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CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

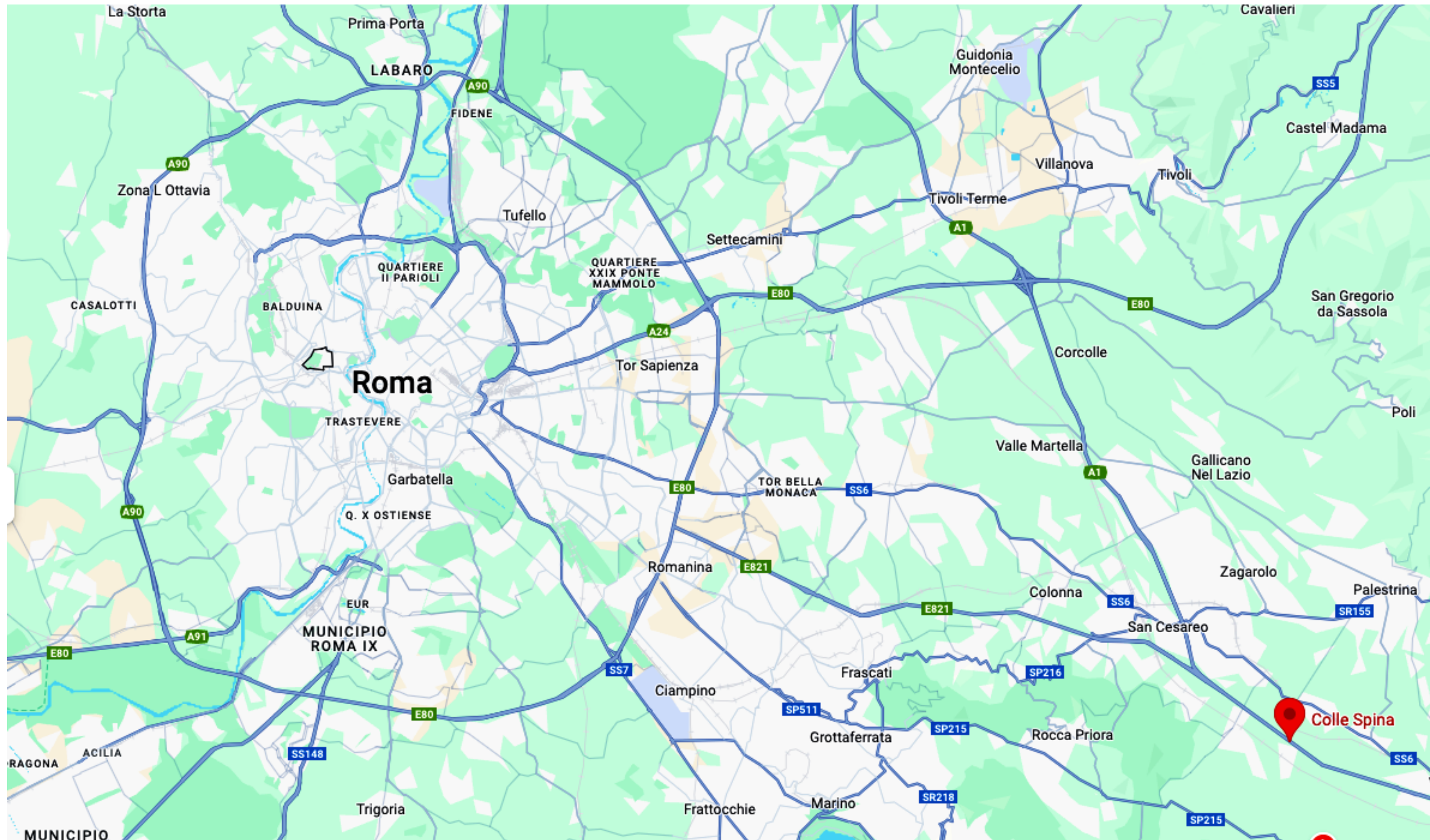


Flavour and Orígin of Matter
Sabor y Orígen de la Materia

Simone Marciano

Valencia 12/12/2025, IFIC

My studies



My studies

Bachelor's and Master's
Degrees



My studies

Ph. D. title



The curious case of Mr. Neutrino



1930

Fermi's theory of
weak interactions
and beta decay



1956

The Standard
Model of Particle
Physics

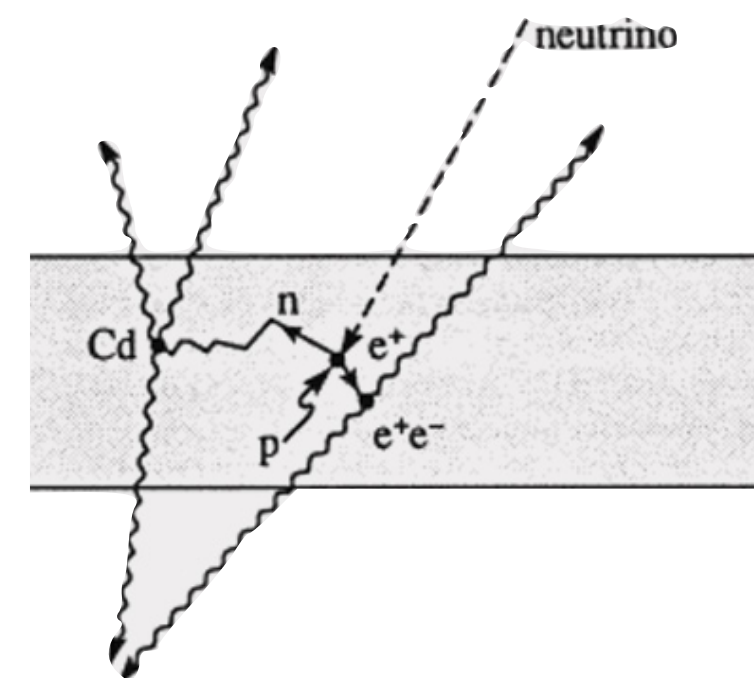
Pauli's hypothesis:

"what if the missing energy
is carried off by an otherwise
invisible particle?"

1934



Discovery of the
neutrino by
Cowan & Reines



~ 1960/1970



Neutrinos: an overview

✓ Neutrinos are assumed to be massless particles in the SM

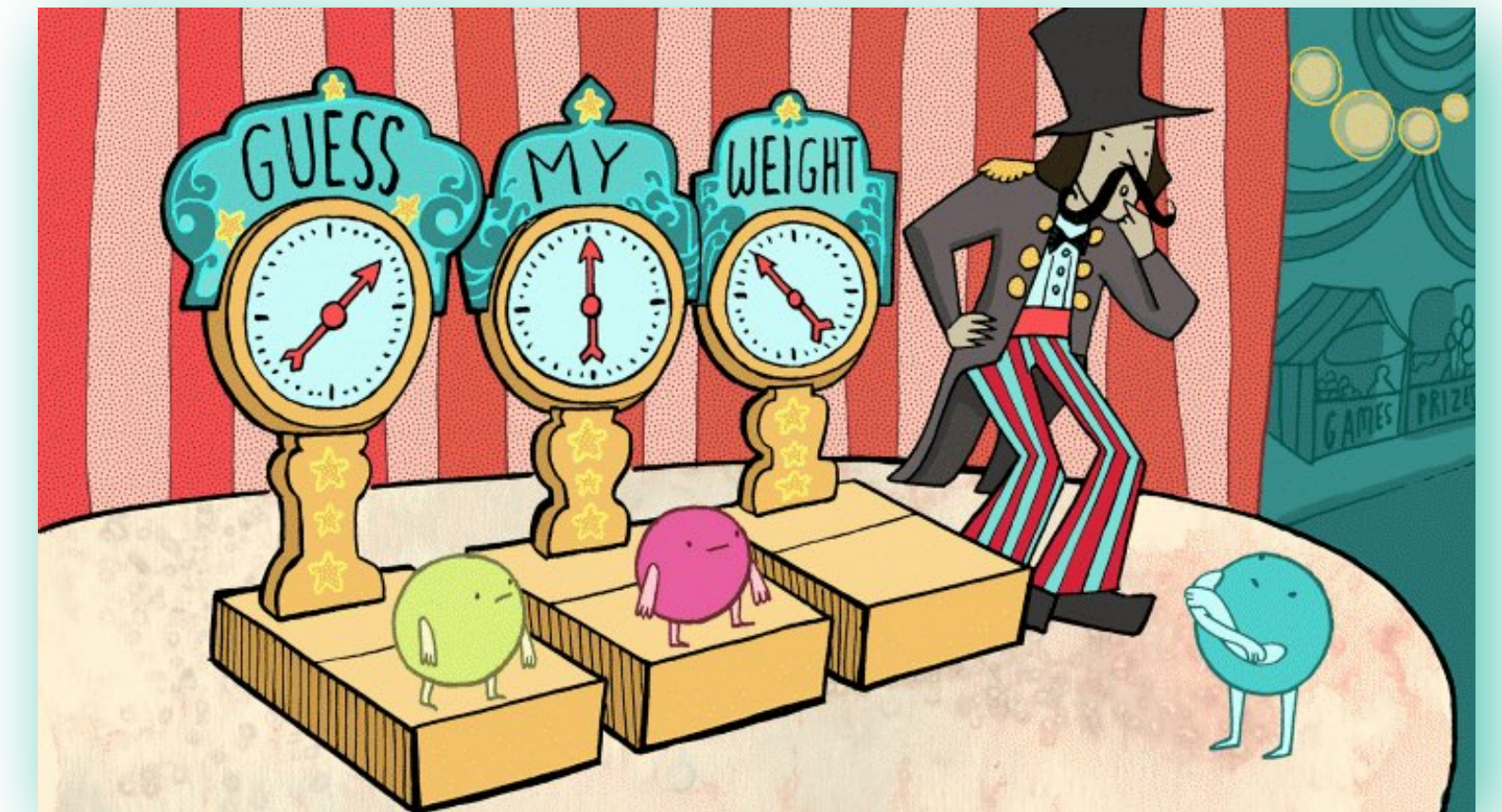
- No right-handed neutrino ν_R
- Minimal lepton sector
- Accidental lepton number conservation



✓ There are three different neutrino flavors: **electron-**, **muon-** and **tauon-** neutrinos

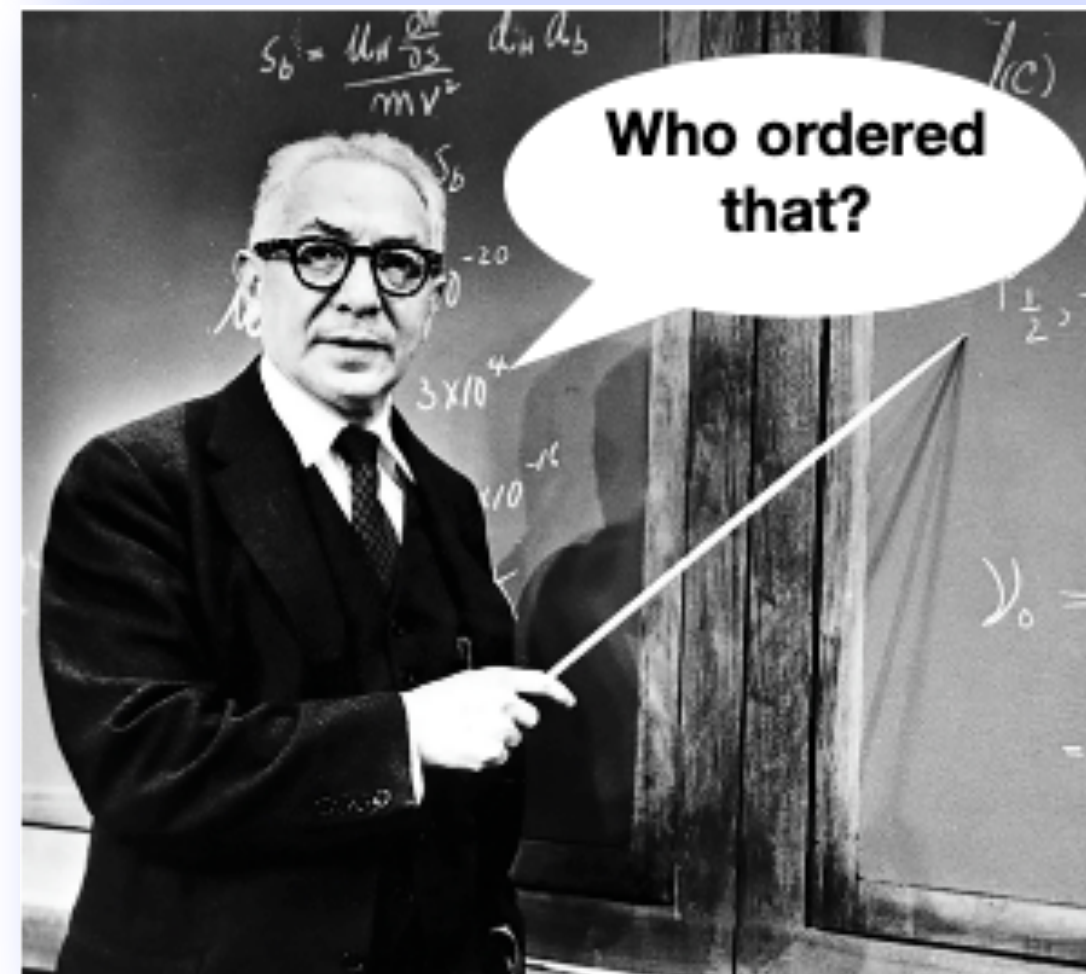
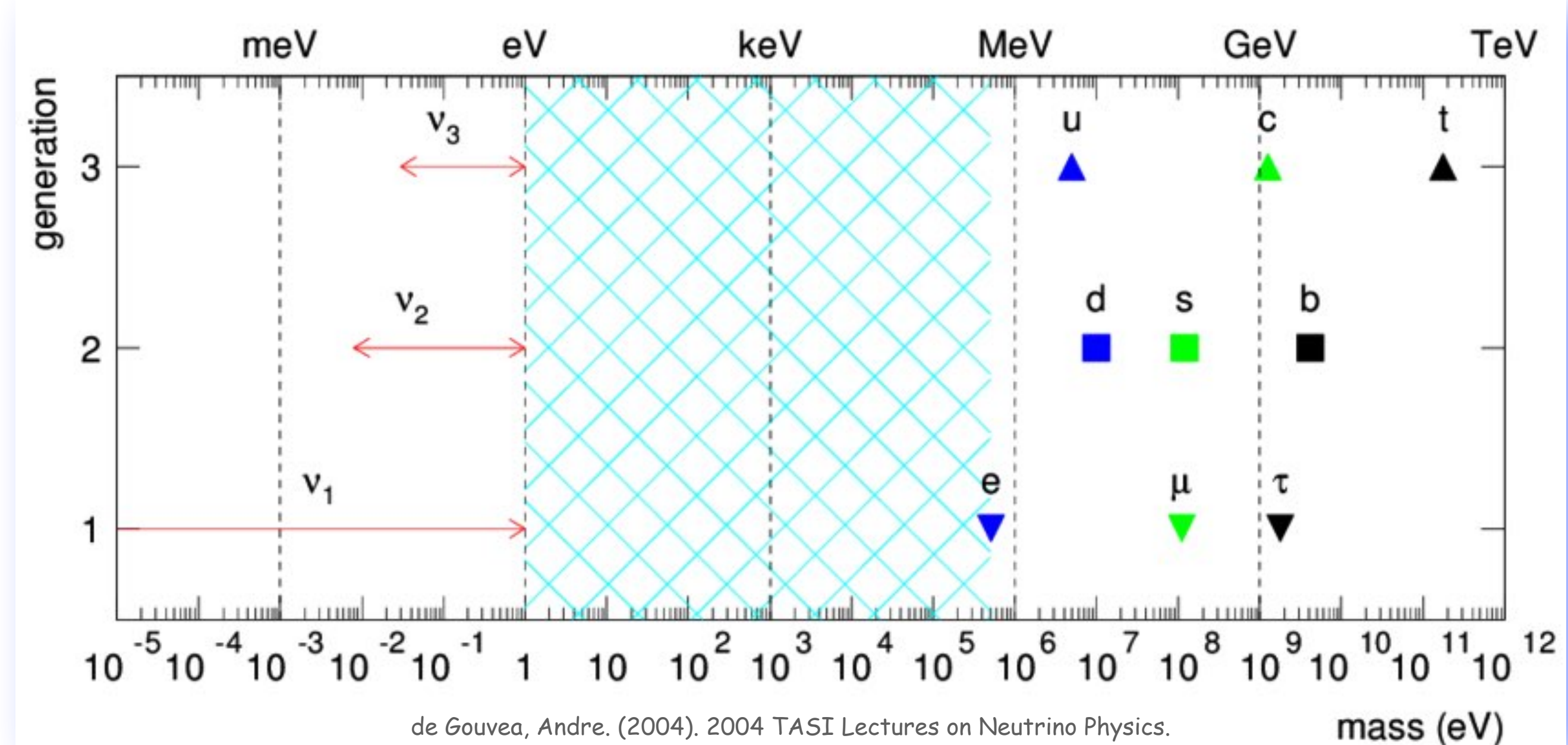
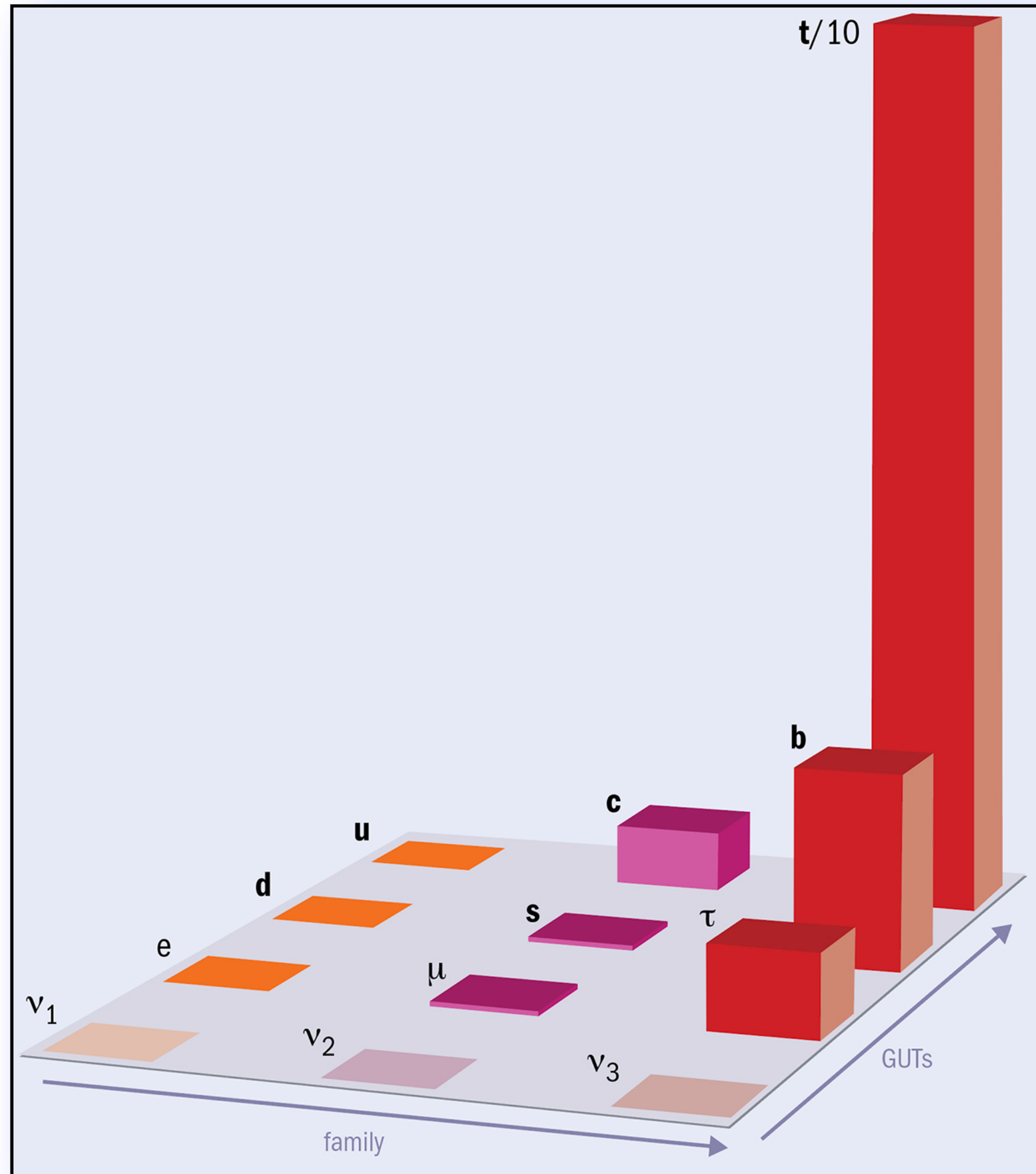
- Their mass eigenstates do not correspond to the flavor ones
- Mass eigenstates evolve in time via the Schrödinger equation
- Flavor neutrino states **oscillate**

➡ Neutrinos must have a non zero mass!

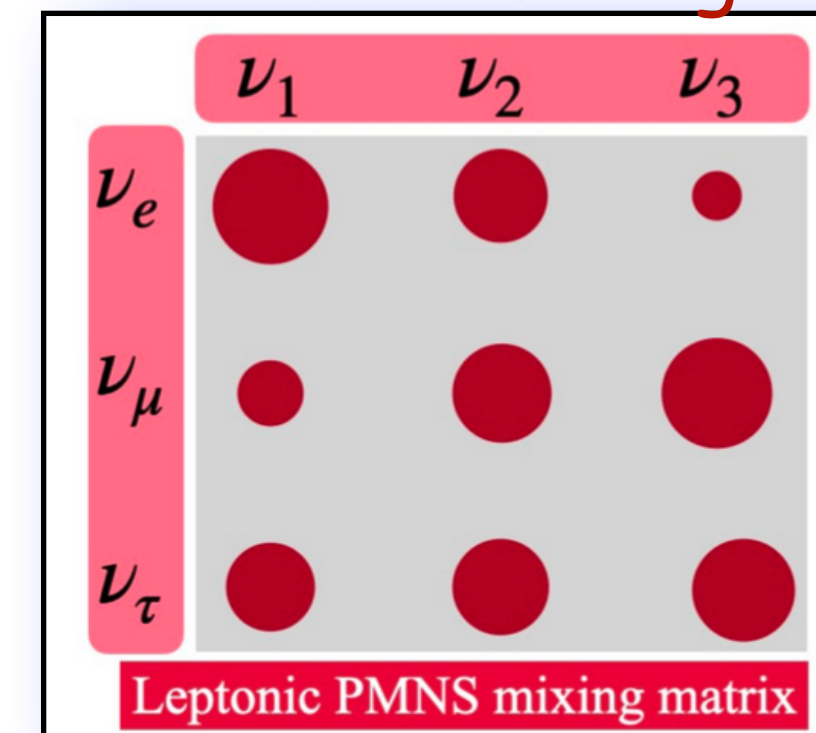


Neutrino masses and mixing

Mass hierarchies



Fermion mixing



My research focus

Extended Scalar Sectors

- A. Giarnetti, SM, J. H. Garcia, D. Vatsyayan [2312.14119 [hep-ph]]
- A. Giarnetti, SM, J. H. Garcia, D. Vatsyayan [2312.13356 [hep-ph]]

Flavour Symmetries

- G. Arcadi, SM, D. Meloni [2205.02565 [hep-ph]]
- A. Giarnetti, SM, D. Meloni, M. Rettaroli [2505.20281 [hep-ph]]
- SM, D. Meloni, M. Parriciatu [2402.18547 [hep-ph]]

Neutrino Flavour Oscillation Simulations

- A. Giarnetti, SM, D. Meloni [2407.17247 [hep-ph]]

Parametrisations

- A. Giarnetti, SM, D. Meloni [2407.02487 [hep-ph]]
- J. H. Garcia, SM, J. Racker, D. Vatsyayan [2510.18962 [hep-ph]]

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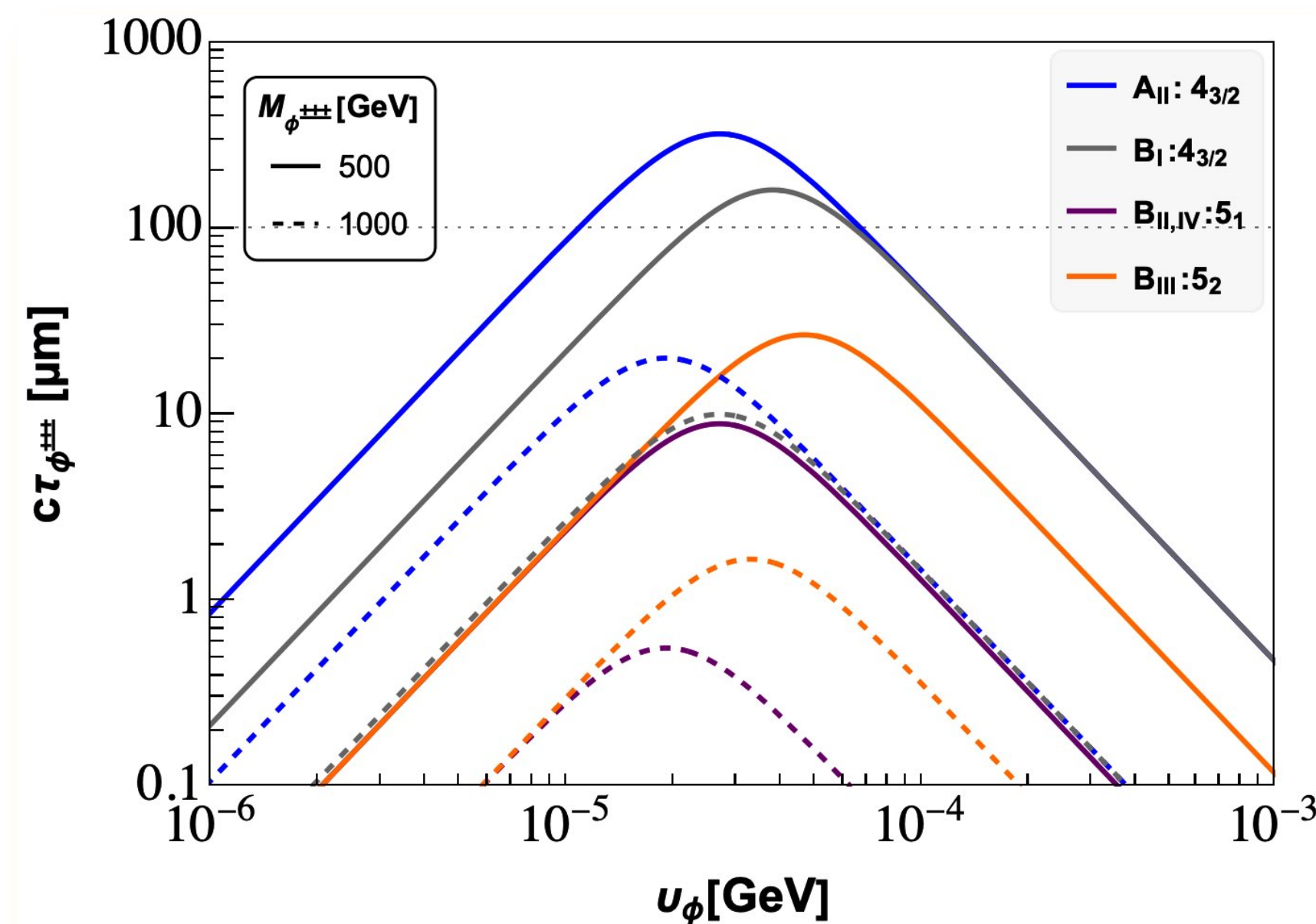
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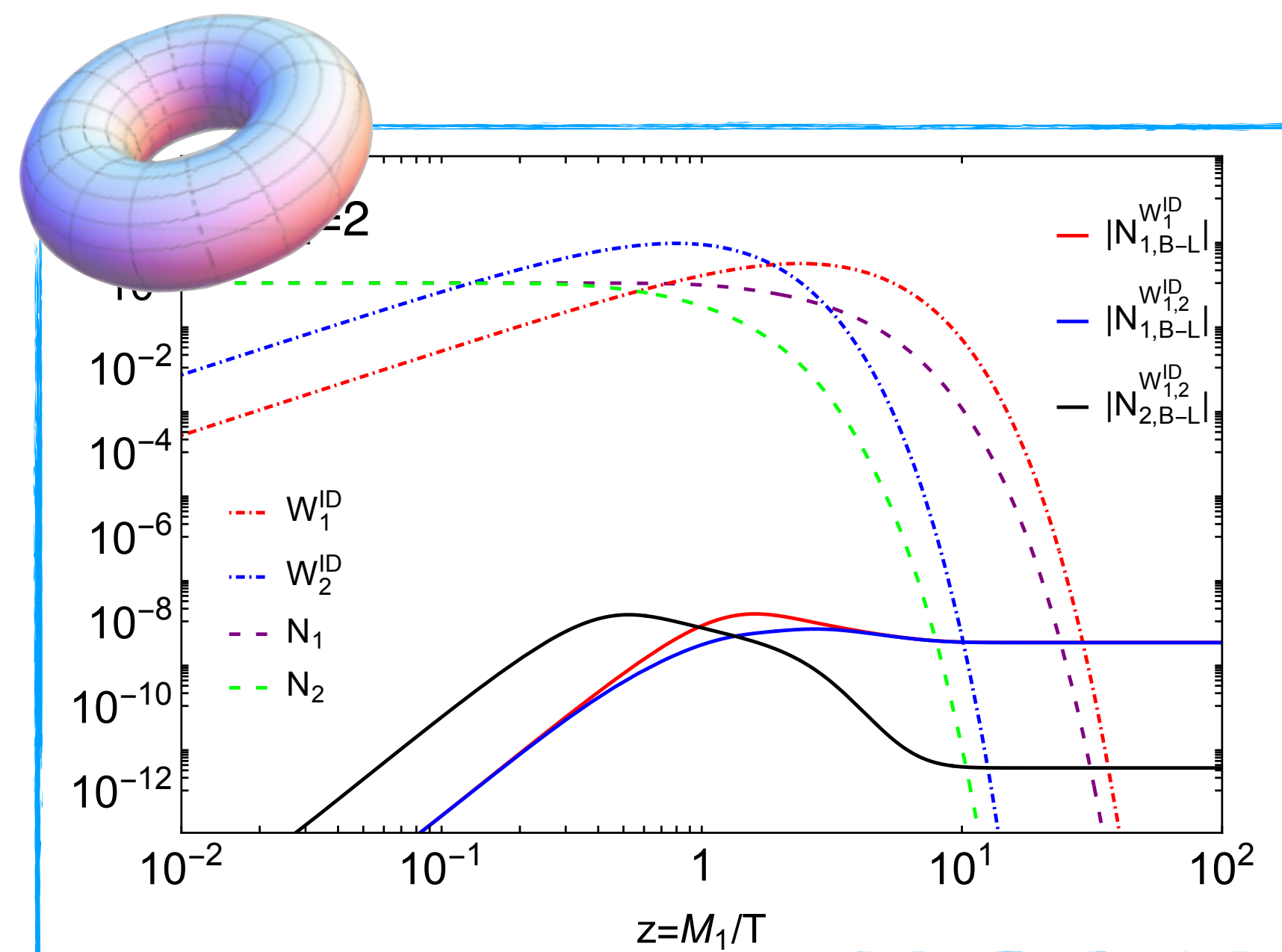
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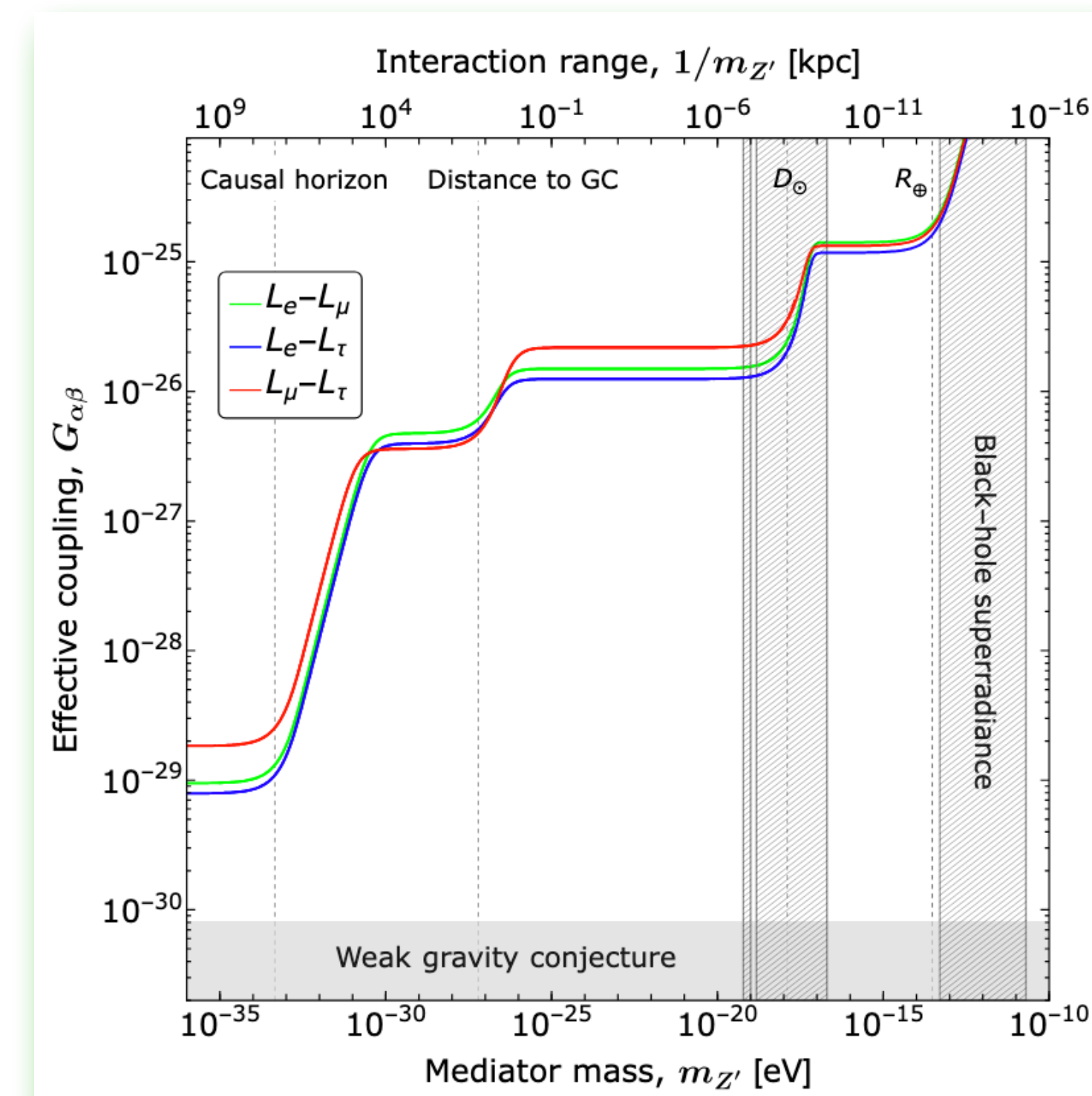
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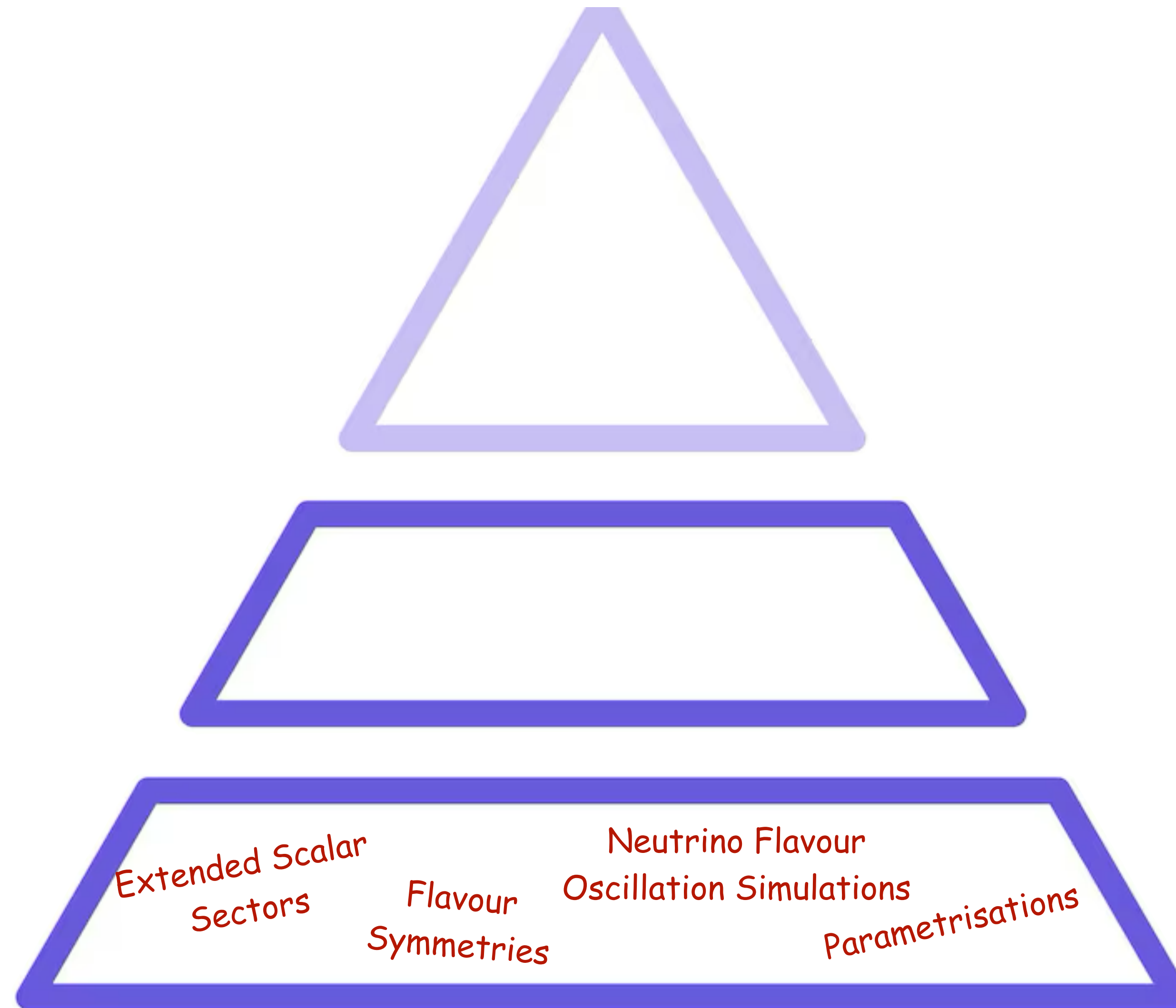
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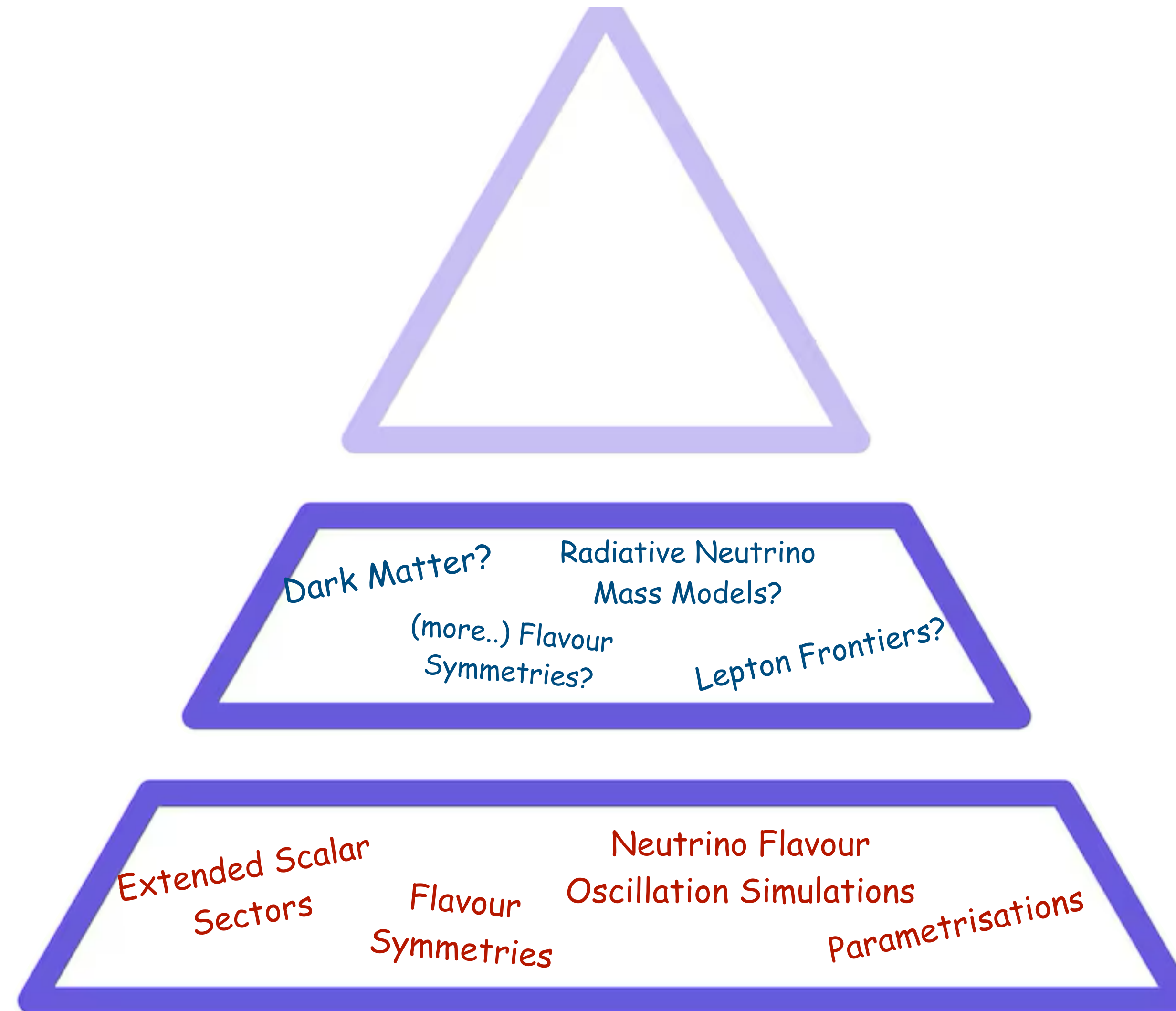
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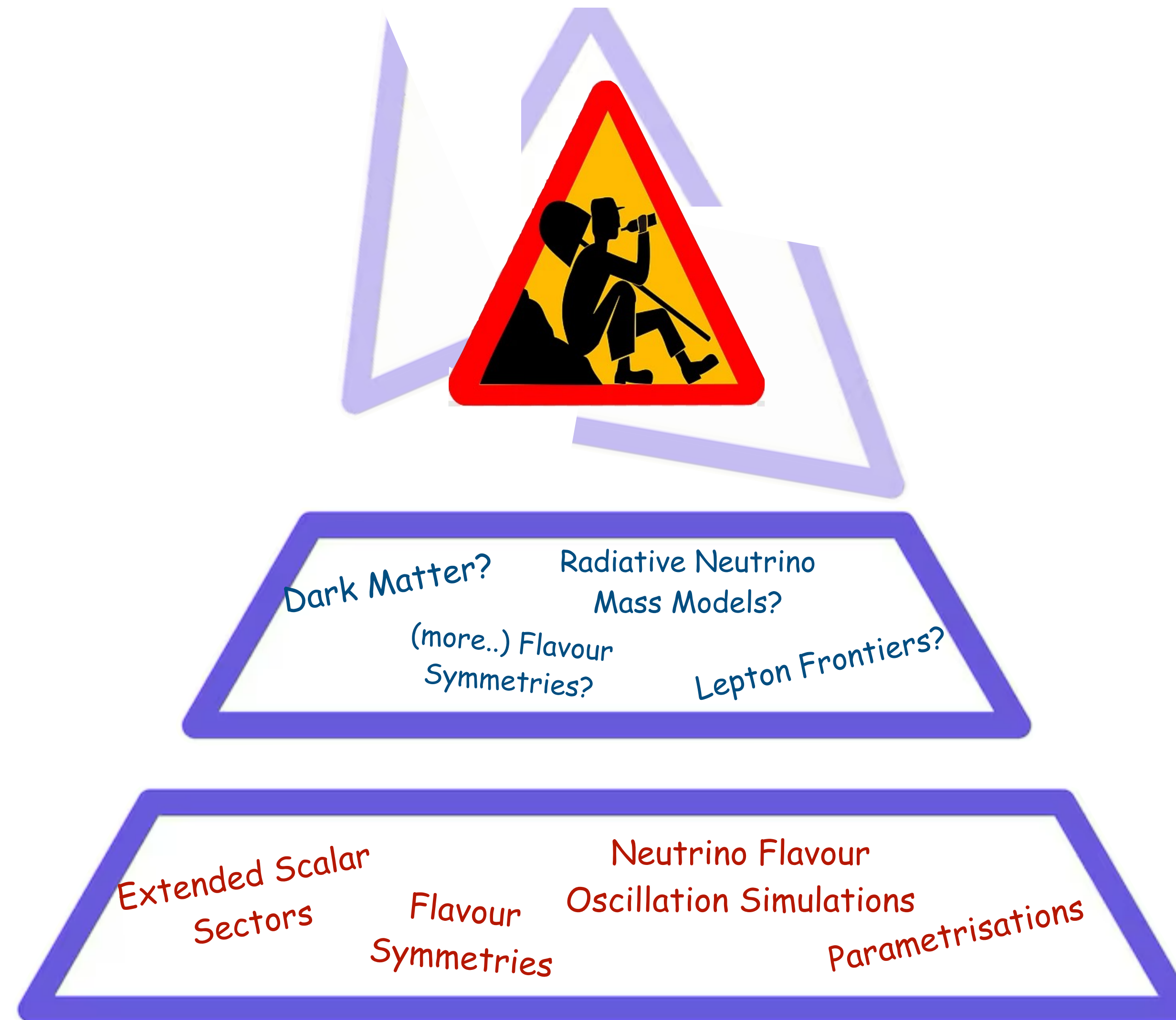
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see you around!

you can find me in B. 5. 3
(ground floor)