INTRODUÇÃO À INVESTIGAÇÃO

MEFT – 5º ANO

Filipe Rafael Joaquim (CFTP-DFIST)

DF
DEPARTAMENTO
DE FÍSICA
TÉCNICO LISBOA

Communicate in Science

"A good scientist is expected to communicate results and conclusions effectively, both in writing and by direct presentations, both to an audience of scientist specialists from different fields and to the general public."

"Surviving skills for scientists", Federico Rosei

Communication in Science:

Simplicity creates FOCUS

Hints to write a scientific article

The primary goal of an article is:

TO BE READ!

Hints to write a scientific article

Before starting to write…

WHAT – The you write must depend on the subject you are writing about

TO WHOM – The target audience determines the writing style

WHERE – The magazine/journal where you intend to publish your article may have constraints on the style.

Organize all your material before starting to write (experimental data, notes, calculations,…)

STRUCTURE

Introduction

Acknowledgements

Results

Title

TAIMRDAR

References

Methods

Abstract

Discussion/conclusions

STRUCTURE

Introdução

Acknowledgements/
Agradecimentos

Resultados

THIS STRUCTURE IS NOT UNIVERSAL AND CAN/SHOULD BE ADDAPTED TO EACH CASE

THEREFORE….

CONSIDER WHAT I WILL TELL YOU AS GUIDELINES TO WHAT YOU WILL WRITE

Abstract

Discussão/Conclusões

TAIMRDAR

Title and Abstract establish the first contact (and sometimes the only one) with the reader and/or Editors/Referees

Therefore, T&A must:

- Reflect the contents of the article independently of the access to the main text;
- Be as short and clear as possible;
- Emphasise the original aspects of the work;
- Avoid unnecessary details.

TAIMRDAR

The title may decide whether a potential reader will read the article or not…

- SHORT and “CATCHY”;
- Suitable to the kind of journal/magazine. It should not be too vague, but also not too descriptive. Balance!
- Avoid unnecessary words.

TAIMRDAR

"~~Study of~~ the ~~behaviour~~ of gravity in the presence of MCBH"

"Gravity in the presence of minimally-coupled black holes"

"How does gravity behave in the presence of minimally-coupled black holes?"

• • •

"~~Phenomenology of~~ the Higgs decaying into two photons in the presence of new heavy states at the LHC"

"New heavy states and $H \rightarrow \gamma\gamma$ at the LHC"

• • •

"~~The effects~~ of added calcium on salinity tolerance of tomato"

"Calcium addition improves salinity tolerance of tomato"

TAIMRDAR

Of course… There are hopeless cases…

~~“A comprehensive analysis of the ways to increase your financial power with internet resources”~~

“Top 10 ideas for online money-making”

“How to make money online”

“Get richer with the internet”

TAIMRDAR

THE ABSTRACT MUST SUMMARISE THE ENTIRE ARTICLE IN A SELF-CONTAINED WAY.

Physical Review D
particles, fields, gravitation, and cosmology

American Physical Society APS physics

Log in | Create Account (what's this?)
RSS Feeds | Email Alerts

Home Browse Search Subscriptions Help

Citation Search: Phys. Rev. Lett. Vol. Page/Article Go

Access provided through the subscription of Instituto Superior Tecnico Go Mobile!

APS > Journals > Phys. Rev. D > Volume 68 > Issue 3

< Previous Article | Next Article >

Phys. Rev. D 68, 033019 (2003) [10 pages]

Neutrino masses from beta decays after KamLAND and WMAP

Abstract References Citing Articles (18)

Download: PDF (139 kB) Export: BibTeX or EndNote (RIS)

F. R. Joaquim*
Centro de Física das Interacções Fundamentais (CFIF), Departamento de Física, Instituto Superior Técnico, Avenida Rovisco Pais, 1049-001 Lisboa, Portugal

Received 12 May 2003; published 25 August 2003

The first data released by the KamLAND Collaboration have confirmed the strong evidence in favor of the large mixing angle solution of the solar neutrino problem. Taking into account the ranges for the oscillation parameters allowed by the global analysis of the solar, CHOOZ and KamLAND data, we update the limits on the neutrinoless double beta decay effective neutrino mass parameter and analyze the impact of all the available data from neutrinoless double beta decay experiments on the neutrino mass bounds, in view of the latest WMAP results. For the normal neutrino mass spectrum the range (0.05–0.23) eV is obtained for the lightest neutrino mass if one takes into account the Heidelberg Moscow evidence for neutrinoless double beta decay and the cosmological bound. It is also shown that under the same conditions the mass of the lightest neutrino may not be bounded from below if the spectrum is of the inverted type. Finally, we discuss how future experiments can improve the present bounds on the lightest neutrino mass set by the Troitsk, Mainz, and Wilkinson microwave anisotropy probe results.

URL: http://link.aps.org/doi/10.1103/PhysRevD.68.033019
DOI: 10.1103/PhysRevD.68.033019
PACS: 14.60.Pq, 23.40.-s, 26.65.+t

*Electronic address: filipe@gtae3.ist.utl.pt

THAT'S WHY SOME PEOPLE LIKE TO WRITE THE ABSTRACT AT THE END OF THE WRITING PROCESS.

THE ABSTRACT MUST:

- SUMMARISE THE ARTICLE'S CONTENT IN A CLEAR AND SINTHETIC WAY.
  - Place the article in its context (I)
  - Objectives (I)
  - Methods (M)
  - Results (R)
  - Conclusions

All this:

Respecting possible constraints imposed by the journal/magazine.

TAIMRDAR

In the abstract you should avoid the use of:

- Equations
- Unknown acronyms
- References
- Ambiguous sentences

REMEMBER:

THE ABSTRACT SHOULD BE SELF-CONTAINED

TAIMRDAR

Abstract

A well prepared abstract should enable the reader to identify the basic content of a document quickly and accurately, to determine its relevance to their interests, and thus to decide whether to read the document in its entirety. The abstract should concisely state the principal objectives and scope of the investigation where these are not obvious from the title. More importantly, it should concisely summarize the results and principal conclusions. Do not include details of the methods employed unless the study is methodological, i.e. primarily concerned with methods.

The abstract must be concise, not exceeding 250 words. If you can convey the essential details of the paper in 100 words, do not use 200. Do not repeat information contained in the title. The abstract, together with the title, must be self-contained as it is published separately from the paper in abstracting services such as Biological Abstracts or Current Contents. Omit all references to the literature and to tables or figures, and omit obscure abbreviations and acronyms even though they may be defined in main body of the paper.

TAIMRDAR

EXAMPLE:

PHYSICAL REVIEW D **68**, 033019 (2003)

Neutrino masses from beta decays after KamLAND and WMAP

F. R. Joaquim*

Centro de Física das Interacções Fundamentais (CFIF), Departamento de Física, Instituto Superior Técnico, Avenida Rovisco Pais, 1049-001 Lisboa, Portugal

(Received 12 May 2003; published 28 August 2003)

The first data released by the KamLAND Collaboration have confirmed the strong evidence in favor of the large mixing angle solution of the solar neutrino problem. Taking into account the ranges for the oscillation parameters allowed by the global analysis of the solar, CHOOZ and KamLAND data, we update the limits on the neutrinoless double beta decay effective neutrino mass parameter and analyze the impact of all the available data from neutrinoless double beta decay experiments on the neutrino mass bounds, in view of the latest WMAP results. For the normal neutrino mass spectrum the range (0.05–0.23) eV is obtained for the lightest neutrino mass if one takes into account the Heidelberg-Moscow evidence for neutrinoless double beta decay and the cosmological bound. It is also shown that under the same conditions the mass of the lightest neutrino may not be bounded from below if the spectrum is of the inverted type. Finally, we discuss how future experiments can improve the present bounds on the lightest neutrino mass set by the Troitsk, Mainz, and Wilkinson microwave anisotropy probe results.

DOI: 10.1103/PhysRevD.68.033019 PACS number(s): 14.60.Pq, 23.40.−s, 26.65.+t

TAIMRDAR

The first data released by the KamLAND Collaboration have confirmed the strong evidence in favor of the large mixing angle solution of the solar neutrino problem. Taking into account the ranges for the oscillation

PHYSICAL REVIEW D **68**, 033019 (2003)

Neutrino masses from beta decays after KamLAND and WMAP

F. R. Joaquim*

Centro de Física das Interacções Fundamentais (CFIF), Departamento de Física, Instituto Superior Técnico, Avenida Rovisco Pais, 1049-001 Lisboa, Portugal

(Received 12 May 2003; published 28 August 2003)

The first data released by the KamLAND Collaboration have confirmed the strong evidence in favor of the large mixing angle solution of the solar neutrino problem. Taking into account the ranges for the oscillation parameters allowed by the global analysis of the solar, CHOOZ and KamLAND data, we update the limits on the neutrinoless double beta decay effective neutrino mass parameter and analyze the impact of all the available data from neutrinoless double beta decay experiments on the neutrino mass bounds, in view of the latest WMAP results. For the normal neutrino mass spectrum the range (0.05–0.23) eV is obtained for the lightest neutrino mass if one takes into account the Heidelberg-Moscow evidence for neutrinoless double beta decay and the cosmological bound. It is also shown that under the same conditions the mass of the lightest neutrino may not be bounded from below if the spectrum is of the inverted type. Finally, we discuss how future experiments can improve the present bounds on the lightest neutrino mass set by the Troitsk, Mainz, and Wilkinson microwave anisotropy probe results.

DOI: 10.1103/PhysRevD.68.033019 PACS number(s): 14.60.Pq, 23.40.−s, 26.65.+t

TAIMRDAR

large mixing angle solution of the solar neutrino problem. Taking into account the ranges for the oscillation parameters allowed by the global analysis of the solar, CHOOZ and KamLAND data, we update the limits on the neutrinoless double beta decay effective neutrino mass parameter and analyze the impact of all the available data from neutrinoless double beta decay experiments on the neutrino mass bounds, in view of the latest WMAP results. For the normal neutrino mass spectrum the range (0.05–0.23) eV is obtained for the lightest

Neutrino masses from beta decays after KamLAND and WMAP

F. R. Joaquim*

Centro de Física das Interacções Fundamentais (CFIF), Departamento de Física, Instituto Superior Técnico, Avenida Rovisco Pais, 1049-001 Lisboa, Portugal

(Received 12 May 2003; published 28 August 2003)

The first data released by the KamLAND Collaboration have confirmed the strong evidence in favor of the large mixing angle solution of the solar neutrino problem. Taking into account the ranges for the oscillation parameters allowed by the global analysis of the solar, CHOOZ and KamLAND data, we update the limits on the neutrinoless double beta decay effective neutrino mass parameter and analyze the impact of all the available data from neutrinoless double beta decay experiments on the neutrino mass bounds, in view of the latest WMAP results. For the normal neutrino mass spectrum the range (0.05–0.23) eV is obtained for the lightest neutrino mass if one takes into account the Heidelberg-Moscow evidence for neutrinoless double beta decay and the cosmological bound. It is also shown that under the same conditions the mass of the lightest neutrino may not be bounded from below if the spectrum is of the inverted type. Finally, we discuss how future experiments can improve the present bounds on the lightest neutrino mass set by the Troitsk, Mainz, and Wilkinson microwave anisotropy probe results.

DOI: 10.1103/PhysRevD.68.033019 PACS number(s): 14.60.Pq, 23.40.−s, 26.65.+t

TAIMRDAR

WMAP results. For the normal neutrino mass spectrum the range (0.05–0.23) eV is obtained for the lightest neutrino mass if one takes into account the Heidelberg-Moscow evidence for neutrinoless double beta decay and the cosmological bound. It is also shown that under the same conditions the mass of the lightest neutrino may not be bounded from below if the spectrum is of the inverted type. Finally, we discuss how future experiments can improve the present bounds on the lightest neutrino mass set by the Troitsk, Mainz, and Wilkinson microwave anisotropy probe results.

Neutrino masses from beta decays after KamLAND and WMAP

F. R. Joaquim*

Centro de Física das Interacções Fundamentais (CFIF), Departamento de Física, Instituto Superior Técnico, Avenida Rovisco Pais, 1049-001 Lisboa, Portugal

(Received 12 May 2003; published 28 August 2003)

The first data released by the KamLAND Collaboration have confirmed the strong evidence in favor of the large mixing angle solution of the solar neutrino problem. Taking into account the ranges for the oscillation parameters allowed by the global analysis of the solar, CHOOZ and KamLAND data, we update the limits on the neutrinoless double beta decay effective neutrino mass parameter and analyze the impact of all the available data from neutrinoless double beta decay experiments on the neutrino mass bounds, in view of the latest WMAP results. For the normal neutrino mass spectrum the range (0.05–0.23) eV is obtained for the lightest neutrino mass if one takes into account the Heidelberg-Moscow evidence for neutrinoless double beta decay and the cosmological bound. It is also shown that under the same conditions the mass of the lightest neutrino may not be bounded from below if the spectrum is of the inverted type. Finally, we discuss how future experiments can improve the present bounds on the lightest neutrino mass set by the Troitsk, Mainz, and Wilkinson microwave anisotropy probe results.

DOI: 10.1103/PhysRevD.68.033019 PACS number(s): 14.60.Pq, 23.40.−s, 26.65.+t

TAIMRDAR

Quantum biology

Neill Lambert, Yueh-Nan Chen, Yuan-Chung Cheng, Che-Ming Li, Guang-Yin Chen & Franco Nori

Affiliations | Corresponding authors

Nature Physics **9**, 10–18 (2013) | doi:10.1038/nphys2474
Received 01 July 2012 | Accepted 04 October 2012 | Published online 09 December 2012

Citation | Reprints | Rights & permissions | Article metrics

Abstract

Abstract • References • Author information

Recent evidence suggests that a variety of organisms may harness some of the unique features of quantum mechanics to gain a biological advantage. These features go beyond trivial quantum effects and may include harnessing quantum coherence on physiologically important timescales. In this brief review we summarize the latest results for non-trivial quantum effects in photosynthetic light harvesting, avian magnetoreception and several other candidates for functional quantum biology. We present both the evidence for and arguments against there being a functional role for quantum coherence in these systems.

Subject terms: Biological physics • Quantum physics

TAIMRDAR

PRL **97,** 181801 (2006) PHYSICAL REVIEW LETTERS week ending 3 NOVEMBER 2006

Gauge and Yukawa Mediated Supersymmetry Breaking in the Triplet Seesaw Scenario

Filipe R. Joaquim[1,2] and Anna Rossi[1]

[1]*Dipartimento di Fisica "G. Galilei", Università di Padova, I-35131 Padua, Italy*

[2]*Istituto Nazionale di Fisica Nucleare, Sezione di Padova, I-35131 Padua, Italy*

(Received 20 April 2006; published 31 October 2006)

We propose a novel supersymmetric unified scenario of the triplet seesaw mechanism where the exchange of the heavy triplets generates both neutrino masses and soft supersymmetry breaking terms. Our framework is very predictive since it relates neutrino mass parameters, lepton-flavor-violation in the slepton sector, sparticle and Higgs spectra, and electroweak symmetry breakdown. The phenomenological viability and experimental signatures in lepton flavor-violating processes are discussed.

DOI: 10.1103/PhysRevLett.97.181801 PACS numbers: 12.60.Jv, 12.10.Dm, 14.60.Pq

TAIMRDAR

Demographic constraints on niche evolution in a source-sink dynamical model with Allee effects

João de A. Martins[1], 65695.
[1]Instituto Superior Técnico, Lisboa

Any biological population is limited to a certain range of conditions which define its niche. Outside their niches, species can only maintain a population via immigration unless they undergo an adaption process that lets them establish a stable population on an initially non favourable environment. In this work we study the adaption process using a source-sink dynamical model with Allee effects through which we study the effects of demography on niche evolution. With this model we analyse the selection pressure caused by fluctuations of local proliferation rates showing that the specific quantity targeted by the mutation can influence the existence of niche conservation. In the last section of the paper, we preform a brief analysis on the demographic constraints caused by the Allee effects on the establishment of a stable population by a favourable mutant.

A Review on Brain Computer Interfaces

Hugo Pereira Hugon
Instituto Superior Técnico (IST), 2013
Prof. Filipe Rafael Joaquim

Brain Computer Interfaces (BCIs) research has been of growing importance within the aim of restoring movement and providing communication capabilities to people with paralysis. A review of the technology with its advantages and disadvantages is presented, as well as an overview of recent achievements, problems and future perspectives

Introdução à Investigação

Mestrado Integrado em Engenharia Física Tecnológica 2012/2013 - Instituto Superior Técnico (IST)

(Dated: May 8, 2013)

Radial profiles of U_{fl} and I_{sat} were measured for GOLEM tokamak edge plasma. We discovered that, for deeper positions of the probe, the plasma is disturbed. The safe depth of the probe was estimated. The radial poloidal velocity, as well as the radial electron density, were determined. For the second part, polar dependence of radial profiles of U_{fl} and I_{sat} were measured for 4 different angles.

Introdução à Investigação

Professor Responsável: Filipe Joaquim

Mestrado Integrado em Engenharia Física Tecnológica

Instituto Superior Técnico

(Dated: 25/5/2013)

This paper gives an brief introduction to some fundamental concepts of Quantum Game theory , focusing on some concepts of Game theory and its adaptation to quantum theory. It will be introduced some concepts of information theory , the n-qubit system and its framework. It will show the Quantum Prisioners Dillema and its classical counterpart.

The *Introduction*

A scientific paper communicates new research information to scientists, so its first objective ought to be to demonstrate that the story being told is worth telling—that it is scientifically sound and addresses an issue plausibly and logically. The *Introduction* is where the author convinces the reader that the work has been well thought out and, at the same time, orientates the reader's thinking along the same pathway as that of the author. In short, it is the powerhouse of your article that should be feeding life into every other section of the paper.

A good *Introduction* goes much further than just stating the problem and acquainting the reader with the relevant literature. It should describe a series of logical steps that end in a statement of what the experiment is about, why you did it and what you expected to get from it. If you have done a good job in constructing the *Introduction*, you will have converted the reader from a passive and relatively disinterested recipient of the information you want to communicate into an enthusiastic seeker of information.

"Scientific writing=thinking in words", David Lindsay, Csiro Publishing (2011)

TAIMRDAR

BACKGROUND

- Place the reader in the work's context and justify its importance;
- Summarise the state-of-the-art;
- Refer to previous results when appropriate;

GAP

- Identify the existent GAP and how the present work is going to fill it.

PLAN OF ATTACK

- What's the strategy/methods applied to accomplish the objectives.
- Structure of the article (optional)

TA MRDAR

Introdução à Investigação • Maio de 2013

Estudo e aplicação do modelo epidemiológico SIR

João Miguel Abrantes

Instituto Superior Técnico

I. Introdução

A convivência da espécie humana com os microrganismos é marcada por episódios dramáticos da nossa História. Desde a antiguidade que as doenças infecciosas têm um impacto desastroso e representam o medo na Humanidade. A sua disseminação invadiu comunidades, dizimou populações e exterminou raças. No sentido de avaliar a dimensão das maiores epidemias da literatura histórica, pode mesmo constatar-se a existência de um número de mortes superior ao número de baixas nos campos de batalha do passado [1]. Deste modo, tornou-se importante substituir as causas divinas e religiosas ancestrais por medidas preventivas de combate à disseminação de doenças infecciosas. No entanto, a compreensão dos seus mecanismos não era suficiente e começou a analisar-se o problema de um ponto de vista quantitativo que, por conseguinte, levou à utilização de modelos matemáticos em epidemiologia.

O recurso a modelos matemáticos começou rapidamente a ter um papel fundamental na análise da evolução das interações entre os seres vivos e o meio ambiente. Através desta análise foi possível estudar a dinâmica de uma doença infecciosa, avaliar o comportamento futuro do sistema e a reação a diferentes tipos de perturbação, de modo a compreender o mecanismo da sua propagação e planear as estratégias de controlo do seu impacto na sociedade, como por exemplo a vacinação sazonal.

Os primeiros desenvolvimentos neste domínio basearam-se na distinção entre os indivíduos afectados e aqueles que ainda se encontram saudáveis. Em 1906, W. H. Hamer defendeu que a origem de uma epidemia depende da taxa de contacto entre os indivíduos susceptíveis e os indivíduos que apresentem a doença infecciosa, com capacidade de a transmitir [2]. Os avanços científicos da segunda metade do século XX permitem assim concluir que a Epidemiologia Matemática seja considerada, actualmente, um campo de pesquisa em considerável desenvolvimento, nomeadamente na aplicação da teoria de controlo a sistemas dinâmicos epidemiológicos, na caracterização espacial de doenças infecciosas, entre outros temas. Note-se que a Epidemiologia Matemática resulta da colaboração de especialistas em várias áreas de conhecimento como epidemiologistas, biólogos, matemáticos e físicos.

TAIMRDAR

Introdução à Investigação • Maio de 2013

Estudo e aplicação do modelo epidemiológico SIR

João Miguel Abrantes

Instituto Superior Técnico

Neste trabalho pretende-se apresentar as bases da teoria epidemiológica, bem como demonstrar e analisar os fundamentos matemáticos do modelo SIR. Antes de avançar para as considerações finais, será dado ênfase a um exemplo hipotético de aplicação do modelo. Por fim, serão sumarizados todos os resultados da aplicação de um modelo epidemiológico simples, como o modelo SIR, e apresentados os futuros desenvolvimentos neste domínio.

The *Materials and Methods*

The *Materials and Methods* is a great place to get your writing under way and build up some confidence for the more challenging parts of your paper. It is generally uncomplicated because it does not require that you do much interpretation. What you did was what you did and you can't change that—even if, on reflection or with the benefit of experience, you think you could have done it better. The task here is to describe what you did in such a way that an informed colleague in the field could repeat the experiment based on the information you provide.

"Scientific writing=thinking in words", David Lindsay, Csiro Publishing (2011)

Here you describe in detail what you mentioned briefly in the intro.

FOR THE READER TO BE ABLE TO REPEAT YOU EXPERIMENT AND REPRODUCE YOUR RESULTS YOU MUST PROVIDE INFO ABOUT:

- MATERIALS
- EQUIPMENT (MODELS, etc…)
- THE CONDITIONS UNDER WHICH THE EXPERIMENT WAS DONE
- DATA ACUISITION SYSTEM

….

FOR THE READER TO REPEAT YOUR CALCULATIONS:

WHAT IS WHAT?

$$\omega\,,\omega_0\,,I\,,\theta^*\,,g\,,\omega_*$$

MOREOVER, do not hide RELEVANT info from the reader (approximations, assumptions, validity limits, etc…

A. A Basic approach

The simplest model [1] determines the domino wave velocity from the conservation of energy (1) and the conservation of momentum in the direction of the propagating wave (2). The equations that correspond to these principles are:

$$Mg\frac{H}{2}+\frac{1}{2}I{\omega_0}^2=Mg\frac{H}{2}\cos\theta+\frac{1}{2}I\omega^2 \qquad (1)$$

$$\omega_0=\omega_*\cos\theta_*. \qquad (2)$$

These equations mean that the energy when the domino is facing upward ($\theta=0$) is equal to the domino's energy at any other orientation. If we consider that $I=\frac{1}{3}MH^2$, using the thin domino approximation, we can remove one of the variables that are in the equation and we can extend this idea from the angle $\theta=0$ to the angle $\theta=\theta_*$, where the two dominoes collide. Simple calculations result in the following:

The *Results*

To borrow a legal phrase, *Results* means: the results, all the results and nothing but the results. This seems so simple and obvious that you might consider it unnecessary to express it. But you would be surprised at the number of times that one finds results appearing for the first time in the *Discussion* of drafts of articles or, even worse, in the *Summary*. The *Results* section is where readers expect to find all the results that you intend presenting and so that is where you should put them. A reader who finds them anywhere else is likely to be confused about exactly what you found.

Occasionally, in very short or very simple papers, there is little or nothing to discuss after the results have been presented. In these relatively rare cases, it may be possible to add whatever discussion is necessary to the results wherever it seems appropriate and the *Results* section would then be renamed *Results and Discussion*.

Separating Results *from* Discussion *preserves the objectivity of the* Results *which should be presented clearly and clinically without comment.*

"Scientific writing=thinking in words", David Lindsay, Csiro Publishing (2011)

WHAT TO PRESENT?

- Present ONLY what is relevant: less is (sometimes) more;

- Only present results which are going to be discussed;

- Chose the data which will allow you to discuss particular (innovative) aspects of your model/technique

NEGATIVE RESULTS ARE ALSO RESULTS

Results that you were not expecting may allow you to identify limitations of your setup/methods/theory/…

HOW TO PRESENT?

PLOTS, TABLES, BOTH?

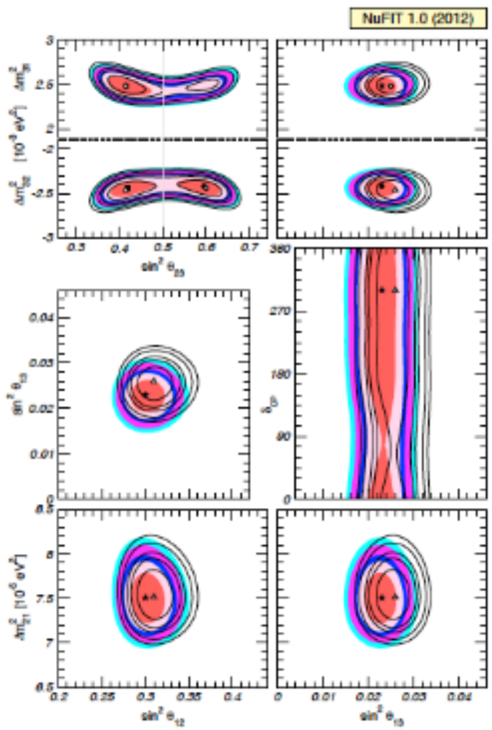


Figure 1. Global 3ν oscillation analysis. Each panels shows two-dimensional projection of the allowed six-dimensional region after marginalization with respect to the undisplayed parameters. The different contours correspond to the two-dimensional allowed regions at 1σ, 90%, 2σ, 99% and 3σ CL (2 dof). Results for different assumptions concerning the analysis of data from reactor experiments are shown: full regions correspond to analysis with the normalization of reactor fluxes left free and data from short-baseline (less than 100 m) reactor experiments are included. For void regions short-baseline reactor data are not included but reactor fluxes as predicted in [42] are assumed. Note that as atmospheric mass-squared splitting we use Δm^2_{31} for NO and Δm^2_{32} for IO.

Global fit to three neutrino mixing: critical look at present precision

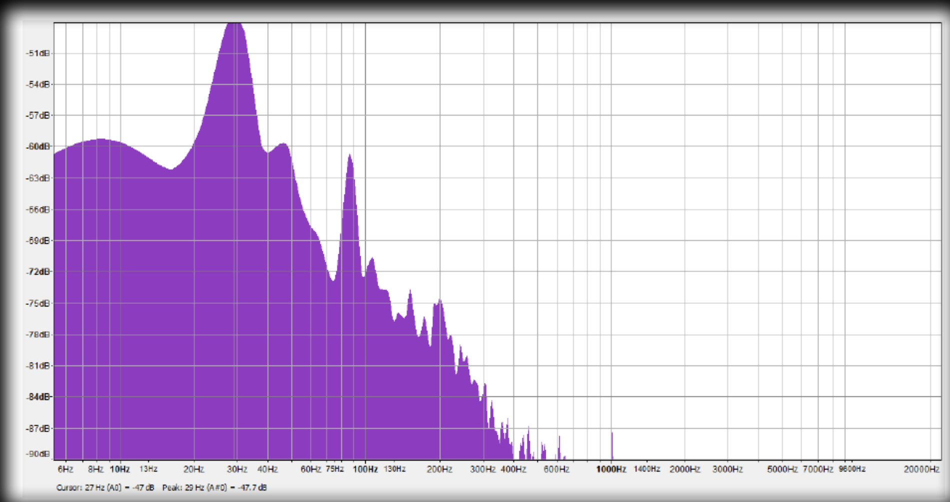
M. C. Gonzalez-Garcia,[a,b] Michele Maltoni,[c] Jordi Salvado,[d] Thomas Schwetz[e]

	Free Fluxes + RSBL		Huber Fluxes, no RSBL	
	bfp $\pm 1\sigma$	3σ range	bfp $\pm 1\sigma$	3σ range
$\sin^2\theta_{12}$	$0.302^{+0.013}_{-0.012}$	$0.267 \to 0.344$	$0.311^{+0.013}_{-0.013}$	$0.273 \to 0.354$
$\theta_{12}/^\circ$	$33.36^{+0.81}_{-0.78}$	$31.09 \to 35.89$	$33.87^{+0.82}_{-0.80}$	$31.52 \to 36.49$
$\sin^2\theta_{23}$	$0.413^{+0.037}_{-0.025} \oplus 0.594^{+0.021}_{-0.022}$	$0.342 \to 0.667$	$0.416^{+0.036}_{-0.029} \oplus 0.600^{+0.019}_{-0.026}$	$0.341 \to 0.670$
$\theta_{23}/^\circ$	$40.0^{+2.1}_{-1.5} \oplus 50.4^{+1.3}_{-1.3}$	$35.8 \to 54.8$	$40.1^{+2.1}_{-1.6} \oplus 50.7^{+1.2}_{-1.5}$	$35.7 \to 55.0$
$\sin^2\theta_{13}$	$0.0227^{+0.0023}_{-0.0024}$	$0.0156 \to 0.0299$	$0.0255^{+0.0024}_{-0.0024}$	$0.0181 \to 0.0327$
$\theta_{13}/^\circ$	$8.66^{+0.44}_{-0.46}$	$7.19 \to 9.96$	$9.20^{+0.41}_{-0.45}$	$7.73 \to 10.42$
$\delta_{CP}/^\circ$	300^{+66}_{-138}	$0 \to 360$	298^{+59}_{-145}	$0 \to 360$
$\frac{\Delta m^2_{21}}{10^{-5}\ \mathrm{eV}^2}$	$7.50^{+0.18}_{-0.19}$	$7.00 \to 8.09$	$7.51^{+0.21}_{-0.15}$	$7.04 \to 8.12$
$\frac{\Delta m^2_{31}}{10^{-3}\ \mathrm{eV}^2}$ (N)	$+2.473^{+0.070}_{-0.067}$	$+2.276 \to +2.695$	$+2.489^{+0.055}_{-0.051}$	$+2.294 \to +2.715$
$\frac{\Delta m^2_{32}}{10^{-3}\ \mathrm{eV}^2}$ (I)	$-2.427^{+0.042}_{-0.065}$	$-2.649 \to -2.242$	$-2.468^{+0.073}_{-0.065}$	$-2.678 \to -2.252$

Table 1. Three-flavour oscillation parameters from our fit to global data after the Neutrino 2012 conference. For “Free Fluxes + RSBL” reactor fluxes have been left free in the fit and short baseline reactor data (RSBL) with $L \lesssim 100$ m are included; for “Huber Fluxes, no RSBL” the flux prediction from [42] are adopted and RSBL data are not used in the fit.

TAIMRDAR

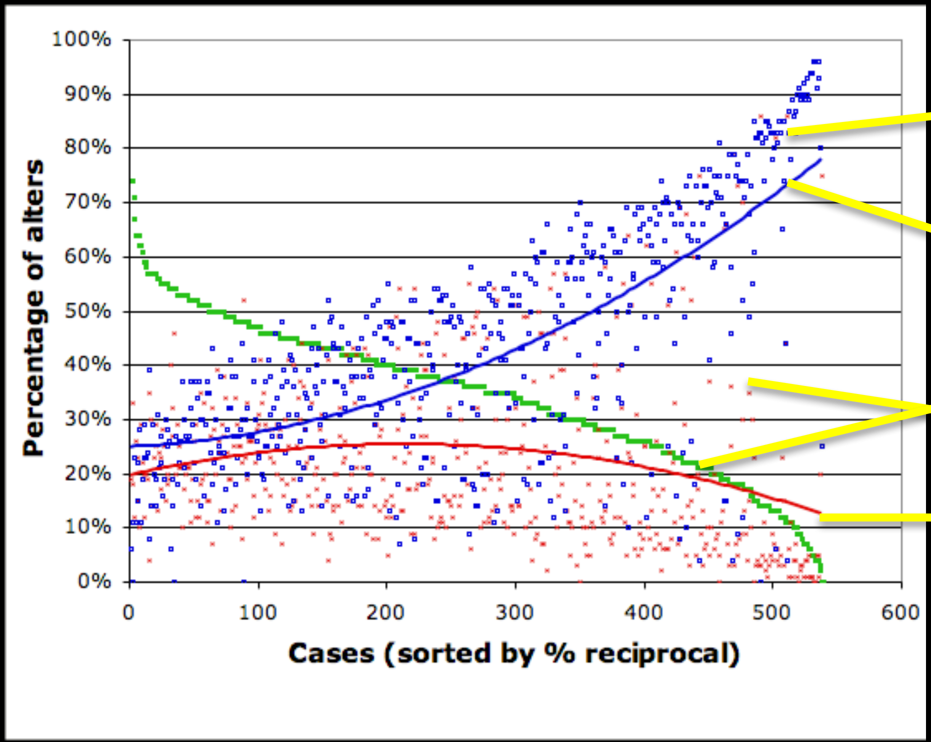
WE ARE IN THE 21ST CENTURY… YOU CAN DO BETTER THAN THIS



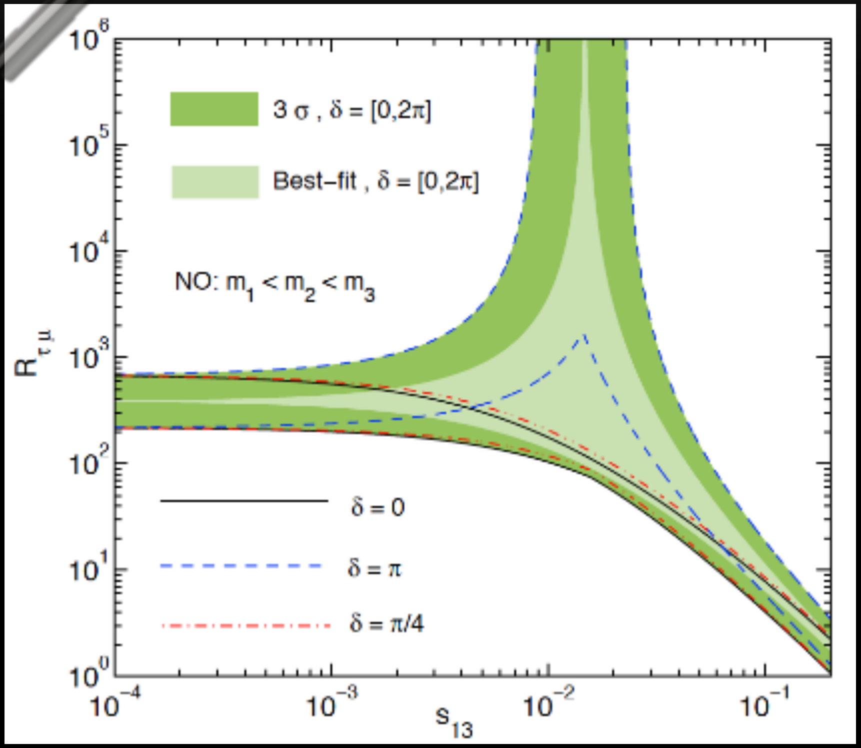
AXES MUST HAVE LABELS

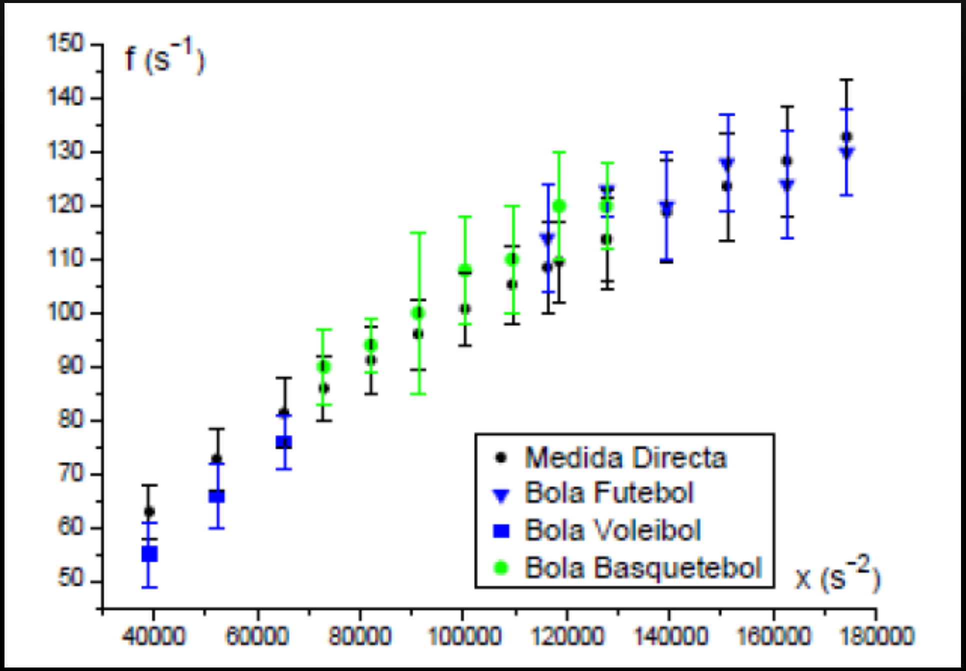
(with units). And everything should be readable without an electronic microscope.

PLOTS SHOULD BE SELF-CONTAINED!



DOIS BONS EXEMPLOS:





REMEMBER THAT THESE PLOTS WILL BE THE SAME TO BE USED IN YOUR ORAL PRESENTATION!!! So…

Perhaps it’s a good idea that people can actually SEE them…

PLOTS AND TABELS MUST HAVE CAPTIONS:

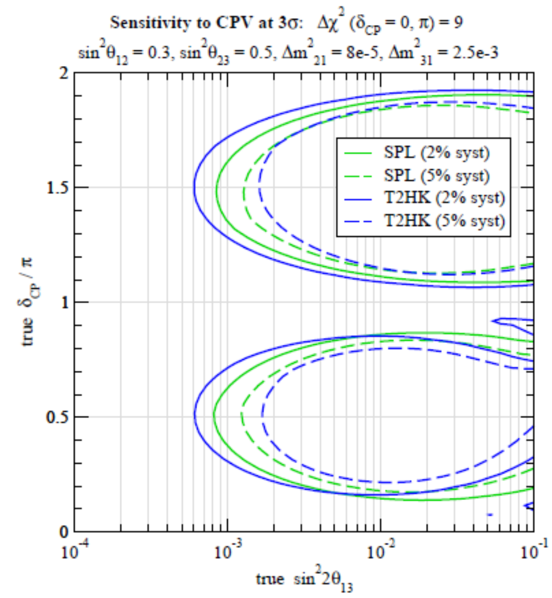


FIG. 7 SPL and T2HK CPV discovery potential. Inside the regions delimited by the solid (dashed) lines, CP conservation can be excluded at the 3σ level, considering systematic errors of 2% (5%). From (Bandyopadhyay *et al.*, 2009; Campagne *et al.*, 2007).

TABLE II Present upper bounds for the branching ratios of flavor-violating charged-lepton decays $l_j \to l_i\gamma$ and $l_i \to l_j l_k l_k$ ($j,k \neq i$) and the μ-e conversion rate in titanium (Ti).

$\mu \to e\gamma$	2.4×10^{-12}	(Adam *et al.*, 2011)
$\tau \to \mu\gamma$	4.4×10^{-8}	(Aubert *et al.*, 2010)
$\tau \to e\gamma$	3.3×10^{-8}	(Aubert *et al.*, 2010)
$\mu^- \to e^+e^-e^-$	1.0×10^{-12}	(Bellgardt *et al.*, 1988)
$\tau^- \to \mu^+\mu^-\mu^-$	3.2×10^{-8}	(Hayasaka *et al.*, 2010)
$\tau^- \to e^+e^-e^-$	3.6×10^{-8}	(Hayasaka *et al.*, 2010)
$\tau^- \to e^+\mu^-\mu^-$	2.3×10^{-8}	(Hayasaka *et al.*, 2010)
$\tau^- \to e^-\mu^+\mu^-$	4.1×10^{-8}	(Hayasaka *et al.*, 2010)
$\tau^- \to \mu^+e^-e^-$	2.0×10^{-8}	(Hayasaka *et al.*, 2010)
$\tau^- \to \mu^-e^+e^-$	2.7×10^{-8}	(Hayasaka *et al.*, 2010)
$\mu \to e$ in Ti	4.3×10^{-12}	(Dohmen *et al.*, 1993)

What makes an effective *Discussion*?

The first thing to appreciate is that *Discussion* means the discussion of *your* results and not those of others. You discuss *your* results in relation to those of others and, possibly, in relation to the 'real world'—their applicability to some practical situation or to the wider sphere of your scientific discipline. Therefore, it is *not* a section in which you launch into a review of the literature on the subject. All literature that you cite must be there because it supports or adds meaning to arguments about *your* results. For example, a statement of the form:

"Scientific writing=thinking in words", David Lindsay, Csiro Publishing (2011)

TAIMRDAR

IN YOUR DISCUSSION YOU SHOULD ANSWER TO THE FOLLOWING QUESTIONS:

- Which principles where established or reinforced?
- Which are the theoretical/experimental implications of your work?
- How are your results when compared with previously obtained ones?
- How can you improve your results?

RESULTS ARE WHAT THEY ARE, SO:

YOUR DISCUSSION SHOULD BE CRITICAL

MAGNIFYING THE IMPORTANCE OF YOUR RESULTS REMOVES SCIENTIFIC CREDIBILITY TO YOUR WORK

The world (in which you are included) is not perfect. So, always try to discuss how you can improve your results…

THE DISCUSSION MUST BE CRITICAL

The world (in which you are included) is not perfect. So, always try to discuss how you can improve your results…

após uma colisão. Sugere-se a realização da experiência num estúdio que filtre o ruído electromagnético e sonoro e que o instante correspondente à subida da bola seja analisado mais detalhadamente. Assim, se houver as condições necessárias, é possível, teoricamente, calcular aproximadamente todas as caraterísticas da bola utilizando apenas o som. Sugere-se também o estudo matemático do comportamento do sistema de equações que constituem o modelo, já que foi efectuado apenas um teste numérico.

ACKNOWLEDGEMENTS / AGRADECIMENTOS

In this section you thank everyone who contributed (in a relevant way) to your work, and you acknowledge funding agencies.

Acknowledgments

We thank Werner Porod and Florian Staub for helpful discussions and assistance with SPheno. M.H. acknowledges support from the Spanish MICINN grants FPA2011-22975, MULTIDARK CSD2009-00064 and by the Generalitat Valenciana grant Prometeo/2009/091 and the EU Network grant UNILHC PITN-GA-2009-237920. F.R.J. thanks the CERN Theory Division for hospitality during the final stage of this work and acknowledges support from the EU Network grant UNILHC PITN-GA-2009-237920 and from the *Fundação para a Ciência e a Tecnologia* (FCT, Portugal) under the projects CERN/FP/123580/2011, PTDC/FIS/098188/2008 and CFTP-FCT UNIT 777. A.V. acknowledges support by the ANR project CPV-LFV-LHC NT09-508531.

When you refer to work/results from other authors (or from you) or when you use directly material from other publications

THE ORIGINAL SOURCE HAS TO BE CITED

mediators could possibly leave signatures at high-energy colliders like the Large Hadron Collider (LHC). Heavy neutrino singlets, such as those introduced in type-I seesaw [1–5], can be produced in association with a charged lepton, but the small mixing with the SM particles [6–9] leads to hardly observable production rates for the new fermions [10] (pair production is even more suppressed except in the presence of new neutral bosons [11–14]). On the other hand, scalar triplets of a type-II seesaw [15–19] and triplet fermions of a type-III seesaw [20] can be produced in pairs via electroweak gauge interactions, with cross sections that could allow for their observation at the LHC [21–27].

[1] P. Minkowski, Phys. Lett. B **67**, 421 (1977).
[2] M. Gell-Mann, P. Ramond and R. Slansky, Conf. Proc. C **790927**, 315 (1979).
[3] T. Yanagida, in *Proceedings of the Workshop on the Unified Theory and the Baryon Number in the Universe*, eds. O. Sawada and A. Sugamoto (KEK, Tsukuba, 1979), p. 95.
[4] S.L. Glashow, in *Quarks and Leptons*, eds. M. Lévy et al., (Plenum, 1980, New-York), p. 707.
[5] R. N. Mohapatra and G. Senjanovic, Phys. Rev. Lett. **44**, 912 (1980).
[6] E. Nardi, E. Roulet and D. Tommasini, Phys. Lett. B **327**, 319 (1994).
[7] D. Tommasini, G. Barenboim, J. Bernabeu and C. Jarlskog, Nucl. Phys. B **444**, 451 (1995).
[8] F. del Aguila, J. de Blas and M. Perez-Victoria, Phys. Rev. D **78**, 013010 (2008).

TAIMRDAR

The bibliographical format is usually imposed by the journal.

ible with the solar and atmospheric neutrino oscillation data (González Felipe and Joaquim, 2001). Such a de-

Farzan, Y., and A. Y. Smirnov (2007), JHEP **01**, 059, arXiv:hep-ph/0610337.

Fernandez-Martinez, E., M. B. Gavela, J. Lopez-Pavon, and O. Yasuda (2007), Phys. Lett. B **649**, 427, arXiv:hep-ph/0703098.

Fernandez Martinez, E., T. Li, S. Pascoli, and O. Mena

Beams) (2001), arXiv:hep-ph/0105297.

González Felipe, R., and F. R. Joaquim (2001), JHEP **09**, 015, arXiv:hep-ph/0106226.

González Felipe, R., F. R. Joaquim, and B. M. Nobre (2004), Phys. Rev. D **70**, 085009, arXiv:hep-ph/0311029.

González Felipe, R., and H. Serôdio (2010), Phys. Rev. D **81**,

WARNING

THIS STRUCTURE IS NOT UNIVERSAL AND CAN/SHOULD BE ADDAPTED TO EACH CASE

THEREFORE….

CONSIDER WHAT I WILL TELL YOU AS GUIDELINES TO WHAT YOU WILL WRITE

Letters, articles, reviews, short communications, conference proceedings…

Ex: for short articles sometimes splitting your articles in sections is not a good idea

WARNING

Gauge and Yukawa Mediated Supersymmetry Breaking in the Triplet Seesaw Scenario

Filipe R. Joaquim[1,2] and Anna Rossi[1]

[1]Dipartimento di Fisica "G. Galilei", Università di Padova, I-35131 Padua, Italy

[2]Istituto Nazionale di Fisica Nucleare, Sezione di Padova, I-35131 Padua, Italy

(Received 20 April 2006; published 31 October 2006)

We propose a novel supersymmetric unified scenario of the triplet seesaw mechanism where the exchange of the heavy triplets generates both neutrino masses and soft supersymmetry breaking terms. Our framework is very predictive since it relates neutrino mass parameters, lepton-flavor-violation in the slepton sector, sparticle and Higgs spectra, and electroweak symmetry breakdown. The phenomenological viability and experimental signatures in lepton flavor-violating processes are discussed.

DOI: 10.1103/PhysRevLett.97.181801 PACS numbers: 12.60.Jv, 12.10.Dm, 14.60.Pq

Modern particle physics has been confronting the intriguing issue of neutrino mass generation and its phenomenological implications. The seesaw mechanism provides a natural explanation for the generation of neutrino masses and their suppression with respect to the other fermion masses of the standard model (SM). In its most popular versions, the seesaw mechanism is realized either by exchanging singlet fermions N [1], or a $SU(2)_W$ scalar triplet T with nonzero hypercharge [2], at a high scale M_L. An attractive feature of the supersymmetric version of the above scenarios is that lepton flavor-violating (LFV) processes (otherwise unobservable) can be enhanced through one-loop exchange of lepton superpartners if their masses do not conserve flavor. Regarding this aspect, most of the literature has been focusing on the most conservative scenario of universal sfermion masses at high energy, as in minimal supergravity or gauge-mediated supersymmetry (SUSY) breaking models. In such cases, flavor nonconservation in the sfermion masses arises from renormalization group (RG) effects due to flavor-violating Yukawa couplings [3–5]. We recall that in the triplet seesaw the flavor structure of the slepton mass matrix $\mathbf{m}_{\tilde{L}}^2$ after RG running can be univocally determined in terms of the low-energy neutrino parameters [5]. This is in contrast with the singlet seesaw where the structure of $\mathbf{m}_{\tilde{L}}^2$ cannot be unambiguously related to the neutrino parameters.

In this Letter we present a novel SUSY scenario of the triplet seesaw mechanism in which the soft SUSY-breaking (SSB) parameters in the minimal supersymmetric extension of the SM (MSSM) are generated at the decoupling of the heavy triplets and the mass scale of such SSB terms is fixed *only* by the triplet SSB bilinear term B_T. This scenario is highly predictive since it relates neutrino masses, LFV in the sfermion sector, sparticle and Higgs spectra, and electroweak symmetry breaking (EWSB).

The supersymmetric version of the triplet seesaw requires introducing the triplets as supermultiplets T, $\bar{T}$ in a vectorlike $SU(2)_W \times U(1)_Y$ representation, $T \sim (3, 1)$, $\bar{T} \sim (3, -1)$. In order to preserve successful gauge coupling unification, we embed our framework in a $SU(5)$ grand unified theory (GUT) [5] where the triplet states fit into the 15 representation $15 = S + T + Z$ transforming as $S \sim (6, 1, -\frac{2}{3})$, $T \sim (1, 3, 1)$, $Z \sim (3, 2, \frac{1}{6})$ under $SU(3) \times SU(2)_W \times U(1)_Y$ (the $\overline{15}$ decomposition is obvious). The SUSY-breaking mechanism is parametrized by a gauge singlet chiral supermultiplet X, whose scalar S_X and auxiliary F_X components are assumed to acquire a vacuum expectation value through some unspecified dynamics in the secluded sector. It is suggestive to assume that the $SU(5)$ model conserves the combination $B - L$ of baryon and lepton number. As a result, the relevant superpotential reads

$$W_{SU(5)} = \frac{1}{\sqrt{2}}(\mathbf{Y}_{15}\bar{5}\,15\,\bar{5} + \lambda 5_H \overline{15} 5_H) + \mathbf{Y}_5 \bar{5}\,\bar{5}_H 10 + \mathbf{Y}_{10} 10\,10\,5_H + M_5 5_H \bar{5}_H + \xi X 15\,\overline{15}, \quad (1)$$

where the matter multiplets are understood as $\bar{5} = (d^c, L)$, $10 = (u^c, e^c, Q)$ and the Higgs doublets fit with their colored partners, $t, \bar{t}$ like $5_H = (t, H_2)$, $\bar{5}_H = (\bar{t}, H_1)$. The $B - L$ quantum numbers are a combination of the hypercharges and the following charges: $Q_{10} = \frac{1}{5}$, $Q_{\bar{5}} = -\frac{3}{5}$, $Q_{5_H} = -\frac{2}{5}$, $Q_{\bar{5}_H} = \frac{2}{5}$, $Q_{15} = \frac{6}{5}$, $Q_{\overline{15}} = \frac{4}{5}$ and $Q_X = -2$. The form of $W_{SU(5)}$ implies that the 15, $\overline{15}$ states play the role of *messengers* of both $B - L$ and SUSY breaking to the visible (MSSM) sector thanks to the coupling with X. Namely, while $\langle S_X \rangle$ only breaks $B - L$, $\langle F_X \rangle$ breaks both SUSY and $B - L$. These effects are parametrized by the superpotential mass term $M_{15} 15 \overline{15}$, where $M_{15} = \xi \langle S_X \rangle$, and the bilinear SSB term $-BM_{15} 15 \overline{15}$, with $BM_{15} = -\xi \langle F_X \rangle$. Once $SU(5)$ is broken to the SM group we find [5], below the GUT scale M_G,

$$W = W_0 + W_T + W_{S,Z}$$

$$W_0 = \mathbf{Y}_e e^c H_1 L + \mathbf{Y}_d d^c H_1 Q + \mathbf{Y}_u u^c Q H_2 + \mu H_2 H_1$$

$$W_T = \frac{1}{\sqrt{2}}(\mathbf{Y}_T L T L + \lambda H_2 \bar{T} H_2) + M_T T \bar{T}$$

$$W_{S,Z} = \frac{1}{\sqrt{2}}\mathbf{Y}_S d^c S d^c + \mathbf{Y}_Z d^c Z L + M_Z Z \bar{Z} + M_S S \bar{S}. \quad (2)$$

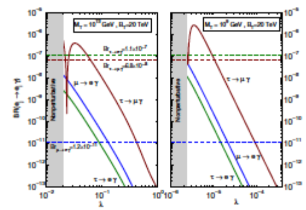


FIG. 2 (color online). Branching ratios of the lepton radiative decays. The horizontal lines indicate the present bound on each BR [21].

supersymmetric particle in our framework. Finally, we have checked that values of $B_T < 10$ TeV are phenomenologically unacceptable. In Fig. 2 we display the branching ratios $\mathrm{BR}(l_j \to l_i \gamma)$ as a function of λ for $B_T = 20$ TeV and $M_T = 10^{13}(10^9)$ GeV in the left (right) panel. The behavior of these branching ratios is in remarkable agreement with the estimates of Eq. (8). Hence, the relative size of LFV does not depend on the detail of the model, i.e., on λ, B_T, or M_T. This feature is not present for a very narrow range of λ where $\mathrm{BR}(\tau \to \mu\gamma)$ is strongly suppressed due to a conspiracy of the various contributions in $(\mathbf{m}_{\tilde{L}}^2)_{\tau\mu}$ which mutually cancel out [see Eq. (5)].

Before concluding, we briefly mention that the tree-level exchange of the T, $\bar{T}$ states also generates the L-violating SSB operator $\lambda \mathbf{Y}_T B_T (\tilde{L} H_2)^2 / M_T$ which induces a sneutrino/antisneutrino mass splitting $\Delta \mathbf{m}_{\tilde{\nu}}^2 = B_T \mathbf{m}_\nu$ at the weak scale. Since B_T is much larger than the weak scale, this could render interesting effects for sneutrino oscillations [20].

In conclusion, we have suggested a unified picture of the supersymmetric type-II seesaw where the triplets, besides being responsible for neutrino mass generation, communicate SUSY breaking to the observable sector through gauge and Yukawa interactions. We have performed a phenomenological analysis of the allowed parameter space emphasizing the role of LFV processes in testing our framework.

We thank A. Brignole for useful comments. The work of F. R. J. is supported by *Fundação para a Ciência e a Tecnologia* (FCT, Portugal) under the Grant No. SFRH/BPD/14473/2003, INFN and PRIN Fisica Astroparticellare (MIUR). The work of A. R. is partially supported by the Project EU No. MRTN-CT-2004-503369.

[1] P. Minkowski, Phys. Lett. B **67**, 421 (1977); M. Gell-Mann, P. Ramond, and R. Slansky, in *Supergravity*, edited by P. Van Nieuwenhuizen and D. Freedman (North-Holland, Amsterdam, 1979), p. 315; T. Yanagida, in *Proceedings of the Workshop on the Unified Theory and the Baryon Number in the Universe*, edited by O. Sawada and A. Sugamoto (KEK, Tsukuba, 1979), p. 95; S. L. Glashow, in *Quarks and Leptons*, edited by M. Lévy *et al.* (Plenum, New York, 1980), p. 707; R. N. Mohapatra and G. Senjanović, Phys. Rev. Lett. **44**, 912 (1980).

[2] R. Barbieri *et al.*, Phys. Lett. B **90**, 91 (1980); T. P. Cheng and L. F. Li, Phys. Rev. D **22**, 2860 (1980); M. Magg and Ch. Wetterich, Phys. Lett. B **94**, 61 (1980); J. Schechter and J. W. F. Valle, Phys. Rev. D **22**, 2227 (1980); G. Lazarides, Q. Shafi, and C. Wetterich, Nucl. Phys. **B181**, 287 (1981); R. N. Mohapatra and G. Senjanovic, Phys. Rev. D **23**, 165 (1981); E. Ma and U. Sarkar, Phys. Rev. Lett. **80**, 5716 (1998).

[3] F. Borzumati and A. Masiero, Phys. Rev. Lett. **57**, 961 (1986).

[4] J. Hisano *et al.*, Phys. Rev. D **53**, 2442 (1996); J. Hisano, D. Nomura, and T. Yanagida, Phys. Lett. B **437**, 351 (1998); J. A. Casas and A. Ibarra, Nucl. Phys. **B618**, 171 (2001); S. Lavignac, I. Masina, and C. A. Savoy, Phys. Lett. B **520**, 269 (2001); A. Masiero, S. K. Vempati, and O. Vives, Nucl. Phys. B **B649**, 189 (2003); E. Arganda and M. J. Herrero, Phys. Rev. D **73**, 055003 (2006).

[5] A. Rossi, Phys. Rev. D **66**, 075003 (2002).

[6] F. R. Joaquim and A. Rossi, hep-ph/0607298.

[7] Beneath the scale M_G, B is conserved since the colored partners t, $\bar{t}$ are understood to be decoupled.

[8] G. F. Giudice and R. Rattazzi, Phys. Rep. **322**, 419 (1999), and references therein.

[9] M. Dine, Y. Nir, and Y. Shirman, Phys. Rev. D **55**, 1501 (1997).

[10] Such $\mathcal{O}(F_X^2/M_T^2)$ two-loop contributions dominate over the $\mathcal{O}(F_X^4/M_T^6) = \mathcal{O}(B_T^4/M_T^2)$ one-loop ones for $M_T > (4\pi Y_T/g^2)B_T$, which is indeed fulfilled in our analysis.

[11] G. F. Giudice and R. Rattazzi, Nucl. Phys. **B511**, 25 (1998).

[12] G. R. Dvali and M. A. Shifman, Phys. Lett. B **399**, 60 (1997); Z. Chacko and E. Ponton, Phys. Rev. D **66**, 095004 (2002); Z. Chacko, E. Katz, and E. Perazzi, Phys. Rev. D **66**, 095012 (2002).

[13] See, e.g., R. N. Mohapatra and A. Y. Smirnov, hep-ph/0603118; J. W. F. Valle, hep-ph/0603223.

[14] A. Brignole and A. Rossi, Nucl. Phys. **B701**, 3 (2004).

[15] M. Hirsch *et al.*, Phys. Rev. D **62**, 113008 (2000); **65**, 119901(E) (2002); E. Ma, Phys. Rev. D **64**, 097302 (2001); E. J. Chun, K. Y. Lee, and S. C. Park, Phys. Lett. B **566**, 142 (2003); M. Hirsch and J. W. F. Valle, New J. Phys. **6**, 76 (2004).

[16] E. J. Chun *et al.*, Phys. Lett. B **622**, 112 (2005).

[17] G. D'Ambrosio *et al.*, Phys. Lett. B **604**, 199 (2004).

[18] We include the low-energy radiative corrections to the Higgs masses by linking our code to FeynHiggs [19].

[19] S. Heinemeyer, W. Hollik, and G. Weiglein, Comput. Phys. Commun. **124**, 76 (2000).

[20] M. Hirsch, H. V. Klapdor-Kleingrothaus, and S. G. Kovalenko, Phys. Lett. B **398**, 311 (1997); Y. Grossman and H. E. Haber, Phys. Rev. Lett. **78**, 3438 (1997).

[21] M. L. Brooks *et al.* (MEGA Collaboration), Phys. Rev. Lett. **83**, 1521 (1999); B. Aubert *et al.* (*BABAR* Collaboration), Phys. Rev. Lett. **95**, 041802 (2005); Phys. Rev. Lett. **96**, 041801 (2006).

SOME FREQUENT MISTAKES

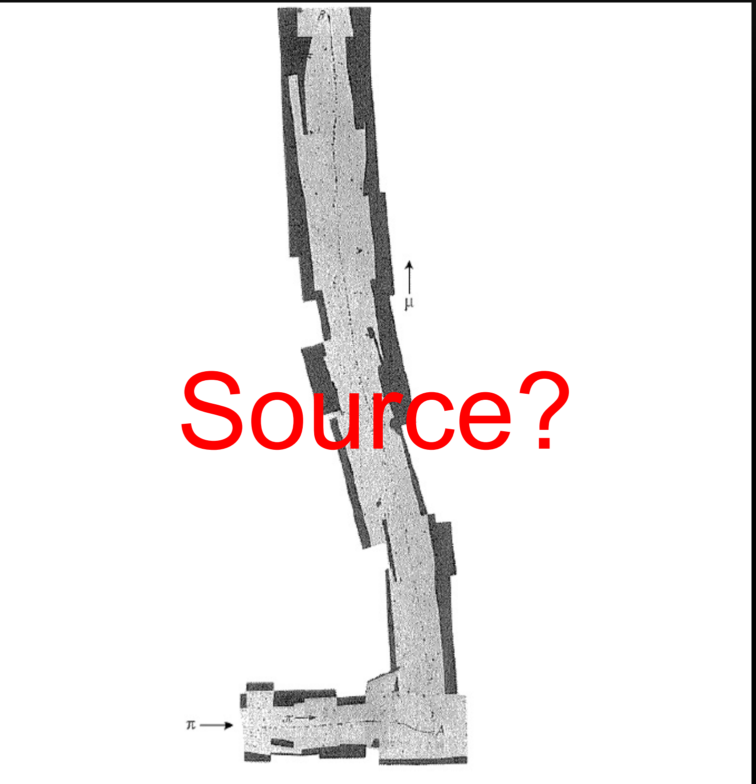


FIG. 2. Track of a pion and subsequent muon in a photographic emulsion exposed to cosmic rays at high altitude

não há contacto. A bola, inicialmente ($t = 0$) com uma velocidade v_0, perde energia até um momento em que a velocidade se anula. Admitimos que a pressão não varia significativamente ao longo deste processo, já que a variação de volume é em geral pequena. Assim, podemos analisar o trabalho envolvido no processo:

$$W = \int P dV \simeq P \int dV = P\Delta V \,. \tag{1}$$

Designando por x_0 a amplitude da deformação do ponto da bola mais próximo da superfície em relação à forma esférica facilmente se calcula ΔV recorrendo aos habituais integrais de volume e à geometria considerada:

u

$$W = P\pi(ax_0^2 - \frac{x_0^3}{3}) \simeq \pi P a x_0^2 \,, \tag{2}$$

Uma vez que $x_0 << a$. A forma do trabalho realizado é semelhante a um oscilador sinusoidal com $F = -kx$ e $U = \frac{1}{2}kx^2$, onde $k = 2\pi Pa$ e portanto a equação de movimento do ponto considerado terá a forma $-2\pi Pax = m\ddot{x}$, cuja solução é $x = x_0 \sin(\omega t)$, válida de $t = 0$ até $t = \pi/\omega$. Designando x_0 pela amplitude máxima da oscilação, temos a importante relação:

$$\omega = \sqrt{\frac{k}{m}} = \left(\frac{2\pi Pa}{m}\right)^{\frac{1}{2}} \,. \tag{3}$$

Note-se que, tal como num oscilador têm-se a igualdade

SOME FREQUENT MISTAKES

forma inicial do som para as bolas utilizadas . O primeiro estudo consistiu em verificar experimentalmente a frequência do thump, onde, a partir da relação 5 se estuda a frequência $2\omega/2\pi$ em função de $x = 2\pi Pa/M$ para três bolas (figura 2): Basquetebol ($a = 12 \pm 0.05\ cm$, $m = 670 \pm 10\ g$, $P = 8, 9, ..., 14\ \ \pm 1/10$ Psi), Futebol ($a = 11 \pm 0.05\ cm$, $m = 410 \pm 10\ g$, $P = 10, 11, ..., 15\ \ \pm 1/10$ Psi) e Voleibol $a = 11 \pm 0.05\ cm$, $m = 370 \pm 10\ g$, $P = 3, 4, 5\ \ \pm 1/10$ Psi).

Units are written in text mode, not in math mode

IV. EXPERIMENTAL RESULTS AND ANALYSIS

The dominoes which were used have a height H=4cm and width=0.5cm and they were placed vertically (standing on their smallest faces). The samples were recorded using a sampling frequency of 44 kHz, and filtered as described in the previous section.

V. CONCLUSION

Previous studies [2][3] have reported normalized wave velocities ($c/\sqrt{gH}$) between 0.9 and 1.7. which is in

Do you really need to open a section to say that?

SOME FREQUENT MISTAKES

A função de partição para oscilador harmónico é dada por

$$Z = \sum_{n=0}^{\infty} exp(-\beta\hbar w(n+1/2) = exp(-\beta\hbar w/2)\frac{1}{1-exp(-\beta\hbar w)}. \quad (13)$$

A probabilidade de ocorrência de um estado n é dada por

$$P_n = \frac{exp(-\beta\hbar w(n+1/2))}{\sum_{n=0}^{\infty} exp(-\beta\hbar w(n+1/2))}. \quad (14)$$

o valor médio do Hamiltoneano é

$$\langle H \rangle = \frac{\sum_{n=0}^{\infty} exp(-\beta\hbar w(n+1/2))\hbar w(n+1/2)}{\sum_{n=0}^{\infty} exp(-\beta\hbar w(n+1/2))} = -\frac{\partial lnZ}{\partial \beta} \quad (15)$$

em que β é dado por $1/k_B T$ sendo T a temperatura do sistema e k_B a constante de Boltzmann. Para o estado A, em que se pode usar a distribuição de Boltzmann por estar em equílibrio térmico,

Since I have no more space I have to create it…

Foreign names should appear in italic or between inverted commas.

References before ending the sentence.

despite a rather slow increase in electricity demand in this country over the last 5 years.[8]

About 90% of this fossil fueled power plants are protected under government capacity payment schemes such as the Contratos de Aquisição de Energia therefore mentioned as C.A.E. or Contratos para a Manutenção do Equilíbrio Contratual therefore mentioned as C.M.E.C. which guarantee the operational and capital costs solely for their availability regardless of electricity production.[8]

Maintaining these power plants under such legal

SOME FREQUENT MISTAKES

Annex 1 - Table "Distance versus Frequency"

$d_{pitch}(cm)$	Frequency (Hz)			
≈ 0,0 ± 0,5	3 919 ± 31	2938 ± 58	4077 ± 20	3535 ± 166
2,0 ± 0,5	2 205 ± 79	2010 ± 11	2371 ± 10	2044 ± 51
5,0 ± 0,5	1 485 ± 26	1179 ± 26	1593 ± 10	1244 ± 24
8,0 ± 0,5	1 185 ± 10	804 ± 10	1270 ± 11	891 ± 10
11,0 ± 0,5	1 001 ± 10	602 ± 10	1118 ± 10	731 ± 11
14,0 ± 0,5	893 ± 10	497 ± 10	1032 ± 10	647 ± 10
17,0 ± 0,5	840 ± 10	426 ± 10	951 ± 10	575 ± 13
20,0 ± 0,5	768 ± 10	372 ± 10	912 ± 10	514 ± 10
23,0 ± 0,5	733 ± 10	322 ± 10	875 ± 10	471 ± 10
26,0 ± 0,5	699 ± 11	275 ± 10	842 ± 10	431 ± 10
29,0 ± 0,5	665 ± 10	244 ± 10	820 ± 10	416 ± 10
32,0 ± 0,5	651 ± 10	214 ± 10	799 ± 10	402 ± 10
35,0 ± 0,5	630 ± 10	196 ± 10	788 ± 12	390 ± 10
38,0 ± 0,5	610 ± 10	177 ± 10	766 ± 10	385 ± 12
41,0 ± 0,5	598 ± 10	157 ± 10	737 ± 10	348 ± 10

What is actually changing from one column to the other?

$$\langle W_3\rangle = \langle H\rangle_D - \langle H\rangle_C = (\frac{\hbar w_0}{2}Q_1^* - \frac{\hbar w_1}{2})coth(\frac{\beta_1 \hbar w_1}{2}). \quad (20)$$

Processo isocórico D→A

É transferido calor para o reservatório frio, a frequência w_0 mantém-se constante do estado D para o estado A durante τ_4, um processo de relaxamento mais curto do que a expansão adiabática, sendo que mais uma vez o oscilador está fracamente acoplado ao reservatório.

O calor transferido é dado por

$$\langle Q_4\rangle = \langle H\rangle_A - \langle H\rangle_D = \frac{\hbar w_1}{2}[coth(\frac{\beta_1 \hbar w_1}{2}) - Q_1^* coth(\frac{\beta_0 \hbar w_0}{2}). \quad (21)$$

Como o calor é transferido para o reservatório frio, então $\langle Q_4\rangle \geq 0$, pelo que a seguinte condição tem de ser satisfeita:

High-school is past but that doesn't mean you should forget what you have learnt there…