Origin of Neutrino Mass — Theory and Phenomenology (NU-ORIGIN)

Outline:

- Past research activities
- Aim of FELLINI project NU-ORIGIN
- Scope of secondment
- Expectations

C. Hagedorn
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Past research activities

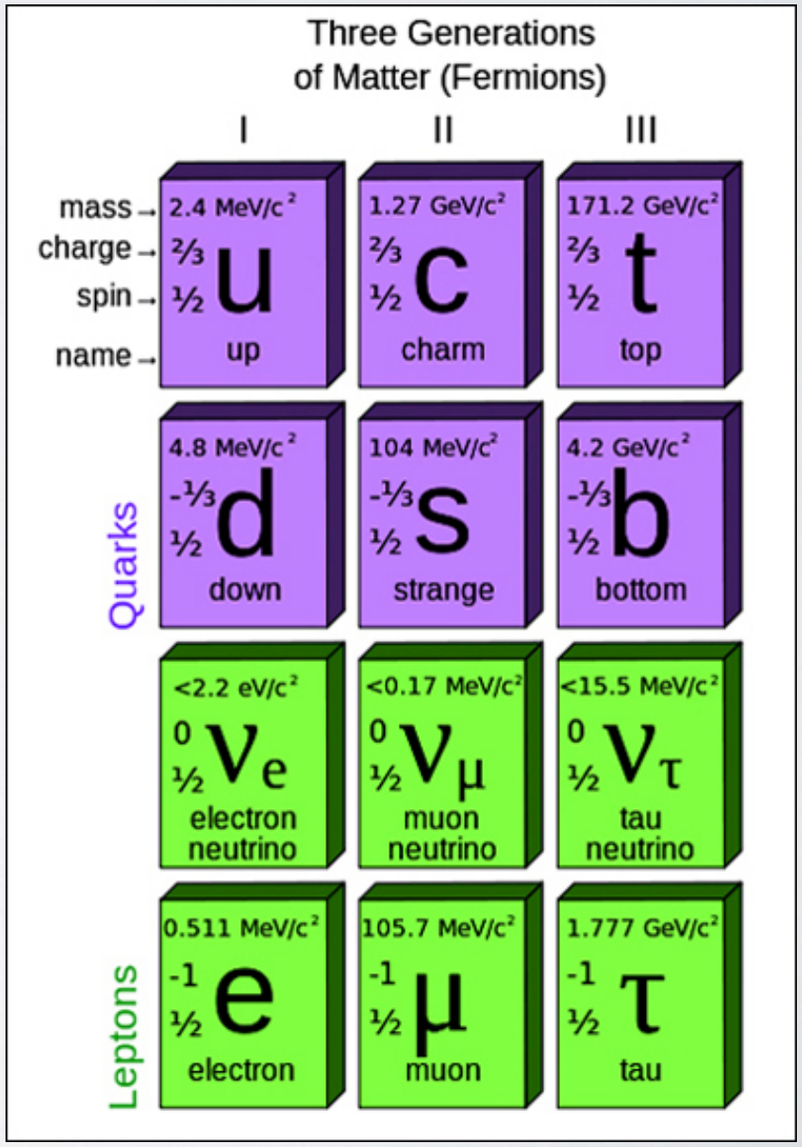
Main interests

- Puzzle of number of generations
- Understanding of fermion masses and mixing
- Model building beyond Standard Model
- Phenomenology of lepton sector
- Leptogenesis mechanisms

Past research activities

Main interests

- Puzzle of number of generations



Past research activities

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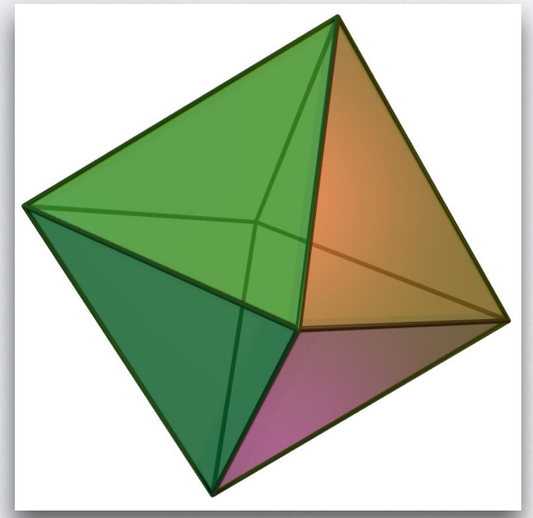
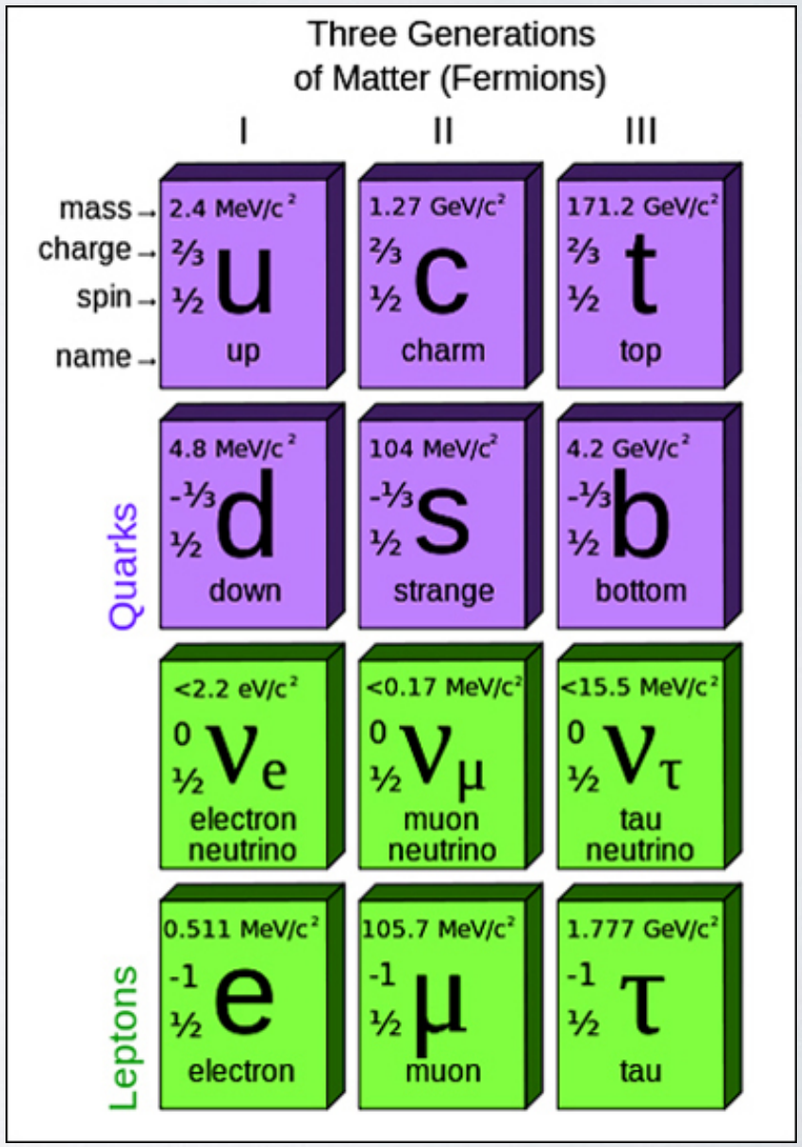
- Puzzle of number of generations

Symmetry as explanation?



$$\begin{pmatrix} L_1 \\ L_2 \\ L_3 \end{pmatrix} \sim \mathbf{3}$$



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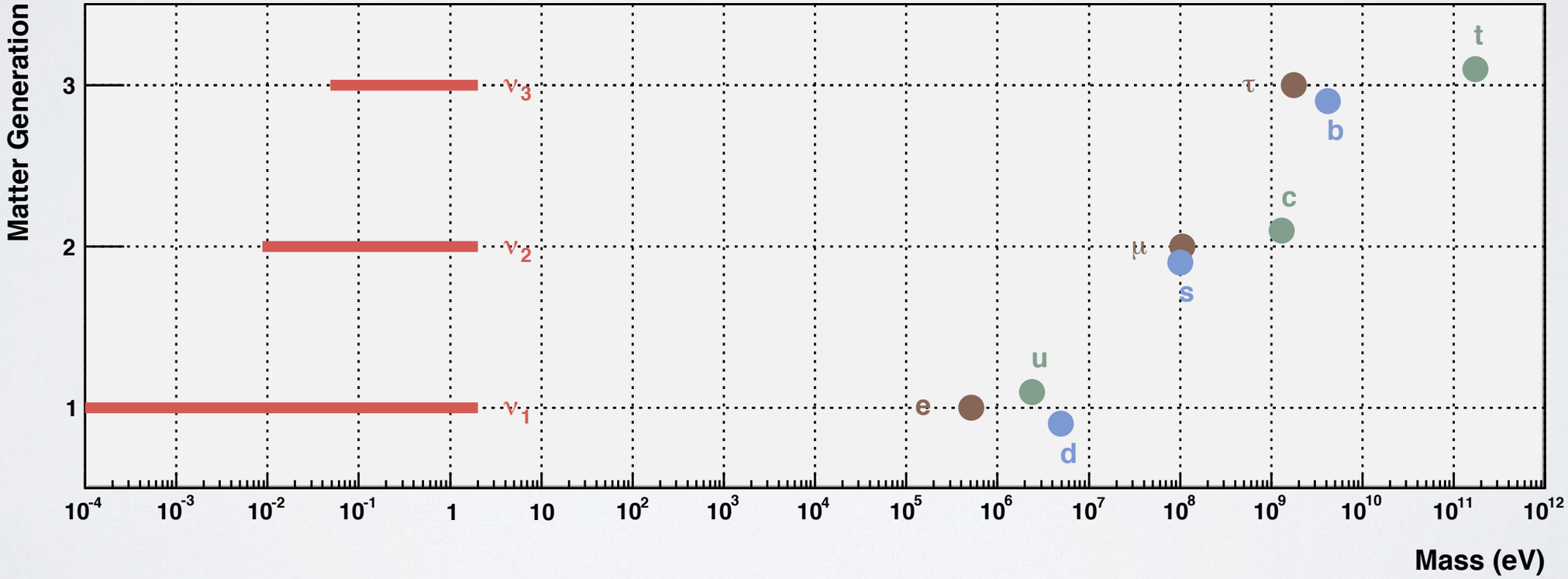

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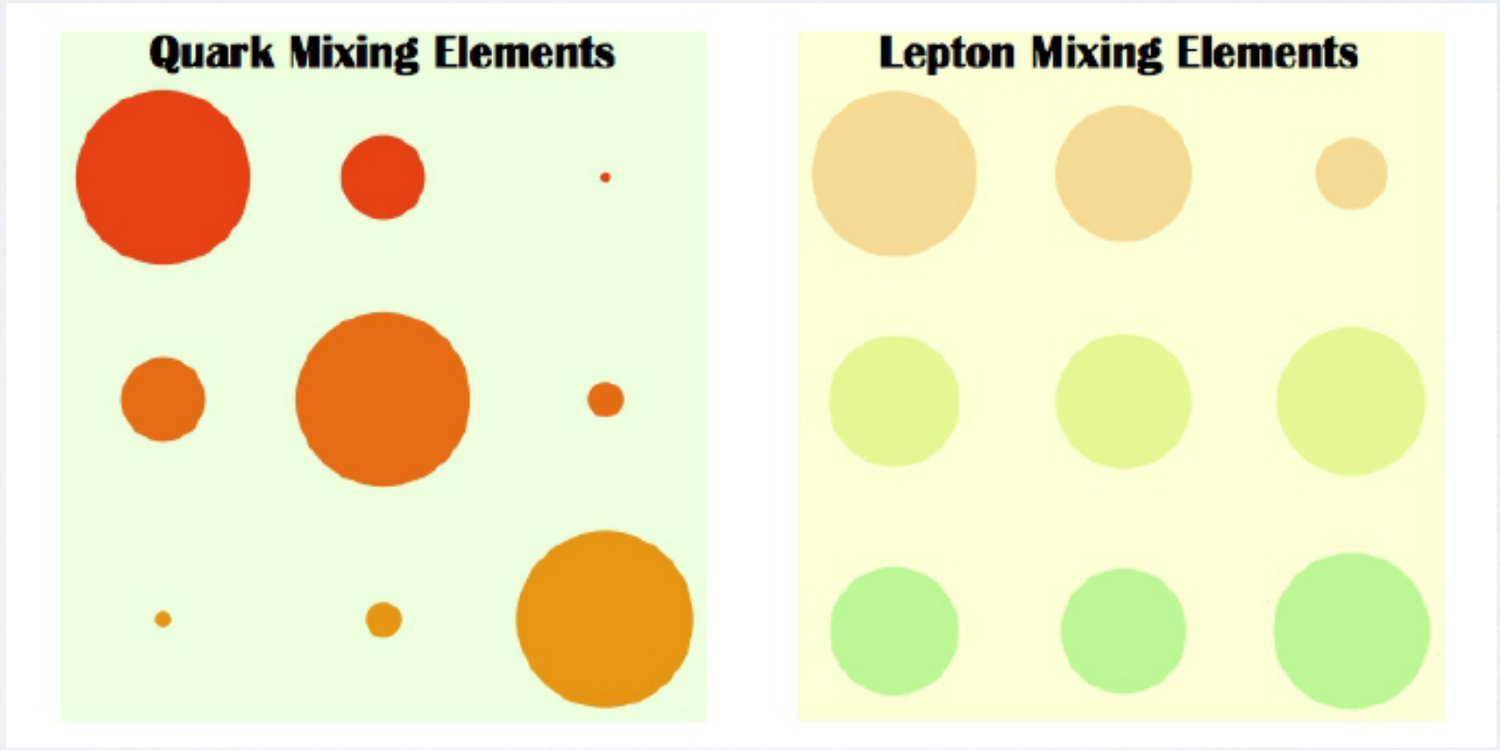

Also these features can be understood with help of symmetries.

Past research activities

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- Model building beyond Standard Model

Many ideas to extend the Standard Model of particle physics

SUSY models

e.g. H/König ('18)

Theories of Grand Unification

e.g. H/King/Luhn ('12)

Models with extra dimension/s

e.g. H/Serone ('11)

etc.

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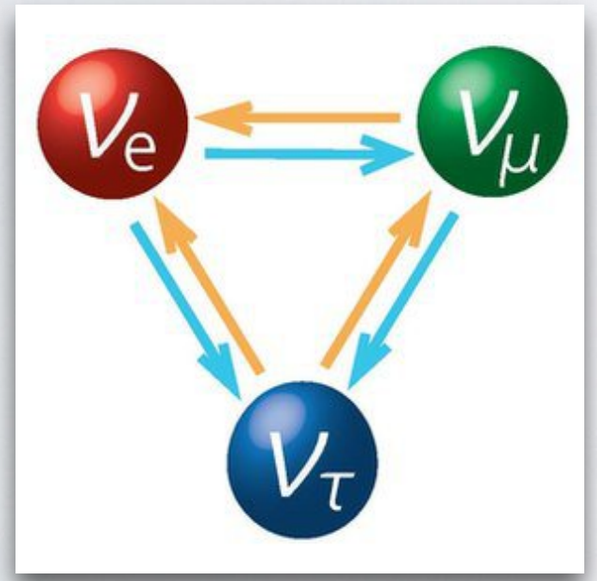

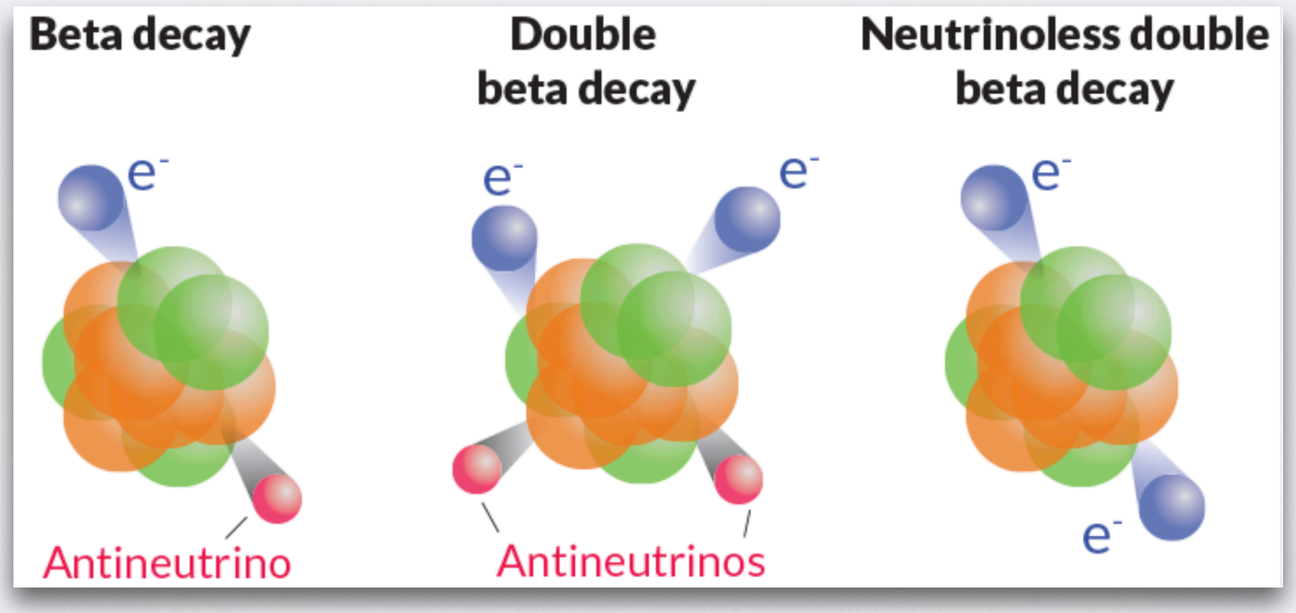

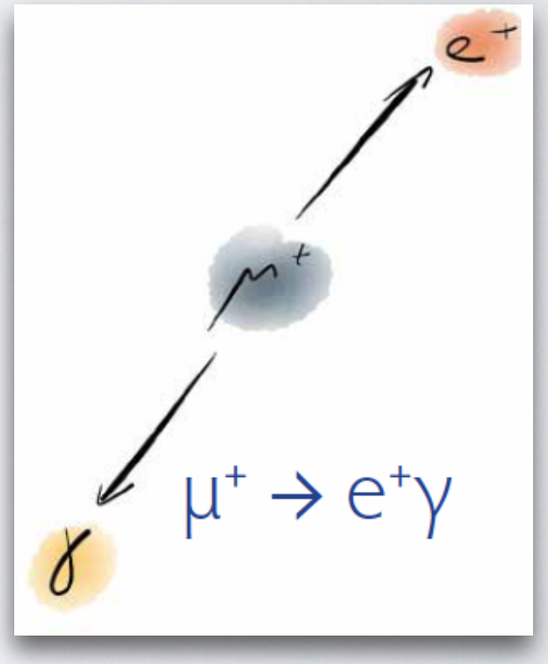

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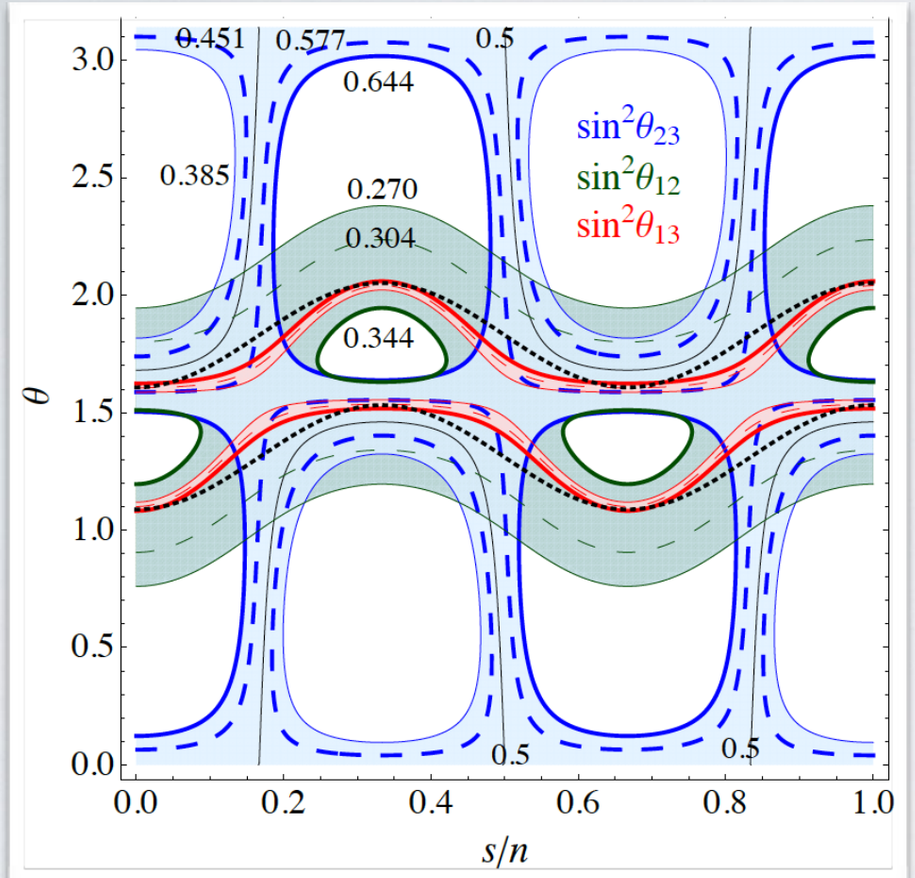
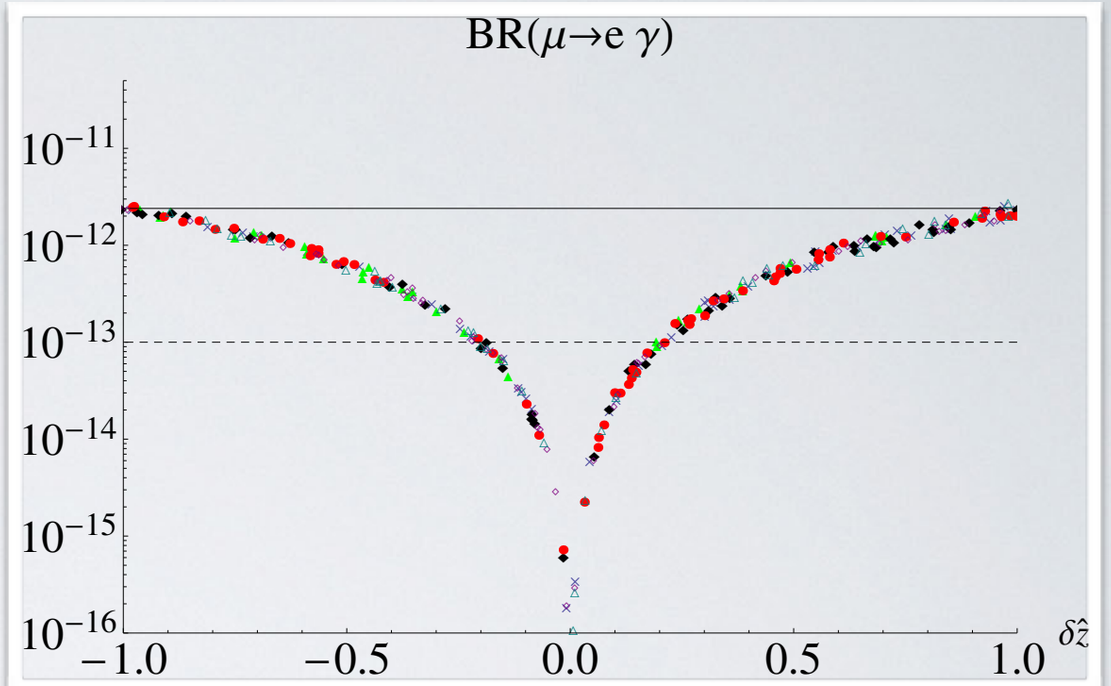
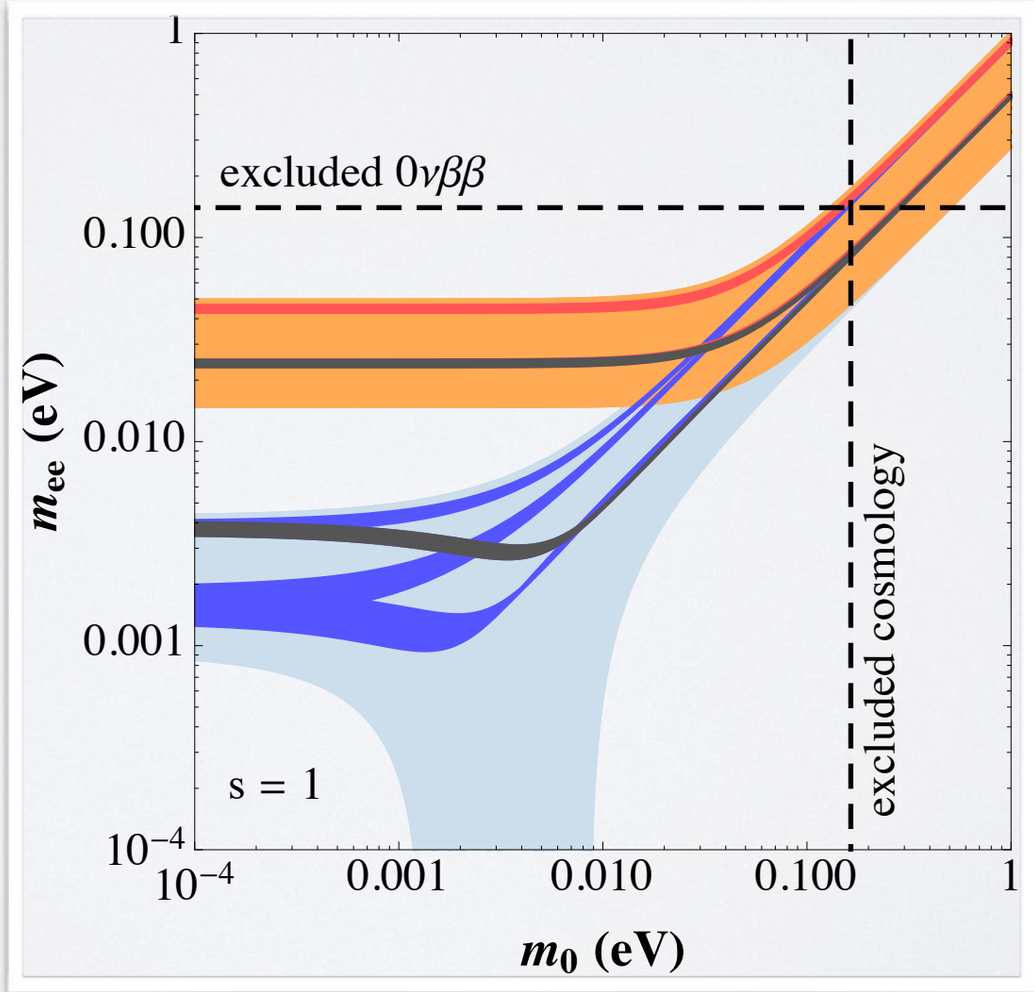


e.g. H/Meroni/Molinaro ('14)





e.g. H/Serone ('11/2)

e.g. H/Molinaro ('16)

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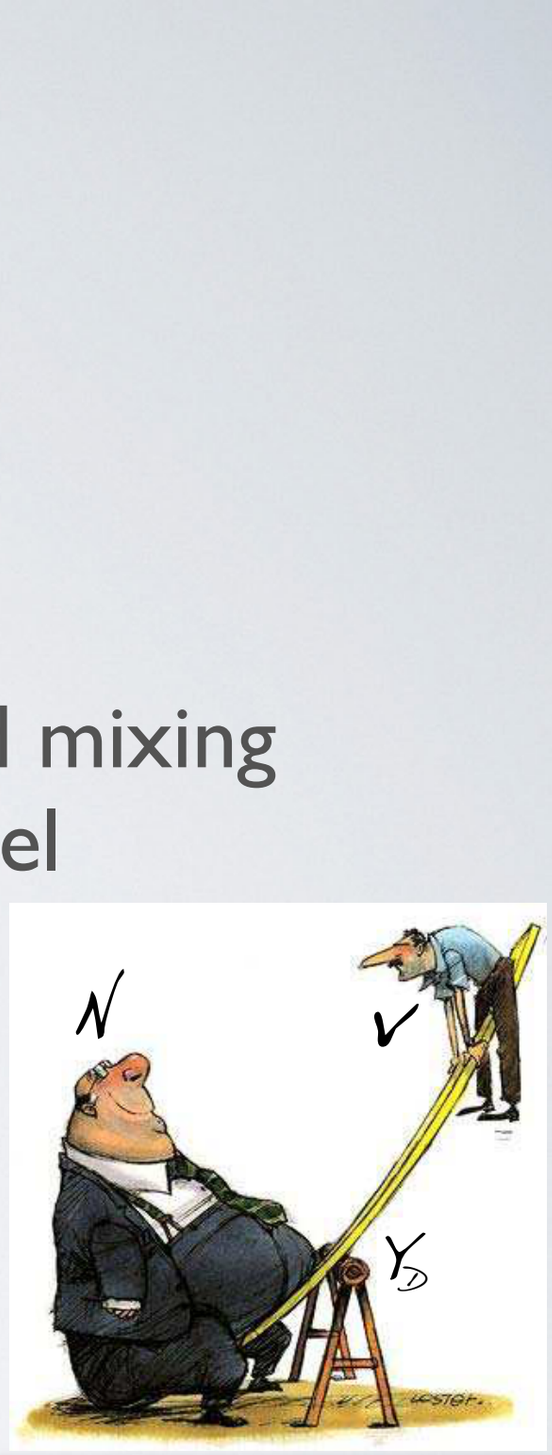
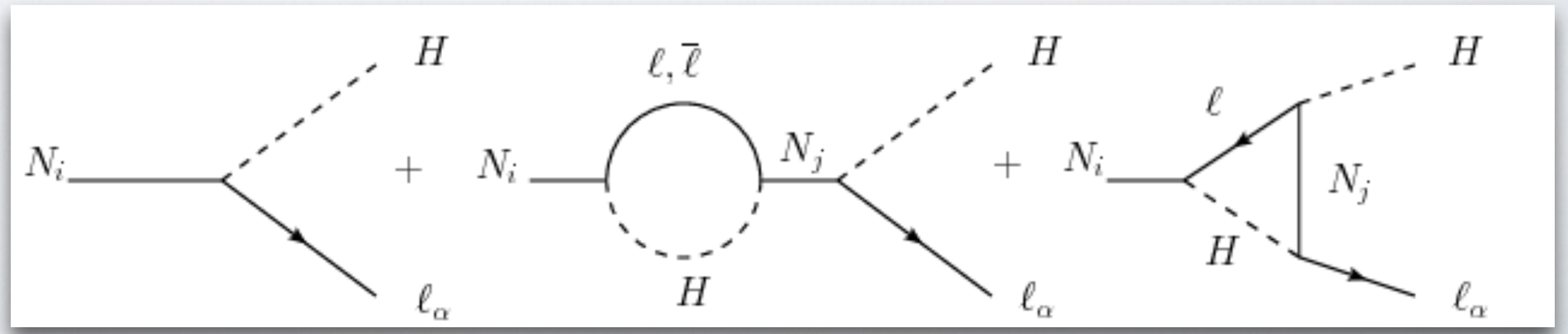
- Leptogenesis mechanisms



Leptogenesis explains matter-antimatter asymmetry of our Universe through a lepton asymmetry.



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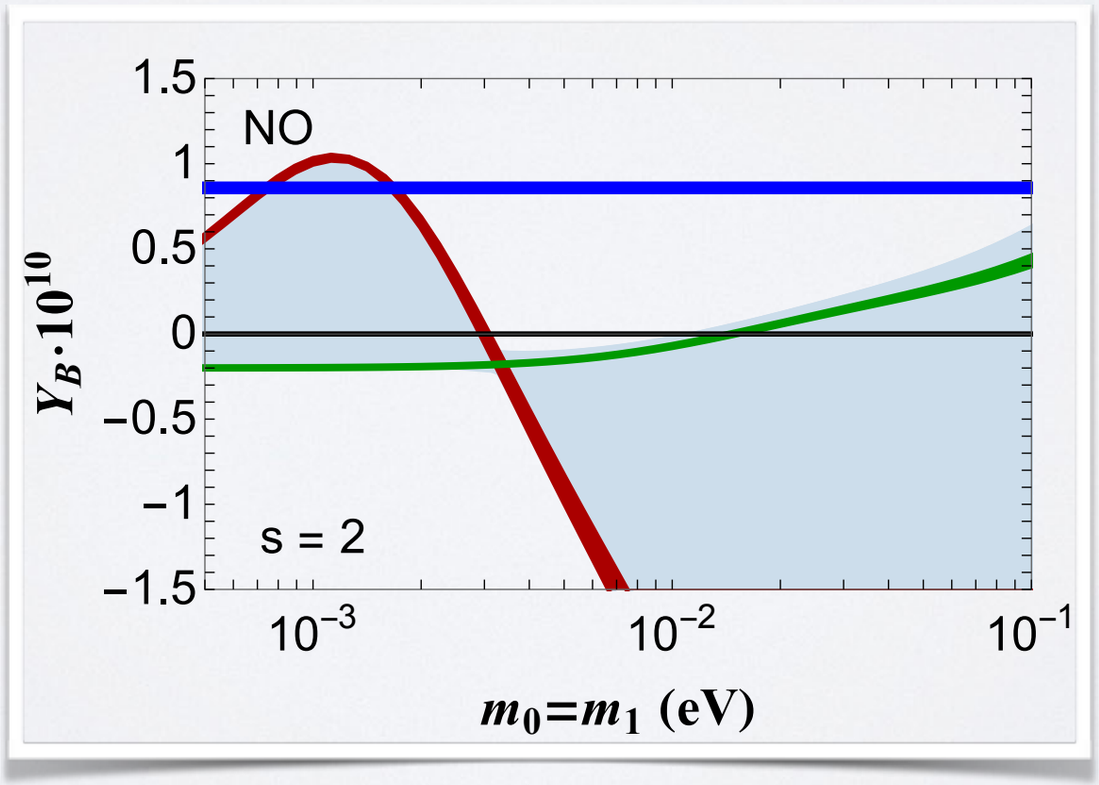
Connection of Y_B to lightest neutrino mass m_0



e.g. H/Molinaro ('16)

Aim of FELLINI project NU-ORIGIN

Test and extend neutrino mass models

- SPI: embedding of models into fundamental frameworks
- SPII: signals related to new particles needed for neutrino masses
- SPIII: explanation of matter-antimatter asymmetry and Dark Matter

$$\frac{\text{Dark Matter}}{\text{Visible matter}} \approx 5$$

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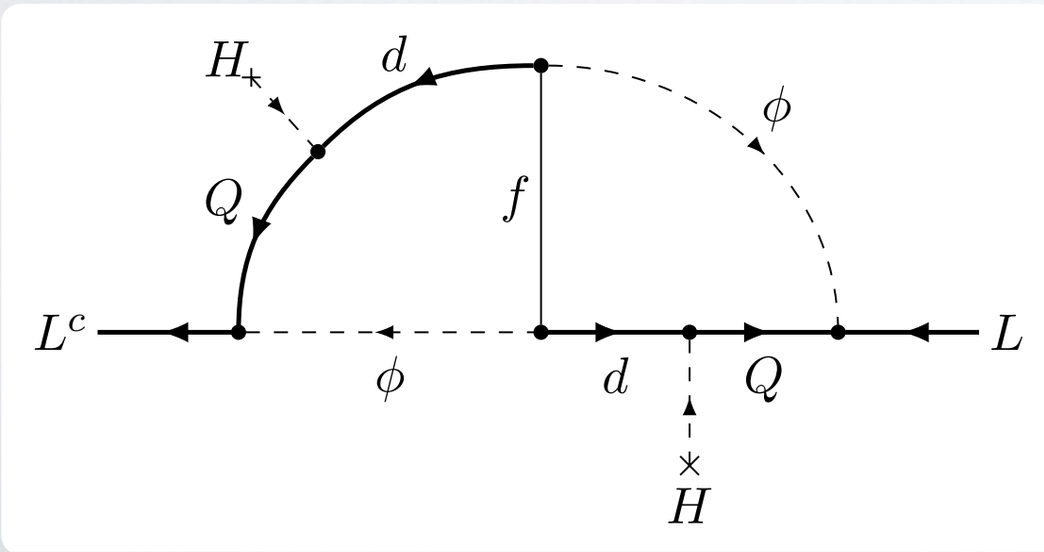
Which models?



Why?

Small neutrino masses and new particles in reach.

Many aspects not studied …

Aim of FELLINI project NU-ORIGIN

Many aspects not studied …

SPI: embedding of models into fundamental frameworks

- Endow such models with symmetries
- Embed these into Theories of Grand Unification

SPII: signals related to new particles needed for neutrino masses

- Phenomenology of lepton sector
- Phenomenology of quark sector
- (Direct) signals at colliders
- Systematic analysis of classes of models

Aim of FELLINI project NU-ORIGIN

Many aspects not studied …

SPIII: explanation of matter-antimatter asymmetry and Dark Matter

- Invent generation mechanism for matter-antimatter asymmetry of our Universe
- Explore possibilities to co-generate matter-antimatter asymmetry and Dark Matter

Scope of secondment

- Ideally supplement this FELLINI project
- Acquisition of new expertise
- Possible focus on *collider signals* and/or *baryogenesis*
- Opportunity to establish collaborations with scientists from these research fields and possibly different communities (e.g. USA, Japan)

Expectations

- Extension of expertise to new fields
  (phenomenology of quark sector,
  Dark Matter,
  collider signals and/or baryogenesis)
- Opportunity to co-supervise bachelor, master and PhD students and to give lectures on specialized topics
- Responsability for funds: invitation of guests, travel money

- Improve chances for long-term funding/permanent position by extending expertise, research network, focus on research with optionally (co-)supervision/teaching and holding prestigious INFN/EU-grant