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# Distinguishing muon LFV effective couplings using $\mu^- + e^- \to e^- + e^-$

**Joe Sato***, **Yuichi Uesaka**
*Physics Department, Saitama University, 255 Shimo-Okubo, Sakura-ku, Saitama, Japan*
*E-mail:* joe@phy.saitama-u.ac.jp

**Yoshitaka Kuno**

*Department of Physics, Osaka University, Toyonaka, Osaka, Japan*

**Toru Sato**

*Research Center for Nuclear Physics, Osaka University, Ibaraki, Osaka, Japan*

**Masato Yamanaka**

*Department of Science and Engineering, Kyushu Sangyo University, Fukuoka, Japan*

A search for $\mu^- e^- \to e^- e^-$ process in a muonic atom is one of the promising probe for charged lepton flavor violation (CLFV). In this work, we investigate an asymmetry of the emitted electrons when the initial muon bound by the nucleus is polarized.

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*Speaker.





PoS(NuFACT2018)126

The charged lepton flavor violation (CLFV) is one of good probes to constrain the physics models at high-energy [1]. Especially, the CLFV processes with muon have been experimentally restricted thanks to high intensity muon beam: e.g. $Br(\mu^+ \to e^+\gamma) < 4.2\times10^{-13}$[2], $Br(\mu^+ \to e^+e^+e^-) < 1.0\times10^{-12}$[3], and $Br(\mu^-\mathrm{Au} \to e^-\mathrm{Au}) < 7\times10^{-13}$[4].

As a new prove of the muonic CLFV, the search for the $\mu^-e^- \to e^-e^-$transition in a muonic atom was proposed by Ref. [5]. In our recent work[6, 7], we performed careful calculation for the rate of $\mu^-e^- \to e^-e^-$in a muonic atom. In this paper, we focus on the $\mu^-e^- \to e^-e^-$search with a muon polarized in a muonic atom to extract the chiral property of the CLFV interaction,

$$\mathscr{L}_{CLFV} = \mathscr{L}_{\text{photo}} + \mathscr{L}_{\text{contact}}, \tag{1}$$

$$\mathscr{L}_{\text{photo}} = -\frac{4G_F}{\sqrt{2}} m_\mu \left[A_R \overline{e_L}\sigma^{\mu\nu}\mu_R + A_L\overline{e_R}\sigma^{\mu\nu}\mu_L\right]F_{\mu\nu} + [H.c.], \tag{2}$$

$$\begin{aligned}\mathscr{L}_{\text{contact}} = -\frac{4G_F}{\sqrt{2}}[&g_1(\overline{e_L}\mu_R)(\overline{e_L}e_R) + g_2(\overline{e_R}\mu_L)(\overline{e_R}e_L)\\ &+ g_3(\overline{e_R}\gamma_\mu\mu_R)(\overline{e_R}\gamma^\mu e_R) + g_4(\overline{e_L}\gamma_\mu\mu_L)(\overline{e_L}\gamma^\mu e_L)\\ &+ g_5(\overline{e_R}\gamma_\mu\mu_R)(\overline{e_L}\gamma^\mu e_L) + g_6(\overline{e_L}\gamma_\mu\mu_L)(\overline{e_R}\gamma^\mu e_R)] + [H.c.],\end{aligned} \tag{3}$$

Detailed analysis will appear soon[8]

## References


[1] L. Calibbi and G. Signorelli, Riv. Nuovo Cim. **41**, no. 2, 1 (2018).

[2] A. Baldini *et al*. (MEG Collaboration), Eur. Phys. J. C**76**, 434 (2016).

[3] U. Bellgardt *et al*., Nucl. Phys. B **299**, 1 (1988).

[4] W. Bertl *et al*., Eur. Phys. J. C **47**, 337 (2006).

[5] M. Koike, Y. Kuno, J. Sato, and M. Yamanaka, Phys. Rev. Lett. **105**, 121601 (2010).

[6] Y. Uesaka, Y. Kuno, J. Sato, T. Sato, and M. Yamanaka, Phys. Rev. D **93**, 076006 (2016).

[7] Y. Uesaka, Y. Kuno, J. Sato, T. Sato, and M. Yamanaka, Phys. Rev. D **97**, 015017 (2018).

[8] Y. Uesaka, Y. Kuno, J. Sato, T. Sato, and M. Yamanaka, arXiv:1908.11653 .


PoS(NuFACT2018)126