# ACTIVIDADES IFIC-TEO 2014
# UNIVERSITAT DE VALÈNCIA & CSIC

**Juan M Nieves**

**18 Diciembre 2014**

- José W.F. Valle, galardonado con la **Medalla de la DPyC-SMF 2014 (México)**
- Pablo Villanueva y Raquel Molina: Premios Extraordinários de Doctorado curso 2013/2014

• DFT ha participado activamente en el Programa de Seminarios (**IVICFA**) & Colloquia del IFIC

• Participado/colaborado en la organización de:



## MultiDark Consolider Workshop

## PROJECT FPA2011-23897

*Estudios perturbativos y no perturbativos del modelo estándar y sus extensiones*

Local members of the project:

- Vicent Giménez Gómez (IP)
- Arcadi Santamaría Luna
- Armando Pérez Cañellas
- Jorge Vidal Perona
- Nuria Carrasco (Postdoc INFN Roma III)
- Alberto Aparici (PhD December 2013)
- Margarida Hinarejos (Prometeo contract)


## PROJECT FPA2011-23897

*Estudios perturbativos y no perturbativos del modelo estándar y sus extensiones*


External researchers of the project:

- Stefano Bertolini (INFN SISSA)
- José Wudka (U. California, Riverside)
- Gabriel González-Sprinberg (U. de la Republica, Uruguay)
- Alejandro Romanelli (U. de la Republica,Uruguay)
- Mari Carmen Bañuls (Max-Planck-Ins. für Quantenoptik)
- Vittorio Lubicz (U. di Roma III)
- Silvano Simula (INFN-Roma III)
- Federico Mescia (U. de Barcelona)
- Roberto Frezzotti (U. di Roma II)
- David Palao (U. Frankfurt)

## PROMETEO 2009-128

ValènciaPLQ
Particles, Lattices and Qbits


*Estudios perturbativos y no perturbativos del modelo estándar y sus extensiones*

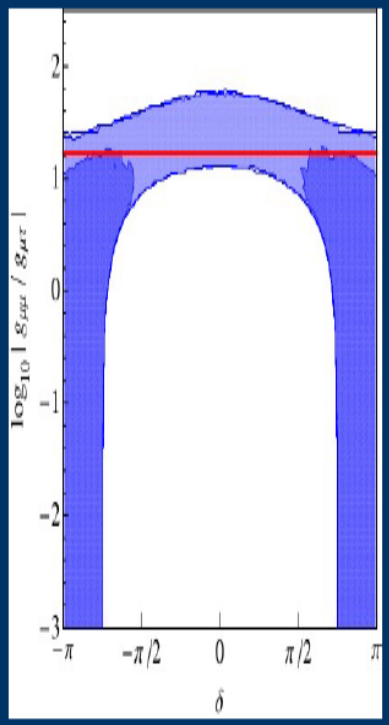

Members of the project:

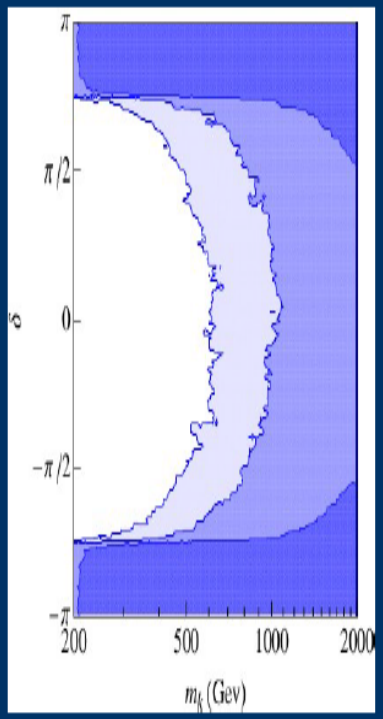
- Arcadi Santamaría Luna (IP)
- Vicent Giménez Gómez
- Armando Pérez Cañellas
- Jorge Vidal Perona

# Testing the Zee-Babu Model

**A. Santamaria**

Tight constraints from many sources
Exciting if new doubly charged scalars discovered at LHC
J. Herrero-García, M. Nebot, N. Rius, AS, *Nucl. Phys. B885 (2014) 542*

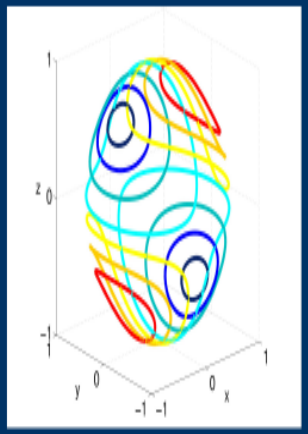


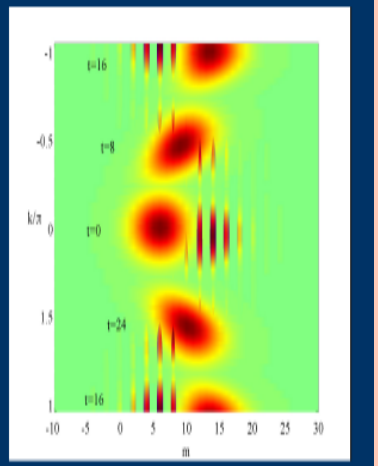

# Quantum Walks and Wigner functions on a lattice

**M. Hinarejos, M.C. Bañuls, A. Romanelli, C. Di Franco and A. Perez**

Non-Markovianity in quantum walks on a line. *Phys. Rev. A 89, (2014) 052330.*
Asymptotic trace distance as a function of the the initial conditions on the Bloch sphere.
Figure selected for "Kaleidoscope" in Phys. Rev. A




Wigner function evolution for a particle with spin under the effect of an inhomogeneous magnetic field.
In press in New J. Phys. (2014).



# B-physics from Nf=2 and Nf=2+1+1 tmQCD: the Standard Model and beyond

**N. Carrasco and V. Giménez (ETMC)**

Unquenched Nf=2, continuum limit, LQCD computations of the b-quark mass, the B and Bs decay constants and the B-mixing bag parameters for the ΔB=2 weak Hamiltonian matrix elements describing neutral B-meson oscillations in the SM and beyond. We simulate four values of the lattice spacing with pion masses ranging from 280 to 500 MeV. Extrapolation from the charm to the bottom quark region has been carried out on ratios of physical quantities that have an exactly known infinite mass limit. Preliminary results suggest that sea-quark effects from strange and charm quarks are smaller than the present accuracy.

*Published in JHEP 1403 (2014) 016; PoS LATTICE2013 (2014) 313 and 382*

Results: mb(mb,MS)=4.29(12) GeV

fBs=228(8) MeV fB=189(8) MeV fBs/fB =1.206(24)

fDs=250(7) MeV fD=208(7) MeV fDs/fD =1.201(21)

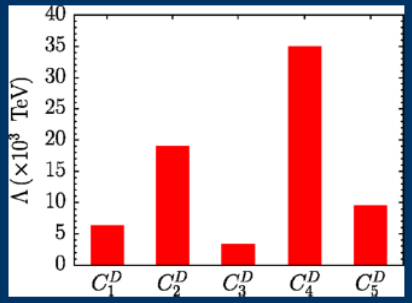
ξ =1.225(31) fBd √B1=216(10) MeV fBs √B1=262(10) MeV

By using our results for the bag parameters we are able to provide a refined UTA improving the bounds coming from B(s) − B mixing constraints on New Physics.

# D-Dbar Mixing in the Standard Model and Beyond from Nf=2 tmQCD

**N. Carrasco and V. Giménez (ETMC)**

First unquenched LQCD results for the bag parameters controlling the short distance contribution to D meson oscillations in the SM and beyond, used to constrain New Physics effects in D-Dbar mixing, to put a lower bound to the generic New Physics scale and to constrain off-diagonal squark mass terms for TeV-scale Supersymmetry.



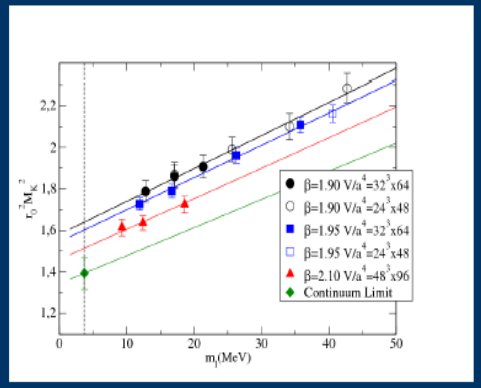

*Phys.Rev. D90 (2014) 014502.*
*PoS LATTICE2013 (2014) 393*
*arXiv:1410.0161 [hep-lat]*

Lower bounds on the New Physics scale as obtained from the constraints on the imaginary part of the Wilson coefficients, Im C

# Up, down, strange and charm quark masses with Nf = 2+1+1 tmQCD

**N. Carrasco and V. Giménez (ETMC)**

This analysis uses data at three values of the lattice spacing and pion masses in the range 210–450 MeV and includes the quantum effects of four dynamical quarks.




*Nucl.Phys. B887 (2014) 19-68.*

Results (MS bar scheme):

mud(2 GeV) = 3.70 (17) MeV

mu(2 GeV) = 2.36 (24) MeV

md(2 GeV) = 5.03 (26) MeV

ms(2 GeV) = 99.6 (4.3) MeV

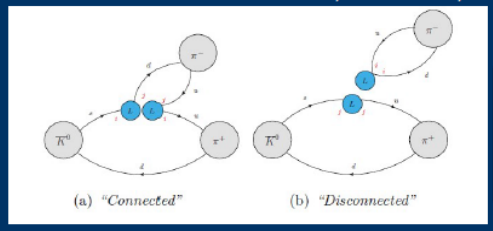
mc(mc) = 1.348(46) GeV

# VIA and the ΔI=1/2 rule: A lattice QCD test of the naïve factorization hypothesis for K, D, B and static mesons

**N. Carrasco, V. Lubicz, L. Silvestrini**

RBC–UKQCD observed large violations of the naïve factorization hypothesis in K→ππ decays, but Re(A0) has been computed at unphysical kinematics, with pion masses of about 330 MeV and 420 MeV. We perform a comparison between the matrix elements of four-fermion ΔF=2 operators in QCD, evaluated on the lattice, and the VIA predictions. We find large violations of the VIA in particular for one of the two relevant Wick contractions in the kaon sector. We also find that the violation decreases significantly as the meson mass increases so that the VIA predictions turn out to be rather well verified for B -meson matrix elements and, even better, in the infinite mass limit.

*Phys.Lett. B736 (2014) 174-179.*




**"Emerging" explanation ΔI=1/2 rule**
ΔI=3/2: opposite signs = cancellation
ΔI=1/2: equal signs = enhancement

Pich & de Rafael; Bardeen, Buras & Gerard; LQCD (Lellouch & Lüscher, RBC-UKQCD)

ASTROPARTICLES

Astroparticles and High Energy Physics Group

# Astropartículas y Física de Altas Energías


IP: José W.F. Valle

Equipo: M. Hirsch, S. Pastor, M.A. Tórtola

Postdocs: R. Lineros, R. Fonseca, F. González-Canales , A. Rojas, F.A. Pereira

Doctorandos: C. Bonilla, L. Doramé, F.J. Escrihuela, P. Fernández,

C. Arbeláez, D. Forero, L. Reichert, S.M. Boucenna

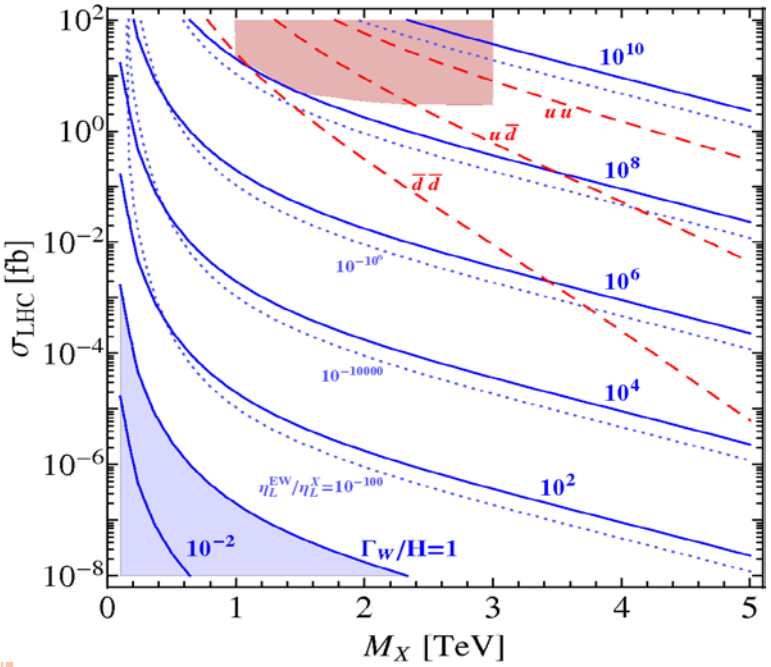

GOBIERNO DE ESPAÑA MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

GENERALITAT VALENCIANA


MULTIDARK CSD2009-00064 FPA2011-22975 PROMETEO II/2014/084


**Palabras clave: neutrinos, oscilaciones, astropartículas, SUSY, materia oscura, rayos cósmicos**

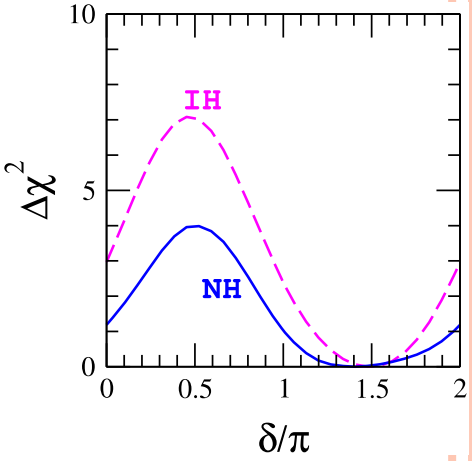
# Algunos ejemplos de resultados en 2014



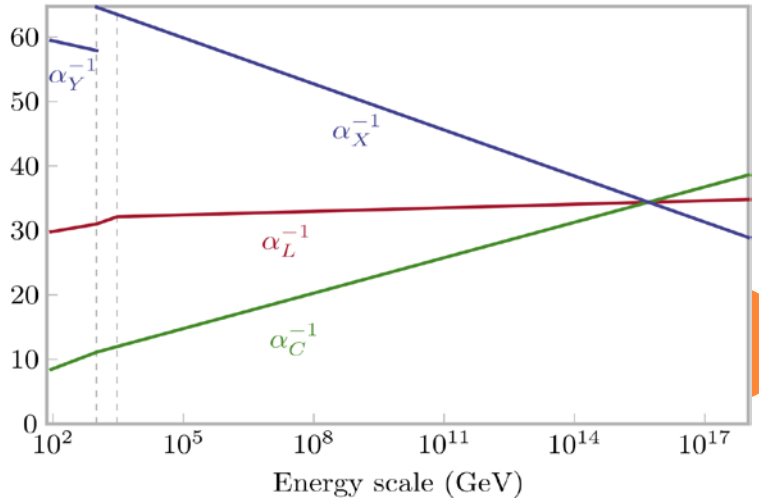

**PRL 112, 221601:** Observación de violación de número leptónico en el LHC es ***incompatible*** **con la leptogénesis**

**PRD 90, 093006**: indicios de sensibilidad a la **fase CP en oscilaciones de neutrinos**

| parameter | best fit $\pm 1\sigma$ |
|---|---|
| $\Delta m^2_{21}$ $[10^{-5}\text{eV}^2]$ | $7.60^{+0.19}_{-0.18}$ |
| $\lvert\Delta m^2_{31}\rvert$ $[10^{-3}\text{eV}^2]$ (NH) | $2.48^{+0.05}_{-0.07}$ |
| $\lvert\Delta m^2_{31}\rvert$ $[10^{-3}\text{eV}^2]$ (IH) | $2.38^{+0.05}_{-0.06}$ |
| $\sin^2\theta_{12}/10^{-1}$ | $3.23\pm0.16$ |
| $\sin^2\theta_{23}/10^{-1}$ (NH) | $5.67^{+0.32}_{-1.24}$ |
| $\sin^2\theta_{23}/10^{-1}$ (IH) | $5.73^{+0.25}_{-0.39}$ |
| $\sin^2\theta_{13}/10^{-2}$ (NH) | $2.26\pm0.12$ |
| $\sin^2\theta_{13}/10^{-2}$ (IH) | $2.29\pm0.12$ |
| $\delta/\pi$ (NH) | $1.41^{+0.55}_{-0.40}$ |
| $\delta/\pi$ (IH) | $1.48\pm0.31$ |




**PRD 90, 013005 y 1411.0566**: masas de neutrinos y **unificación con grupo gauge 3-3-1**



# En números…

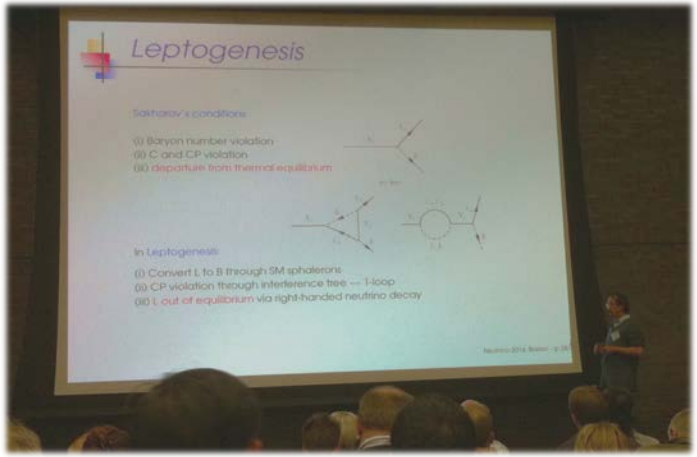
**Artículos JCR: 19** (+5 Auger)
**Congresos internacionales / nacionales: 24 / 4**
(sólo participación activa: charla o póster)

Otros artículos en revistas: 1
Libros completos / editados: 1 / 1
Seminarios fuera del IFIC: 10

Ej: serie de **clases de J.W.F. Valle** en la escuela **ISAPP2014** en Belgirate (Italia)

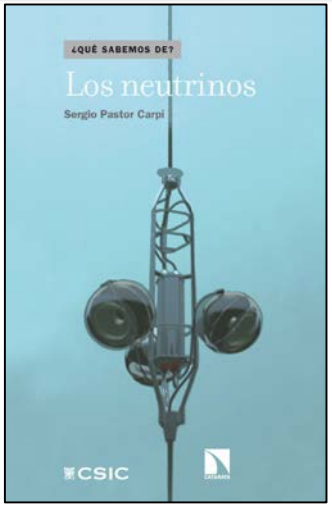
**4 Tesis doctorales defendidas en 2014 (UV)** + 1 Trabajo Fin de Máster

**1. Laslo Reichert.** *LHC Phenomenology and Neutrino Physics in GUT inspired SUSY models.*
Dir: M. Hirsch y J.W.F. Valle. 28 jul
**2. David Vanegas.** *Phenomenology of massive neutrinos: from oscillations to new physics.*
Dir: M.A. Tórtola y J.W.F. Valle. 26 sep
**3. Carolina Arbeláez.** *Neutrinos in GUTs and left right symmetry.* Dir: M. Hirsch y J.W.F. Valle. 13 oct
**4. Sofiane Boucenna.** *Neutrino physics and dark matter.* Director: J.W.F. Valle. 10 nov




**M. Hirsch**
Charla invitada en
*Neutrino 2014*
Boston
jun 2014

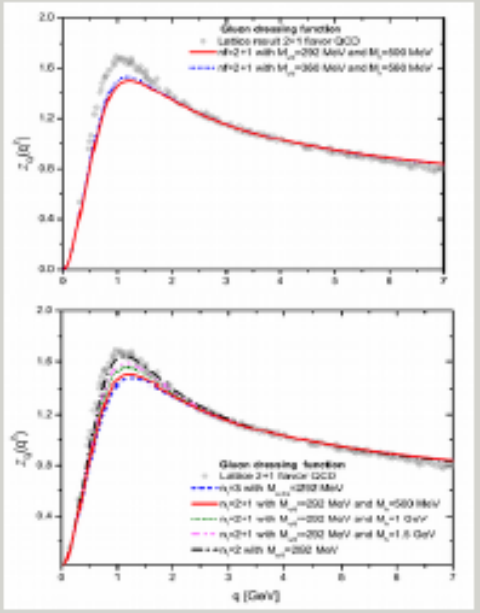
**S. Pastor**, *Los neutrinos*
Libro de la Colección
¿Qué sabemos de…?
Ed. CSIC-Catarata
oct 2014



# FUNDAMENTAL INTERACTIONS AND THEIR EXPERIMENTAL IMPLICATIONS

## FPA2011-23596

Botella, Bordes, Bernabéu, Barenboim, Papavassiliou, Sanchis-Lozano, Peñarrocha, Vidal y Vives. **Posdocs**: C. Pallis, C. Espinoza, M. Baker, H. Serodio, S. Palomares, J. Jones, F. Campanario y J. Park. **Predoc**: C. Bosch, J. Rasero, M. Lopez-Ibañez y P. Villanueva.

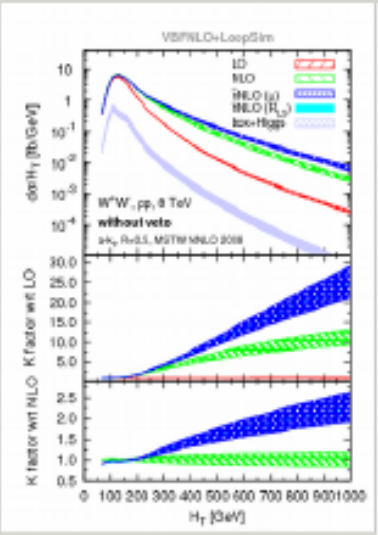


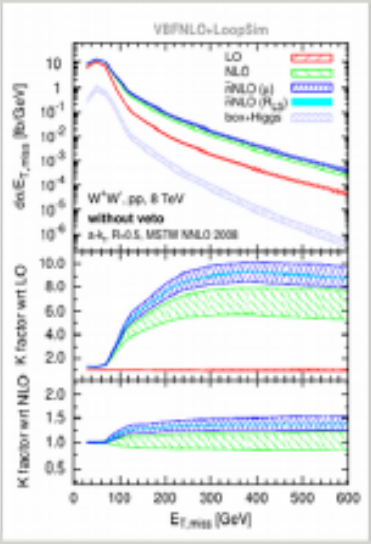

*'A new method for determining the quark-gluon vertex.'* A.C. Aguilar, D. Binosi, D. Ibañez, J. Papavassiliou. Phys.Rev. D**90** (2014) 065027.

Método no perturbativo para determinar el comportamiento del vértice entre gluones y quarks. Cálculo de los efectos de la inclusion de quarks dinámicos en el propagador de gluon y del fantasma y comparación con el retículo.

*'Novel T-Violation observable open to any pair of decay channels at meson factories.'* Jose Bernabeu, Francisco J. Botella, Miguel Nebot. Phys.Lett. B**728** (2014) 95-98.

"Entanglement" EPR entre mesones B ha conducido a la observación de TRV (Time Rev. Viol.) por BABAR. Para conocer el canal de desintegración que filtra un estado de B dado, los canales de sabor y de CP son privilegiados. Nuestra propuesta permite realizar un programa de TRV utilizando cualquier canal de desintegración.



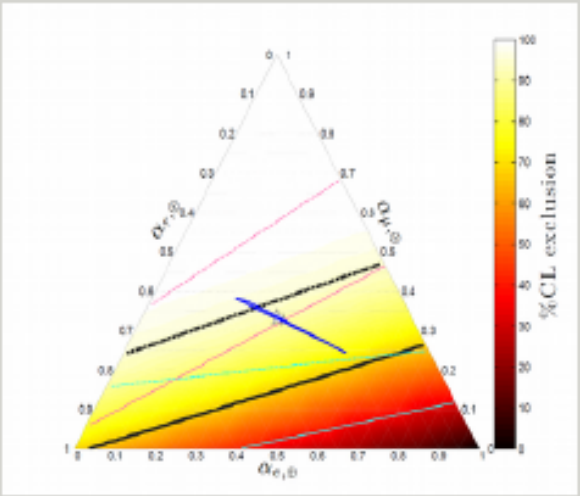




*'$W^+W^-$ production at high transverse momenta beyond NLO.* Francisco Campanario, Michael Rauch, Sebastian Sapeta. Nucl.Phys. B**879** (2014) 65-79.

Calculo amplitudes a 1 loop en procesos 2→4 incluyendo hexágonos: (a) Producción de Higgs asociada con tres jets at NLO.
(b) Producccion de WVjj inducida por QCD a NLO QCD.
(c) Producción de WW y WZ a NNLO

*'Flavor composition of the high-energy neutrino events in IceCube'*, O. Mena, S. Palomares-Ruiz and A. C. Vincent, Phys. Rev. Lett. **113**: 091103, (2014).

Estudio composición en sabor de los neutrinos detectados por el experimento IceCube (Breakthrough of the Year de la revista Physics World). La combinacion estandar esta desfavorecida al 92% CL para un espectro de $E^{-2}$

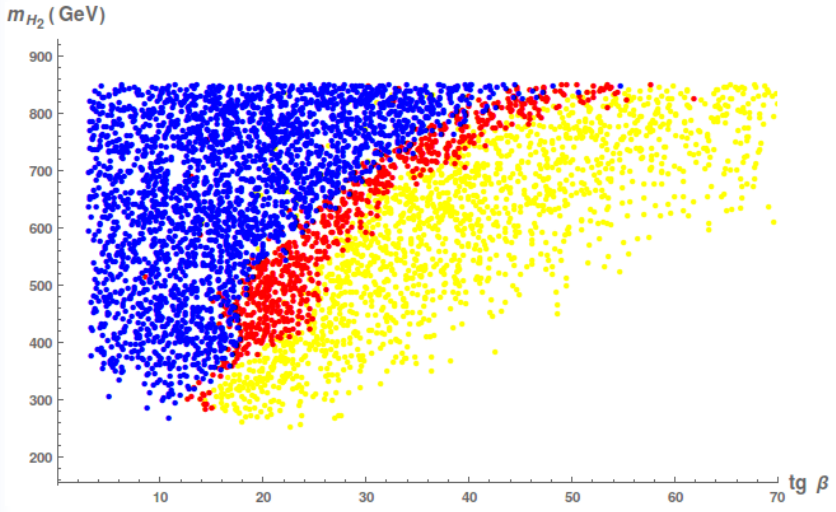


PROMETEO

Gabriela Barenboim
Jose Bernabeu
Vasiliki Mitsou
Oscar Vives

## Modelos supersimétricos con sectores de Higgs genéricos

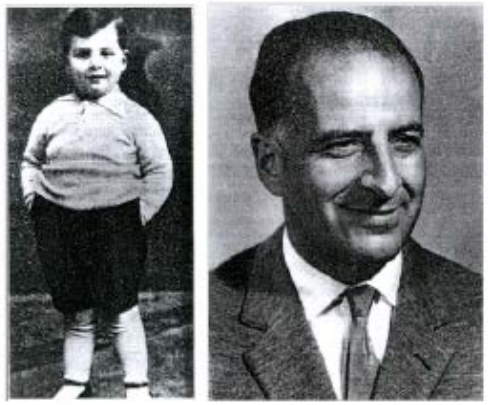
Tras la medida de la masa del Higgs se analizó el sector de Higgs en MSSM generales buscando estados de Higgs adicionales. Se descartó que el Higgs observado se corresponda al segundo Higgs del MSSM con otro Higgs más ligero y se han utilizado las búsquedas de Higgs en el canal tau-tau para restringir los nuevos estados escalares como función de tg beta.




G. Barenboim, C. Bosch, M. L. López-Ibáñez and O. Vives, ``Improved τ-weapons for Higgs boson hunting,'' Phys. Rev. D90 (2014) 015003

## On the history of the PMNS Matrix ... with today's perspective

La base conceptual para entender la inter-relación de masas y mezclas para las oscilaciones de neutrinos fué desarrollada en un periodo cuando la visión dominante era la de neutrinos sin masa. Bruno Pontecorvo está asociado a la mayor parte de componentes necesarias para este fenómeno cuántico: universalidad muón-electrón, diferentes sabores de neutrinos, desajuste entre interacción débil y masa, fenomenología de oscilaciones, neutrinos solares.



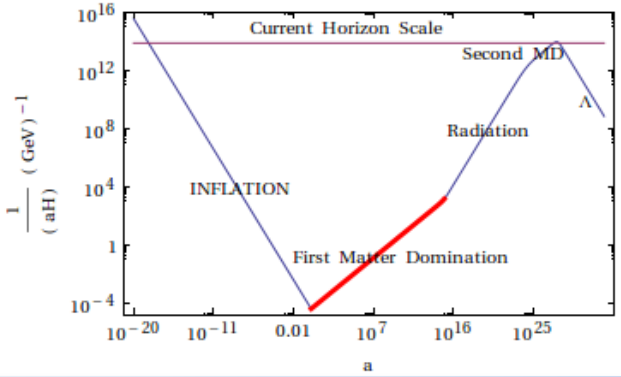
Jose Bernabeu (Valencia U. & Valencia U., IFIC). Nuovo Cim. C037 (2014) 03, 145, In Memory PONTECORVO 100.

PROMETEO

Gabriela Barenboim
Jose Bernabeu
Vasiliki Mitsou
Oscar Vives

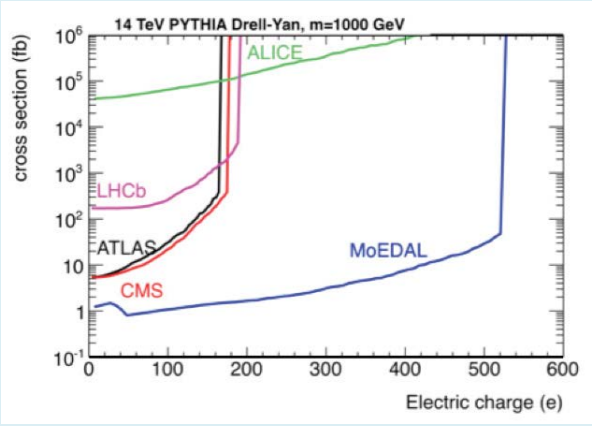
## Structure formation in an early period of matter domination

We investigated the left-over structure from an early period of matter domination. The survival of these objects can only be possible if the dominating matter decays to a daughter particle which is not only almost degenerate with the parent particle but also has an open annihilation channel




G.Barenboim & J. Rasero; JHEP 1404 (2014) 138

## Review on scenarios predicting highly ionising particles at the LHC




B. Acharya, J. Bernabeu, M. King, V.A. Mitsou, O. Vives et al [MoEDAL Coll.], "The Physics Program of the MoEDAL Experiment at the LHC," Int. J. Mod. Phys. A29 (2014) 1430050

## μ-from-ν Supersymmetric SM

Ghosh, López-Fogliani, **Mitsou**, Muñoz, Ruiz de Austri, **JHEP 11(2014)102** [arXiv:1410.2070]; **PRD, *to appear*** [arXiv:1403.3675]]

R-parity breaking terms
→ **neutrino masses**

- Enlarged Higgs sector: 125-GeV Higgs decays to light (pseudo)scalars and neutralinos
- Novel $Z^0/W^{\pm}$ decays to displaced leptons/taus/jets

# LHCPHENO

FPA2011-23778

# Prometeoll

2013/007

CPAN ingenio 2010

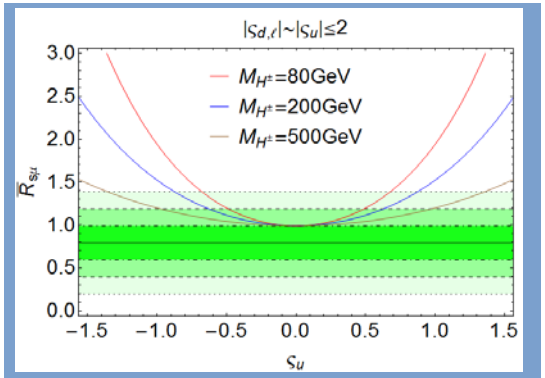
LHCphenOnet

FP7

A. Pich, G. Abbas, F. Campanario, G. Chachamis, M. Deak, R. J. Hernández, J. Lu, A. Maiezza, I. Malamos, V. Mateu, J. Portolés, G. Rodrigo, I. Rosell, P. Ruiz-Femenía, G. Sborlini

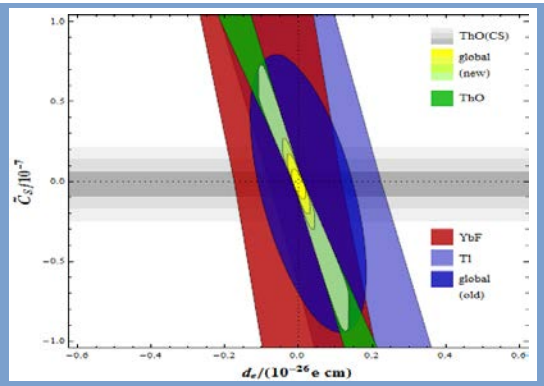
Doctorandos: S. Buchta, A. Celis, J. Fuentes, V. Ilisie, A. Lami, A. Rodríguez, J. Santos, M. Zahiri Abyaneh

## ▪ Phenomenology of Electroweak Processes: Effective Field Theories, Flavour Physics



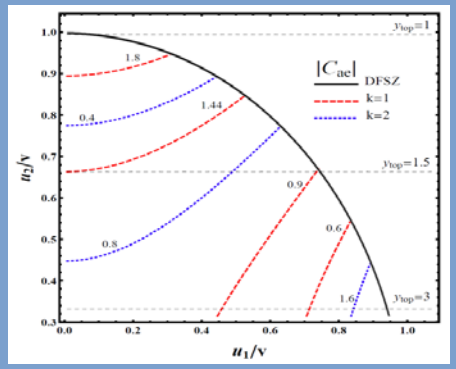

**X.-Q. Li, J. Lu, A. Pich**

"$B^0_{s,d}\to\ell^+\ell^-$ Decays in the Aligned Two-Higgs-Doublet Model", JHEP 1406 (2014) 022




**M. Jung, A. Pich**

"Electric Dipole Moments in Two-Higgs-Doublet Models", JHEP 1404 (2014) 076

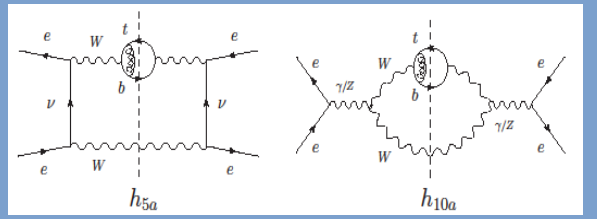


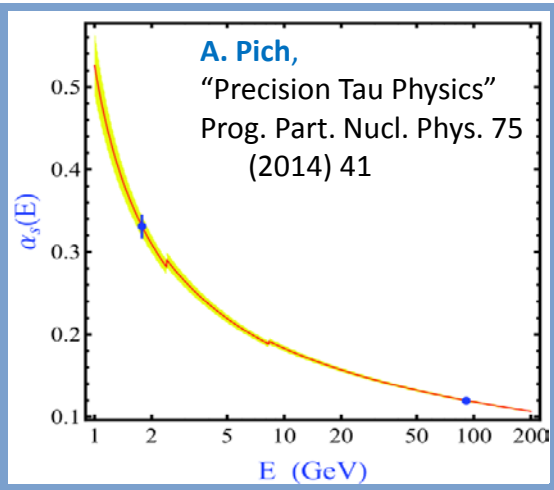

**A. Celis, J. Fuentes, H. Serodio**

"Effective Aligned 2HDM with a DFSZ-like invisible axion", Phys. Lett. B737 (2014) 185

**P.D. Ruiz Femenía**

"A first estimate of the NNLO nonresonant corrections to top-antitop threshold production at lepton colliders", Phys.Rev. D89 (2014) 9, 097501




**A. Pich,**

"Precision Tau Physics" Prog. Part. Nucl. Phys. 75 (2014) 41

# LHCPHENO

FPA2011-23778

# Prometeoll

2013/007

CPAN Ingenio 2010

LHCphenOnet

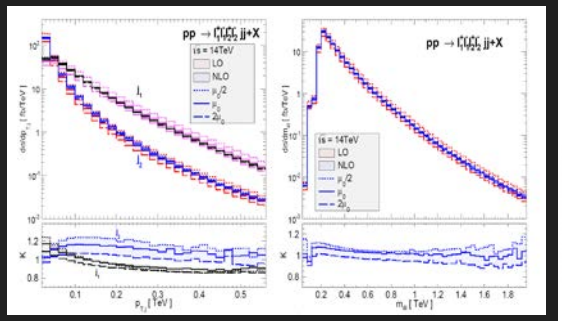
FP7

A. Pich, G. Abbas, F. Campanario, G. Chachamis, M. Deak, R. J. Hernández, J. Lu, A. Maiezza, I. Malamos, V. Mateu, J. Portolés, G. Rodrigo, I. Rosell, P. Ruiz-Femenía, G. Sborlini

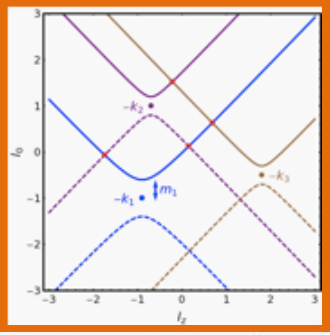
Doctorandos: S. Buchta, A. Celis, J. Fuentes, V. Ilisie, A. Lami, A. Rodríguez, J. Santos, M. Zahiri Abyaneh

## ▪ Phenomenology of Quantum Field Theories: Perturbative QCD

**F. Campanario et al., EPJC74-3085, EPJC74-2882, JHEP10-173, JHEP07-148, PRD89-054009, PRD89-014009, NPB879-65 (2014),**
Higher order corrections to **multi-boson and Higgs boson** production at the LHC.
CP properties of the Higgs boson.
Release of **VBFNLO 2.7.0**

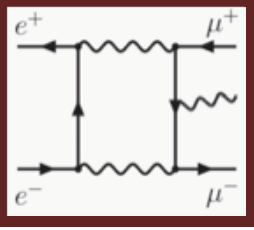


**S. Buchta, I. Bierenbaum, G. Chachamis, I. Malamos, P. Draggiotis, S. Catani, G. Rodrigo, JHEP10(2014)014**
New perturbative method establishing a **dual relation between multi-loop and tree-level** scattering amplitudes.
Loop singularities in the loop-tree duality representation are restricted to a **finite region** of the loop momentum space.



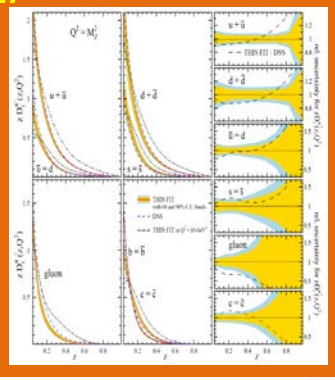
**F. Campanario, H. Czyz, J. Gluza, M.Gunia, T. Riemann, G. Rodrigo, V. Yundin, JHEP02(2014)114**

QED NLO contributions to the reaction $e^+e^-$ to $\mu^+\mu^-$ and their implementation in the Monte Carlo event generator **PHOKHARA**

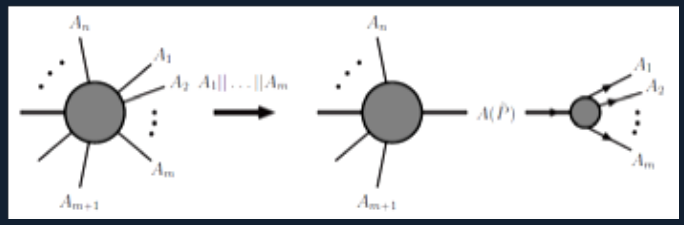



**D.de Florian, R.Sassot, M.Epele, R.J. Hernández, M. Stratman, arXiv:1410.6027**

New global fit to **fragmen-tation functions** from e+e-, ep and pp



**S. Catani, D.de Florian, G. Sborlini, G. Rodrigo, JHEP01(2014)018, JHEP10(2014)161, 1409.6137**
Singular behaviour of scattering amplitudes in the **multi-collinear limit**. New effects due to breaking of strict factorization. Splitting amplitudes at higher orders, polarised and unpolarised.



# FISICA HADRONICA, INTERACCIONES FUNDAMENTALES Y FISICA NUCLEAR

Pedro González, Santiago Noguera , Vicente Vento, Javier Vijande

1.- Predicción de nuevos estados del Bottomium (P. González)

2.- Estructura del Pión (S. Noguera)

3.- Efectos del medio nuclear en la colisión profundamente inelástica sobre blancos nucleares polarizados (V. Vento).

4.- Propiedades del monopolo y monopolium y su búsqueda en LHC en la colaboración Moedal (V. Vento).

5.- Búsqueda fenomenológica de Tetra Quarks (Javier Vijande)

2. Generalized screened potential model
P. Gonzalez (Valencia U., IFIC). Jun 19, 2014. 12 pp.
Published in **J.Phys. G41 (2014) 095001**
DOI: 10.1088/0954-3899/41/9/095001
e-Print: arXiv:1406.5025 **[hep-ph]** | PDF

Predicción (3ª columna) de nuevos estados J++ en el espectro del bottomonium (a partir de 10600 MeV) no esperados con modelos convencionales de quarks (5ª columna). Estos estados serían, en el bottomonium, equivalentes a los nuevos estados, no esperados, ya detectados en charmonium (X(3872), etc). La predicción está basada en un modelo de potencial en que la interacción quark-antiquark tiene en cuenta implícitamenrte el efecto de canales mesón-mesón tal y como es esperado en lattice QCD

| $J^{PC}$ | GSP States $k_{[T_{i-1},T_i]}$ | $M_{EQM}$ MeV | $M_{PDG}$ MeV | $M_{Cor}(k)$ MeV |
|---|---|---|---|---|
| $0^{++}$ | $1p_{[T_0,T_1]}$ | 9920 | $9859.44 \pm 0.42 \pm 0.31$ | 9920 $(1p)$ |
| $1^{++}$ | $1p_{[T_0,T_1]}$ | 9920 | $9892.78 \pm 0.26 \pm 0.31$ | 9920 $(1p)$ |
| $2^{++}$ | $1p_{[T_0,T_1]}$ | 9920 | $9912.21 \pm 0.26 \pm 0.31$ | 9920 $(1p)$ |
| $0^{++}$ | $2p_{[T_0,T_1]}$ | 10259 | $10232.5 \pm 0.4 \pm 0.5$ | 10259 $(2p)$ |
| $1^{++}$ | $2p_{[T_0,T_1]}$ | 10259 | $10255.46 \pm 0.22 \pm 0.50$ | 10259 $(2p)$ |
| $2^{++}$ | $2p_{[T_0,T_1]}$ | 10259 | $10268.65 \pm 0.22 \pm 0.50$ | 10259 $(2p)$ |
| $0^{++}$ | $3p_{[T_0,T_1]}$ | 10521 | | 10531 $(3p)$ |
| $1^{++}$ | $3p_{[T_0,T_1]}$ | 10526 | | 10531 $(3p)$ |
| | | | $10530 \pm 5 \pm 9$ | |
| $2^{++}$ | $3p_{[T_0,T_1]}$ | 10528 | | 10531 $(3p)$ |
| $0^{++}$ | $1p_{[T_1,T_2]}$ | 10620 | | |
| $1^{++}$ | $1p_{[T_1,T_2]}$ | 10668 | | |
| $0^{++}$ | $1p_{[T_2,T_3]}$ | 10704 | | |
| $2^{++}$ | $1p_{[T_1,T_2]}$ | 10710 | | |
| | | | | 10768 $(4p)$ |
| $1^{++}$ | $2p_{[T_1,T_2]}$ | 10776 | | |
| $0^{++}$ | $1p_{[T_3,T_4]}$ | 10784 | | |
| $2^{++}$ | $2p_{[T_1,T_2]}$ | 10815 | | |

Table 4: Calculated $J^{++}$ bottomonium masses from $V_{GSP}(r)$ : $M_{GSP}$. Masses for experimental resonances, $M_{PDG}$, have been taken from [9]. For $p$ waves we quote separately the $np_0$, $np_1$ and $np_2$ states. Masses and states from the Cornell potential $V_{Cor}(r)$, denoted by $M_{Cor}(k)$ are also shown for comparison.

PHYSICAL REVIEW D 89, 054031 (2014)

# Pion distribution amplitude and the pion-photon transition form factor in a nonlocal chiral quark model

We study the pion distribution amplitude ($\pi$DA) in the context of a nonlocal chiral quark model. The corresponding Lagrangian reproduces the phenomenological values of the pion mass and decay constant, as well as the momentum dependence of the quark propagator obtained in lattice calculations. It is found that the obtained $\pi$DA has two symmetric maxima, which arise from the new contributions generated by the nonlocal character of the interactions. This $\pi$DA is applied to leading order and next-to-leading order calculations of the pion-photon transition form factor. Implications of the results are discussed.

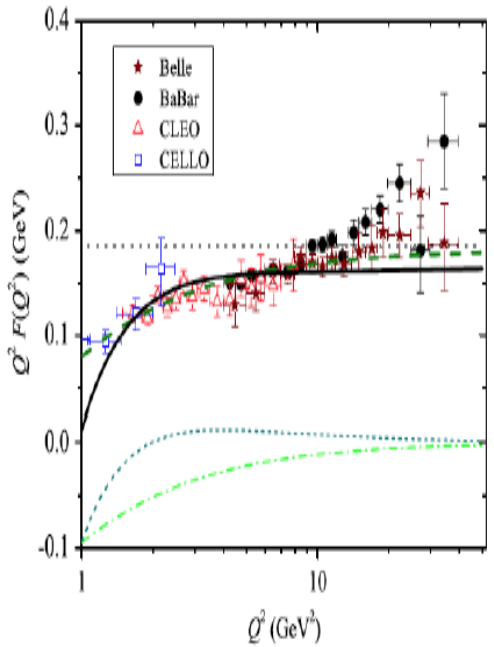



FIG. 6 (color online). Values of $Q^2F(Q^2)$, Eq. (40), at LO (long-dashed line) and NLO (solid line), in comparison with experimental data. Dashed-dotted and short-dashed curves show the contributions given by the term $C/Q^2 + D/Q^4$ at LO and NLO, respectively, while the horizontal dotted line indicates the asymptotic QCD limit.

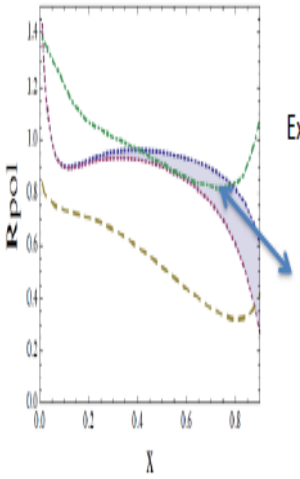
Eur. Phys. J. A (2014) 50: 116
DOI 10.1140/epja/i2014-14116-8

THE EUROPEAN PHYSICAL JOURNAL A

Regular Article – Theoretical Physics

## Medium effects in DIS from polarized nuclear targets

Hunor Fanchiotti[1,2], Carlos A. García Canal[1,2], Tatiana Tarutina[1,2,a], and Vicente Vento[3]




Experimental proposal

Fanchiotti et al.

FIG. 5: $R_{pol}$ bound for $^7$Li as a function of $x$ in the MSS approach as in the previous figure (dotted curves). The dot-dashed curve corresponds to the calculation in Ref. [14] with the sea contribution included, while the dashed curve the that of Ref. [12, 13].

[12] I. C. Cloet, W. Bentz and A. W. Thomas, Phys. Rev. Lett. **95** (2005) 052302 [nucl-th/0504019].

[13] I. C. Cloet, W. Bentz and A. W. Thomas, Phys. Lett. B **642** (2006) 210 [nucl-th/0605061].

[14] J. R. Smith and G. A. Miller, Phys. Rev. C **72** (2005) 022203 [nucl-th/0505048].

The EMC Effect in Spin Structure Functions

A 12 GeV Proposal to Jefferson Lab PAC 42

May 3, 2014

W. K. Brooks[1], H. Hakobyan, B. Kopeliovich, S. Kuleshov, S. Marcella, and H. Morales
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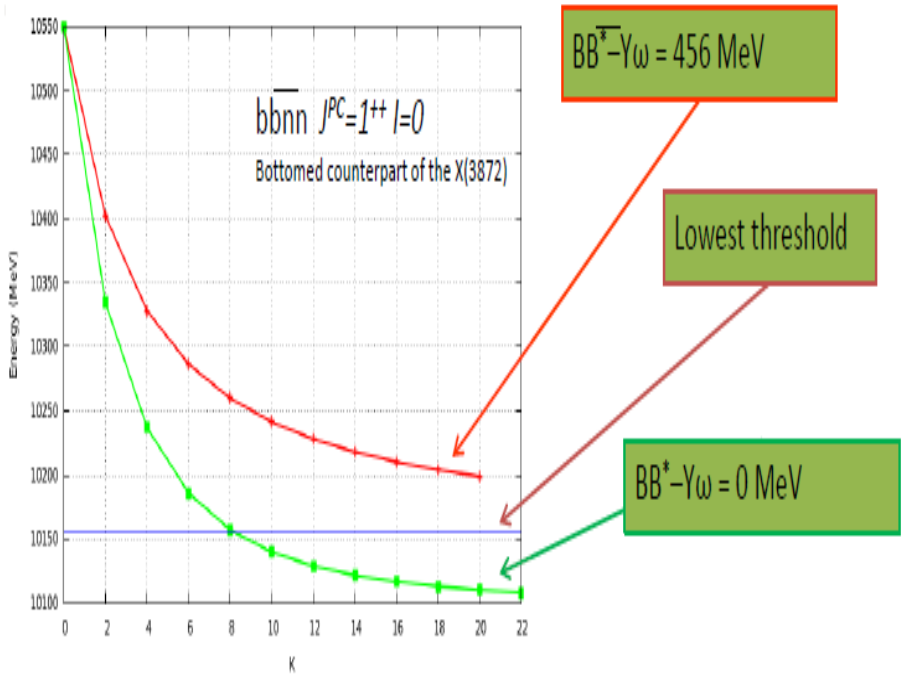
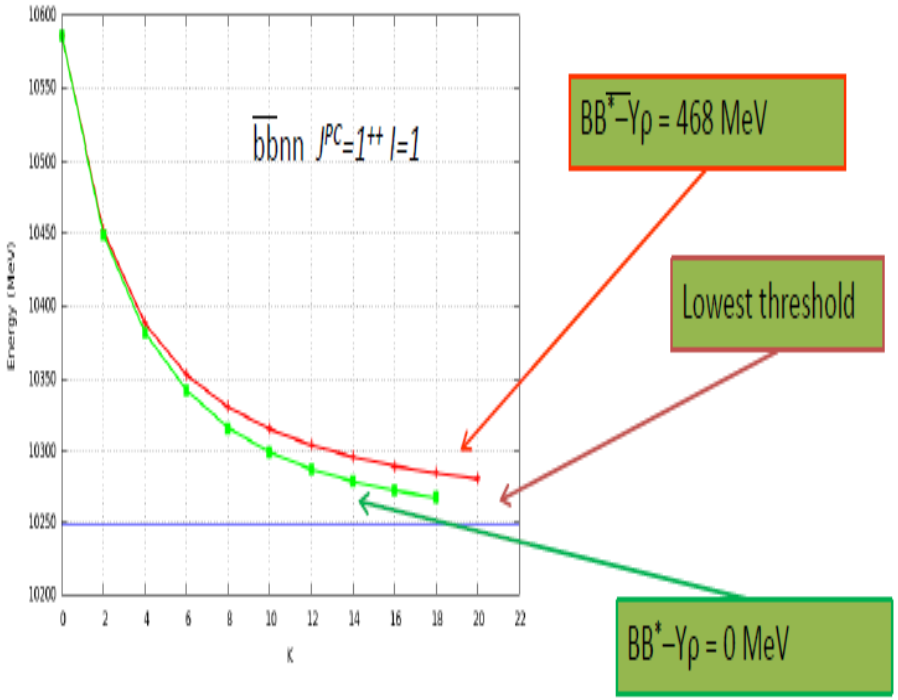
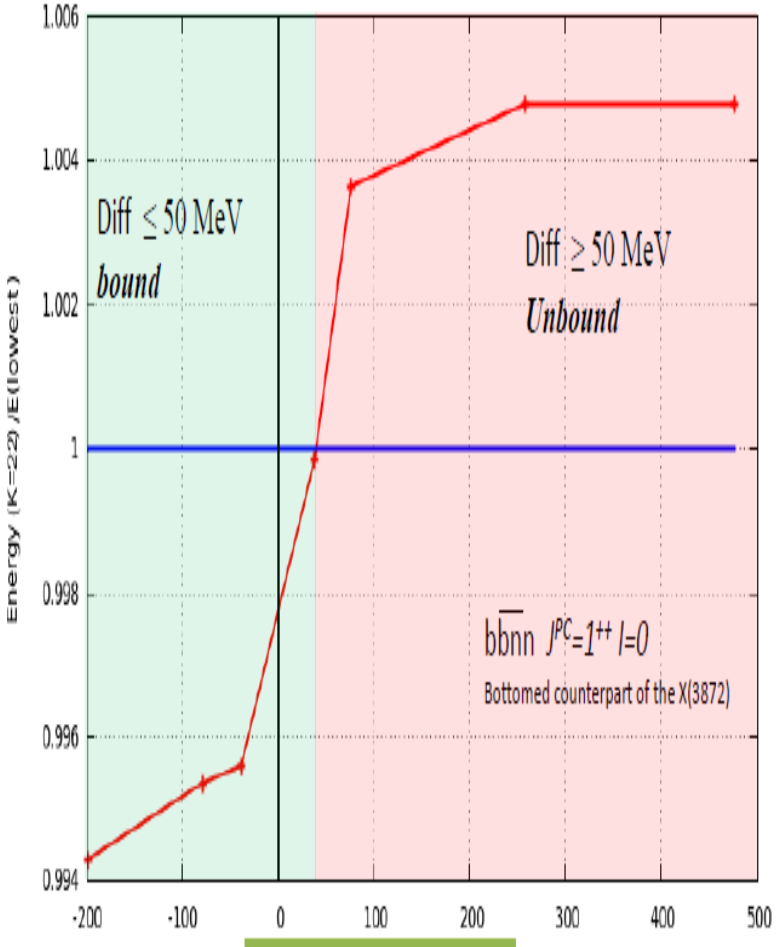
and the CLAS collaboration

clas

CLAS Large Acceptance Spectrometer




$$\begin{pmatrix} B\bar{B}^* \leftrightarrow B\bar{B}^* & B\bar{B}^* \leftrightarrow \Upsilon\omega \\ B\bar{B}^* \leftrightarrow \Upsilon\omega & \Upsilon\omega \leftrightarrow \Upsilon\omega \end{pmatrix}$$

- Threshold vicinity is a required but not sufficient condition to bind a four-quark state
- Attractive interaction is required in the upper threshold → strong coupling between both thresholds.

J.V., A.V., Phys. Lett. B 736, 325 (2014)

# MEMORIA (2014) DEL PROYECTO:
# "AGUJEROS NEGROS CUANTICOS, SUPERGRAVEDAD Y COSMOLOGIA", IP: María Antonia Lledó

**MIEMBROS:** A. Fabbri (Investigador IFIC-Centro Fermi), M.A. Lledó (TU), J. Navarro-Salas, (CU), G. Olmo (JAE doc, IFIC), I. Agulló (Associate Professor, LSU, USA), F. Nadal (JAE), P. Galli (FPI), A. del Rio (FPU)

## - Analog Hawking radiation in Bose-Einstein condensates:

1. *"The analog of the Hawking effect in BECs"*, A. Fabbri, arXiv:1411.7842 [gr-qc]
2. *Momentum distribution as a signature of Hawking radiation in Bose-Einstein condensates*, D. Boiron, A. Fabbri, P.-E. Larre', N. Pavloff, C. Westbrook, P. Zin, arXiv:1406.5229 [cond-mat.quant-gas]
3. *"Gray-body factor and infrared divergences in 1D BEC acoustic black holes"*, P. R. Anderson, R. Balbinot, A. Fabbri and R. Parentani, arXiv:1404.3224 [gr-qc], Phys. Rev. D **90**, no. 10, 104044 (2014)
4. *"Amplifying the Hawking signal in BECs"*, R. Balbinot and A. Fabbri, arXiv:1403.1877 [gr-qc], Adv. High Energy Phys. **2014**, 713574 (2014)

## - QFT and cosmology

1. *"Electric-magnetic duality and renormalization in curved spacetimes"*, I. Agullo, A. Landete and J. Navarro-Salas, arXiv:1409.6406 [gr-qc]. Phys. Rev. D (2014).
2. *"Renormalized stress-energy tensor for spin-1/2 fields in expanding universes"*, A. del Rio, J. Navarro-Salas and F. Torrenti, arXiv:1407.5058 [gr-qc], Phys. Rev. D **90**, 084017 (2014).
3. *"Spacetime correlators of perturbations in slow-roll de Sitter inflation"*, A. del Rio and J. Navarro-Salas, arXiv:1401.6912 [gr-qc], Phys. Rev. D **89**, 084037 (2014).
4. *"Adiabatic regularization and particle creation for spin one-half fields,"* A. Landete, J. Navarro-Salas and F. Torrenti, [arXiv:1311.4958 [gr-qc], Phys. Rev. D **89** (2014) 4, 044030

## - Quantum Gravity and Black Holes

1. *"An alternative scenario for critical scalar field collapse in $AdS_3$"*, G. Clement and A. Fabbri, arXiv:1410.3109 [gr-qc].
2. *"Rotating black holes in massive gravity"*, E. Babichev and A. Fabbri, arXiv:1406.6096 [gr-qc], Phys. Rev. D **90**, 084019 (2014)
3. *"A class of charged black hole solutions in massive (bi)gravity"*,E. Babichev and A. Fabbri, arXiv:1405.0581 [gr-qc], JHEP **1407**, 016 (2014)
4. *"Black holes in five-dimensional Palatini $f(R)$ gravity and implications for the AdS/CFT correspondence"*, D. Bazeia, L. Losano, G. J. Olmo and D. Rubiera-Garcia, arXiv:1405.0208 [hep-th], Phys. Rev. D **90**, 044011 (2014)
5. *"A scenario for critical scalar field collapse in $AdS_3$"*, G. Climent and A. Fabbri, arXiv:1404.0589 [gr-qc]
6. *"Dynamical generation of wormholes with charged fluids in quadratic Palatini gravity"*, F. S. N. Lobo, J. Martinez-Asencio, G. J. Olmo and D. Rubiera-Garcia, arXiv:1403.0105 [hep-th], Phys. Rev. D **90**, 024033 (2014)
7. *"Microscopic wormholes and the geometry of entanglement"*, F. S. N. Lobo, G. J. Olmo and D. Rubiera-Garcia, arXiv:1402.5099 [hep-th], Eur. Phys. J. C **74**, no. 6, 2924 (2014)
8. *"Stability analysis of black holes in massive gravity: a unified treatment"*, E. Babichev and A. Fabbri, arXiv:1401.6871 [gr-qc], Phys. Rev. D **89**, 081502 (2014)
9. *"Comment on 'Critical scalar field collapse in $AdS_3$: an analytical approach"'*, G. Clément and A. Fabbri, arXiv:1401.4093 [gr-qc], Class. Quant. Grav. **31**, 098001 (2014)

10. *"Planck scale physics and topology change through an exactly solvable model"*, F. S. N. Lobo, J. Martinez-Asencio, G. J. Olmo and D. Rubiera-Garcia, arXiv:1311.5712 [hep-th], Phys. Lett. B **731**, 163 (2014)

- **Supergravity and deformations**

- R. Fioresi and M. A. Lledó, *Deformations of the Minkowski and conformal spaces and superspaces*, World-Scientific, Singapore (to appear in 2015).

- **Modified gravity**

1. *"Early-time cosmic dynamics in $f(R)$ and $f(|\hat{\Omega}|)$ extensions of Born-Infeld gravity"*, A. N. Makarenko, S. D. Odintsov, G. J. Olmo and D. Rubiera-Garcia, arXiv:1411.6193 [gr-qc].

2. *"Thick brane in $f(R)$ gravity with Palatini dynamics"*, D. Bazeia, L. Losano, R. Menezes, G. J. Olmo and D. Rubiera-Garcia, arXiv:1411.0897 [hep-th].

3. *"Infrared lessons for ultraviolet gravity: the case of massive gravity and Born-Infeld"*, J. B. Jimenez, L. Heisenberg and G. J. Olmo, arXiv:1409.0233 [hep-th], JCAP **1411**, 004 (2014)

4. *"Born-Infeld gravity and its functional extensions"*, S. D. Odintsov, G. J. Olmo and D. Rubiera-Garcia, arXiv:1406.1205 [hep-th], Phys. Rev. D **90**, 044003 (2014)

5. *"Brane-world and loop cosmology from a gravity-matter coupling perspective"*, G. J. Olmo and D. Rubiera-Garcia, arXiv:1405.7184 [hep-th], Phys.Lett. B11, 034 (2014).

6. *"Little Rip, $\Lambda$CDM and singular dark energy cosmology from Born-Infeld-$f(R)$ gravity"*, A. N. Makarenko, S. D. Odintsov and G. J. Olmo, arXiv:1404.2850 [gr-qc], Phys. Lett. B **734**, 36 (2014)

7. *"Born-Infeld-$f(R)$ gravity"*, A. N. Makarenko, S. Odintsov and G. J. Olmo, arXiv:1403.7409 [hep-th], Phys. Rev. D **90**, 024066 (2014)

8. *"Astrophysical constraints and insights on extended relativistic gravity"*, S. Mendoza and G. J. Olmo, arXiv:1401.5104 [gr-qc].

9. *"The Cauchy problem in hybrid metric-Palatini f(X)-gravity"*, S. Capozziello, T. Harko, F. S. N. Lobo, G. J. Olmo and S. Vignolo, arXiv:1312.1320 [gr-qc], Int. J. Geom. Meth. Mod. Phys. **11**, no. 5, 1450042 (2014)

- **Conferences, meetings, and workshops**

- **Organization:** Spanish Relativity Meeting ERE2014, 1-5 Sept., Valencia.
- **Plenary talk:** *"The analog of the Hawking effect in BECs"*, A. Fabbri (ERE2014, Valencia).
- **Plenary talk:** *"Minimal extensions of Einstein's theory of gravity"*, G.J. Olmo (XXXII EFNNE, Nov2014, João Pessoa, Brasil).
- **Coloquium:** *Analog of black hole evaporation in Bose-Einstein condensates*, A. Fabbri, August 2014, Wake Forest University (NC, USA)
- **Other contributions:**
  - Spanish Relativity Meeting ERE2014, Sept.2014, Valencia (Spain).
  - GSSI workshop *Multiple Messengers and Challenges in Astroparticle Physics* , Oct.2014, l'Aquila (Italy).
  - *Quantum Field Theory and Gravity*, Jul.2014, Tomsk (Russia).
  - *International Conference on High-Energy Physics* (ICHEP2014), Jul. 2014, Valencia

- **Divulgación**

- Interview, Leonard Parker (The discoverer of cosmological particle creation), Método (UV) n. 83, 10 (2014), by J. Navarro-Salas

# RESULTADOS DESTACADOS

- **A NEW ANOMALY:**

  The Electric-Magnetic duality symmetry of free electromagnetism is broken in the presence of gravity due to renormalizacion effects.

  I. Agullo, A. Landete and J. Navarro-Salas, PRD, 2014.

- **QUANTUM ENTANGLEMENT AS A MANIFESTATION OF WORMHOLE PHYSICS:**

  Microscopic wormholes and the geometry of entanglement.

  F. S. N. Lobo, G. J. Olmo and D. Rubiera-Garcia, EPJC, 2014.

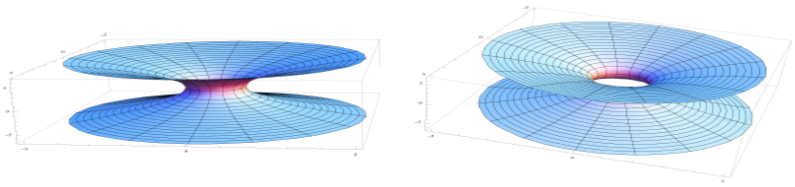


Figura 1: Euclidean embedding of a regular wormhole.

- **A NEW BOOK**:

  Deformations of the Minkowski and conformal spaces and superspaces, World-Scientific, Singapore, 2015.

  R. Fioresi and M. A. Lledó,

- **ACOUSTIC BLACK HOLES IN BECs:**

  Momentum distribution as a signature of Hawking radiation in BECs.
  D. Boiron, A. Fabbri, P.E. Larré, N. Pavloff, C. Westbrook, P. Zin

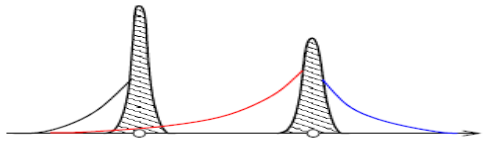


Figura 2: Momentum distribution for a BEC acoustic BH: typical experimental result.

## Papers:

José A. de Azcárraga and J.M. Izquierdo,
*Minimal D=4 supergravity from the superMaxwell algebra*
arXiv:1403.4128 [hep-th], Nucl. Phys. **B885**, 34-45 (2014)

José A. de Azcárraga, S. Fedoruk, J.M. Izquierdo and J. Lukierski
*Two-twistor particle models and free massive higher spin particles*
arXiv:1409.7169 [hep-th]

## Divulgación:

José A. de Azcárraga
*Fotones, iones y gatos cuánticos*
Revista Española de Física, abril-junio 2014, págs. 1-4

## Innovación educativa[1]

José A. de Azcárraga y Félix M. Goñi
*Sobre la necesidad de una reforma universitaria*
Revista Española de Pedagogía **257**, 5-22 (2014)

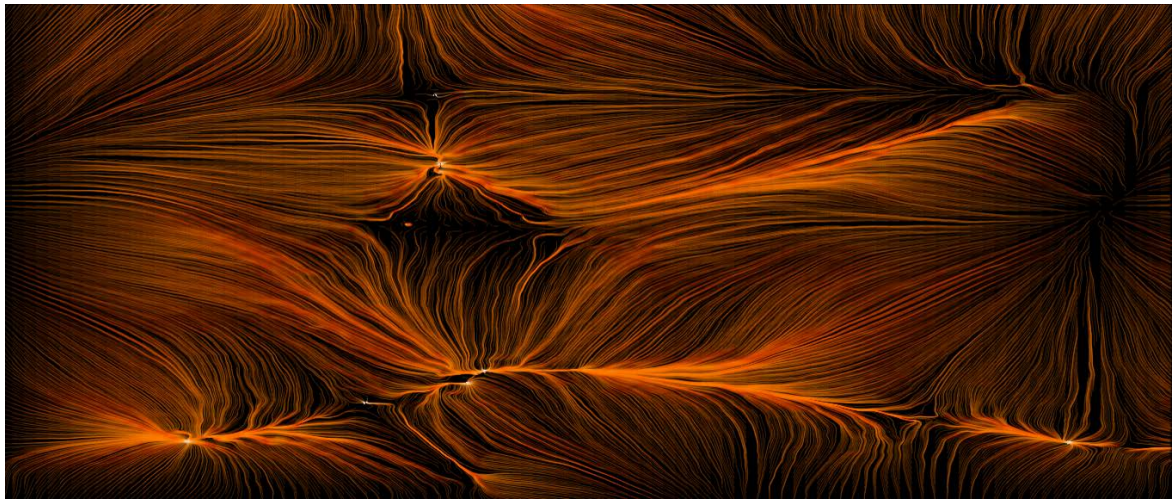
## Artículos en revistas de pensamiento:

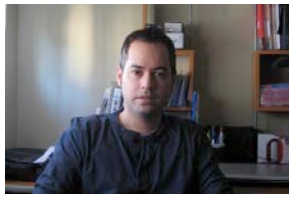
José A. de Azcárraga
*La reforma universitaria*
CLAVES de Razón Práctica, ago-sep 2014, págs. 164-173

## + múltiples conferencias, etc





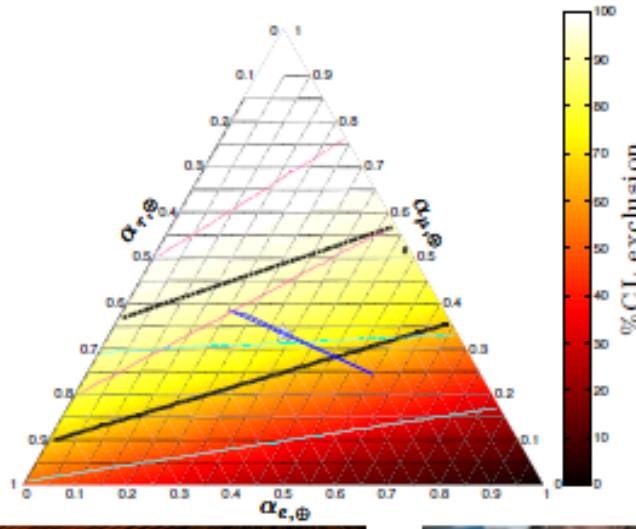
http://som.ific.uv.es

Flavor and Origin of Matter

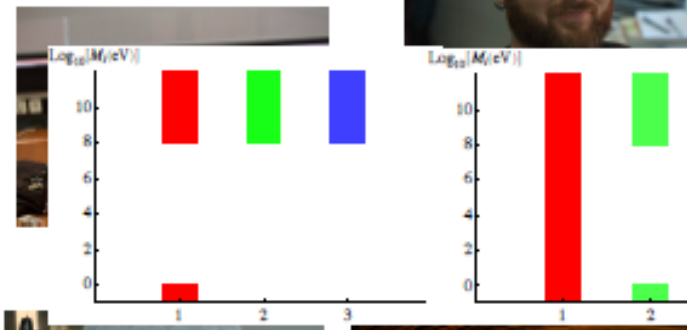
Sabor y Origen de la Materia

# ICECUBE High Energy Neutrinos

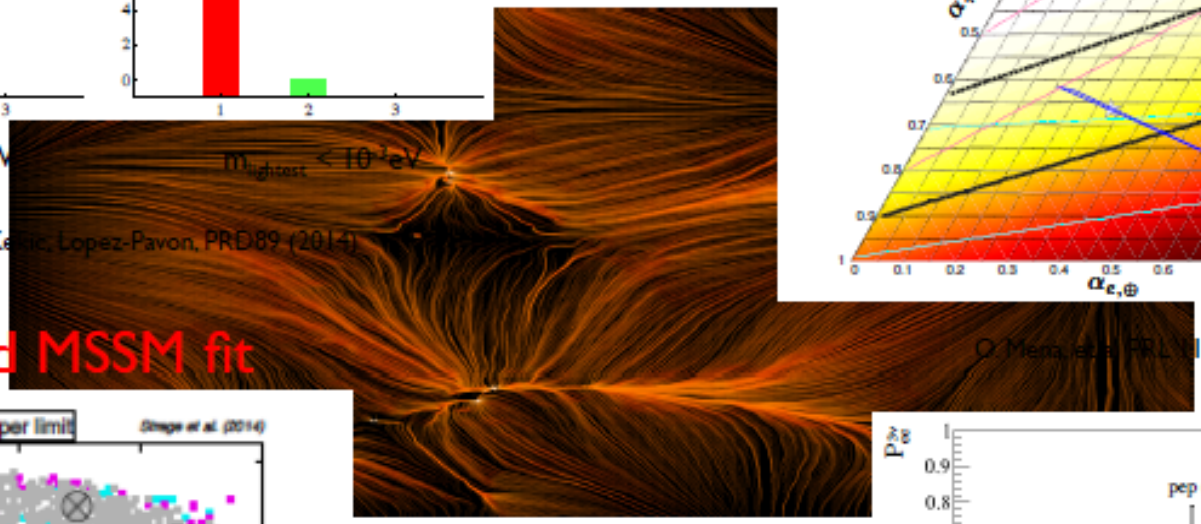
## Flavour composition




## Cosmological bounds on Low scale see-saw models



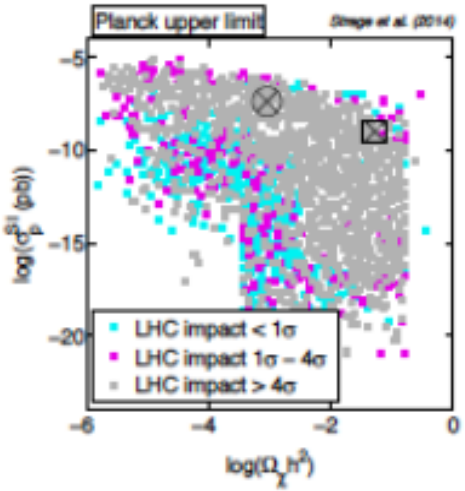





Fernández, Kajic, Lopez-Pavon, PRD89 (2014)

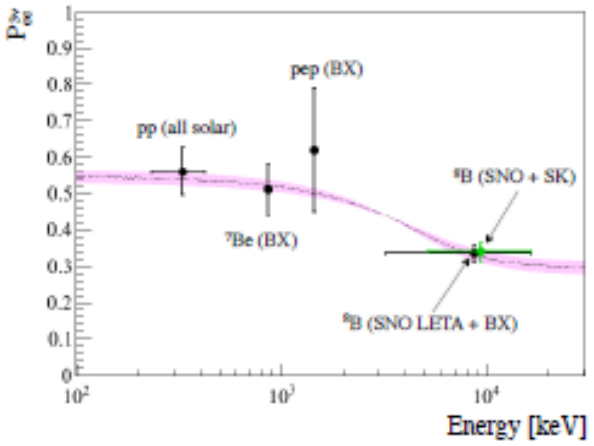
O. Mena, et al. PRL 113 (2014)

## 15-d MSSM fit




Strege et al, JHEP 1409 (2014)

## Implications of Borexino solar neutrino data




Borexino coll. PRD89 (2014)

# Física teórica nuclear y de muchos cuerpos

**Members:** E. Oset, J. Navarro, J. Ros, M. J. Vicente-Vacas, J. Nieves, L. Alvarez-Ruso (RyC), T. Ledwig (pdoc), T. Uchino (pdoc), M. Albaladejo (pdoc), J. Garzón (doc), F. Aceti (doc), En Wang (doc), C. Hidalgo (doc), C.W. Xiao (doc), A. Hiller (doc), J. Morais (doc) ), P. Fernández (doc) ), E. Saul (doc)

**Topics:**

- ✓ Dynamically generated three-hadron resonances
- ✓ Finite volume treatment of scattering of hadrons and limits to phase shifts extraction from lattice QCD
- ✓ Hadron properties (spectroscopy, magnetic moments, form factors) in the free space and in nuclei
- ✓ Neutrino-nucleon and neutrino-nucleus reactions
- ✓ Chiral perturbation theory with $\Delta$ states
- ✓ Heavy quark spin and flavor symmetries
- ✓ Dinámica no-lineal y sistemas complejos
- ✓ Función de respuesta en materia nuclear usando interacciones efectivas

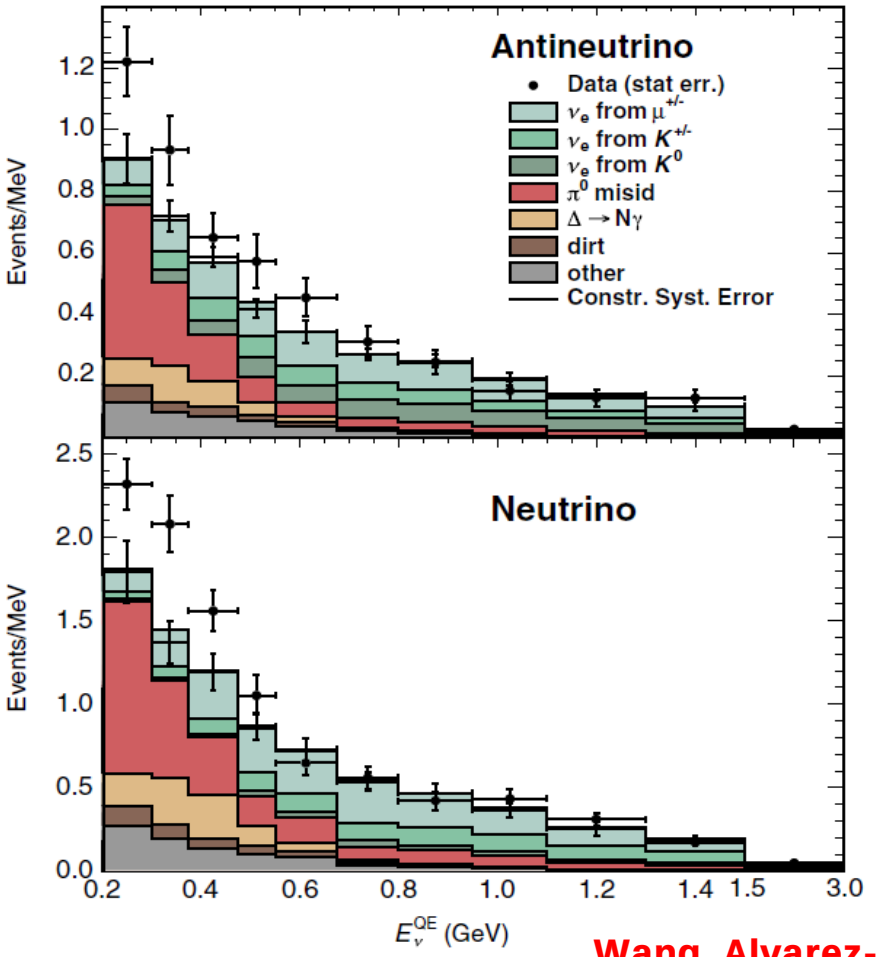
**Collaborations:**

Granada, Murcia, Salamanca, Barcelona, Córdoba, Madrid, Osaka, Beijing, Jülich, Nara, Kyoto, Bonn, Minesota, Fermilab…

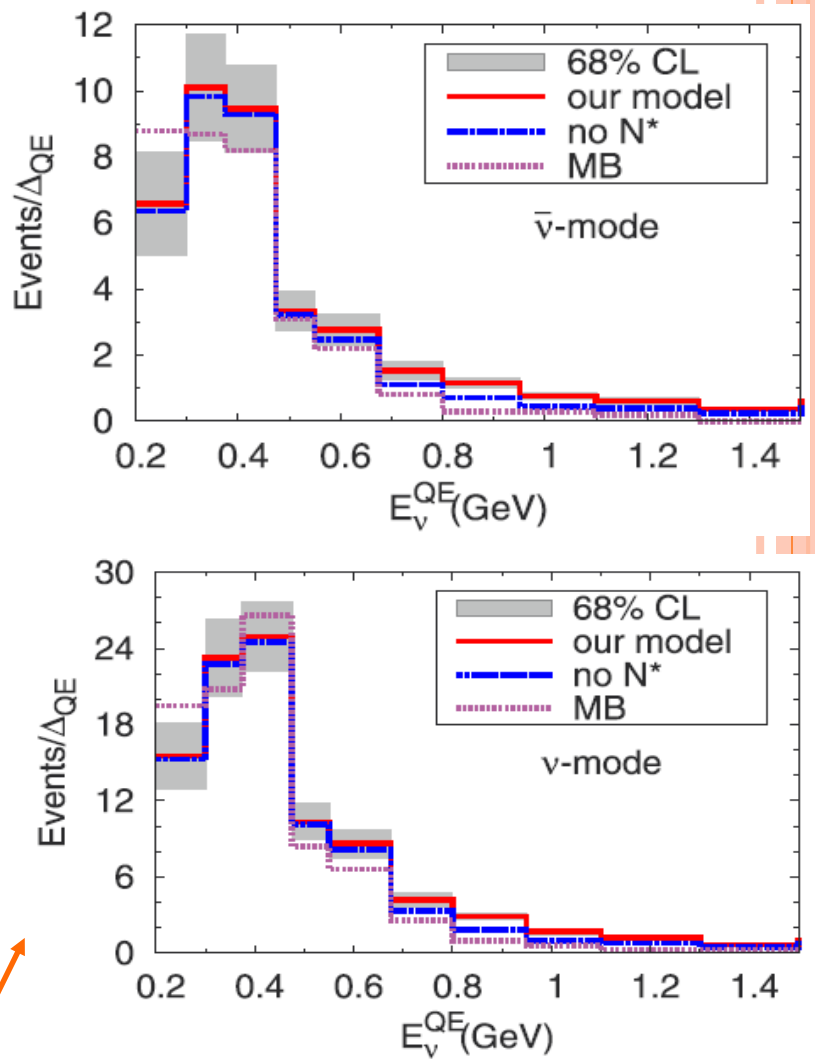
# Photon emission in NC interactions

Important background for $\nu_\mu \rightarrow \nu_e$ studies ($\theta_{13}$, $\delta$) if $\gamma$ is misidentified as $e^\pm$ from CCQE: $\nu_e\, n \rightarrow e^-\, p$ or $\bar{\nu}_e\, p \rightarrow e^+\, n$

e-like events @ MiniBooNE




insufficient to explain the excess of e-like events at MiniBooNE

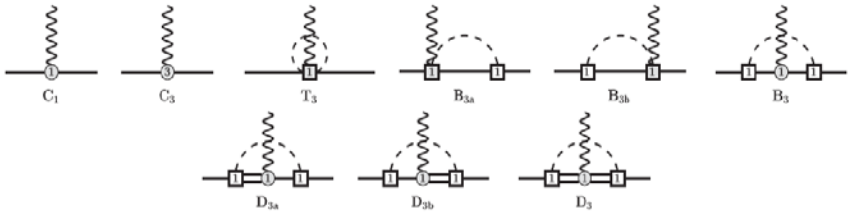



Wang, Alvarez-Ruso, Nieves, PRC 89(2014); PLB 740 (2015)

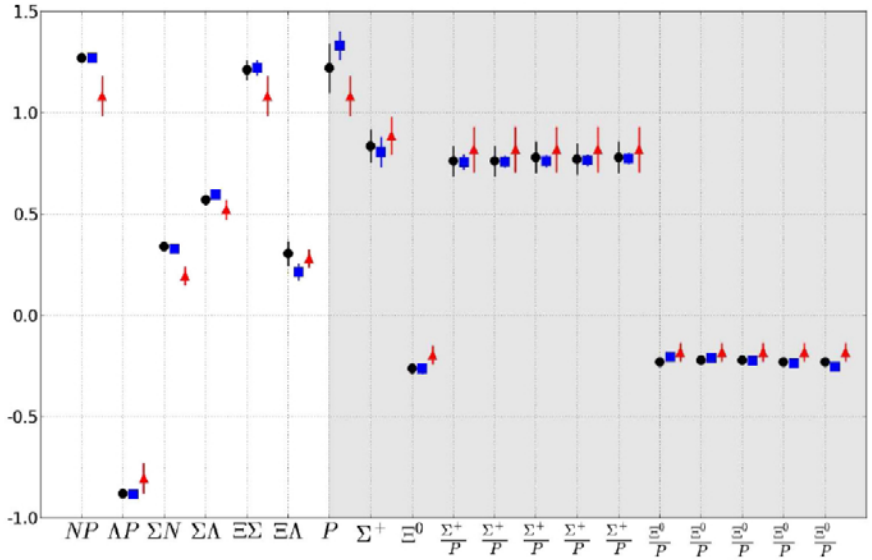
**Octet-baryon axial-vector charges and SU3-breaking effects in the semileptonic hyperon decays :** T. Ledwig, J. Martin Camalich, L. S. Geng and M. J. Vicente Vacas

*PHYSICAL REVIEW D 90, 054502 (2014)*

*The octet-baryon axial-vector charges and the g1 / f1 ratios measured in the semileptonic hyperon decays are studied using the EOMS covariant baryon chiral perturbation theory with explicit decuplet contributions. We clarify the role of different low-energy constants and find a good convergence for the chiral expansion of the axial-vector charges of the baryon octet with O(p3) corrections typically around 20% of the leading ones. This is a consequence of strong cancellations between different next-to-leading-order terms. This results in a rather mild quark-mass dependence. Furthermore, we investigate the extraction of the proton octet charge from semileptonic decay data alone, which is relevant for an analysis of the composition of the proton spin.*




Feynman diagrams contributing to the AV form factor.




Calculated Axial-vector charges of the semileptonic hyperon decays (blue squares) compared to experiment and lattice QCD data(black dots). Red triangles are LO results.

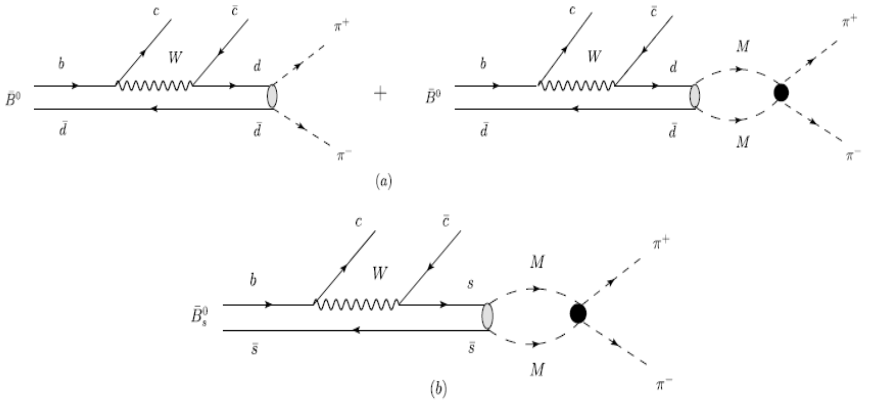
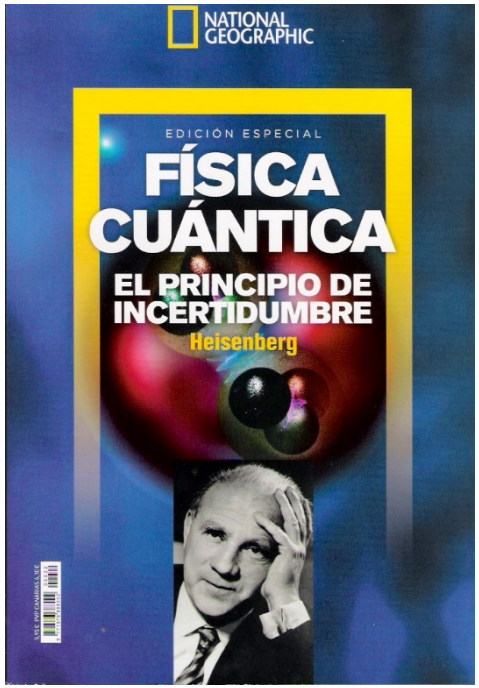


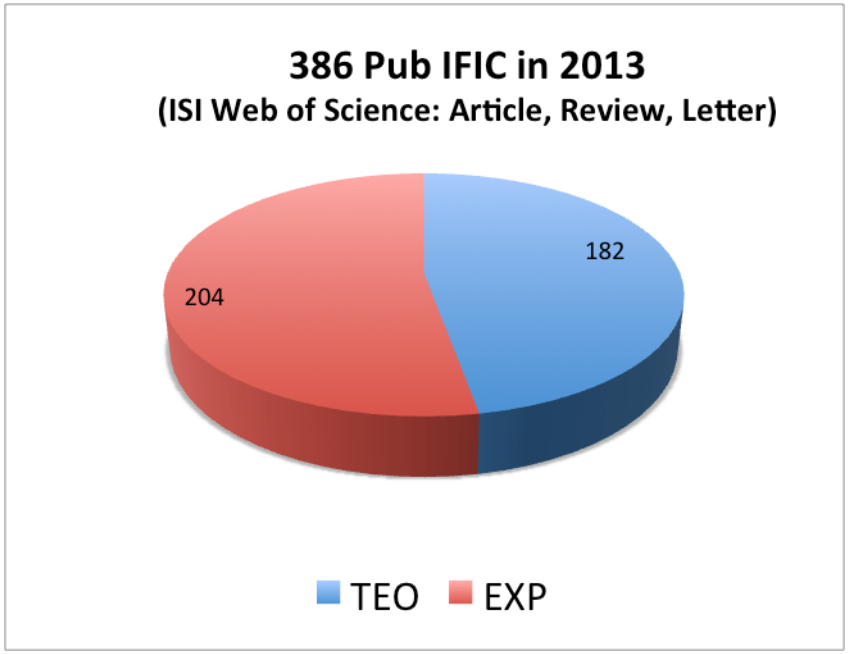

Fig. 3. Diagrammatic representation of $\pi^+\pi^-$, via direct plus rescattering mechanisms in $\bar{B}^0$ decay (a), and via rescattering for $\bar{B}_s^0$ decay (b).

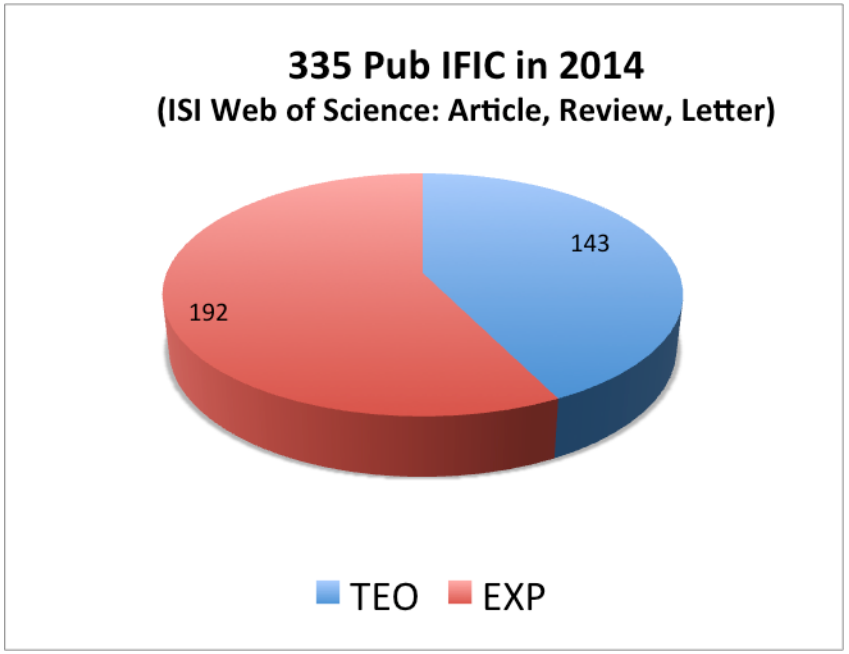
$B^0$ and $B_s^0$ decays into $J/\psi\ f_0(980)$ and $J/\psi\ f_0(500)$ and the nature of the scalar resonances

**W.H. Liang and E. Oset, PLB 737 (2014) 70**




**J. Navarro**

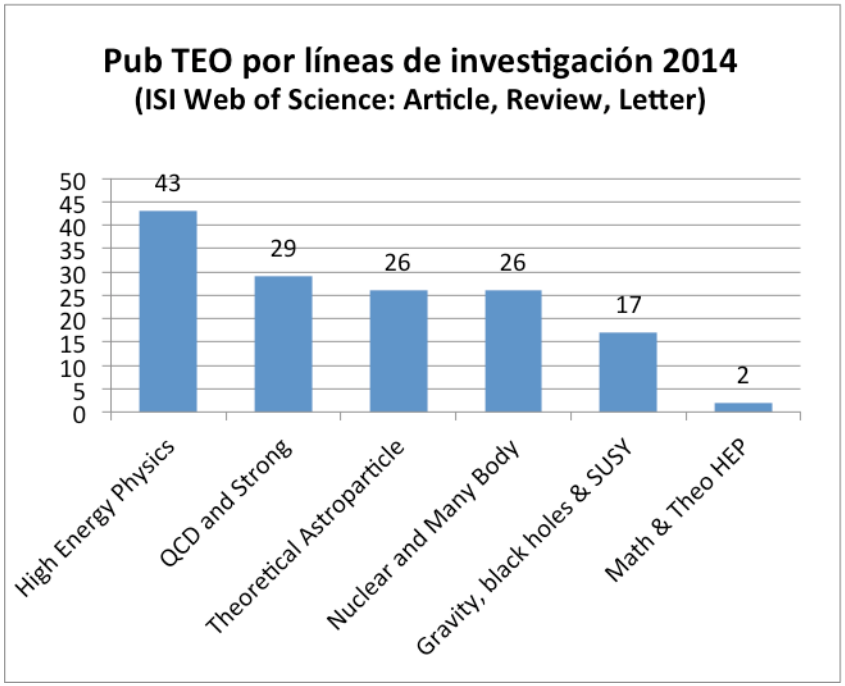



**13 Tesis doctorales**

**4 RyC:** 30/11/2015
30/11/2016
30/09/2017
15/12/2017

**+ 2 RyC (incorp. Enero 2015)**




**Provisional Diciembre 2014**


Felices Fiestas