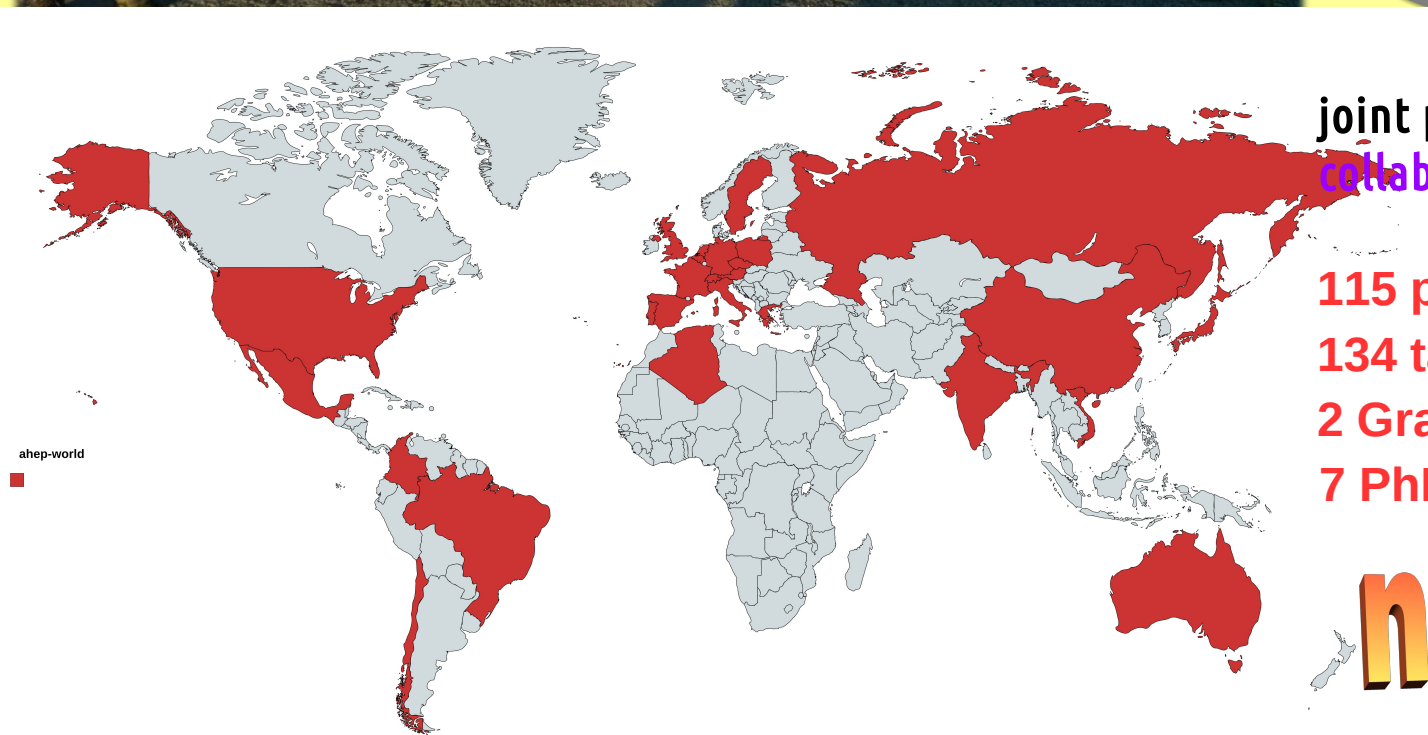




joint pubs with other IFIC-Teo groups
 collaboration with IFIC-Exp is underway

115 pubs in ISI-WoK in 2012-2016
 134 talks @ int confs
 2 Graduate textbooks
 7 PhD theses @ UV in 2012-2016

new physics

neutrino oscillations

$$\begin{pmatrix} \alpha_{11} & 0 & 0 \\ \alpha_{21} & \alpha_{22} & 0 \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \end{pmatrix} U$$

$$\alpha_{11}^2 \geq 0.989, \quad \alpha_{22}^2 \geq 0.999, \quad |\alpha_{21}|^2 \leq 6.6 \times 10^{-4}$$

PhysRevD.92.053009



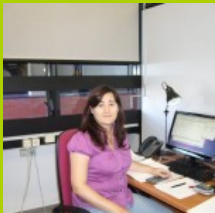
non-unitary lepton mixing

O.G. Miranda, J.W.F. Valle / *Nuclear Physics B* 908 (2016) 436–455

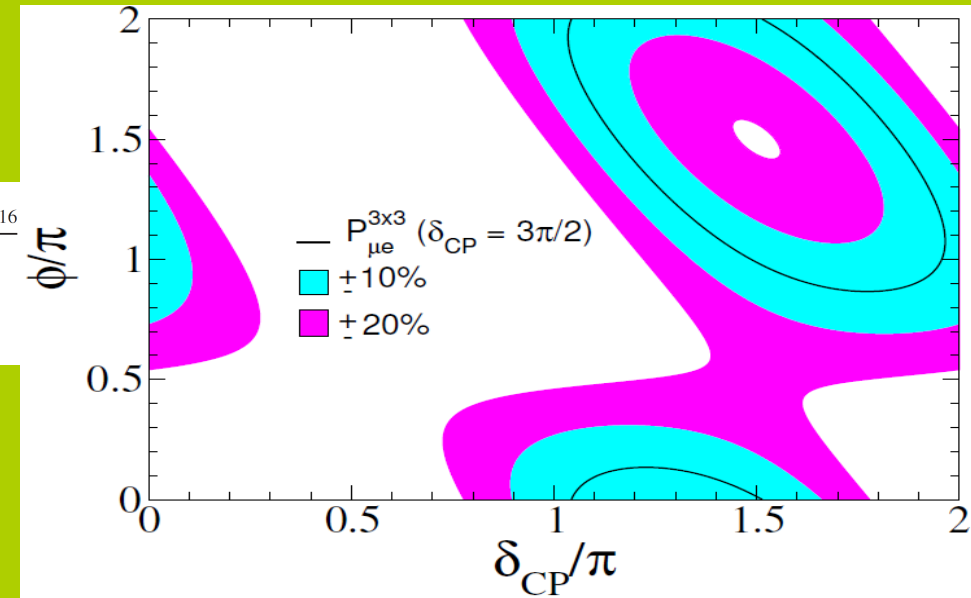
PRL 117, 061804 (2016) PHYSICAL REVIEW LETTERS week ending 5 AUGUST 2016

New Ambiguity in Probing *CP* Violation in Neutrino Oscillations

O. G. Miranda,^{1,*} M. Tórtola,^{2,†} and J. W. F. Valle^{2,‡}



implications for DUNE

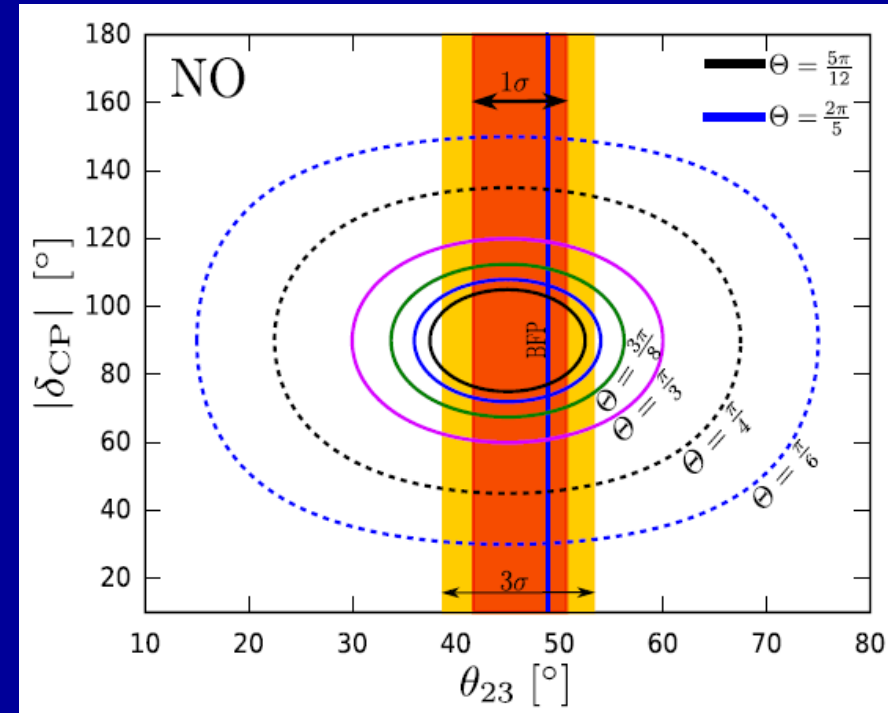
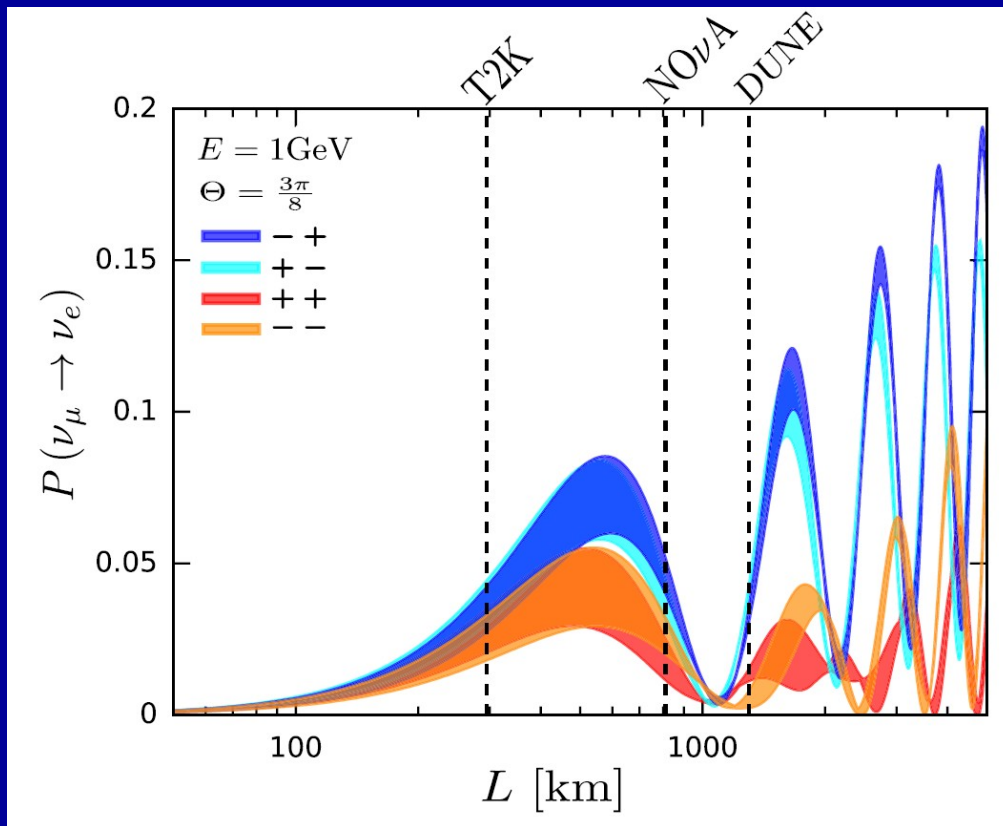


CP confusion

model-independent favor approach

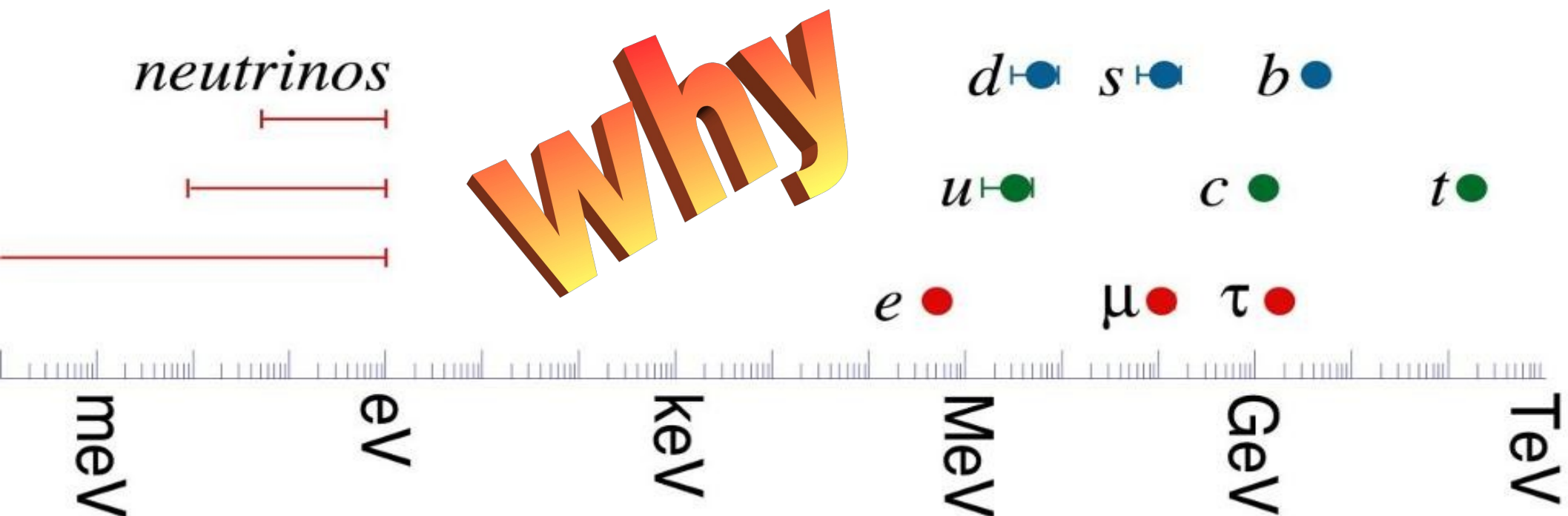
$$\mathbf{X}^T \mathbf{m}_\nu \mathbf{X} = \mathbf{m}_\nu^*$$

*Predicting neutrino mixing
from residual CP symmetries*



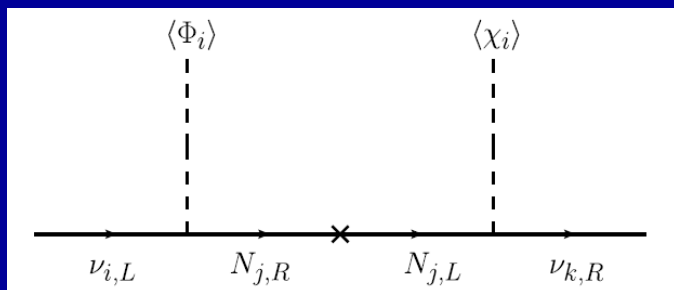
testable in DUNE

P Chen et al
Phys.Lett. B753 (2016) 644-652
Phys.Rev. D94 (2016) no.3, 033002



type-I seesaw for Dirac

Chiulia et al [arXiv:1606.04543](#)
[Phys.Lett. B761 \(2016\) 431](#)



flavor-generalized b-tau unification

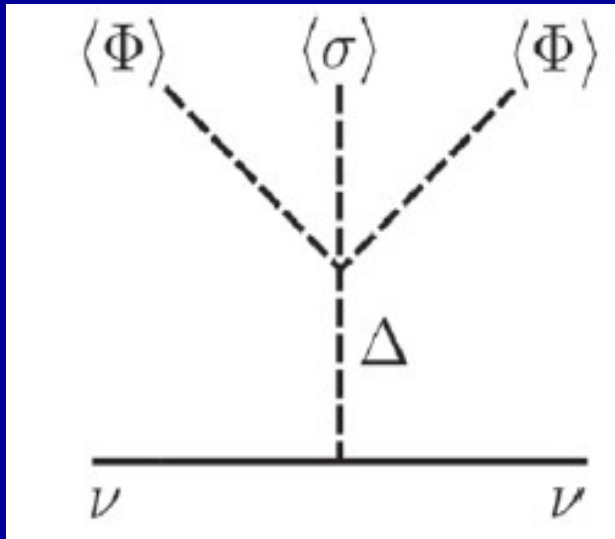
$$\frac{m_\tau}{\sqrt{m_e m_\mu}} \approx \frac{m_b}{\sqrt{m_d m_s}}$$

type-II seesaw for Dirac

Phys.Rev. D25 (1982) 774

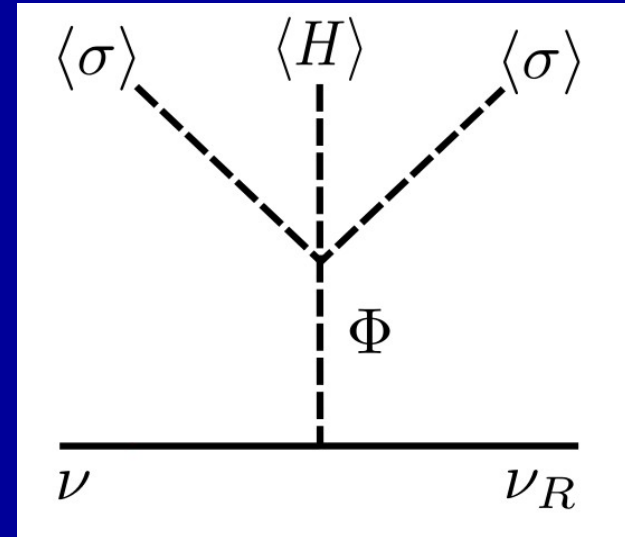
C. Bonilla, J.W.F. Valle / Physics Letters B 762 (2016) 162–165

naturally small induced vev



If global U(1)

Majoron
vs
Dirac



ArXiv:1605.08362 **PLB**

**Laboratory, cosmological
& astrophysical implications**

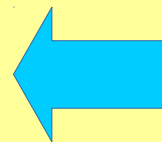




new higgs & vacuum stability



implications for LHC, HL-LHC & ILC



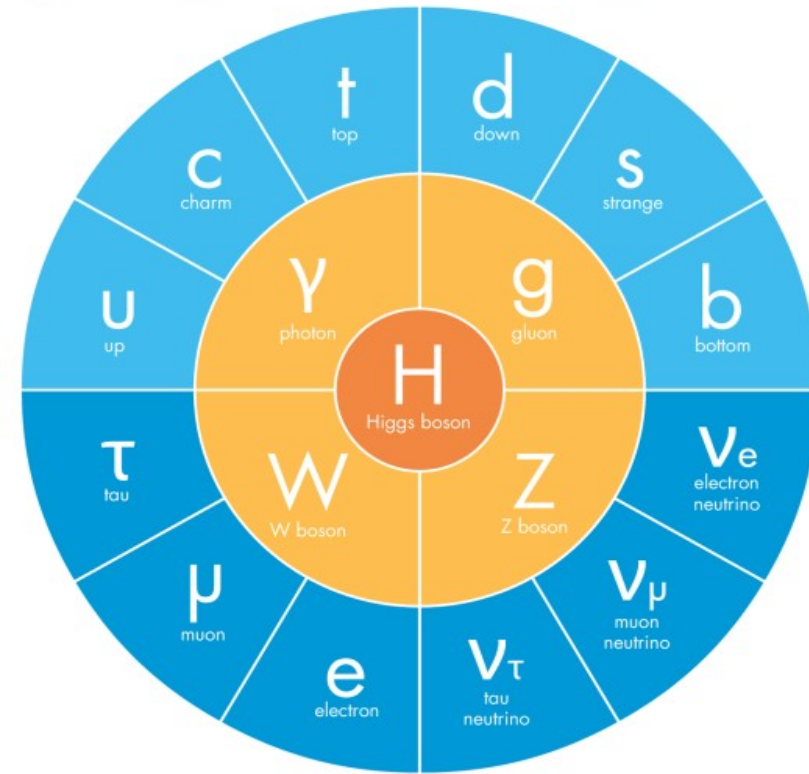
THE STANDARD MODEL

FERMIONS (matter)

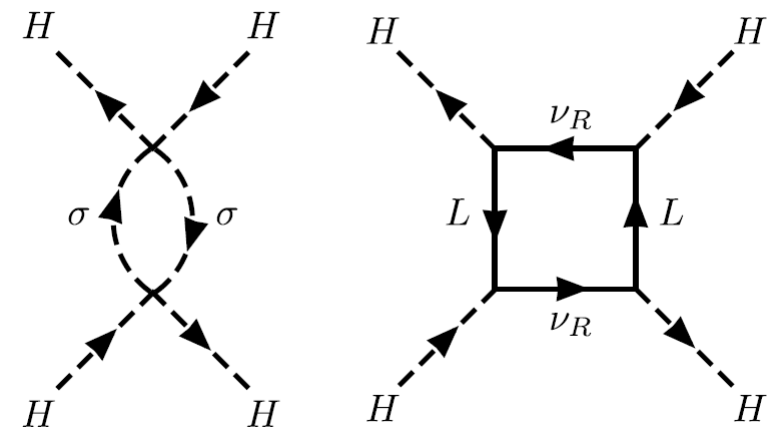
● Quarks ● Leptons

BOSONS (force carriers)

● Gauge bosons ● Higgs boson



C. Bonilla et al. / Physics Letters B 756 (2016) 345–349



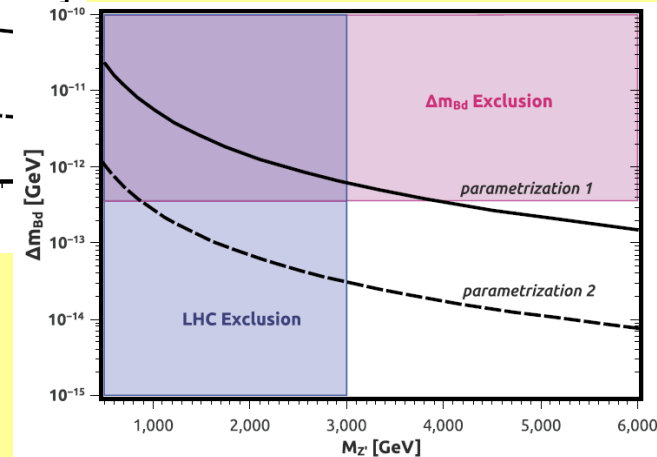
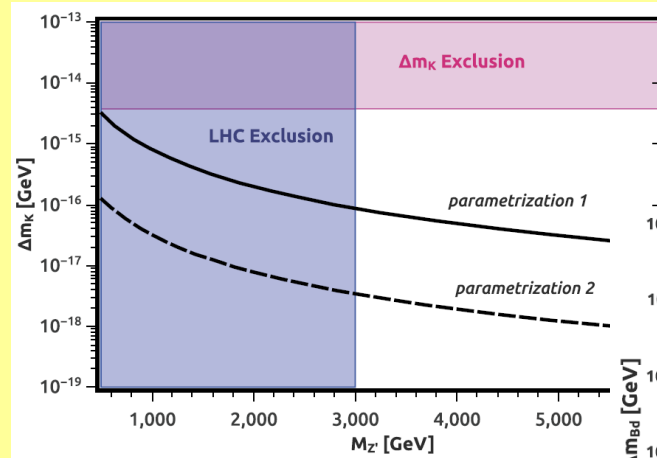
new gauge bosons

LHCb ATLAS & CMS

BaBar Belle ..

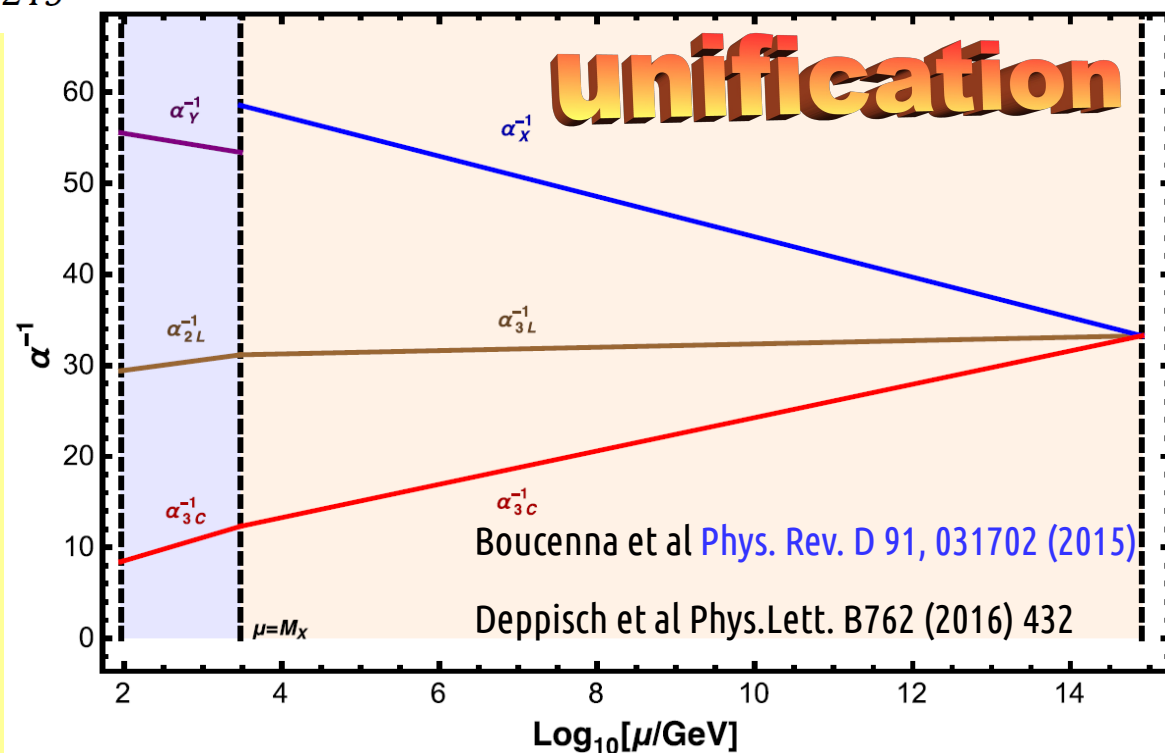
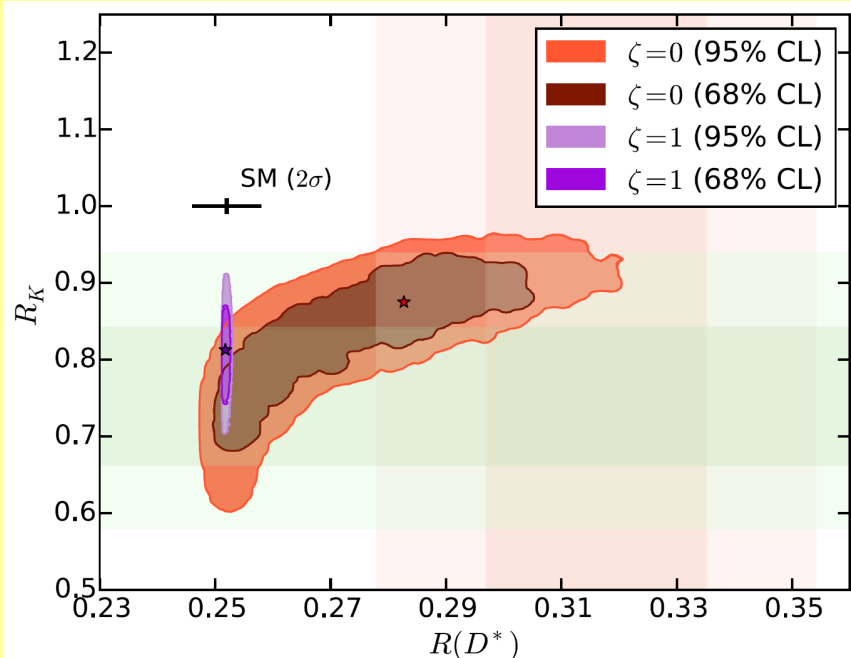


B-anomalies ..



F.S. Queiroz et al. / Physics Letters B 763 (2016) 269–274

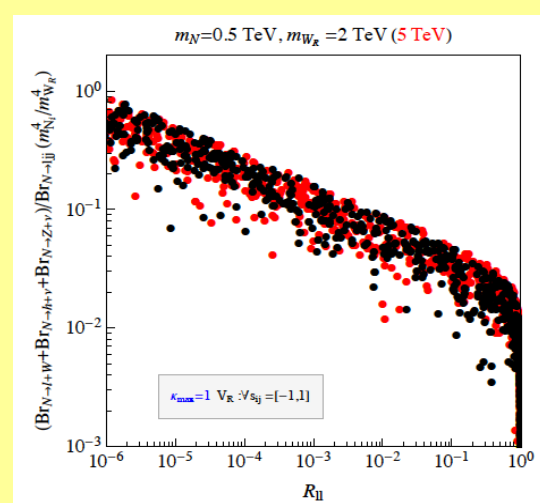
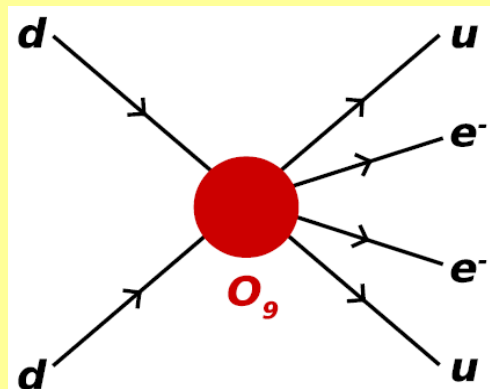
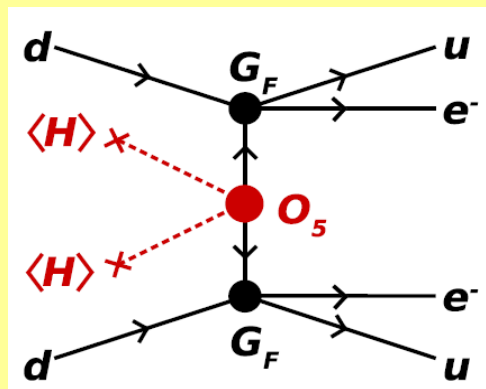
S.M. Boucenna et al. / Physics Letters B 760 (2016) 214–219



Boucenna et al Phys. Rev. D 91, 031702 (2015)

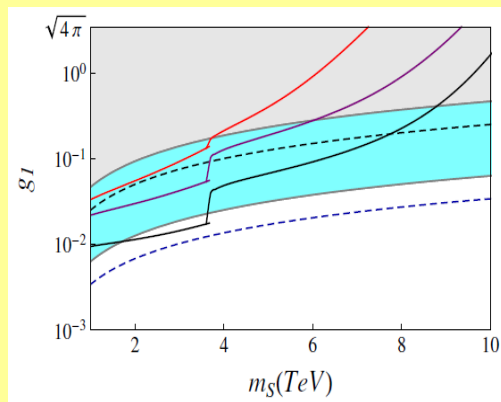
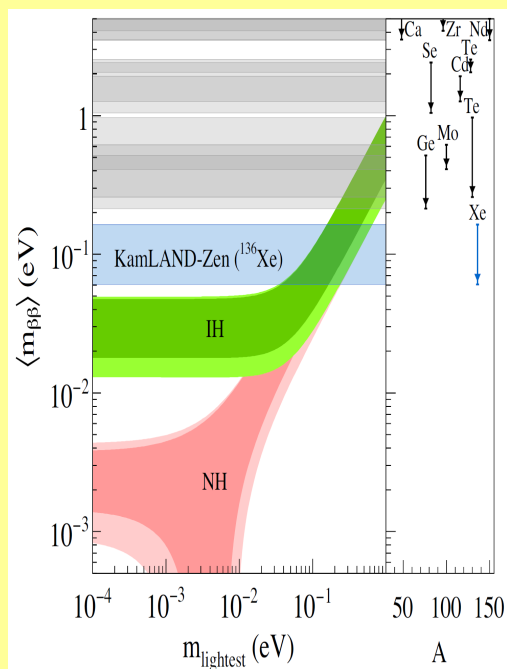
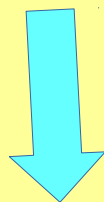
Deppisch et al Phys.Lett. B762 (2016) 432

nu-less double beta decay



G. Anamiati,^a M. Hirsch^a and E. Nardi^b

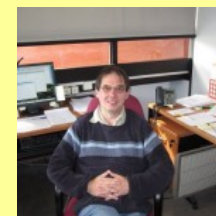
doi:10.1007/JHEP10(2016)010



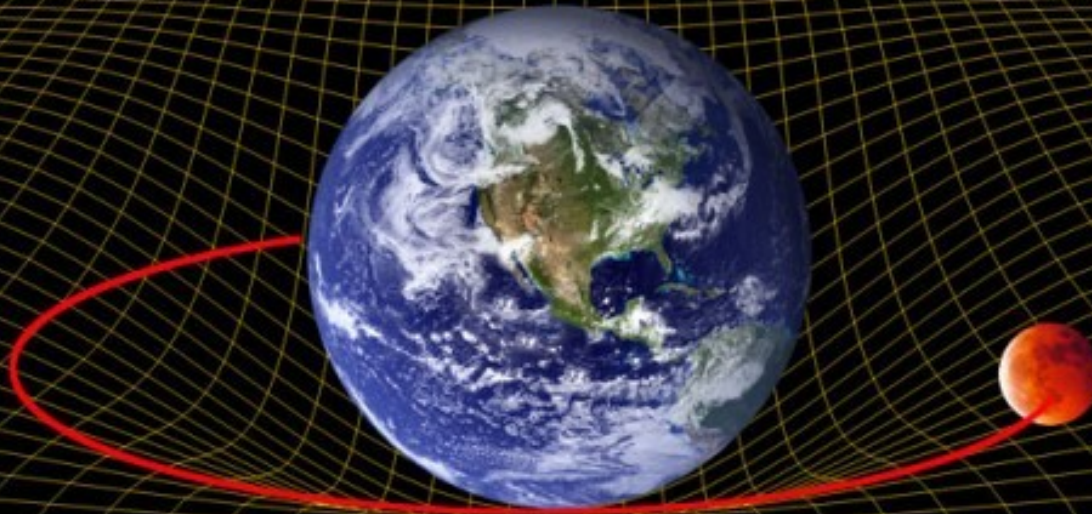
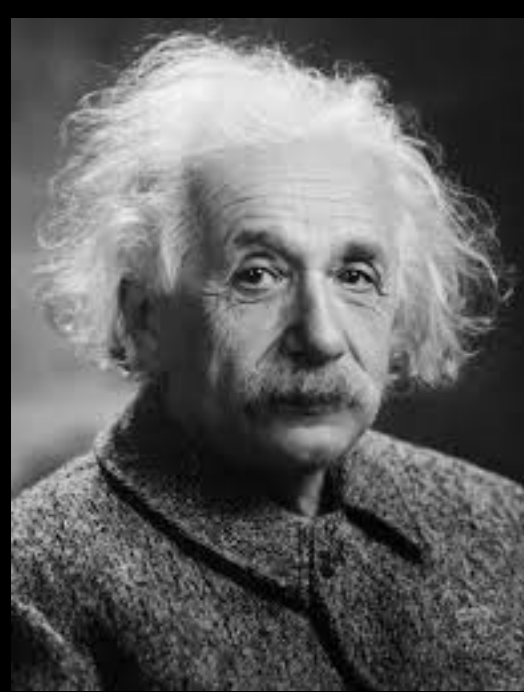
L. Gonzalez,^a J.C. Helo,^{a,b} M. Hirsch^c and S.G. Kovalenko^a

doi:10.1007/JHEP12(2016)130

Interplay between DBD expts
K-Zen, GERDA, CUORE, NEXO, NEXT
and the LHC



Including Gravity



neutrinos in the theory of everything

Chen et al arXiv:1509.06683
JHEP01(2016)007

Addazi et al

Phys.Lett. B759 (2016) 471-478



Dirac type-II seesaw

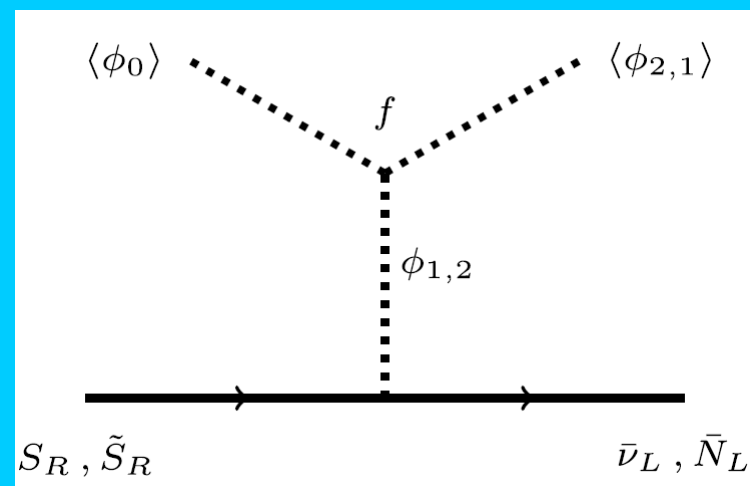
331 from strings

J.W.F. Valle, C.A. Vaquera-Araujo / Physics Letters B 755 (2016) 363–366

Addazi et al

arXiv:1604.02117

DOI 10.1016/j.physletb.2016.06.015

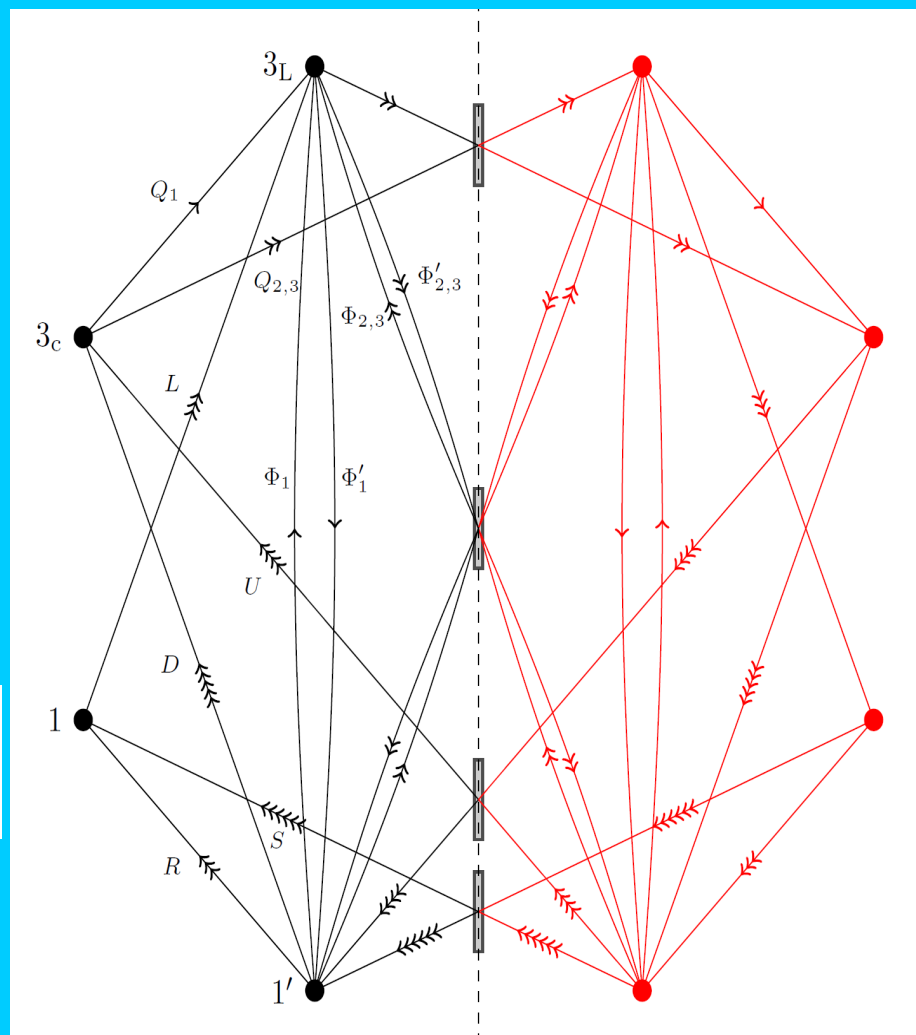


string completion Quiver setup

String completion of an $SU(3)_c \otimes SU(3)_L \otimes U(1)_X$ electroweak model

Andrea Addazi^{a,b}, J.W.F. Valle^c, C.A. Vaquera-Araujo^{c,*}

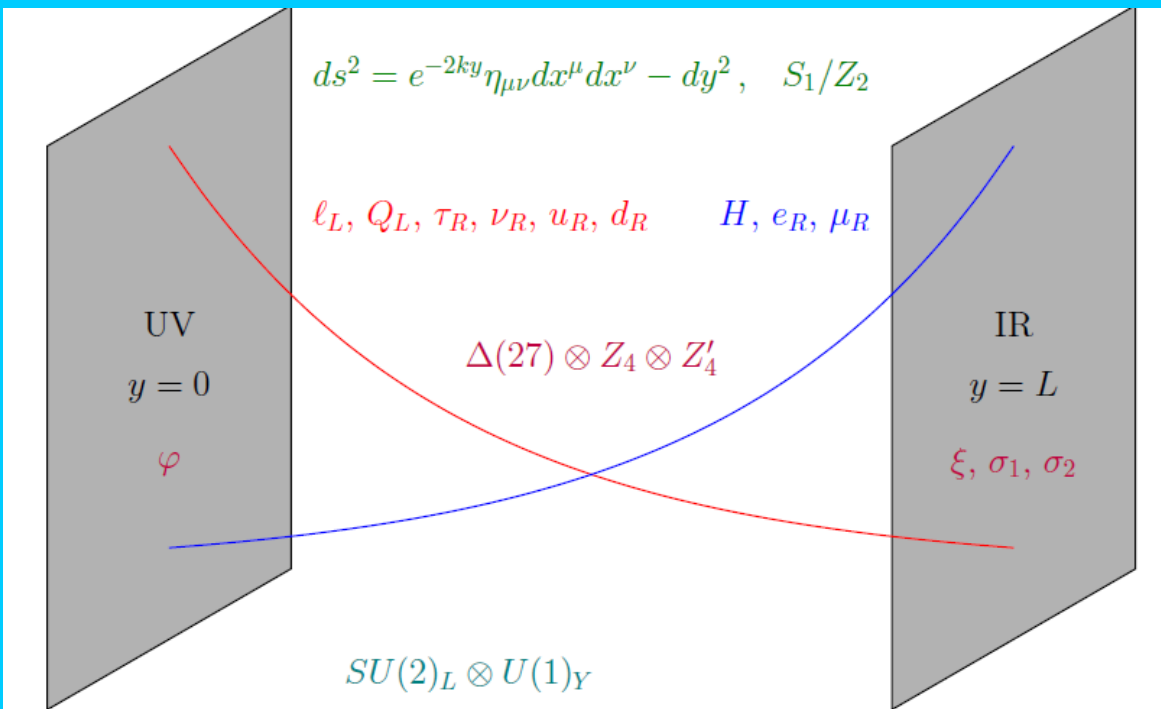
L conserved



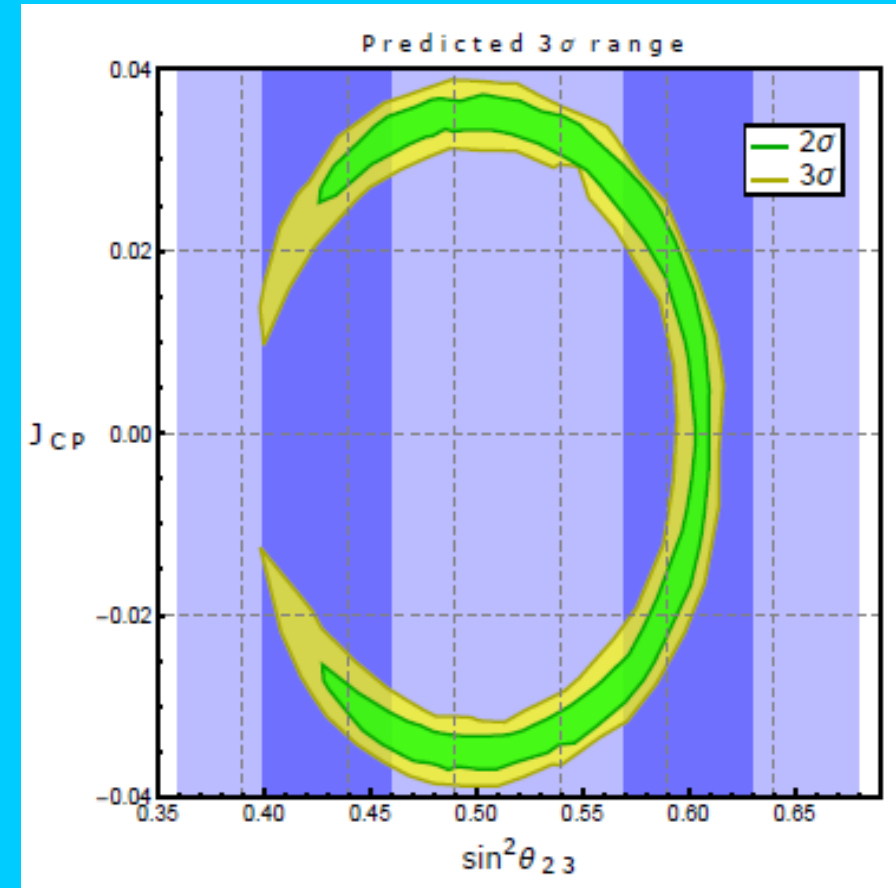
Warped standard model

: Chen et al arXiv:1509.06683

JHEP01(2016)007



masses explained by choices
of the bulk parameters

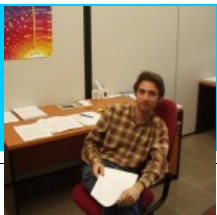


<http://arxiv.org/abs/arXiv:1610.05962>

**predictions for
neutrino oscillations
in DUNE**

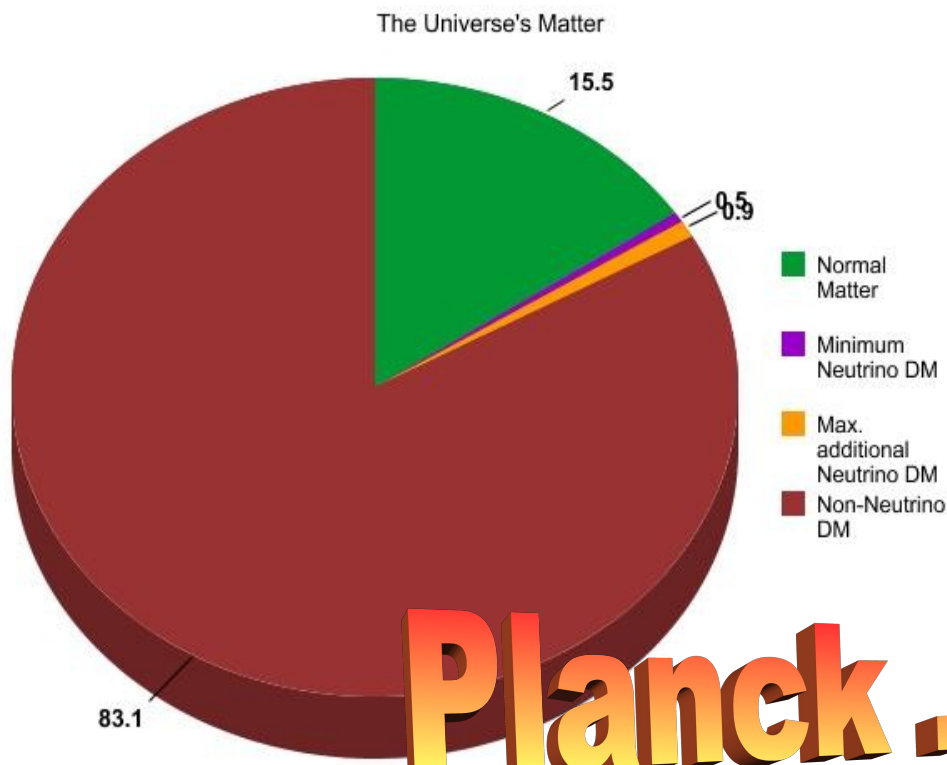
neutrinos in cosmology

Relic neutrino decoupling with flavour oscillations revisited



Pablo F. de Salas^{a,b} and Sergio Pastor^a

Case	z_{fin}	$\delta\bar{\rho}_{\nu_1}(\%)$	$\delta\bar{\rho}_{\nu_2}(\%)$	$\delta\bar{\rho}_{\nu_3}(\%)$	N_{eff}
Normal hierarchy (NH)	1.39779	0.636	0.574	0.518	3.045
Inverted hierarchy (IH)	1.39779	0.635	0.574	0.520	3.045
NSI ee (NH)	1.39812	0.548	0.504	0.465	3.040
NSI $\tau\tau$ (NH)	1.39708	0.839	0.821	0.798	3.059



Created by Ethan Siegel

Today

Life on earth

Acceleration

Dark energy dominates

Solar system forms

Star formation peak

Galaxy formation era

Earliest visible galaxies

14 billion years

11 billion years

3 billion years

700 million years

Recombination

Atoms form
Relic radiation decouples (CMB)

400,000 years

Matter domination

Onset of gravitational collapse

5,000 years

Nucleosynthesis

Light elements created – D, He, Li

3 minutes

Nuclear fusion begins

0.01 seconds

Quark-hadron transition

Protons and neutrons formed

1 μsec

Electroweak transition

Electromagnetic and weak nuclear forces first differentiate

0.01 ns

Supersymmetry breaking

Axions etc.?

Grand unification transition

Electroweak and strong nuclear forces differentiate

10^{-35} s

Inflation

Quantum gravity wall

Spacetime description breaks down

10^{-43} s

BIG BANG

The background of the image is a deep space scene filled with numerous galaxies, stars, and nebulae. The colors are predominantly dark blue and black, with bright yellow and white stars scattered throughout. Some galaxies show distinct spiral or elliptical structures. The overall effect is a sense of vastness and cosmic scale.

**even if only
tiny DM fraction**

**neutrinos can hold the key
to Dark matter problem**

dark matter

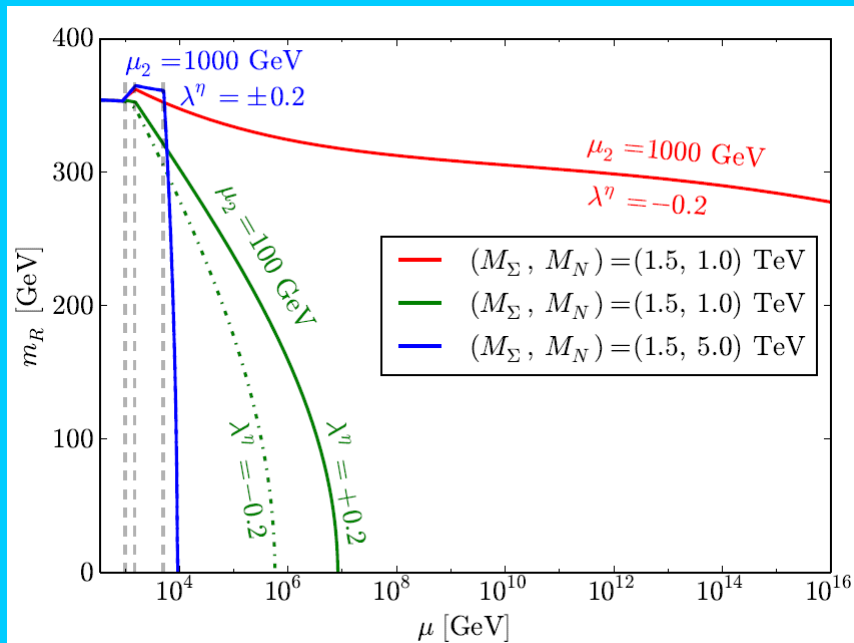
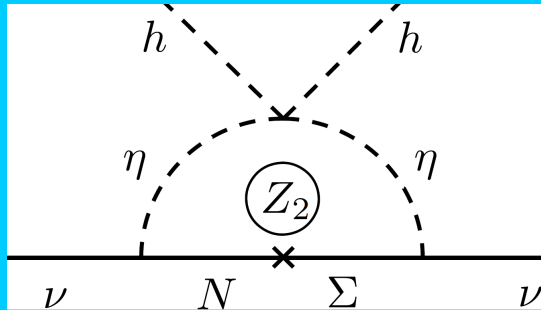
higgs portal DM model



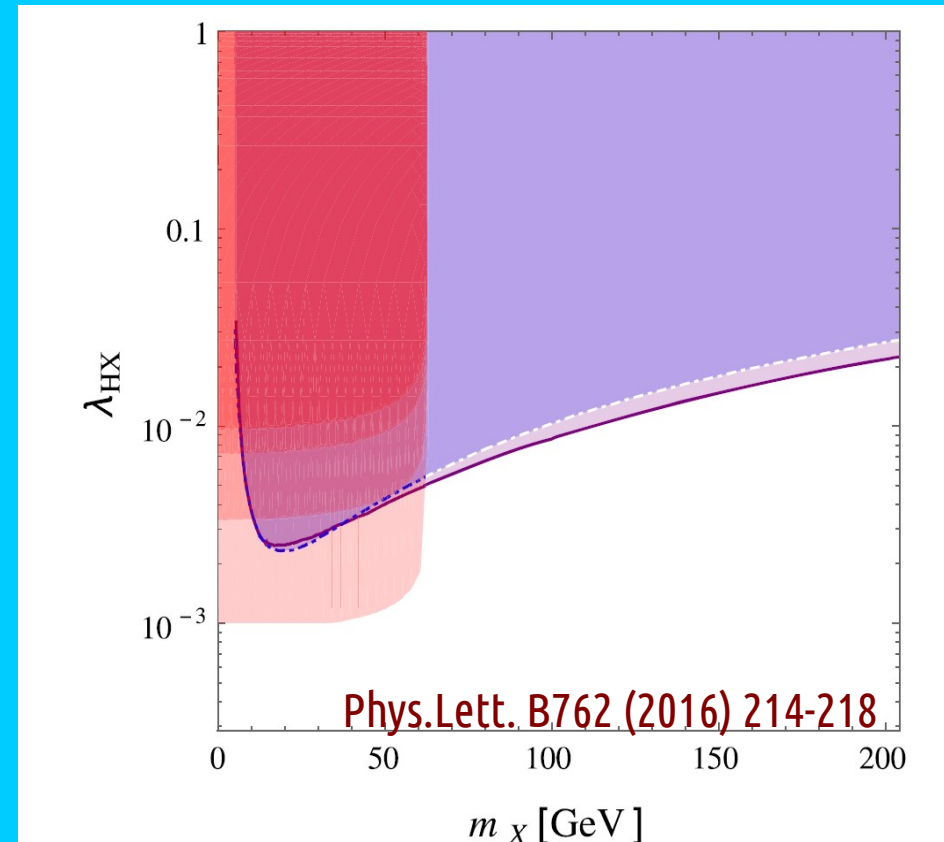
Consistency of WIMP Dark Matter as radiative
neutrino mass messenger

Alexander Merle,^a Moritz Platscher,^b Nicolás Rojas,^c José W.F. Valle^c
and Avelino Vicente^c

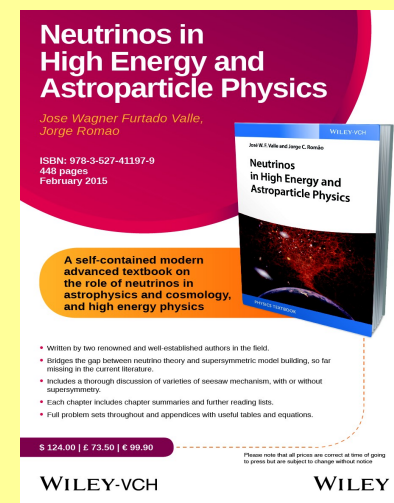
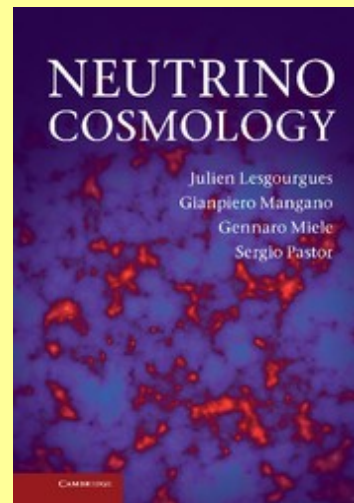
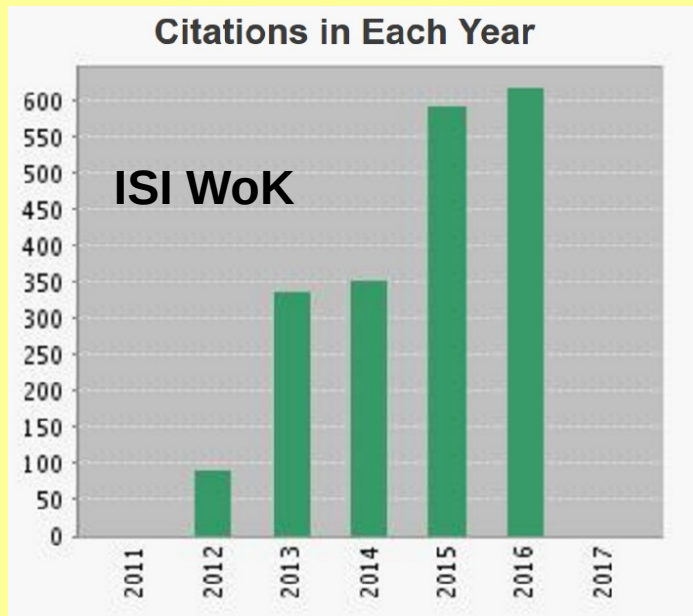
doi:10.1007/JHEP07(2016)013



LHC, LUX, PandaX, Xenon1T...



115 pubs in ISI WoK
134 presentations @ int confs
2 Graduate textbooks
7 PhD theses @ UV from 2012-2016
joint pubs with other IFIC-Teo groups
collaboration with IFIC-Exp is underway



Senior: José W.F. Valle (PI)
 Martin Hirsch (IC)
 Sergio Pastor (co-IP, CT)
 Mariam Tórtola (RyC-UV)

Postdocs

Avelino Vicente (JdIC-Inc), Renato Fonseca (JdIC-Form),
 Carlos Vaquera-Araujo (Mex), Nicolás Rojas (Chile),
 Stefano Gariazzo, Thomas Neder, Rahul Srivastava
Valentina de Romeri (S8A)

Grad students (1.25 PhD/staff)

Cesar Bonilla (PhD 2017), Pablo Fernández de Salas (FPU), **Gaetana Anamiati (GRI)**, Christoph Ternes (FPI)
 Ricardo Cepedello (FPU), Salvador Centelles (FPI-S8A)

FPA2014-58183-P (180 k€, 2015-2017)

PROMETEO II/2014/084, 2014-2017 (?)

Grupo emergente GV2016-142 (M. Tórtola)

