq$	$1, e, \mu$	2 J / 1 J	Yes	139	G_{KK} mass 2.0 TeV	$k/M_0 = 1.0$ 2004.14636
	Bulk RS $g_{KK} \rightarrow t\bar{t}$	$1, e, \mu$	$\geq 1, b, \geq 1, 2$ J	Yes	36.1	G_{KK} mass 3.8 TeV	$f/m = 15\%$ 1804.10823
	2UED / RPP	$1, e, \mu$	$\geq 2, b, \geq 3$ J	Yes	36.1	KK mass 1.8 TeV	Tier (1,1), $\mathcal{R}(A^{(1,1)} \rightarrow t\bar{t}) = 1$ 1803.09678
Gauge bosons	SSM $Z' \rightarrow \ell\ell$	$2, e, \mu$	-	-	139	Z' mass 5.1 TeV	$f/m = 1.2\%$ 1903.06248
	SSM $Z' \rightarrow \tau\tau$	$2, \tau$	-	-	36.1	Z' mass 2.42 TeV	1709.07242
	Leptophobic $Z' \rightarrow b\bar{b}$	-	2 b	-	36.1	Z' mass 2.1 TeV	1906.06299
	Leptophobic $Z' \rightarrow t\bar{t}$	$0, e, \mu$	$\geq 1, b, \geq 2$ J	Yes	139	Z' mass 4.1 TeV	2005.05138
	SSM $W' \rightarrow \ell\nu$	$1, e, \mu$	-	Yes	139	W' mass 6.0 TeV	1906.05609
	SSM $W' \rightarrow \nu\nu$	$1, \tau$	-	Yes	36.1	W' mass 3.7 TeV	1801.06992
	HVT $W' \rightarrow WZ \rightarrow \ell\nu qq$ model B	$1, e, \mu$	2 J / 1 J	Yes	139	W' mass 4.2 TeV	2004.14636
	HVT $V' \rightarrow WV \rightarrow qq qq$ model B	$0, e, \mu$	2 J	-	139	V' mass 3.8 TeV	$g_V = 3$ 1906.05589
	HVT $V' \rightarrow WH/ZH$ model B	multi-channel	-	-	36.1	V' mass 2.93 TeV	$g_V = 3$ 1712.06518
	HVT $W' \rightarrow WH$ model B	$0, e, \mu$	$\geq 1, b, \geq 2$ J	Yes	139	W' mass 3.2 TeV	$g_V = 3$ CERN-EP-2020-073
CI	CI $qqqq$	-	2 J	-	37.0	A 21.8 TeV	$m(N_U) = 0.5 \text{ TeV}$, $g_U = g_D$ 1703.09127
	CI $\ell\ell qq$	$2, e, \mu$	-	-	139	A 35.3 TeV	$\tilde{\eta}_{L,R}$ CERN-EP-2020-066
	CI $t\bar{t}t\bar{t}$	$\geq 1, e, \mu$	$\geq 1, b, \geq 1$ J	Yes	36.1	A 2.57 TeV	$ C_{d1} = 4\pi$ 1811.02305
DM	Axial-vector mediator (Dirac DM)	$0, e, \mu$	1-4 J	Yes	36.1	m_{DM} 1.55 TeV	$g_U = 0.25, g_D = 1.0, m(\chi) = 1 \text{ GeV}$ 1711.03301
	Colored scalar mediator (Dirac DM)	$0, e, \mu$	1-4 J	Yes	36.1	m_{DM} 1.67 TeV	$g = 1.0, m(\chi) = 1 \text{ GeV}$ 1711.03301
	VV _{UV} EFT (Dirac DM)	$0, e, \mu$	1 J, ≤ 1 J	Yes	3.2	M_U 700 GeV	$m(\chi) = 150 \text{ GeV}$ 1608.02372
Scalar reson. $\phi \rightarrow t\bar{t}$ (Dirac DM)	$0-1, e, \mu$	1 b, 0-1 J	Yes	36.1	m_ϕ 3.4 TeV	$y = 0.4, i = 0.2, m(\chi) = 10 \text{ GeV}$ 1812.09743	
LQ	Scalar LQ 1 st gen	$1, 2, e, \mu$	≥ 2 J	Yes	36.1	LQ mass 1.4 TeV	$\beta = 1$ 1902.00377
	Scalar LQ 2 nd gen	$1, 2, \mu$	≥ 2 J	Yes	36.1	LQ mass 1.56 TeV	$\beta = 1$ 1902.00377
	Scalar LQ 3 rd gen	$2, \tau$	2 b	-	36.1	LQ mass 1.03 TeV	$\mathcal{R}(LQ_c \rightarrow b\bar{c}) = 1$ 1902.08103
	Scalar LQ 3 rd gen	$0-1, e, \mu$	2 b	Yes	36.1	LQ mass 970 GeV	$\mathcal{R}(LQ_c \rightarrow t\bar{c}) = 0$ 1902.08103
	Heavy quarks	VLO $TT \rightarrow Ht/Zt/Wb + X$	multi-channel	-	-	36.1	T mass 1.37 TeV
VLO $BB \rightarrow Wt/Zb + X$		multi-channel	-	-	36.1	$T_{1,2}$ mass 1.34 TeV	SU(2) doublet 1808.02343
VLO $T_{1,2} T_{1,3} T_{1,3} \rightarrow Wt + X$		2SS) $\geq 3, e, \mu$	$\geq 1, b, \geq 1$ J	Yes	36.1	$T_{1,3}$ mass 1.64 TeV	$\mathcal{R}(T_{1,3} \rightarrow Wt) = 1, c(T_{1,3} W) = 1$ 1807.11883
VLO $Y \rightarrow Wb + X$		$1, e, \mu$	$\geq 1, b, \geq 1$ J	Yes	36.1	Y mass 1.85 TeV	$\mathcal{R}(Y \rightarrow Wb) = 1, c_Y(Wb) = 1$ 1812.07343
VLO $B \rightarrow Hb + X$		$0, e, \mu, 2, \gamma$	$\geq 1, b, \geq 1$ J	Yes	29.8	B mass 1.21 TeV	$\kappa_B = 0.5$ ATLAS-CONF-2018-024
VLO $QQ \rightarrow WqWq$		$1, e, \mu$	≥ 4 J	Yes	20.3	Q mass 690 GeV	1509.04261
Excited fermions	Excited quark $q^* \rightarrow qg$	-	2 J	-	139	q^* mass 6.7 TeV	only u' and d' , $\Lambda = m(q')$ 1910.08447
	Excited quark $q^* \rightarrow q\gamma$	$1, \gamma$	1 J	-	36.1	q^* mass 5.3 TeV	only u' and d' , $\Lambda = m(q')$ 1709.10440
	Excited quark $b^* \rightarrow bg$	-	1 b, 1 J	-	36.1	b^* mass 2.6 TeV	1805.09299
	Excited lepton ℓ^*	$3, e, \mu, \tau$	-	-	20.3	ℓ^* mass 3.0 TeV	1411.2921
	Excited lepton ν^*	$3, e, \mu, \tau$	-	-	20.3	ν^* mass 1.6 TeV	1411.2921
Other	Type III Seesaw	$1, e, \mu$	≥ 2 J	Yes	79.8	N^c mass 560 GeV	$m(W_2) = 4.1 \text{ TeV}$, $g_U = g_D$ ATLAS-CONF-2018-020
	LRSM Majorana ν	$2, \mu$	2 J	-	36.1	N_1 mass 870 GeV	809.11105
	Higgs triplet $H^{++} \rightarrow \ell\ell$	$2, 3, 4, e, \mu$ (SS)	-	-	36.1	H^{++} mass 3.2 TeV	DY production, $\mathcal{R}(H^{++} \rightarrow t\bar{t}) = 1$ 1710.09748
	Higgs triplet $H^{++} \rightarrow \ell\tau$	$3, e, \mu, \tau$	-	-	20.3	H^{++} mass 400 GeV	DY production, $ \eta = 5e$ 1411.2921
	Multi-charged particles	-	-	-	36.1	multi-charged particle mass 1.22 TeV	DY production, $ \eta = 5e$ 1812.08073
Magnetic monopoles	-	-	-	34.4	monopole mass 2.37 TeV	DY production, $ \eta = 1.0e, \text{Spin } 1/2$ 1906.10130	

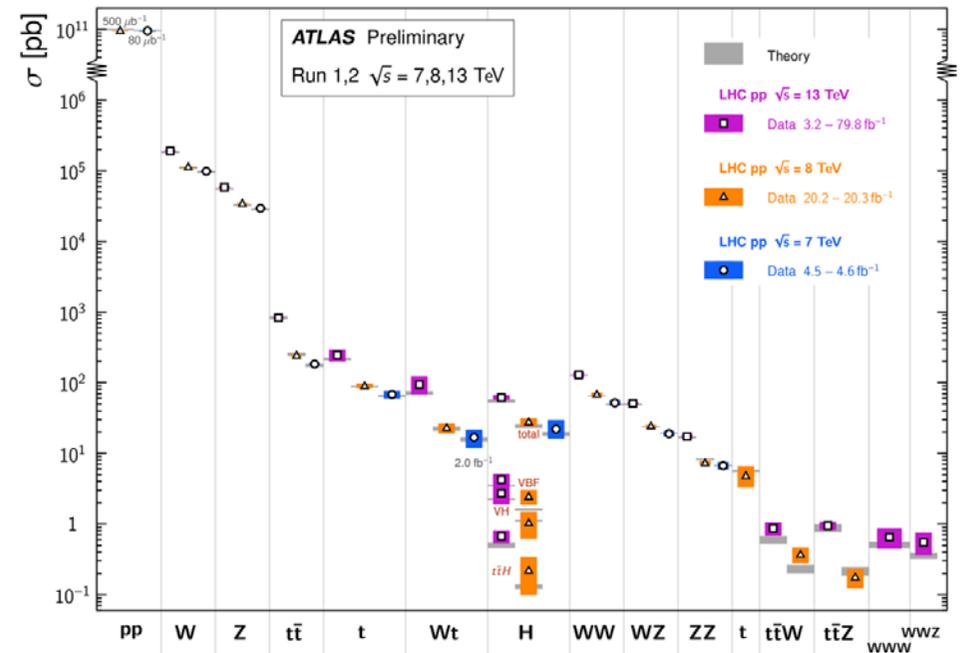
*Only a selection of the available mass limits on new states or phenomena is shown.

†Small-radius (large-radius) jets are denoted by the letter i (J).

So far, no SUSY, no extra Higgs and no DM have been observed.

Standard Model Total Production Cross Section Measurements

Status: May 2020



SM predictions are in good agreement.

Still, the SM is very good...

Recently, there was exciting news which could indicate the evidence of NP.

7th Apr., US CT 10:00 (JST 0:00)



[Home](#) | [About](#) | [Science](#) | [Jobs](#) | [Contact](#) | [Phone Book](#)

[Newsroom](#) | [DUNE at LBNF](#) | [Come visit us](#) | [Resources for](#)

News

Newsroom

[News and features](#)

[Press releases](#)

[Fermilab in the news](#)

[Fact sheets and brochures](#)

[DUNE at LBNF newsroom](#)

[Photo, video and graphics galleries](#)

[Search photo, video and graphics](#)

[Social media](#)

First results from Fermilab's Muon g-2 experiment strengthen evidence of new physics

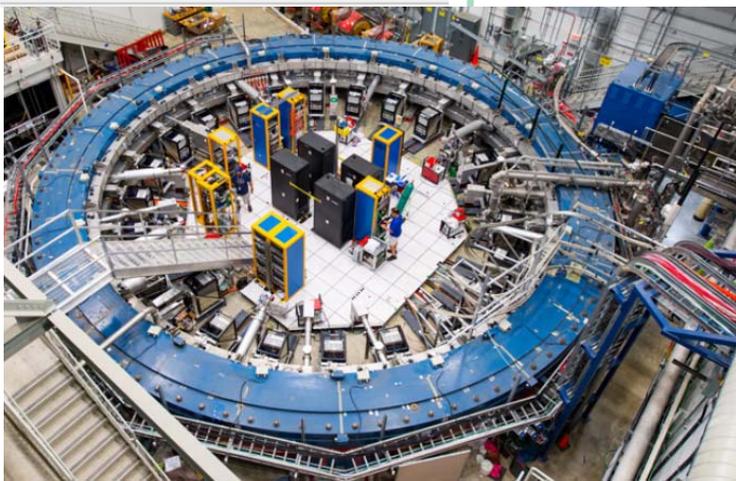
April 7, 2021



Media contact

- Tracy Marc, Fermilab, media@fnal.gov, 224-290-7803

The long-awaited [first results](#) from the Muon g-2 experiment at the U.S. Department of Energy's Fermi National Accelerator Laboratory show fundamental particles called muons behaving in a way that is not predicted by scientists' best theory, the Standard Model of particle physics. This [landmark result](#), made with unprecedented precision, confirms a discrepancy that has been gnawing at researchers for decades.



Special Seminar

Seminar agenda:

- 10:00 – 10:05 Introduction — Kevin Pitts, Fermilab chief research officer
- 10:05 – 10:20 Theory overview — Aida El-Khadra, UIUC theoretical physicist
- 10:20 – 11:00 Muon g-2 results — Chris Polly, Fermilab experimental physicist
- 11:00 – 11:20 Question & Answer

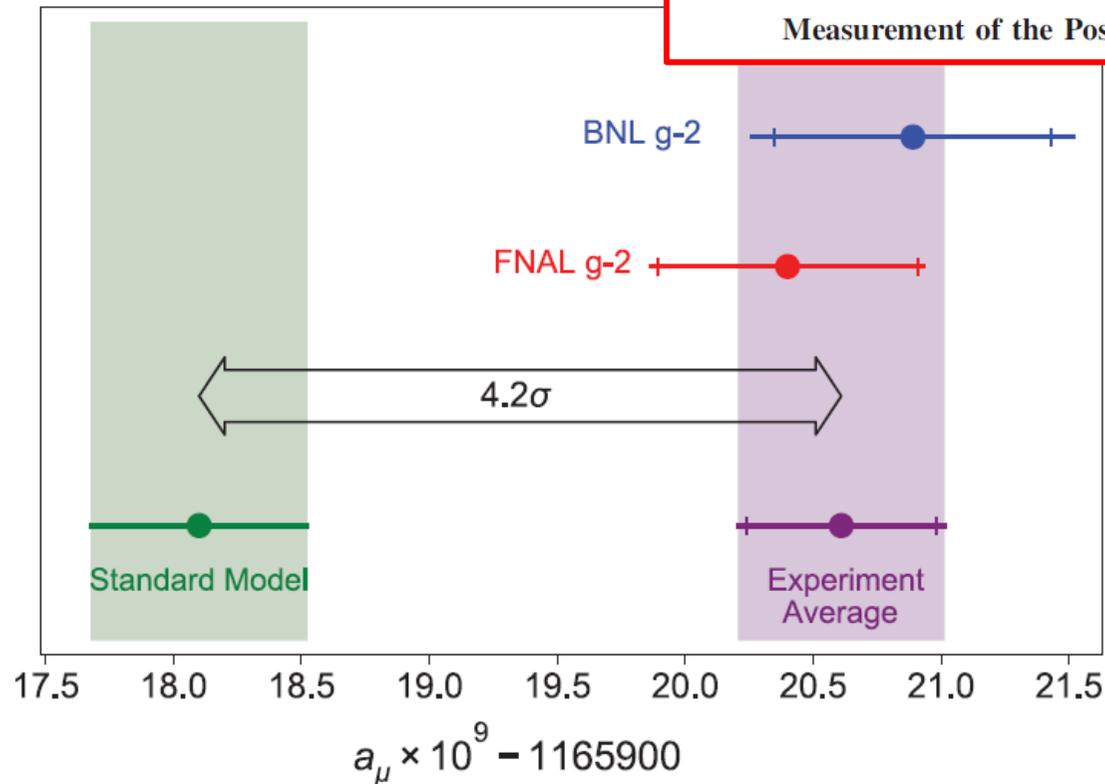
PRL126, 141801 (2021)

PHYSICAL REVIEW LETTERS 126, 141801 (2021)

Editors' Suggestion

Featured in Physics

Measurement of the Positive Muon Anomalous Magnetic Moment to 0.46 ppm



$$\Delta a_\mu \equiv a_\mu^{\text{Exp}} - a_\mu^{\text{SM}}$$

Before: $\Delta a_\mu = (2.79 \pm 0.76) \times 10^{-9} \quad (3.7\sigma)$

After: $\Delta a_\mu = (2.51 \pm 0.59) \times 10^{-9} \quad (4.2\sigma!!)$

Festival on arXiv

- [16] [arXiv:2104.03217](#) [pdf, other]
Supersymmetric Interpretation of the Muon $g - 2$ Anomaly
Motoi Endo, Koichi Hamaguchi, Sho Iwamoto, Teppei Kitahara
- [17] [arXiv:2104.03223](#) [pdf, other]
Wino-Higgsino dark matter in the MSSM from the $g - 2$ anomaly
Sho Iwamoto, Tsutomu T. Yanagida, Norimi Yokozaki
- [18] [arXiv:2104.03227](#) [pdf, other]
Lepton-specific inert two-Higgs-doublet model confronted with the new results for muon and electron $g-2$ anomaly and multi-lepton searches at the LHC
Xiao-Fang Han, Tianjun Li, Hong-Xin Wang, Lei Wang, Yang Zhang
- [19] [arXiv:2104.03228](#) [pdf, other]
Muon $g - 2$ and B -anomalies from Dark Matter
Giorgio Arcadi, Lorenzo Calibbi, Marco Fedele, Federico Mescia
- [20] [arXiv:2104.03231](#) [pdf, other]
Confronting spin-3/2 and other new fermions with the muon $g-2$ measurement
Juan C. Criado, Abdelhak Djouadi, Niko Koivunen, Kristjan Mürsepp, Martti Raidal, Hardi Veermäe
- [21] [arXiv:2104.03238](#) [pdf, other]
Probing light dark matter with scalar mediator: muon ($g - 2$) deviation, the proton radius puzzle
Bin Zhu, Xuewen Liu
- [22] [arXiv:2104.03239](#) [pdf, other]
Heavy Bino and Slepton for Muon $g-2$ Anomaly
Yuchao Gu, Ning Liu, Liangliang Su, Daohan Wang
- [23] [arXiv:2104.03242](#) [pdf, other]
Revisiting the μ - τ -philic Higgs doublet in light of the muon $g - 2$ anomaly, τ decays, and multi-lepton searches at the
Hong-Xin Wang, Lei Wang, Yang Zhang
- • •
- [46] [arXiv:2104.03302](#) [pdf, other]
The Tiny ($g-2$) Muon Wobble from Small- μ Supersymmetry
Sebastian Baum, Marcela Carena, Nausheen R. Shah, Carlos E. M. Wagner

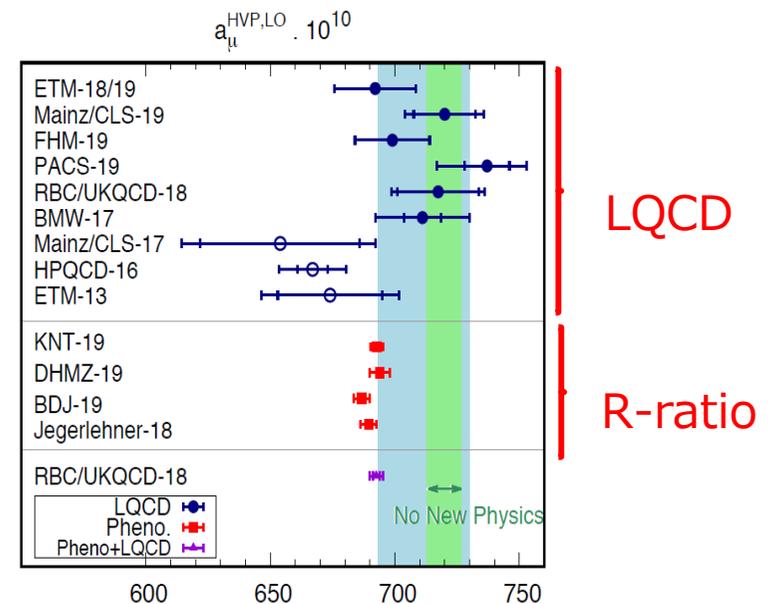
31 papers (8th April)

- SUSY
- Extended Higgs
- WIMP DM
- Axion-like particles
- Extended gauge sym.
- ...

Several issues

- The deviation is $4.2\sigma < 5\sigma$, so it is still “**anomaly**”, not established.
(cf. 750 diphoton excess $\sim 4\sigma$ @ATLAS and CMS)
- **LQCD** result is consistent with experiments

Recent review: 2006.04822



We need to wait more data and improving the SM calculation.
But, it would be worth to more seriously consider the anomaly
as a hint of **BSM!**

Contents

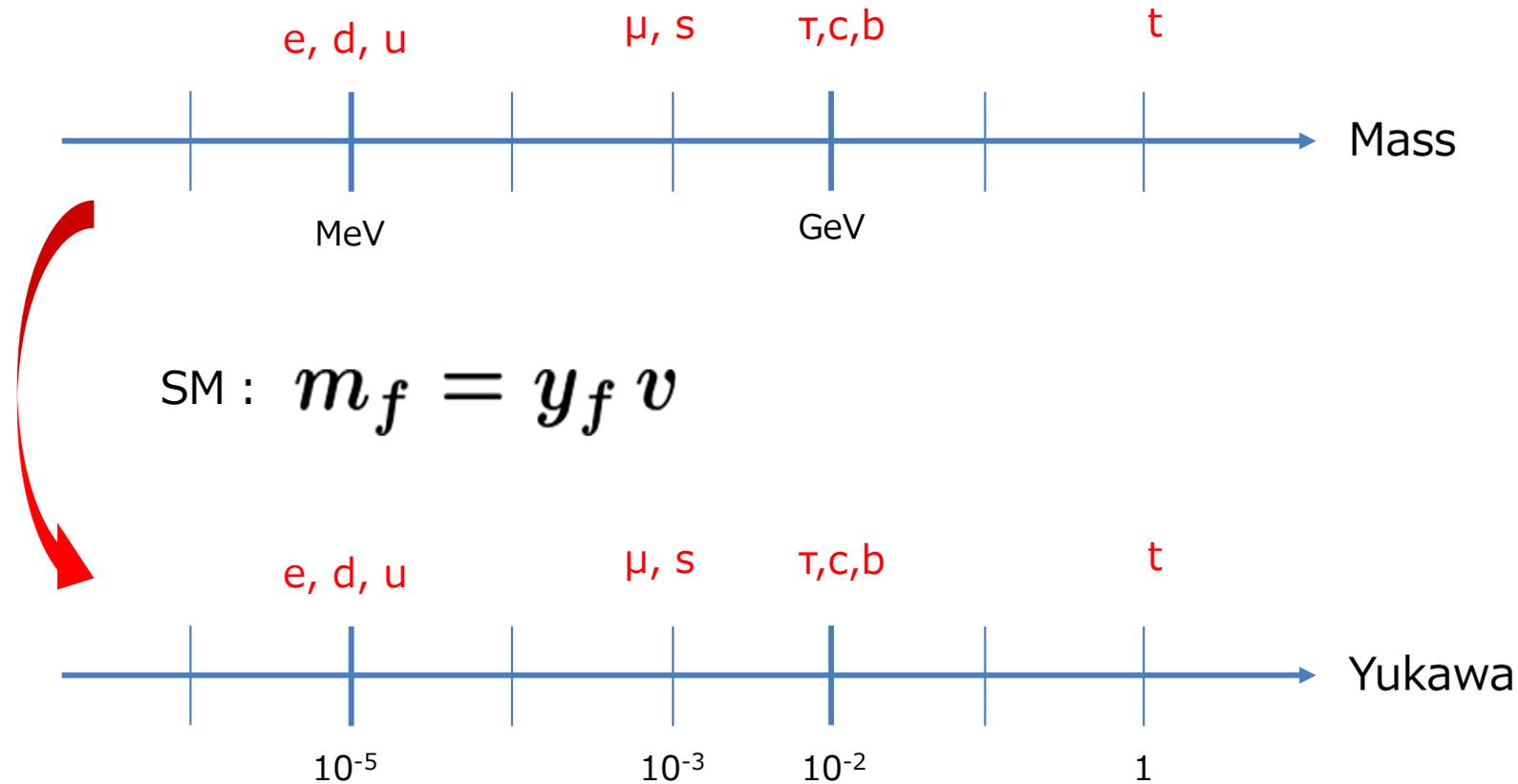
I. Introduction

II. Radiative Charged Seesaw Mechanism

III. ILC implications

IV. Summary

Fermion Mass Hierarchy

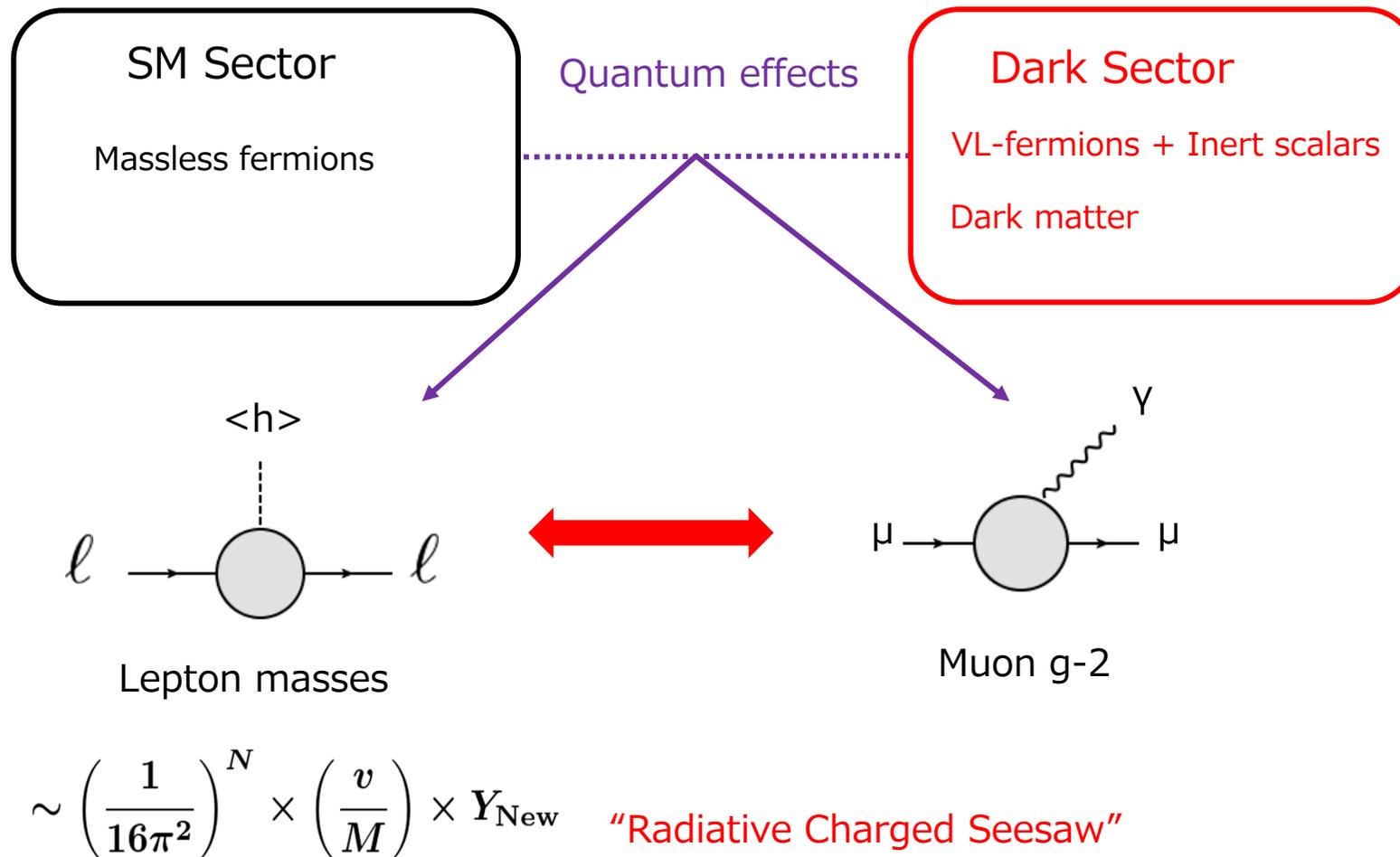


Can we explain the mass hierarchy with $O(1)$ couplings?

Also, can we explain the muon $(g-2)$ anomaly?

Dark sector as origin of lepton masses

- Introduction of “dark sector” to the SM



Dark sector simultaneously explains tiny lepton masses and $(g-2)_\mu$ anomaly.

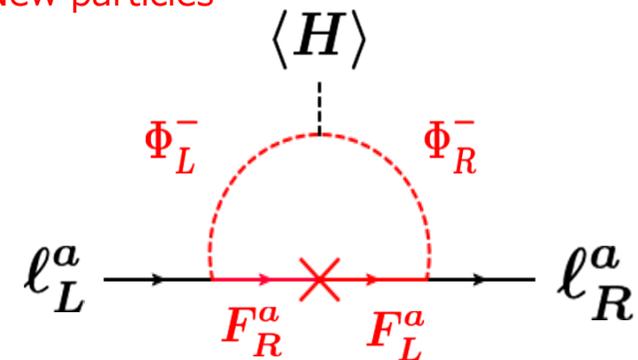
Model

- We consider the case with the tree level tau mass and 1-loop induced μ/e masses.

	Fermions				Scalars		
Fields	$(L_L^e, L_L^\mu, L_L^\tau)$	(e_R, μ_R, τ_R)	(F_L^e, F_L^μ)	(F_R^e, F_R^μ)	H	Φ_L	Φ_R
$U(1)_\ell$ (exact)	$(q_e, q_\mu, 0)$	$(q_e, q_\mu, 0)$	(q_e, q_μ)	(q_e, q_μ)	0	0	0
Z_2 (exact)	$(+, +, +)$	$(+, +, +)$	$(-, -)$	$(-, -)$	+	-	-
Z_2' (soft-breaking)	$(+, +, +)$	$(-, -, +)$	$(+, +)$	$(-, -)$	+	-	-

→ Forbid LFVs
→ Forbid tree level mixing
→ Forbid tree level Yukawa
→ Stabilize the DM candidate

New particles



- Lagrangian for the lepton sector

$$\mathcal{L} = -y_\tau \bar{L}_L^\tau H \tau_R - \sum_{a=e,\mu} (M^a \bar{F}_L^a F_R^a + f_L^a \bar{L}_L^a \Phi_L F_R^a + f_R^a \bar{\ell}_R^a \Phi_R F_L^a) - \mu H \Phi_L \Phi_R + \text{h.c.}$$

Charge assignment under $SU(2)_I \times U(1)_Y$

- We list the possible sets of the $SU(2)_I \times U(1)_Y$ charge.

$$F \sim (I_F, Y_F) \quad \Phi_{L,R} \sim (I_{L,R}, Y_{L,R}) \quad \bar{L}_L \Phi_L F_R$$

$$\text{with } Y_L = -1/2 - Y_F, \quad Y_R = -1 - Y_F \quad \bar{\ell}_R \Phi_R F_L$$

(I_F, Y_F)	(I_L, Y_L)	(I_R, Y_R)	Sign of Δa_ℓ
$(\mathbf{1}, 0)$	$(\mathbf{2}, -1/2)$	$(\mathbf{1}, -1)$	+
$(\mathbf{1}, -1)$	$(\mathbf{2}, 1/2)$	$(\mathbf{1}, 0)$	-
$(\mathbf{2}, 1/2)$	$(\mathbf{1} \text{ or } \mathbf{3}, -1)$	$(\mathbf{2}, -3/2)$	+
$(\mathbf{2}, -1/2)$	$(\mathbf{1} \text{ or } \mathbf{3}, 0)$	$(\mathbf{2}, -1/2)$	- or \pm
$(\mathbf{2}, -3/2)$	$(\mathbf{1} \text{ or } \mathbf{3}, 1)$	$(\mathbf{2}, 1/2)$	-
$(\mathbf{3}, 1)$	$(\mathbf{2}, -3/2)$	$(\mathbf{3}, -2)$	+
$(\mathbf{3}, 0)$	$(\mathbf{2}, -1/2)$	$(\mathbf{3}, -1)$	\pm
$(\mathbf{3}, -1)$	$(\mathbf{2}, 1/2)$	$(\mathbf{3}, 0)$	-
$(\mathbf{3}, -2)$	$(\mathbf{2}, 3/2)$	$(\mathbf{3}, 1)$	-

E. Ma, 1311.3213 (PRL)

Common dark sector contributes to mass
and $(g-2)_\mu \rightarrow$ **Sign of $(g-2)_\mu$ is fixed.**

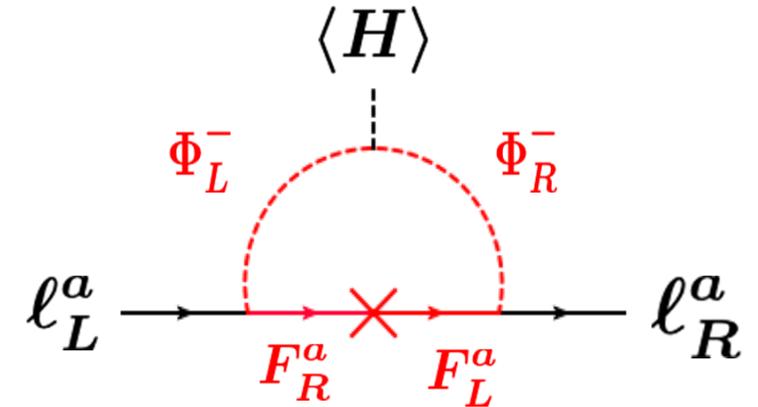
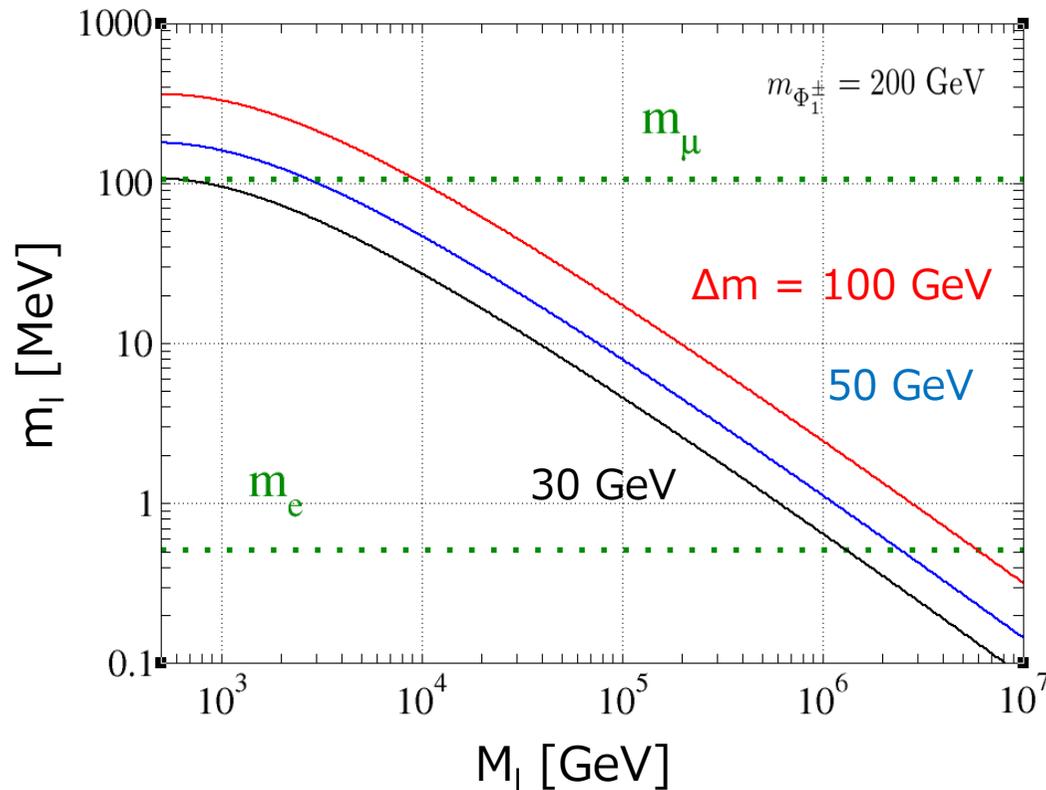
Let us focus on the simplest case with $F \sim (\mathbf{1}, 0)$.

Charged lepton masses

$$m_\ell \simeq \frac{f_L^\ell f_R^\ell s_{2\theta}}{16\pi^2} \frac{m_{\Phi_1^\pm}}{M_\ell} (m_{\Phi_2^\pm} - m_{\Phi_1^\pm}) \left(1 + \ln \frac{m_{\Phi_1^\pm}^2}{M_\ell^2} \right)$$

$$\begin{pmatrix} \Phi_L^\pm \\ \Phi_R^\pm \end{pmatrix} = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} \Phi_1^\pm \\ \Phi_2^\pm \end{pmatrix}$$

$$f_L f_R s_{2\theta} = 1$$



- Case with an O(1) coupling :

Muon mass $\rightarrow M \sim \text{O}(1) \text{ TeV}$

Electron mass $\rightarrow M \sim \text{O}(1) \text{ PeV}$

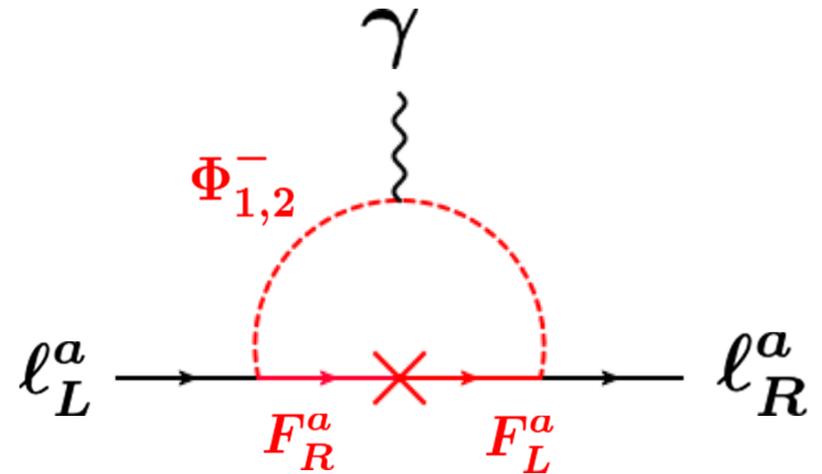
Anomalous magnetic moments

$$\Delta a_\ell \equiv a_\ell^{\text{exp}} - a_\ell^{\text{SM}} \quad \text{FNAL (2021)}$$

$$\Delta a_\mu = (251 \pm 59) \times 10^{-11} \quad 4.2\sigma$$

Nature, 588 (2020)

$$\Delta a_e = (4.8 \pm 3.0) \times 10^{-13} \quad 1.6\sigma$$



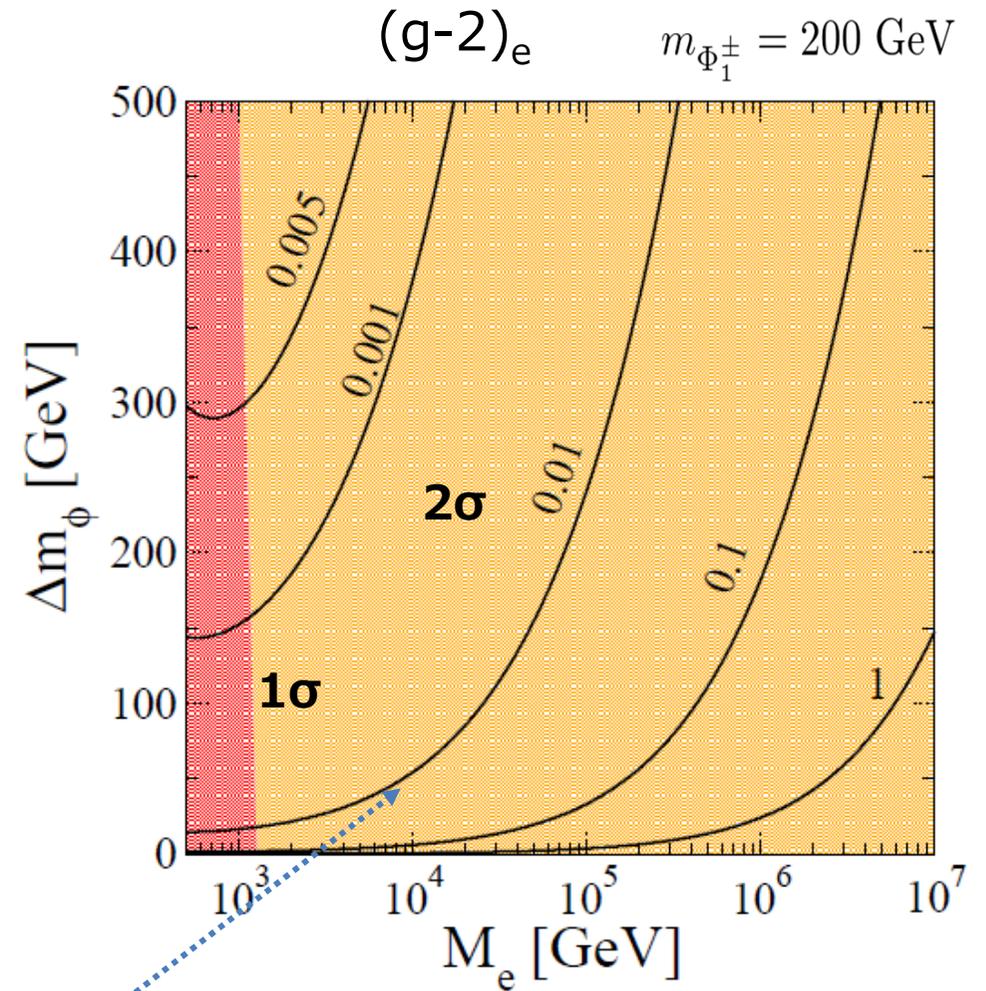
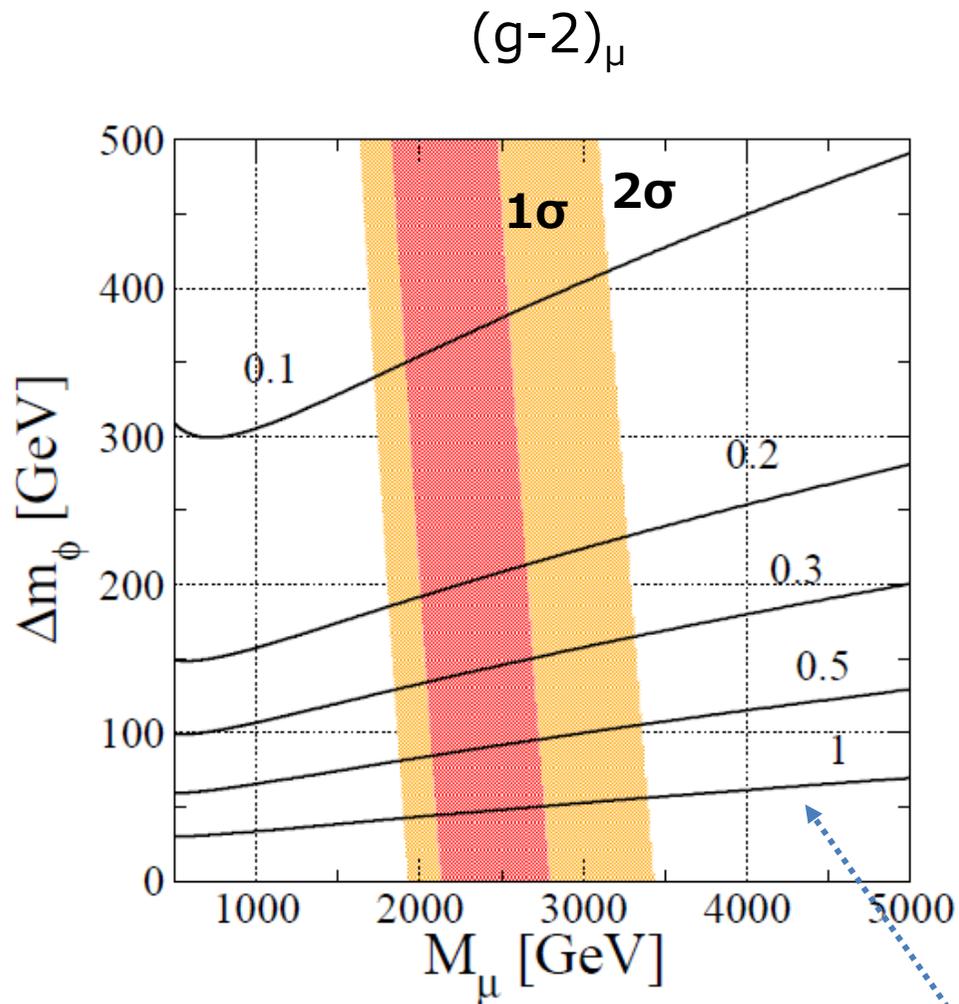
$$\Delta a_\ell \simeq + \frac{m_\ell^2}{M_\ell^2} \frac{5 + \ln(m_{\Phi_1}^2 / M_\ell^2)}{1 + \ln(m_{\Phi_1}^2 / M_\ell^2)}$$

For $M_\ell \gg m_{\Phi_1}$

- It gives a **positive** contribution to $(g-2)_\ell$.
- The dependence of the new Yukawa couplings does not explicitly appear.
- The magnitude is mainly determined by $(m_\ell/M_\ell)^2$.

Anomalous magnetic moments

Cheng-Wei Chiang, KY, 2104.00890 [hep-ph]



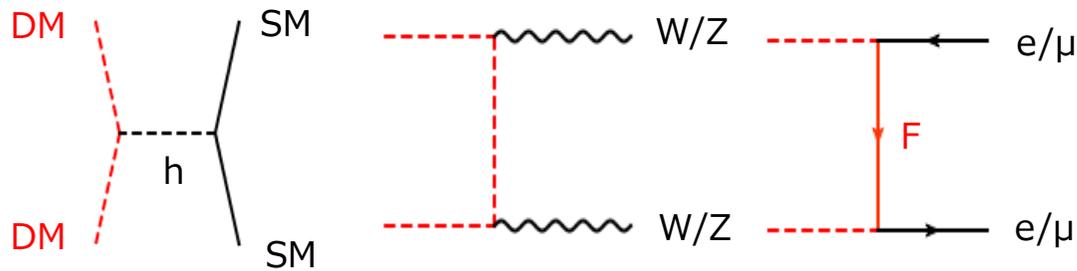
$f_L f_R s_{2\theta}$

Dark matter

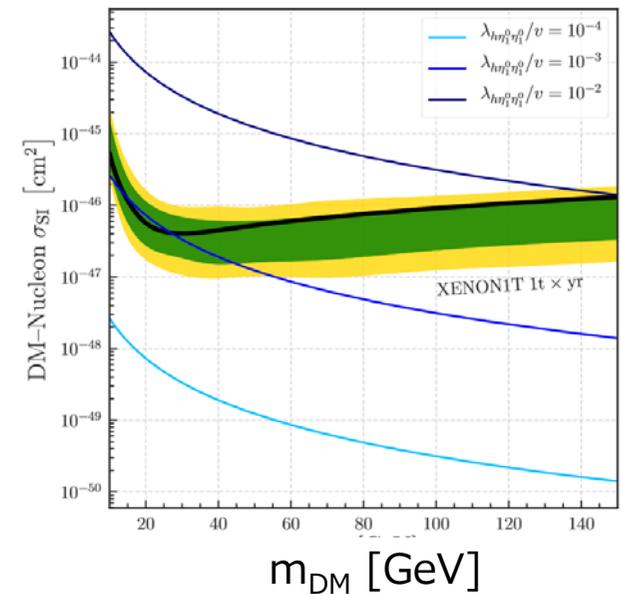
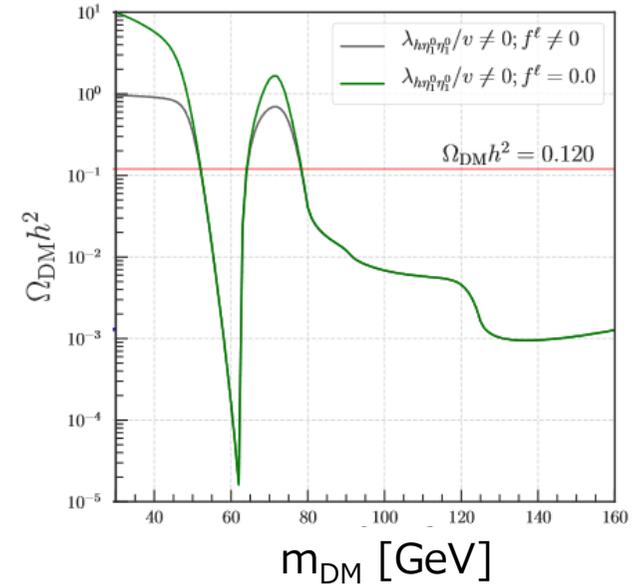
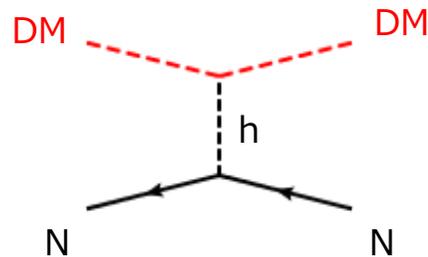
Kai-Feng Chen, Cheng-Wei Chiang, KY, 2006.07929 (JHEP)

DM = Re (Φ_L^0)

Annihilation processes



Direct searches



- There are solutions at $m_{DM} \sim 63$ GeV and 80 GeV.
- We need $|\lambda_{DM}| < 10^{-3}$ to avoid direct search constraint.

Contents

I. Introduction

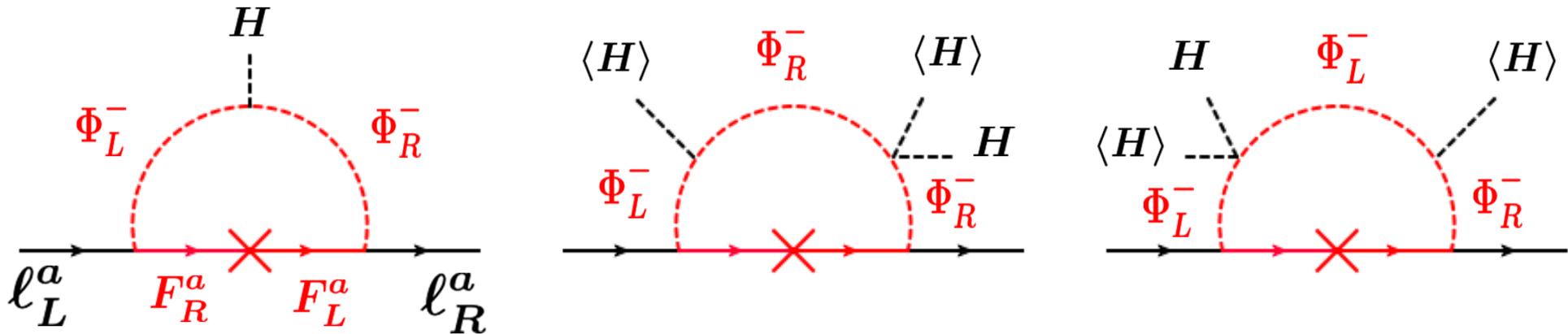
II. Radiative Charged Seesaw Mechanism

III. ILC implications

IV. Summary

Yukawa coupling

- Yukawa coupling does not simply obey $y_f = m_f/v$.



$$y_\ell \simeq \frac{m_\ell}{v} \frac{1}{|1 + \ln(m_{\Phi_1}^2/M_\ell^2)|} \left[\left| 2 + \ln \left(\frac{m_{\Phi_1}^2}{M_\ell^2} \right) \right| + \frac{v^2 \lambda_0}{m_{\Phi_1^\pm}^2} \right] \quad \text{For } M_1 \gg m_{\Phi_1}$$

$$\equiv \kappa_\ell$$

$$\lambda_0 = \frac{m_{\text{DM}}^2}{v^2} + \lambda_{\text{DM}} - \frac{\lambda_{\text{HR}}}{2}$$

$$V = \lambda_{\text{HR}}(H^\dagger H)(\Phi_R^* \Phi_R) + \dots$$

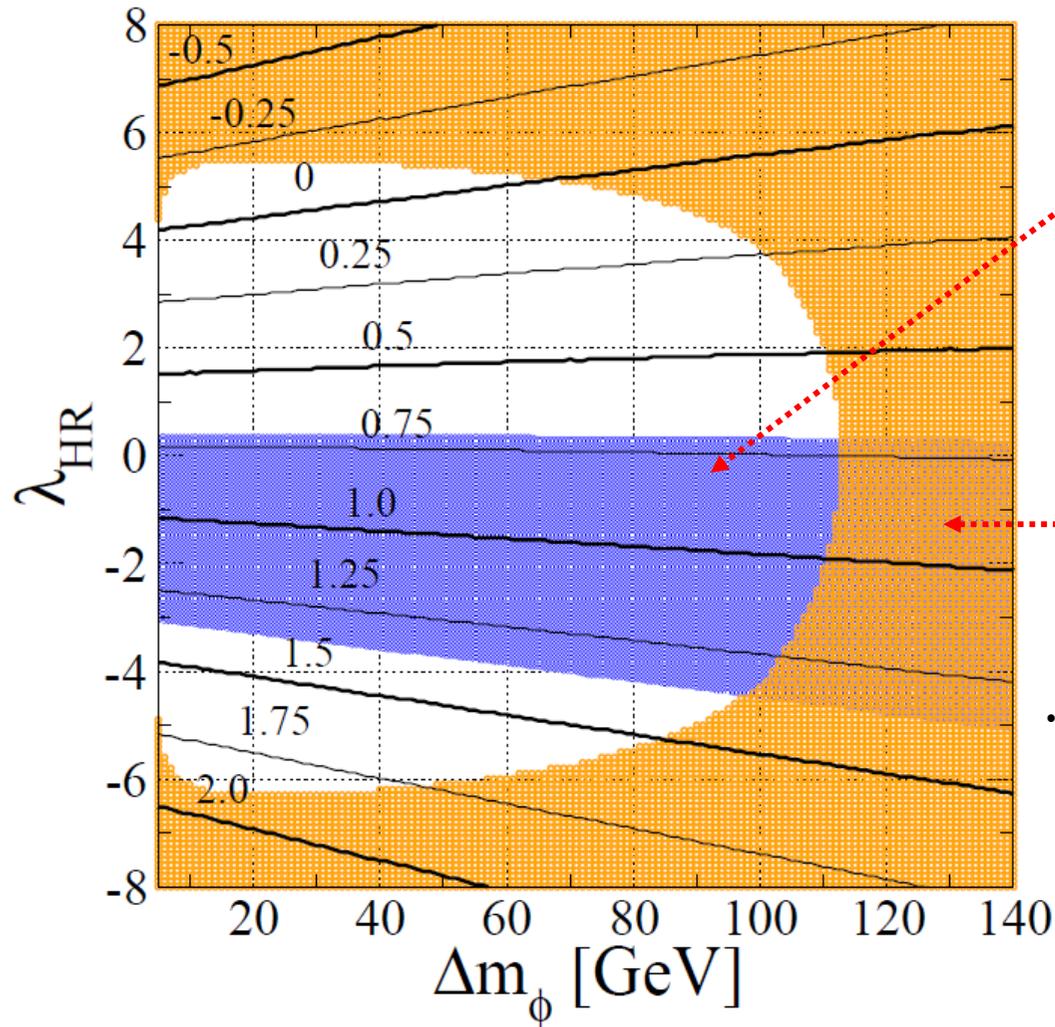
- The deviation is not suppressed by the loop factor, and it can be sizable.

Yukawa coupling

Cheng-Wei Chiang, KY, 2104.00890 [hep-ph]

□ Contours for $\kappa_\ell = y_\ell / y_\ell^{\text{SM}}$

$m_{\Phi_1^\pm} = 200 \text{ GeV}$



Allowed (95%CL) by the signal strength for $pp \rightarrow h \rightarrow \mu\mu$.

ATLAS, 2007.07830 [hep-ex]

CMS-PAS-HIG-19-006

Excluded by perturbativity bound by using 1-loop RGEs.

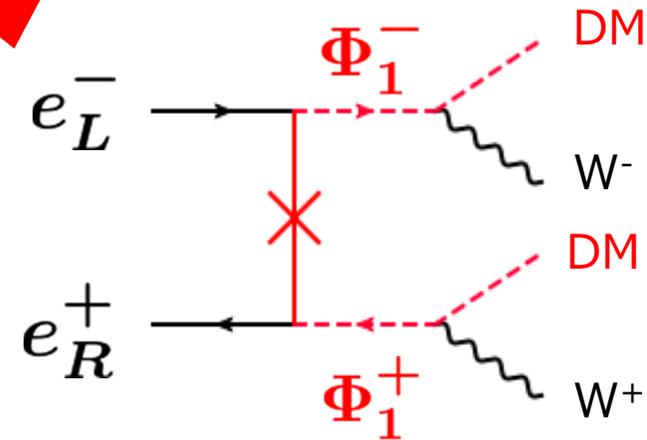
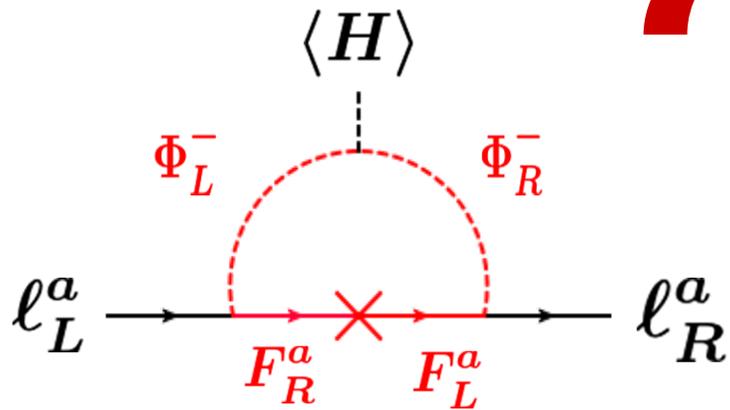
• Future measurements of the μ -Yukawa:

→ HL-LHC $\sim 7\%$, ILC(250) $\sim 5\%$

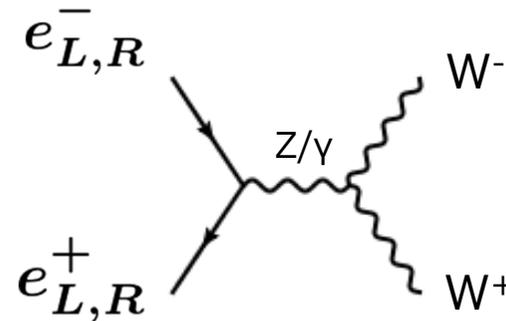
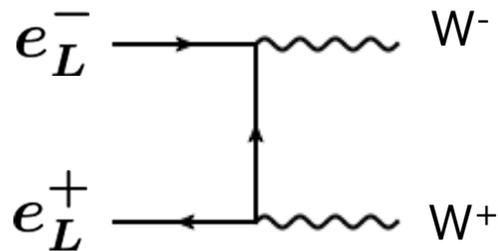
Direct searches at the ILC

Cheng-Wei Chiang, Ryomei Obuchi, KY, work in progress

Rotating by 90°



SM background

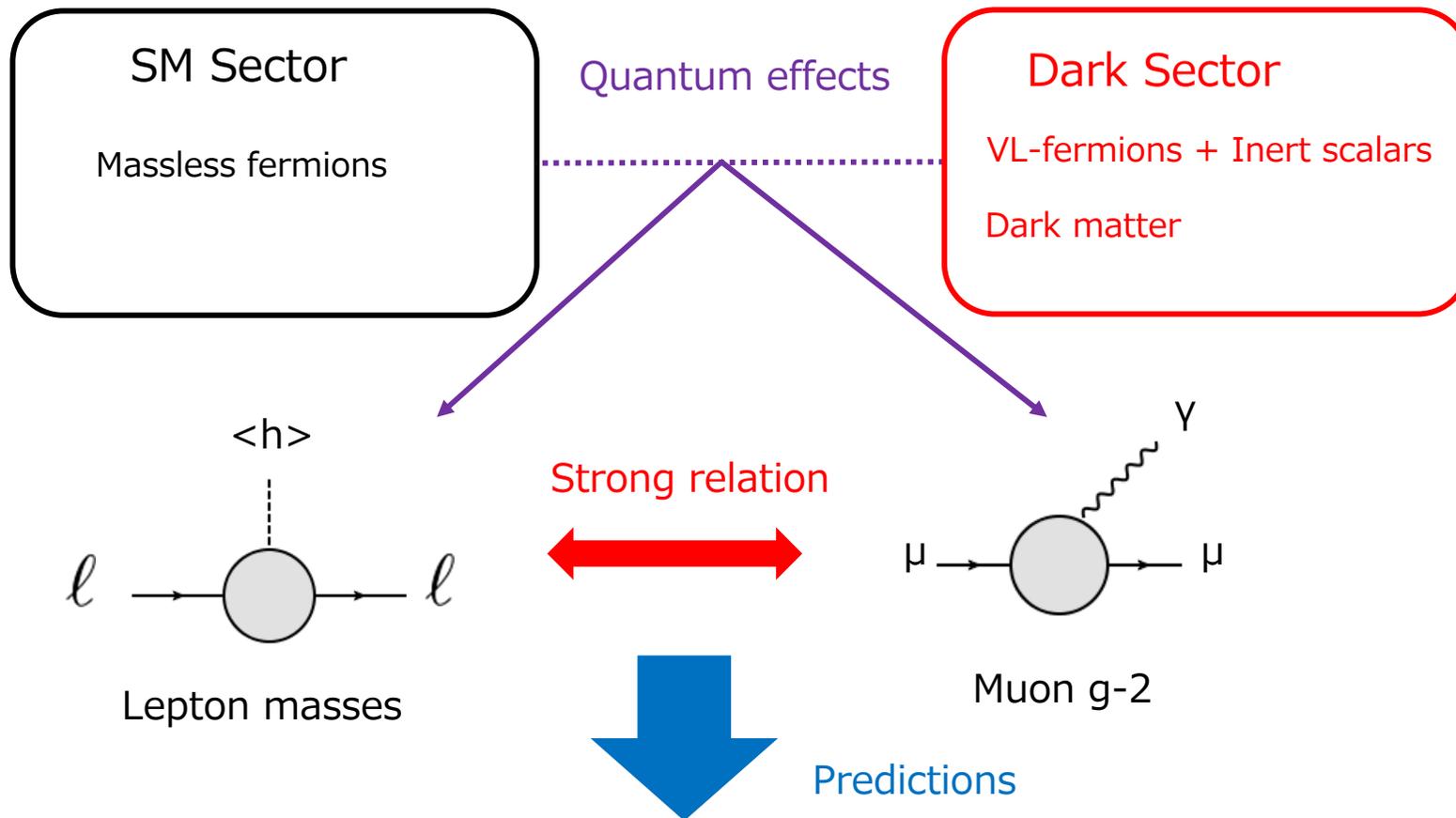


Chirality structure of the initial electron/positron is clearly different.

Beam polarization would be crucially important!

Summary

Radiative charged seesaw scenarios can naturally solve DM and $(g-2)_\mu$.



- (1) Large deviations in the **muon Yukawa coupling** and
- (2) **characteristic chiral structure** in the signature at the ILC.