



The minimal U(1) two-Higgs doublet (2HDM) models for quark and lepton flavour

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Msc Programme: Flavour symmetries and the strong CP problem

Supervisors:

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2022: BSc in Engineering Physics

PIC1 Project:

The power of symmetry in fundamental physics



Report(LEFT)

Supervisor:

Filipe Joaquim

2024: MSc in Engineering Physics

PIC2 Project:

Minimal U(1) 2HDM for quark and lepton flavour



Video (MEFT)

Supervisors:

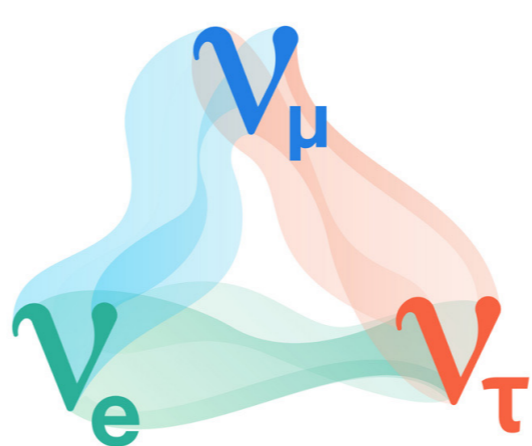
Filipe Joaquim
Henrique Câmara

The problems

Neutrino Oscillations

Three generations of neutrinos oscillate among themselves;

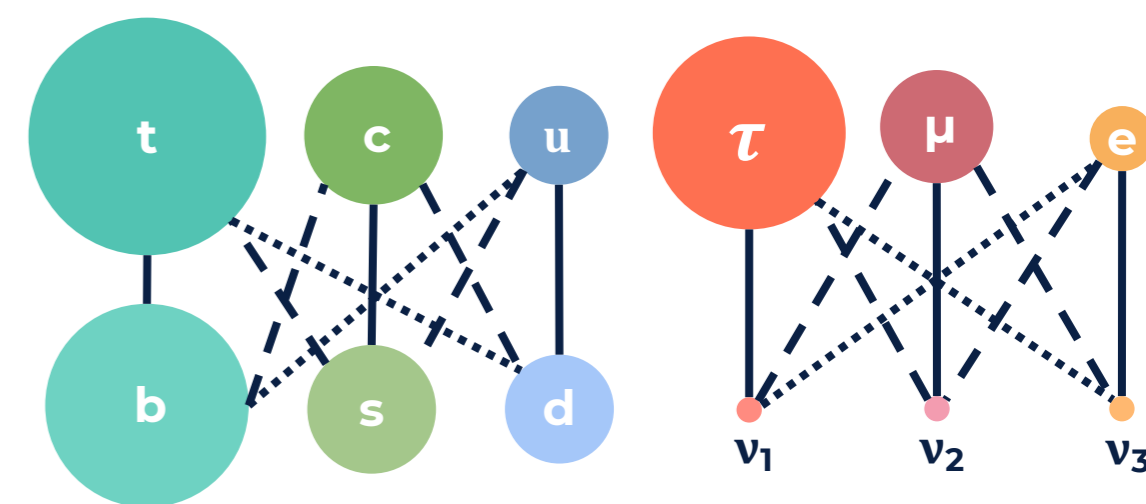
So, they are **massive particles**, contrarily to what is predicted by the Standard Model (SM).



Flavour Puzzle

The SM **does not explain** the specific values for the observed **fermion masses**;

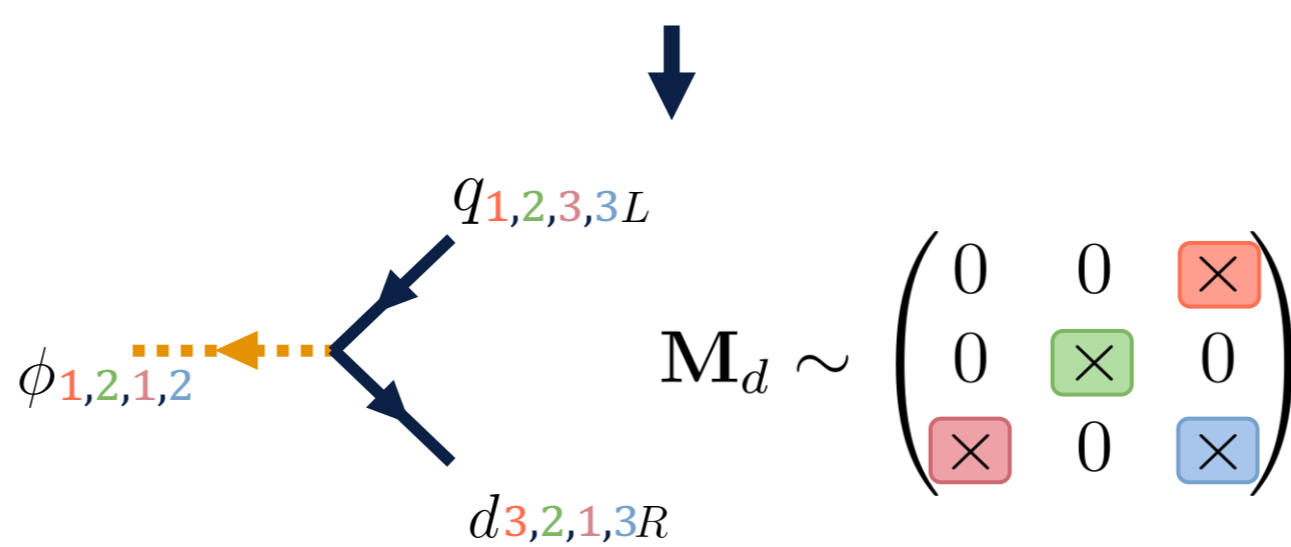
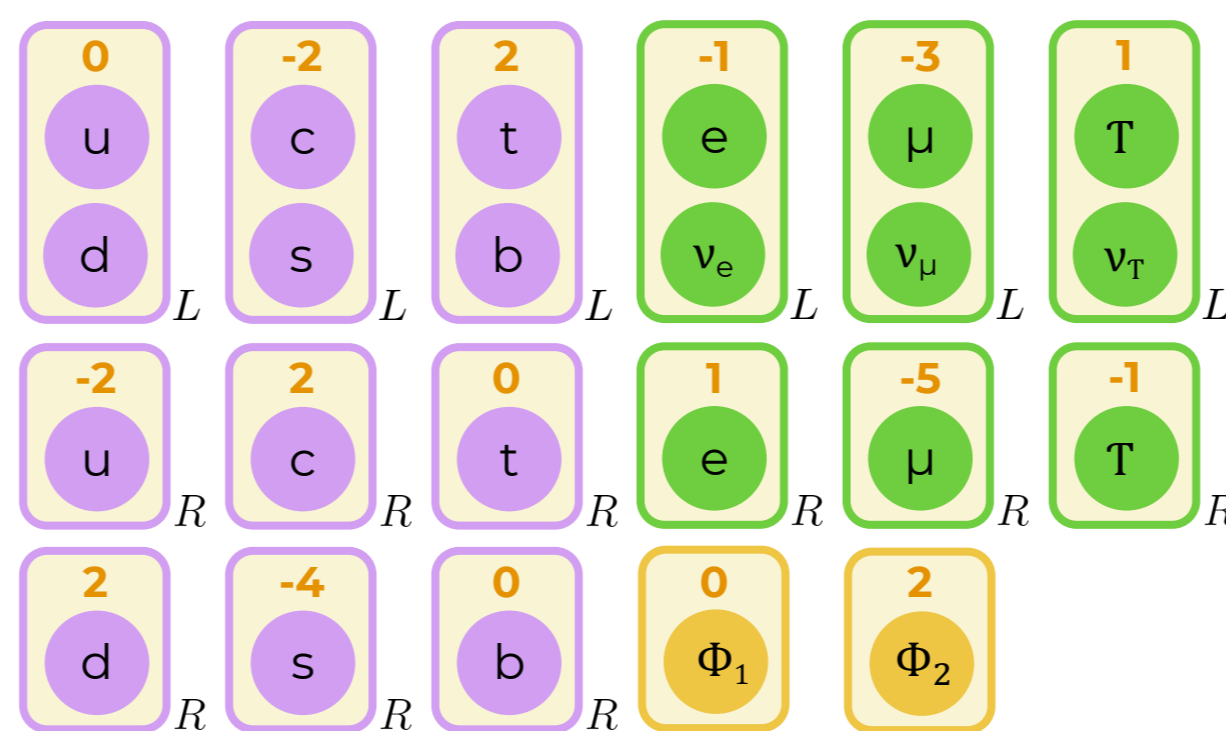
We also don't know why fermions mix the way they do.



The solution

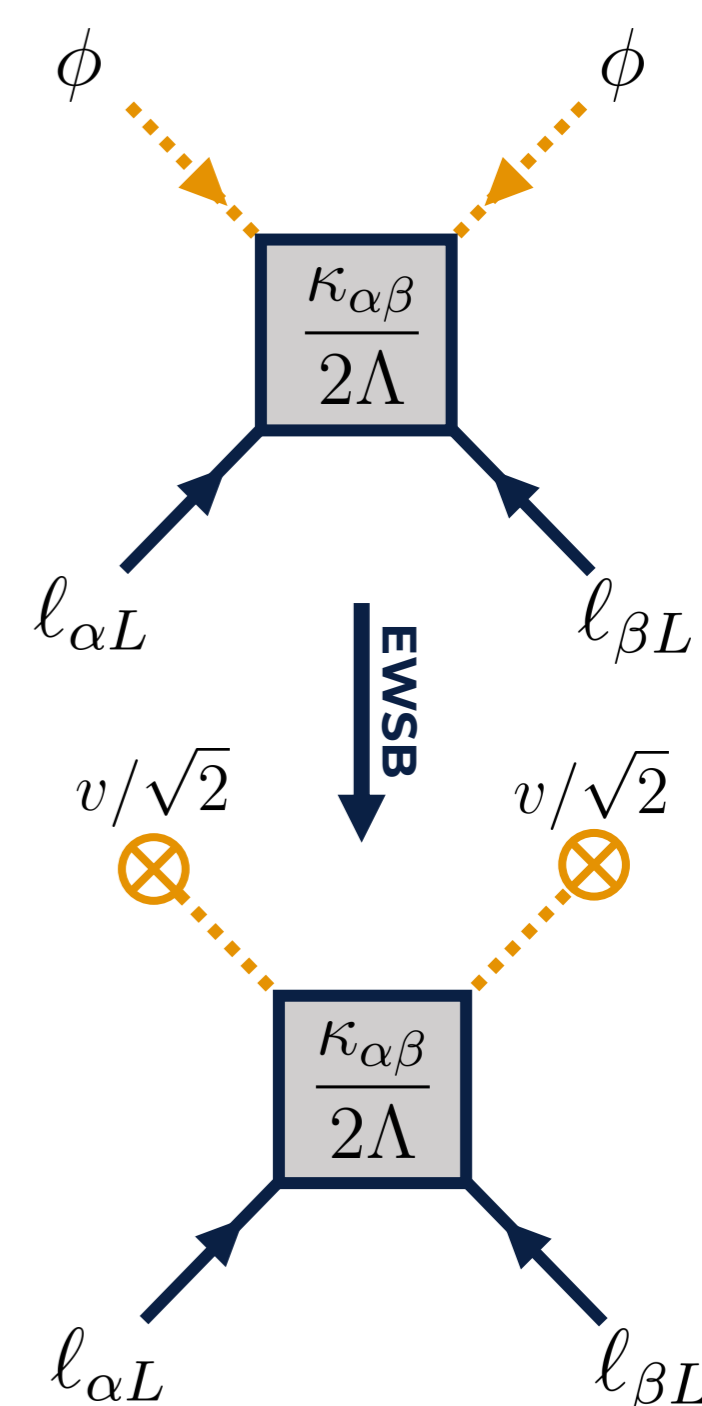
Flavour Charges

Assign **flavour charges** to reduce the number of free parameters and make the theory more predictive.



Weinberg Operator

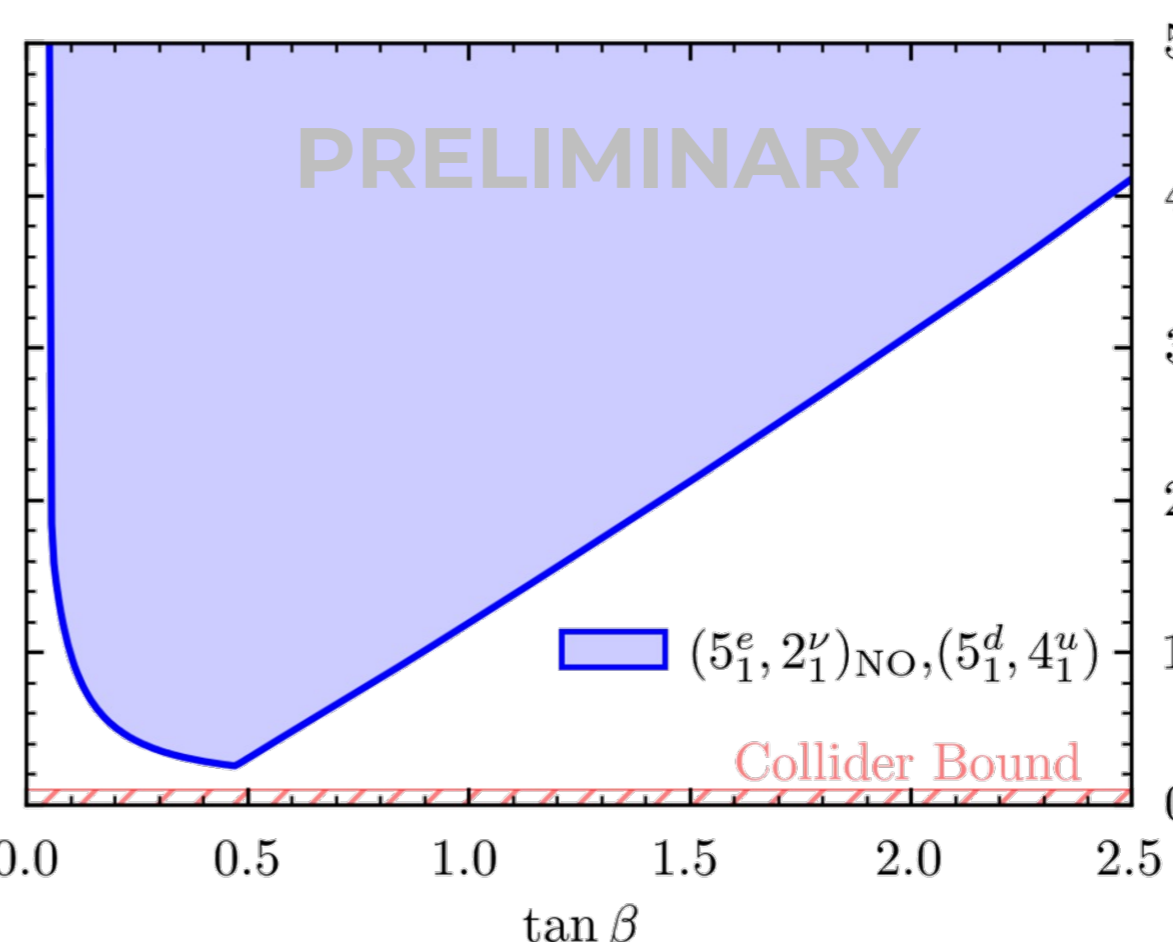
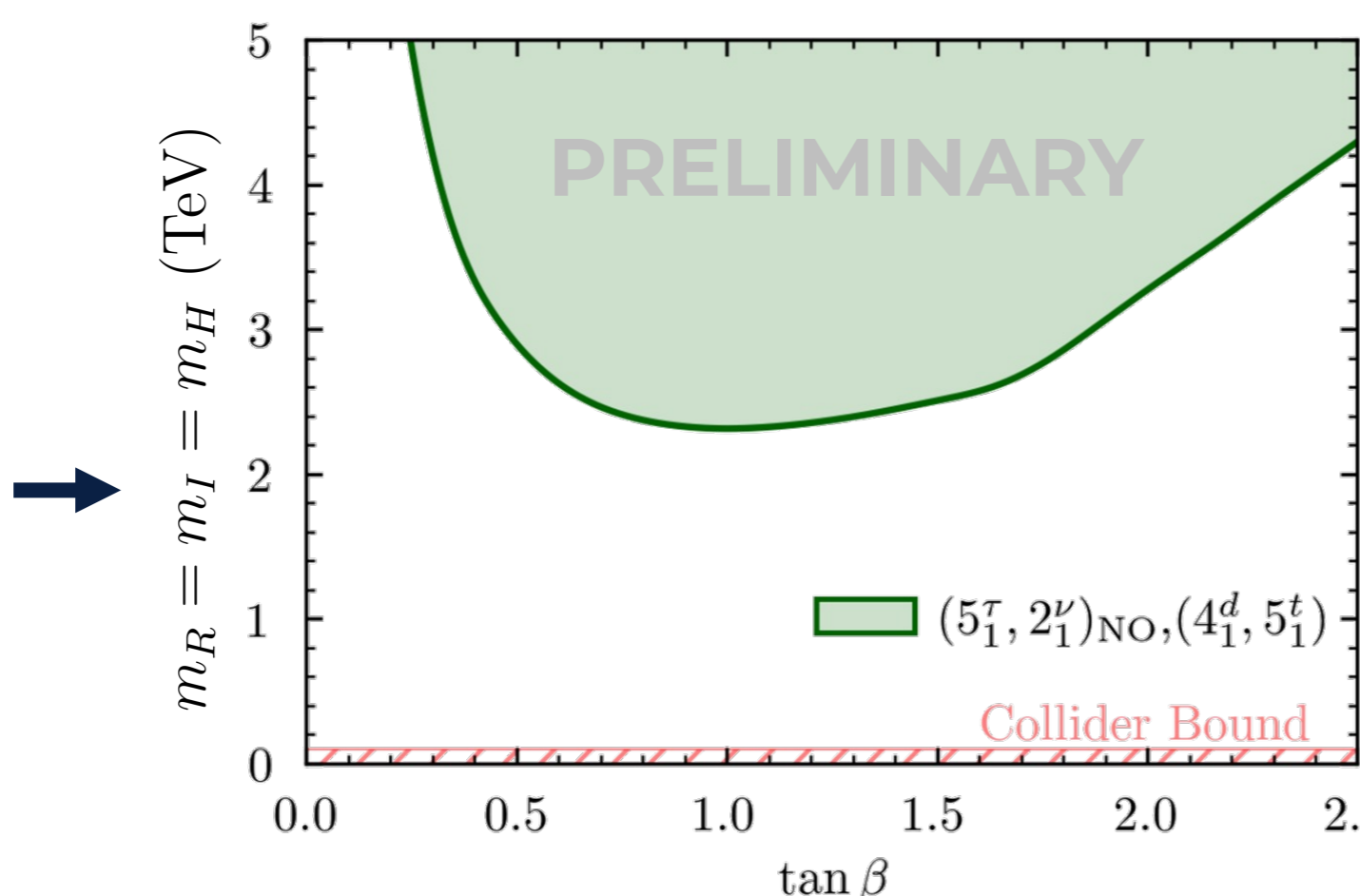
After EWSB neutrinos gain a **Majorana mass term**.



The results

Procedure

- Random values for $\tan \beta$, m_I , m_H , m_{H^\pm}
- ↓
- Theoretical constraints
- ↓
- Precision observables
- ↓
- Lepton and quark sector constraints



Different flavour charge combinations may automatically satisfy strict constraints