MU04

Muon phenomenology and its related topics

SATO, Joe (Yokohama National University) on behalf of MU04 2023/05/09

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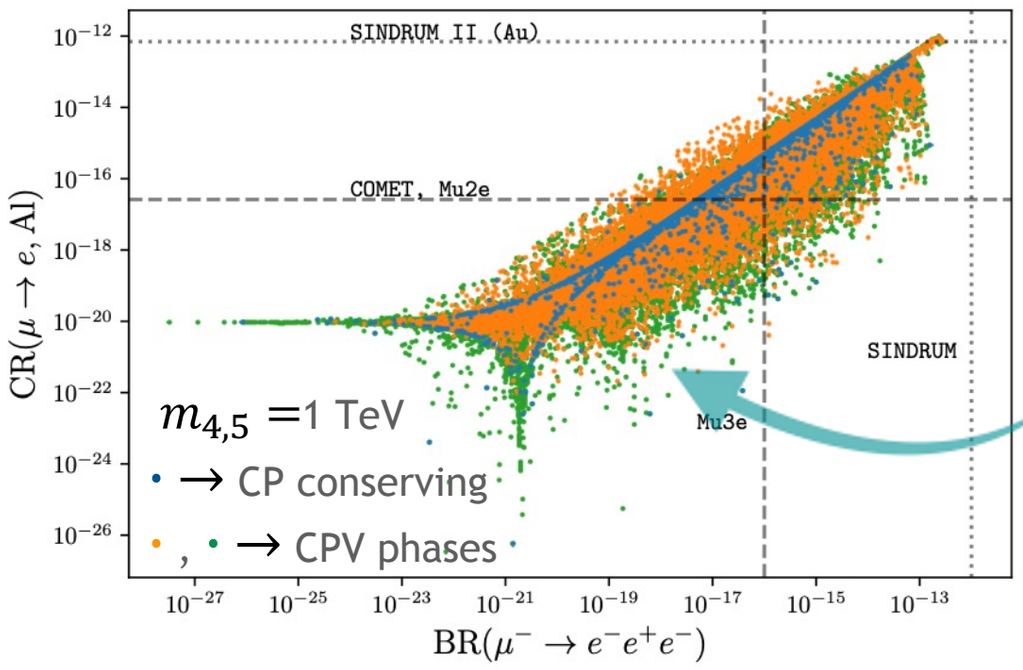
Works

Impact of CPV phases (Dirac & Majorana) on cLFV observables

In the absence of new physics direct discovery, use
ratios of cLFV observables to **identify nature of new mediators** (& constrain their masses):
But! CP phases (**Dirac and/or Majorana**) generically **present** in **models of ν masses...**
Phases can impact naïve expectations... And how (future) data is interpreted!

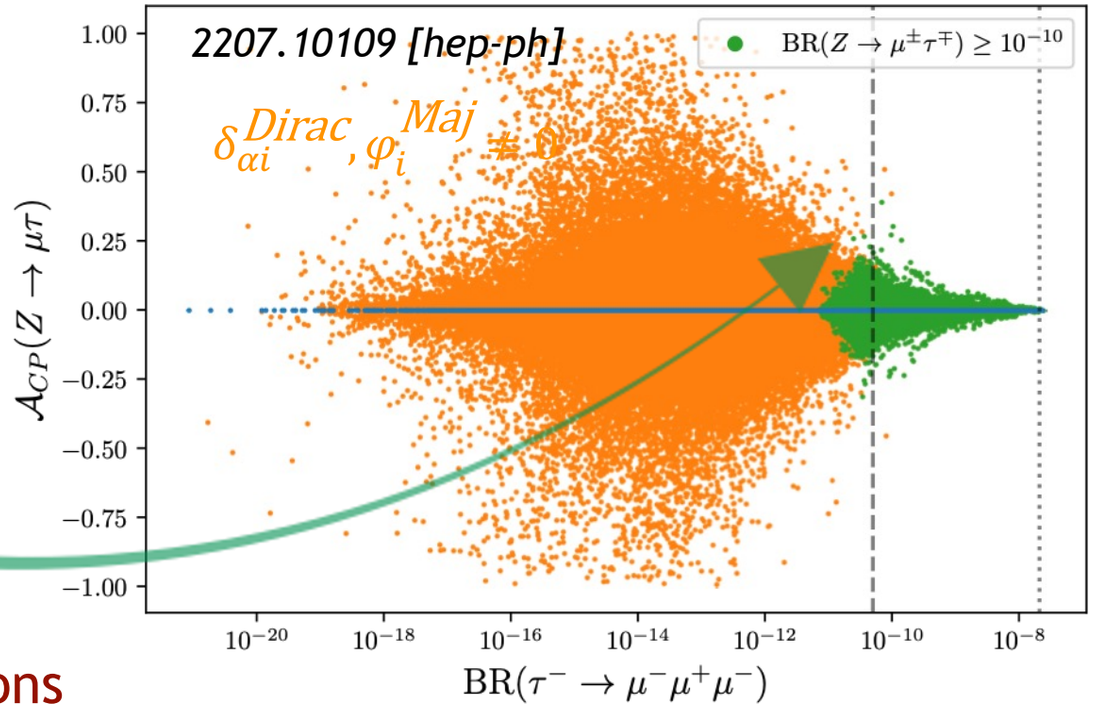
Consider SM + 2 sterile Majorana fermions (new active-sterile mixings, CPV phases $\delta_{\alpha i}^{Dirac}, \varphi_i^{Maj}$)



⇒ significant **loss of** (expected) **correlation between observables**
impact for (future) **data interpretation**
(e.g. large active-sterile mixing regimes not excluded in the presence of leptonic CPV!)

⇒ **Important** contributions to **cLFV Higgs and Z decays!**

⇒ **CP asymmetry** in cLFV Z boson decay
BR($\boldsymbol{Z \to \mu\tau}$) & BR($\boldsymbol{\tau \to 3\mu}$) within sensitivity
$\boldsymbol{\mathcal{A}_{CP}(Z \to \mu\tau)}$ as large as 25%!



Highly suggestive of SM + 2 (CPV) Majorana fermions

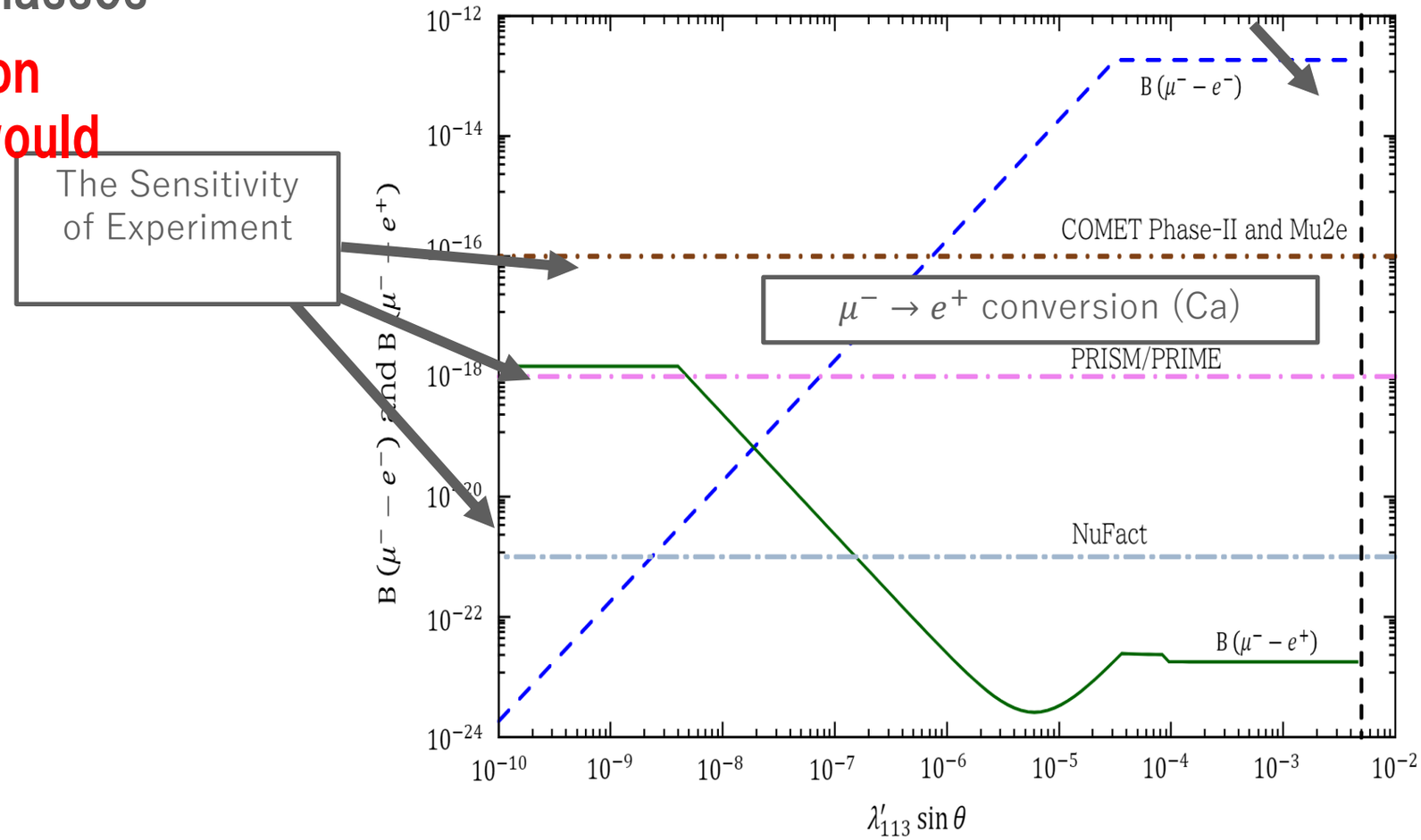
A trial on how large Branching ratio for $\mu^- \to e^-$ in muonic atoms we can derive → 10^-18 order

J. S, K.Sugawara, Y. Uesaka, M. Yamanaka, PLB 836, 2023, 137617

Source fpr the process is not necessarily Majorana neutrino masses

By separating Partilce # Violation and lepton flavor violation we would see large LNV processes

As Looson the strong suppresion by Majorana mass

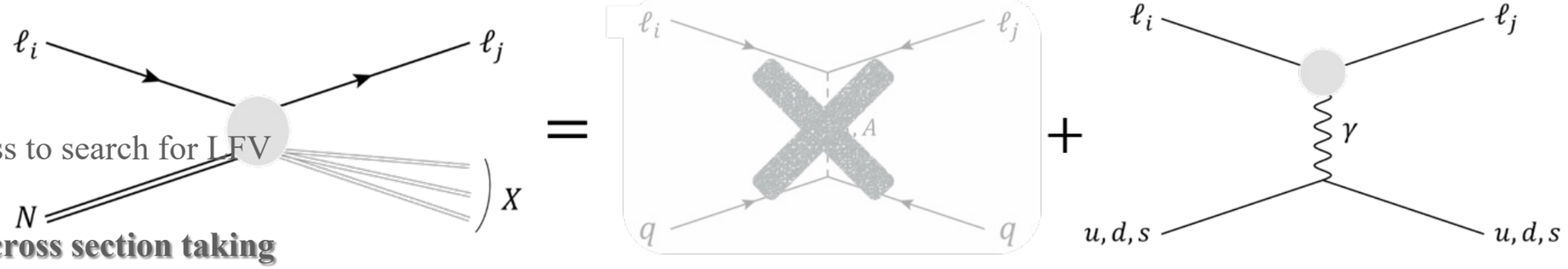


Leptoqurak modeL !!

$$\mathcal{L}_{\mu^- \to e^+} = -\lambda'_{113}\,\overline{(e_L)^c}\,u_L\widetilde{b_R^*} + \lambda'_{231}\widetilde{b_L}\,\overline{d_R}\nu_\mu - \lambda'_{213}\overline{(\mu_L)^c}u_L\widetilde{b_R^*} + \lambda'_{131}\widetilde{b_L}\,\overline{d_R}\nu_e - m_{LR}^2\tilde{b}_L^*\tilde{b}_R + \text{h. c.}$$

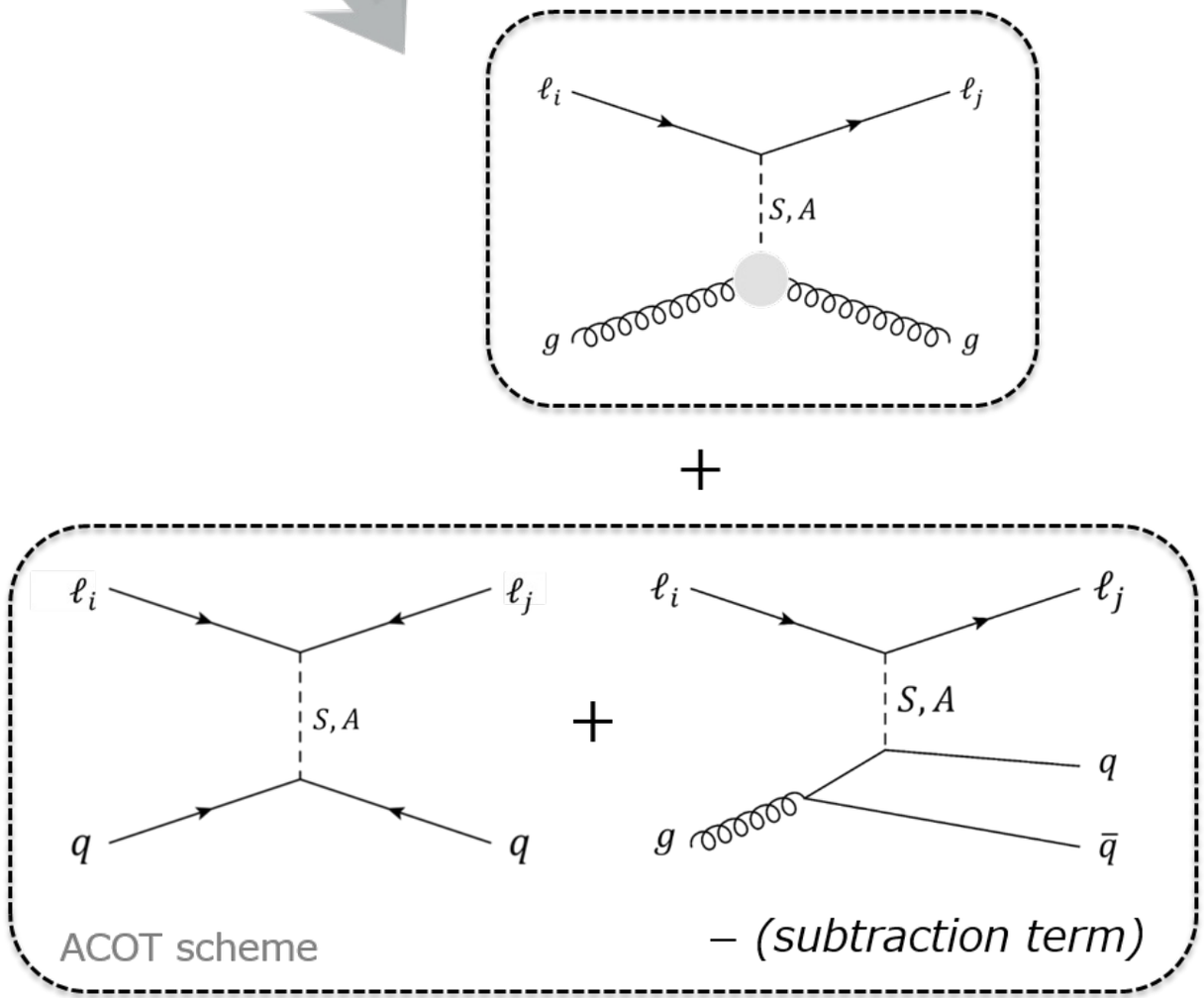
Charged lepton flavor violation associated with heavy quark production in deep inelastic lepton-nucleon scattering via scalar exchange

Y. Kiyo, M. Takeuchi, Y. Uesaka, M. Yamanaka, JHEP **04**, 044 (2022)



- LFV-DIS: Promising process to search for LFV
- **Formulation of LFV-DIS cross section taking into account important ingredients**
  - **(1) gluon contribution $\ell_i g \to \ell_j g$**
  - **(2) quark mass and number conservation (with ACOT scheme)**
- Heavy quark effects (q-number conservation and finite mass) and the gluon contribution could change the cross section by an order
- Distinctive momentum distributions in each subprocess enable to identify the LFV operator, and determine relevant parameters

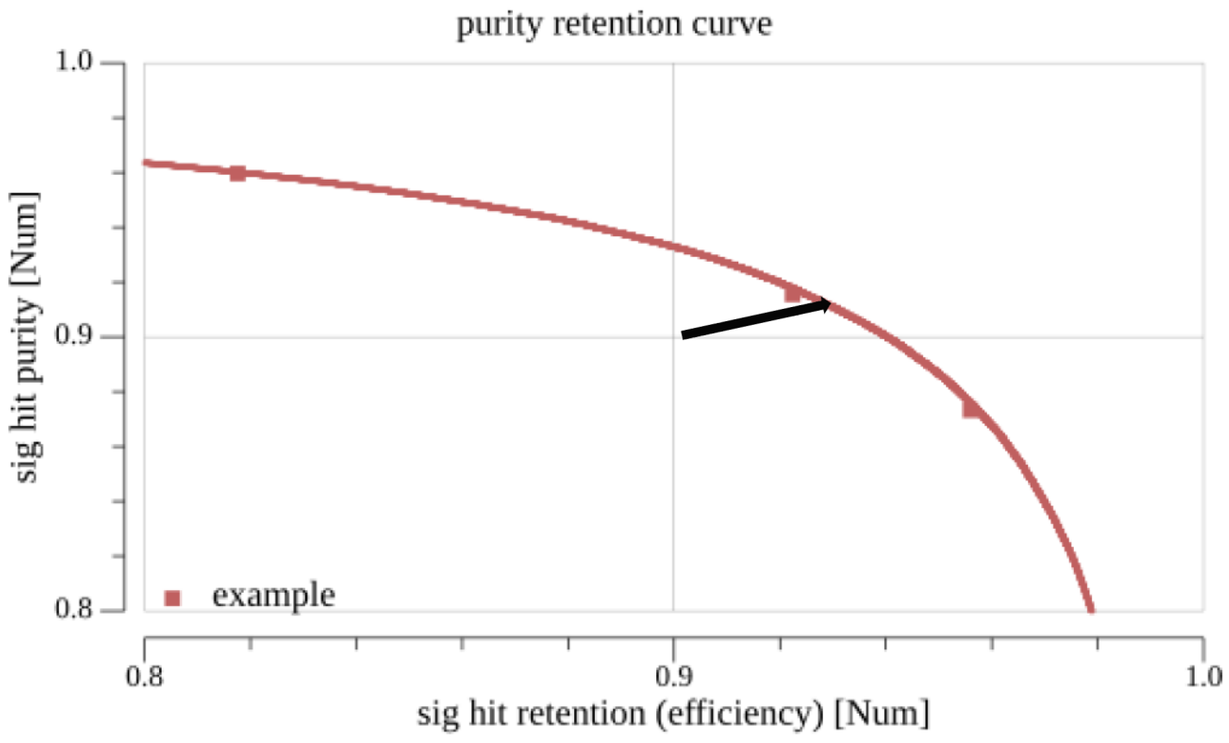
Improved handling



Communiacation

オーベルニュ netkeba.com

In January, we （SATO, Ikuya and SATO Joe） visited Auvergnu.
Discuttion with Ana Teixeiraand also Carloganu
　on COMET and its related topics
Ikuya gave a seminar on the analysis of （expected） COMET data



better than （0.9,0.9）

Summary

We have several publications though no collaboration.

Work on effective couplings still continues …

We strongly communicated with each other.

We expect a strong collaboration especially in COMET.
We would like to continue the project !

Asymmetric Mediator in Scotogenic Model

K. Asai, Y. Sakai, J. Sato, Y. Takanishi, M. Yamanaka, Physics Letters B **836** 13762 (2023)

Da

Mysteries and ideas for resolving them

Neutrino mass

Baryon asymmetry

Why $\Omega_{\rm DM}/\Omega_B \simeq 5$?

Scotogenic Model

E. Ma , PRD (2006)

Additional fields

- RH neutrinos($iN_{1,2,3}$)
- Inert doublet scalar η
- Singlet scalar σ

Leptogenesis

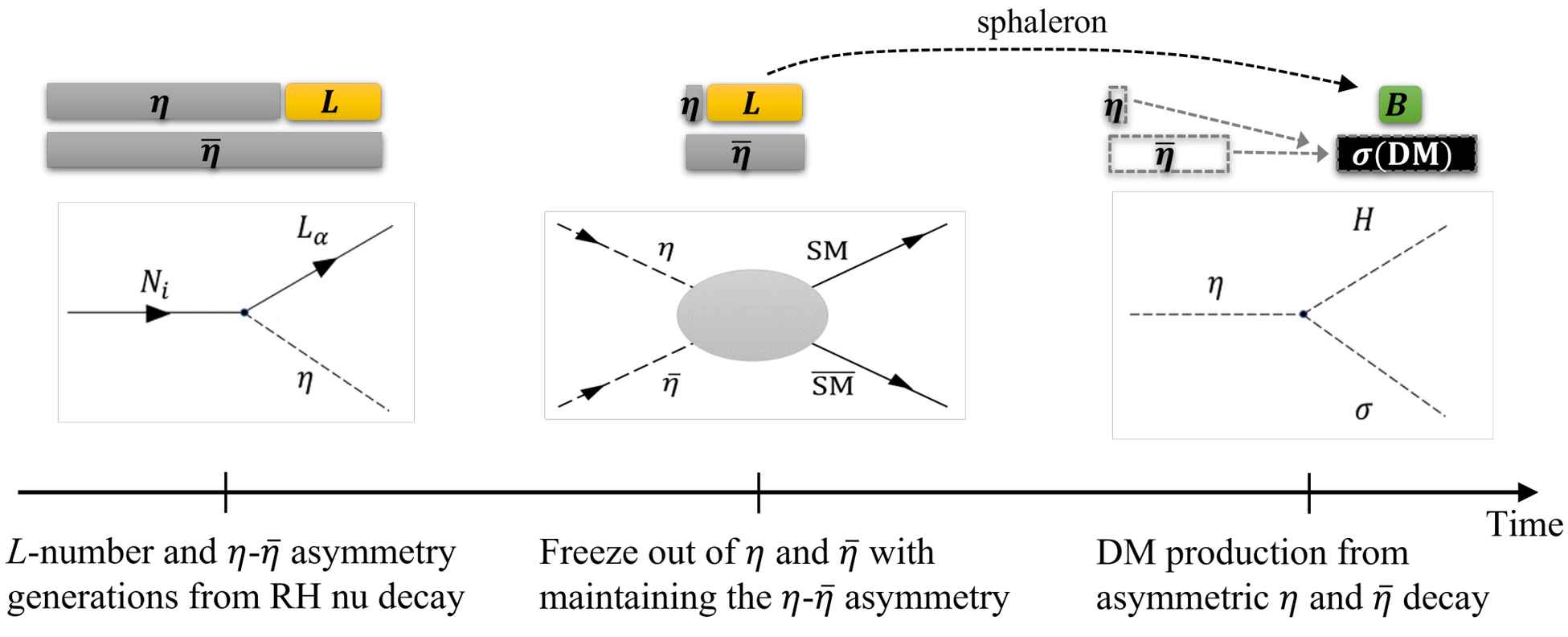
M. Fukugita, T. Yanagida, PLB (1986)

Asymmetric Dark Mater

D. Kaplan, M. Luty, K. Zurek, PRD (2009)

Aim

Unified picture to account for the four mysteries



L-number and η-$\bar{\eta}$ asymmetry generations from RH nu decay

Freeze out of η and $\bar{\eta}$ with maintaining the η-$\bar{\eta}$ asymmetry

DM production from asymmetric η and $\bar{\eta}$ decay