

# Flavour violation in ``minimal'' SUSY SU(5) models

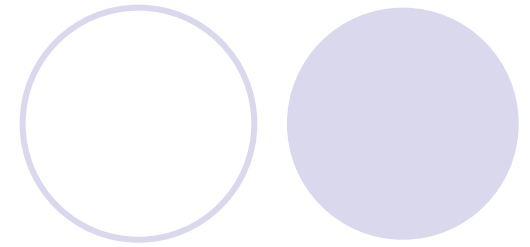
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In preparation.

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S. Mishima (IAS, Princeton)

# “minimal” SUSY SU(5)



- “minimal” SUSY SU(5)

$5_H, \bar{5}_H, 24_H,$   $10_i, \bar{5}_i, 1_{i'}$  mass

$$W_H = M_5 \bar{5}_H 5_H + \lambda_5 \bar{5}_H 24_H 5_H + M_{24} 24_H^2 + \lambda_{24} 24_H^3$$

$$W_M = Y_{10} 10_i 10_j 5_H + Y_5 \bar{5}_i 10_j \bar{5}_H + \dots$$

+ possible non-renormalizable terms

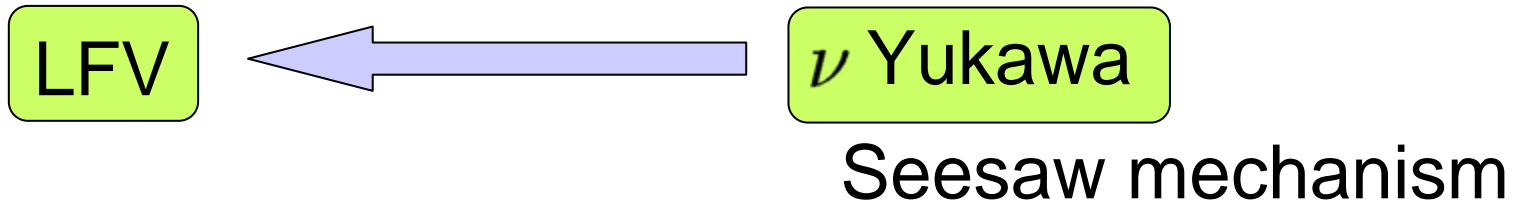
~~SU(5)~~ & ~~SM~~ breaking part is unchanged.

# Plan

- Introduction
- Seesaw Mechanism
- Analysis
- Summary

# Introduction

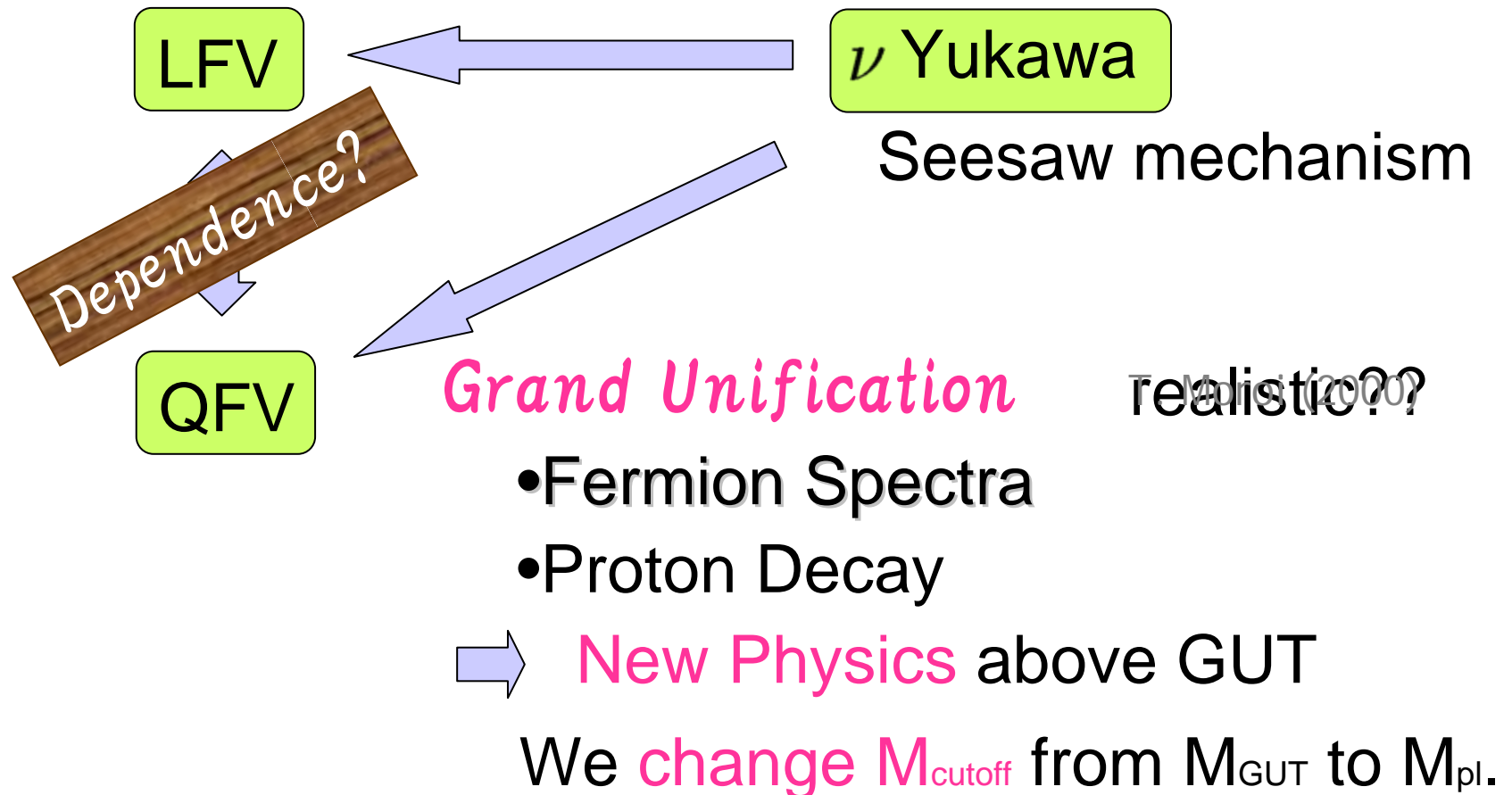
- LFV vs. QFV in SUSY-GUTs



F. Borzumati &  
A. Masiero (1986)

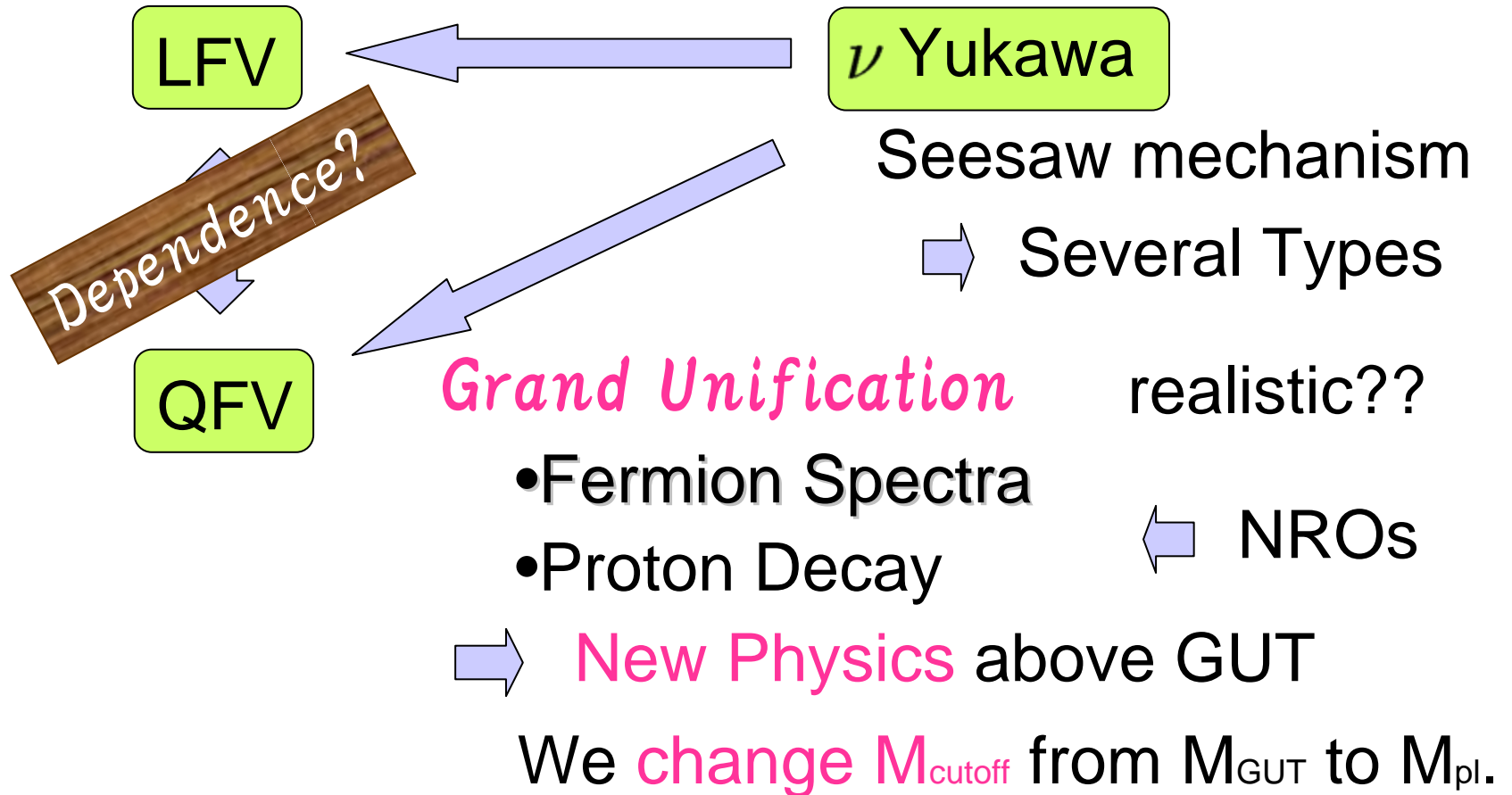
# Introduction

## • LFV vs. QFV in SUSY-GUTs



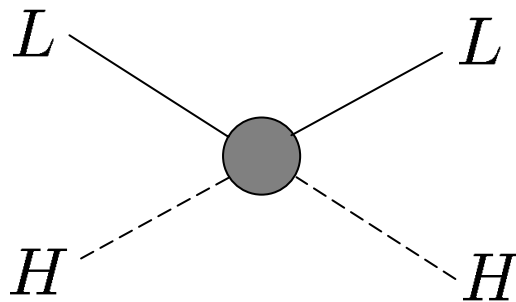
# Introduction

- LFV vs. QFV in SUSY-GUTs

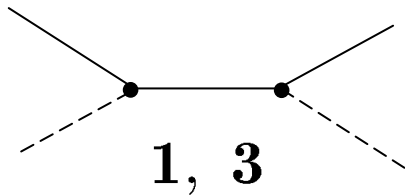


# Seesaw Mechanism

- Possible Types of Seesaw mechanism



— : Fermion / R-parity odd  
 - - - : Scalar / R-parity even

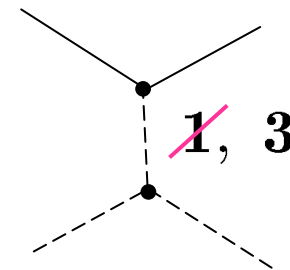


Type I

Type III

$$Y_{ij}^I \bar{5}_i \cdot 1_j \cdot 5_H$$

$$Y_{ij}^{III} \bar{5}_i \cdot 24_j \cdot 5_H$$



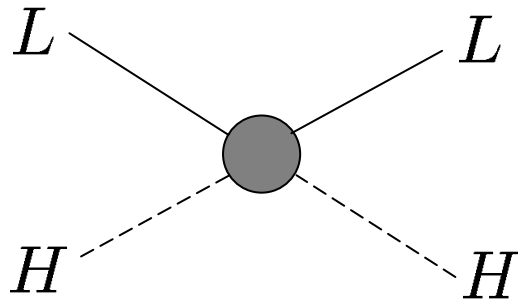
Type II

$$Y_{ij}^{II} \bar{5}_i \cdot \bar{5}_j \cdot 15_H$$

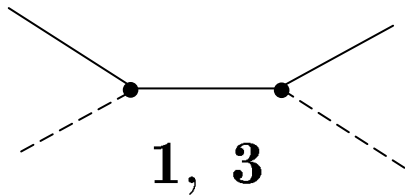
$$\lambda_U 5_H \cdot 5_H \cdot \bar{15}_H$$

# Seesaw Mechanism

- Possible Types of Seesaw mechanism



$$2 \times 2 = 1_A + 3_S$$

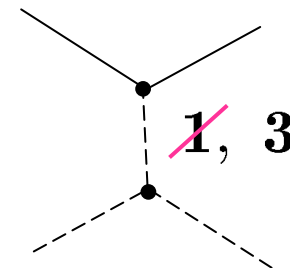


1, 3

Type I      Type III

$$m_\nu = Y_\nu M_N^{-1} Y_\nu^T v_u^2$$

$$Y_\nu = U_{\text{MNS}}^* \sqrt{\hat{m}_\nu} R \sqrt{\hat{M}_N}$$



~~1~~, 3

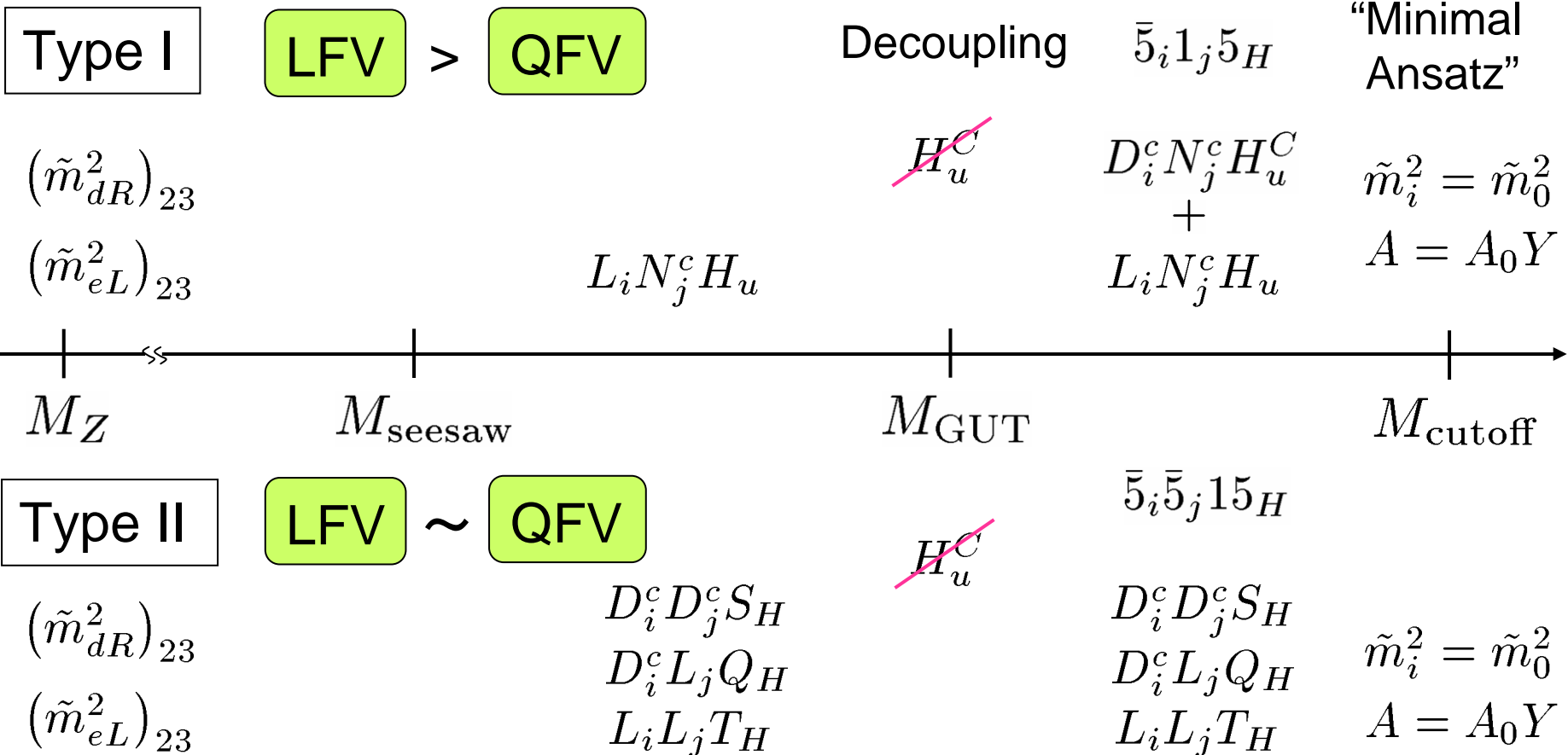
Type II

$$m_\nu = Y_\nu \lambda_U v_u^2 / M_T$$



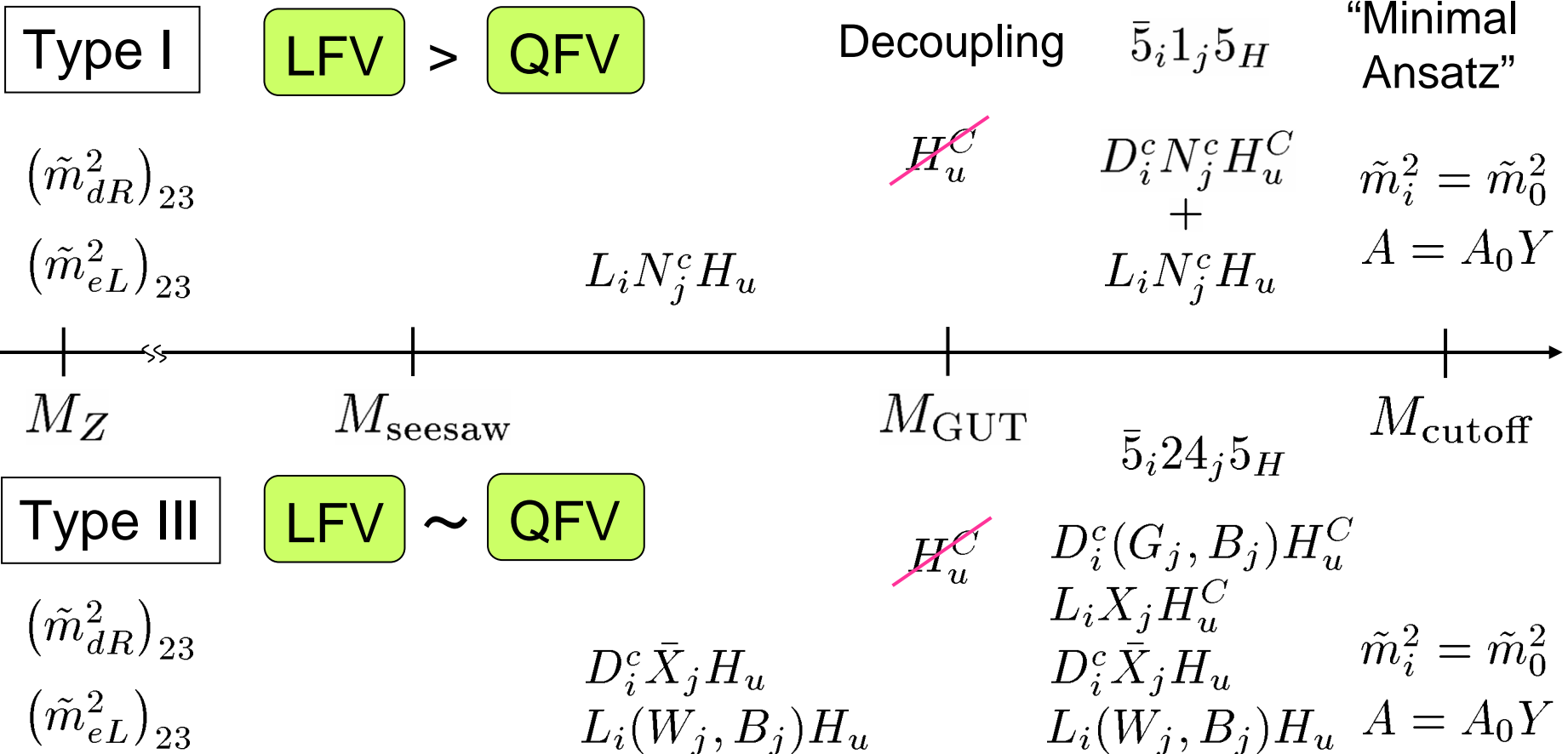
# Seesaw Mechanism

## Type I vs. Type II Seesaw



# Seesaw Mechanism

## Type I vs. Type III Seesaw



# Analysis

## Parameters & Benchmark values

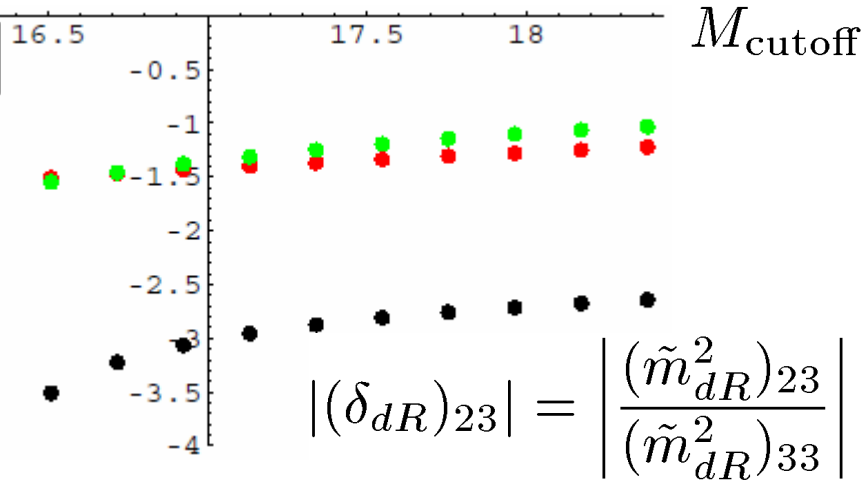
- We change  $M_{\text{cutoff}}$ .
- GUT parameters :  $M_{\text{GUT}} = M_{\text{C}} = 2 \times 10^{16} \text{ GeV}$   
 $\lambda_{24_H} = 1/2$
- Seesaw parameters :  $M_{\text{seesaw}} = 10^{14} \text{ GeV}$   
Type I, III :  $\hat{M}_N = M_R \mathbf{1}, \quad \mathbf{R} = \mathbf{1}$   
Type II :  $\lambda_U = 1/2$
- Low energy parameters :  $\tan \beta = 10$   
 $m_\nu : \text{NH}, \quad \sin \theta_{13} = 0, \quad \theta_{\text{Maj}} = 0$
- ~~SUSY~~ parameters :  $\tilde{m}_0 = A_0 = M_{1/2} = 1 \text{ TeV}$

# Analysis

Preliminary.

● Results :  $M_{\text{seesaw}} = 10^{14}$  GeV

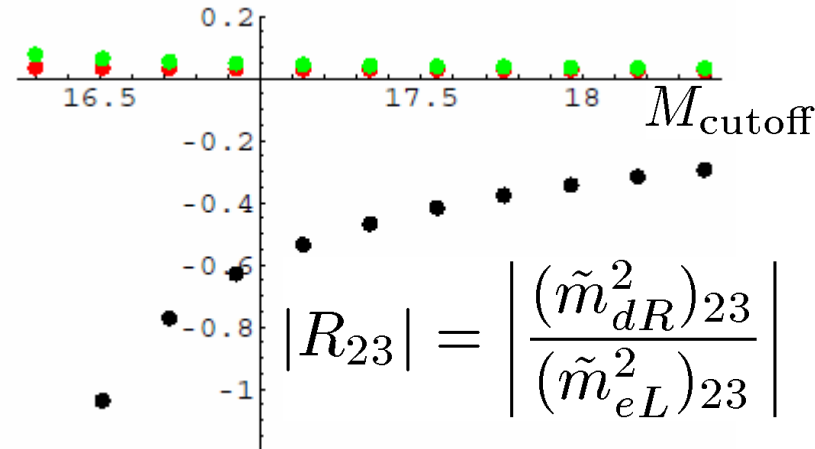
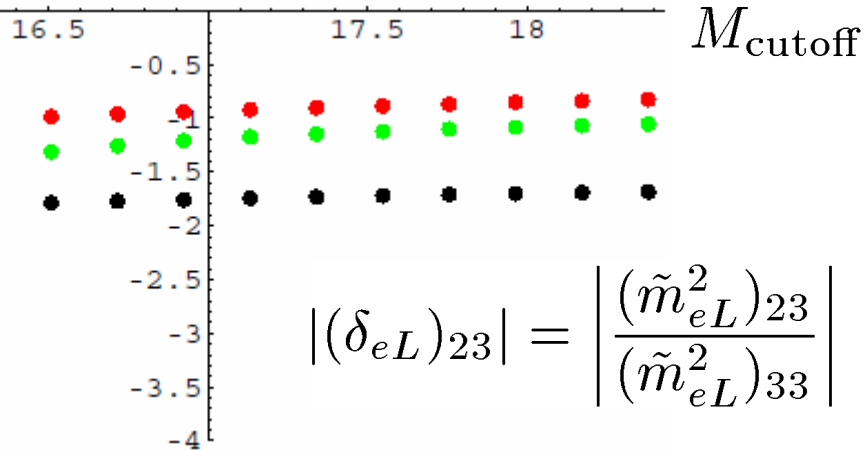
QFV



- : Type I
- : Type II
- : Type III

QFV/LFV

LFV



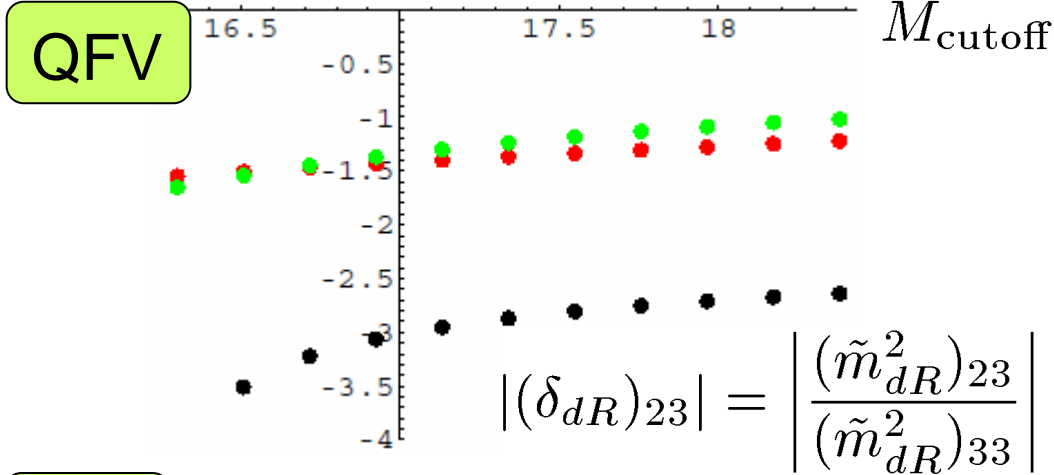
# Analysis

Preliminary.

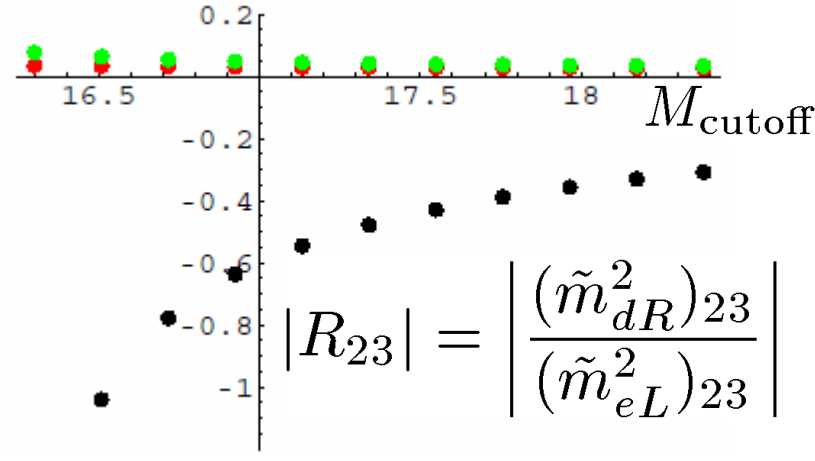
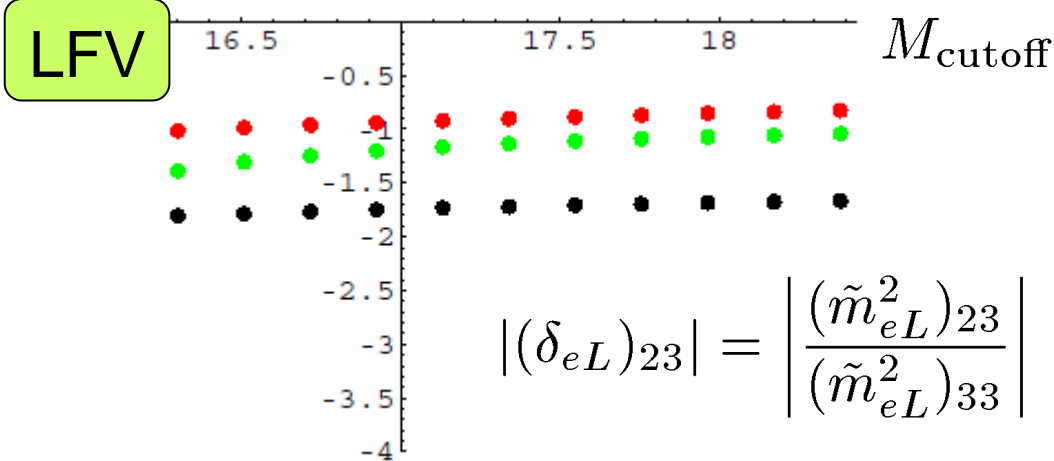
● Results :  $M_{\text{seesaw}} = 10^{14} \text{ GeV}$

$\lambda_{24_H} = 0.01$

- : Type I
- : Type II
- : Type III



**QFV/LFV**

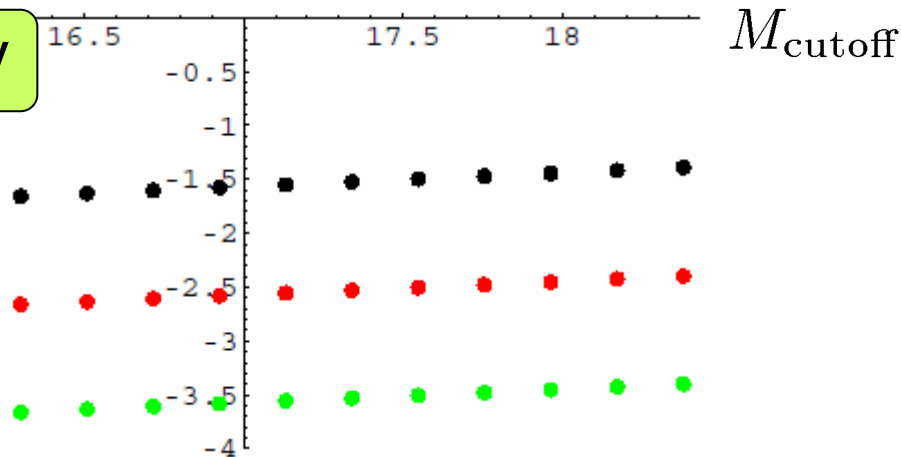


# Analysis

Preliminary.

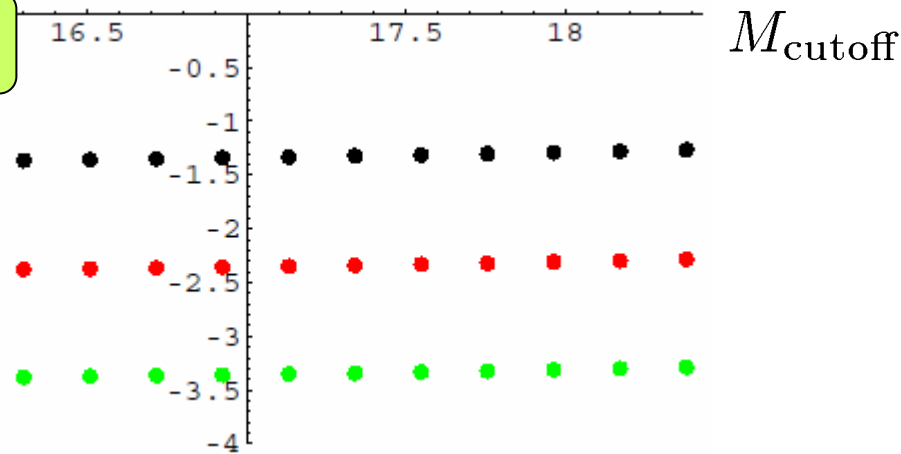
● Results :  $M_{\text{seesaw}} = 10^{12}$  GeV (Type II)

QFV

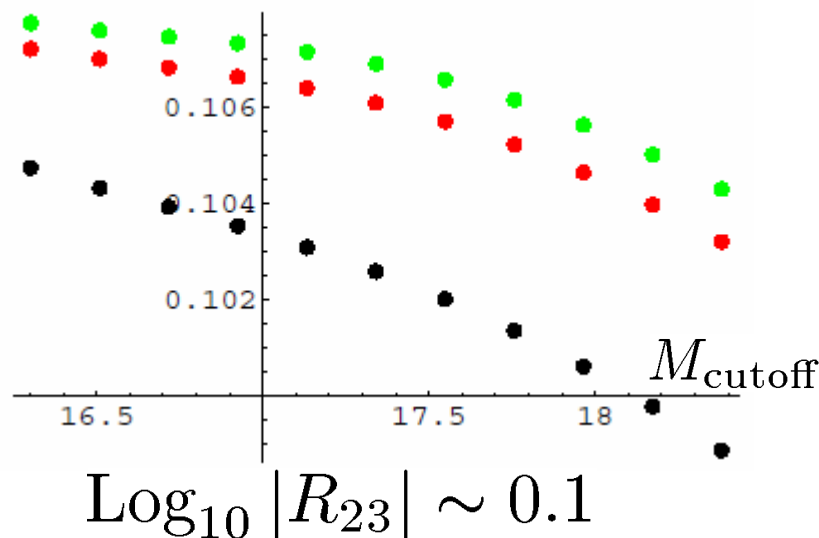


- :  $Y_\nu^2 \sim 0.5 \times 10^{-1}$
- :  $Y_\nu^2 \sim 0.5 \times 10^{-2}$
- :  $Y_\nu^2 \sim 0.5 \times 10^{-3}$

LFV



QFV/LFV



# Summary



- We investigate LFV & QFV in “minimal” SU(5) models with Type I /II/III seesaw.
  - Cutoff dependence:
    - Type I : sensitive
    - Type II, III : QFV/LFV is insensitive
  - $\lambda_{24_H}$  dependence : quite small
- Future works
  - More exhaustive scan.
  - Phenomenological constraints
  - More natural model : MP, SO(10)...