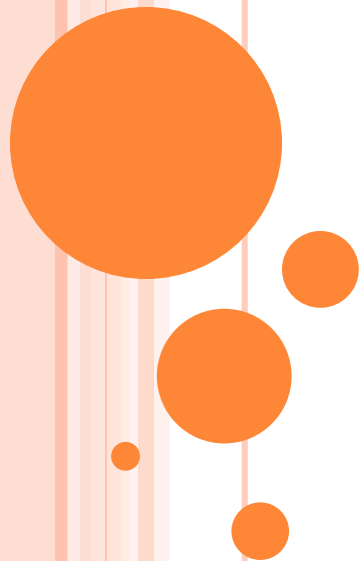




ACTIVIDADES IFIC-TEO 2015

UNIVERSITAT DE VALÈNCIA & CSIC



Juan M Nieves
22 Diciembre 2015



ACTIVIDADES IFIC-TEO 2015

UNIVERSITAT DE VALÈNCIA & CSIC



Juan M Nieves
22 Diciembre 2015

- José Bernabéu Alberola, nombrado Académico Correspondiente Nacional de la Real Academia de Ciencias de España y Académico Honorífico de la Real Academia de Medicina de la Comunidad Valenciana.
- Vicent Mateu Barreda - Premio al Investigador Novel en Física Teórica de 2014 de la RSEF y fundación BBVA
- Juan Andrés Herrero García: Premio Extraordinario de Doctorado curso 2013/2014

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

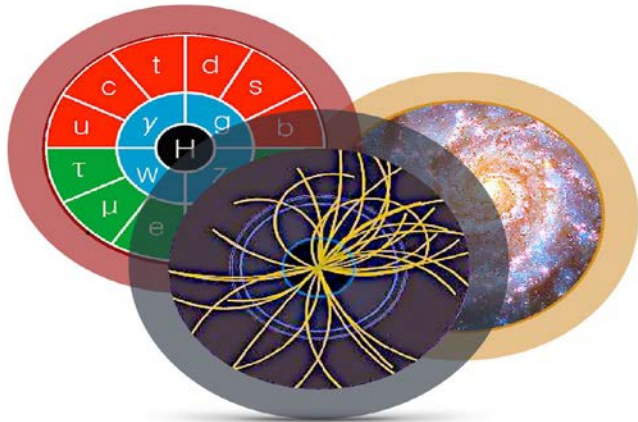

Germán Rodrigo



- José Bernabéu Alberola, nombrado Académico Correspondiente Nacional de la Real Academia de Ciencias de España y Académico Honorífico de la Real Academia de Medicina de la Comunidad Valenciana.
 - Vicent Mateu Barreda, Premio al Investigador Novel en Física Teórica de 2014 de la RSEF y fundación BBVA
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- DFT ha participado activamente en el Programa de Seminarios **(IVICFA)** & Colloquia del IFIC
 - Participado/colaborado en la organización de:



LHCPHENO 2015: Workshop on High-Energy Physics Phenomenology in the LHC era

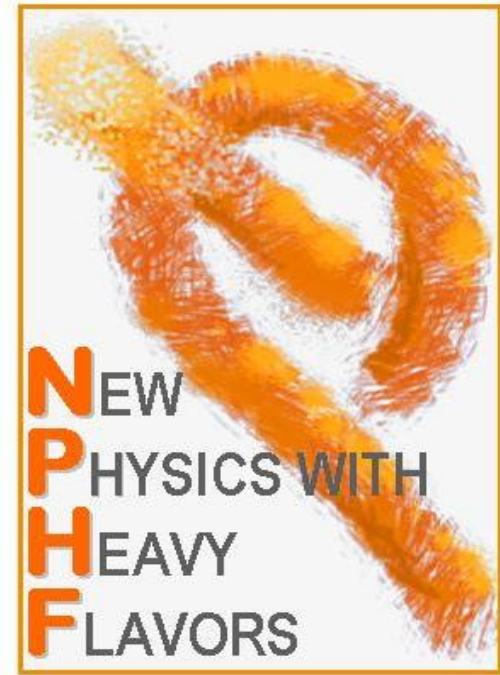


25-27 November 2015
 Parc Científic Valencia
<http://ific.uv.es/lhcpheo/lhcpheo2015>



1st Hadron Spanish Network Days
Spanish-Japanese JSPS Workshop
 June 15-17, 2015

**Fourth Workshop on Flavour
 Physics in the LHC era
 (REFIS) 23-25 November 2015**



First Workshop on String Theory and Gender

6,7 July 2015

FPA2014-54459-P

Elementary Particles: the Standard Model and Beyond

FPA2011-23897, GVPROMETEOII2014-087

Estudios perturbativos y no perturbativos del Modelo Estándar y sus Extensiones

GVPROMETEOII2013-017

De la Física del LHC a las claves del universo primordial en la era de los datos

Equipo de Investigación:

- Arcadi Santamaria Luna (IP1, IP GVPROMETEOII2014-087)
- José A. Peñarrocha Gantes (IP2)
- Vicent Giménez Gómez (IP FPA2011-23897)
- José Bernabéu Alberola (IP GVPROMETEOII2013-017)
- Gabriela Barenboim
- José Manuel Bordes Villagrasa
- Sergio Palomares Ruiz
- Armando Pérez Cañellas
- Miguel Angel Sanchis Lozano
- Jorge Vidal Perona
- Oscar Vives García

Equipo de trabajo local:

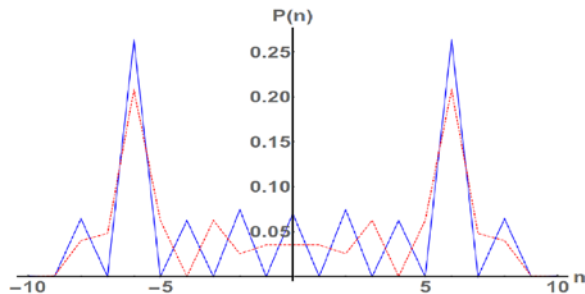
- Dr. Dipankar Das
- Dr. Wanil Park
- Dr. Michael Jay Pérez
- Julian Alcaide
- Cristian Bosch Serrano
- Carlos Faubel Alamà
- Maria Luisa López Ibáñez
- Alejandro Segarra Tamarit

Quantum Information

M. Hinarejos, M.C. Bañuls, P. Gomis and A. Pérez

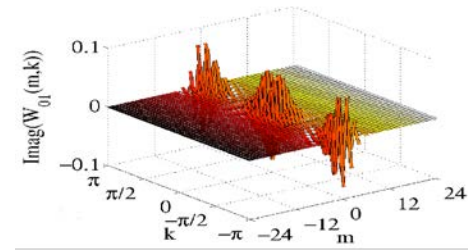
Wigner function representing a double Gaussian state on a lattice

M Hinarejos, M C Bañuls y A Pérez.
New J. Phys. 17 (2015) 013037



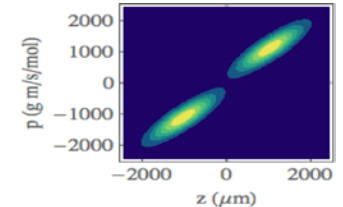
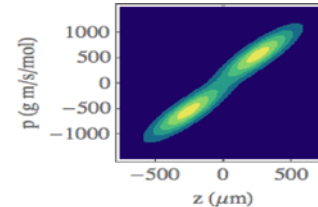
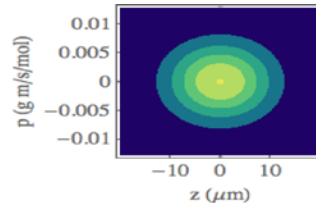
Evolution of the Stern-Gerlach state of Silver atoms using Wigner functions.

P. Gomis and A. Pérez:
arXiv:1507.08541



The Dirac Quantum Cellular Automaton
Probability distribution, compared with the
Quantum Walk

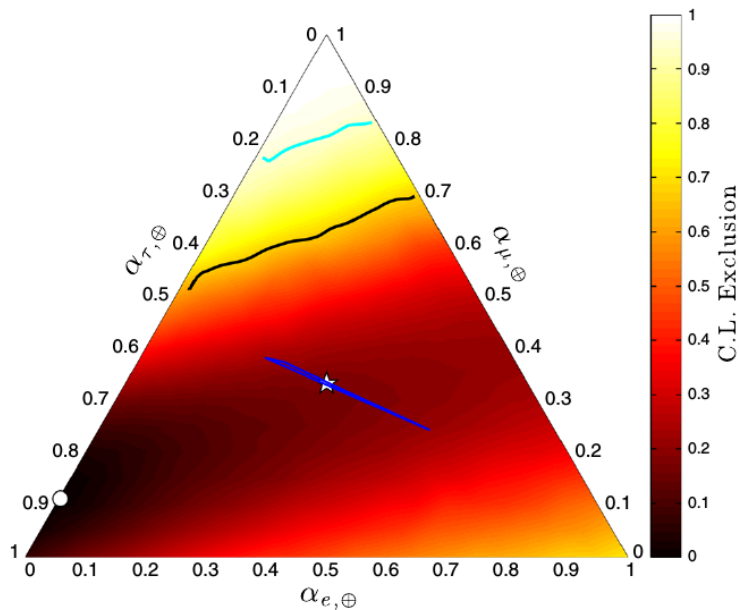
A. Pérez: arXiv:1504.07418



Spectral analysis of the high-energy IceCube neutrinos

Sergio Palomares-Ruiz, Aaron C. Vincent, and Olga Mena

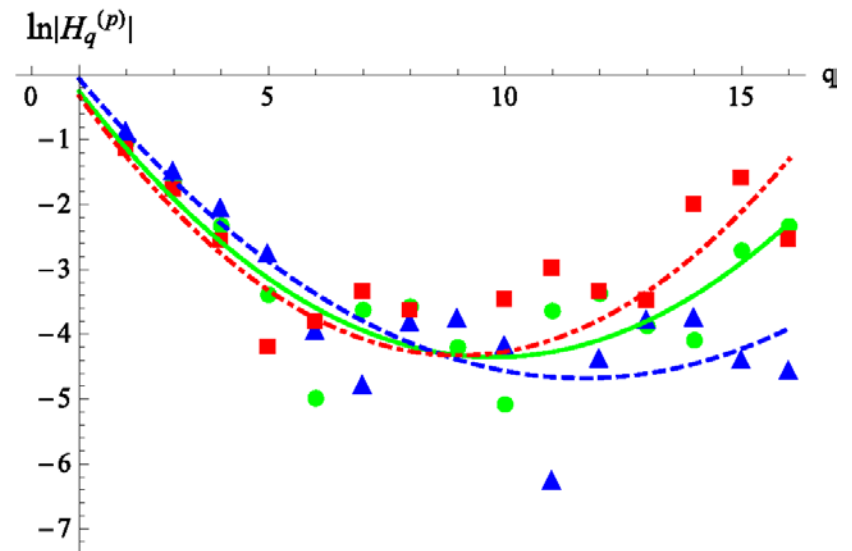
Phys. Rev. D 91, 103008



Exclusions of the neutrino flavor composition of the 36 high-energy events seen at IceCube after 988 days, in the energy range 28 TeV–3 PeV.

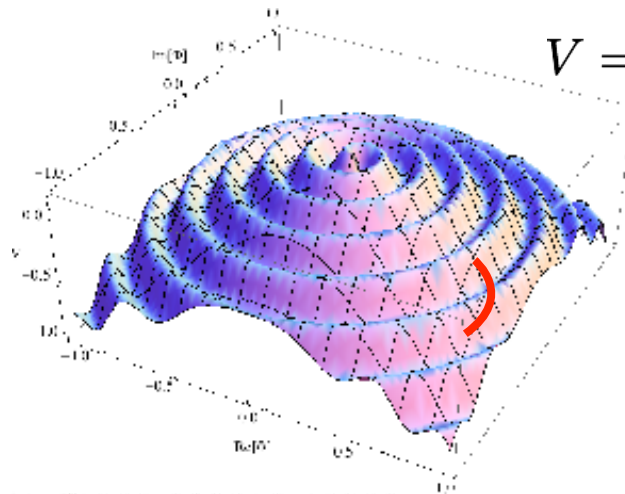
Searching for hidden sectors in multiparticle production at the LHC

M.A. Sanchis-Lozano, E.K. Sarkisyan-Grinbaum, S. Moreno-Picot
e-Print: [arXiv:1510.08738](https://arxiv.org/abs/1510.08738)



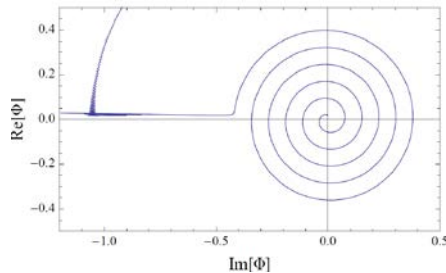
Values of $\ln|H_q|$ at $s = 13$ TeV versus q for a 2-step scenario ($p = 2$, circles) and a 3-step scenario ($p = 3$) with $\langle N_h \rangle = 2$ (triangles) and $\langle N_h \rangle = 10$ (squares).

- Spiral Inflation (Gabriela Barenboim & Wanil Park)
PLB 741 (2015) 252, PRD91,6 (2015)



$$V = V_\phi + \Lambda^4 [1 - \sin(\phi/M + \theta)]$$

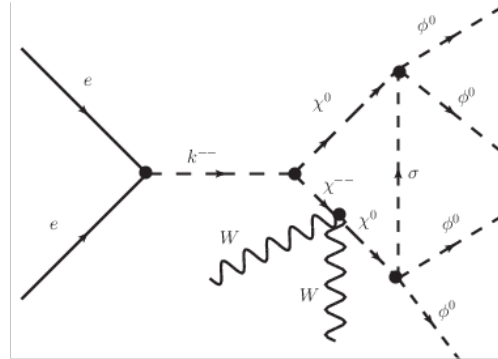
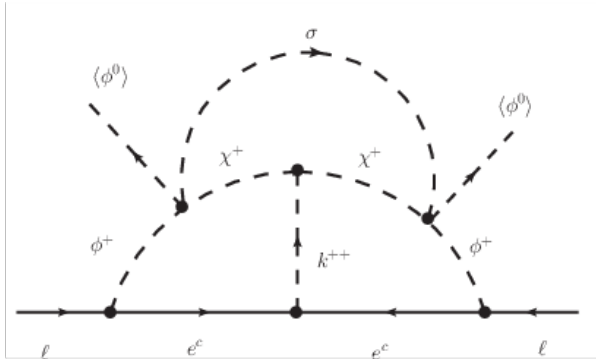
Generically, inflation models suffer from eta-problem and/or trans-Planckian excursion of inflaton.



Both problems can be solved if inflaton is a elongated compactified trajectory in a sub-Planckian multi-dimensional field space

Three-loop neutrino mass with neutrinoless double beta decay and dark matter candidate

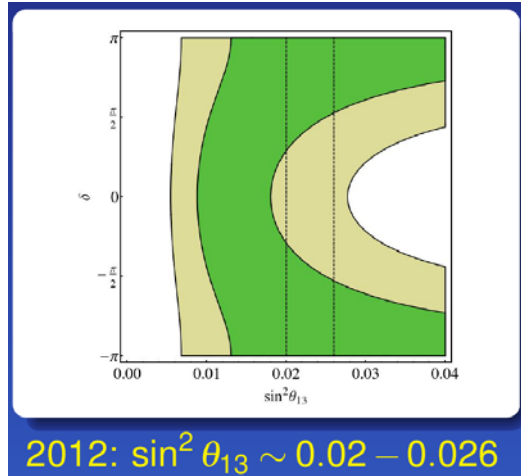
Julian Alcaide, Arcadi Santamaria, José Wudka



ν mass matrix highly constrained

$$|m_{\nu}| = \begin{pmatrix} < 10^{-4} & < 10^{-4} & \sim 0.01 \\ < 10^{-4} & \sim 0.01 & \sim 0.01 \\ \sim 0.01 & \sim 0.01 & \sim 0.01 \end{pmatrix} \text{ eV}$$

- Only NH allowed
- Prediction for $m_{\text{light}} \sim 0.004 \text{ eV}$
- Prediction for $\sin^2 \theta_{13}$



2012: $\sin^2 \theta_{13} \sim 0.02 - 0.026$

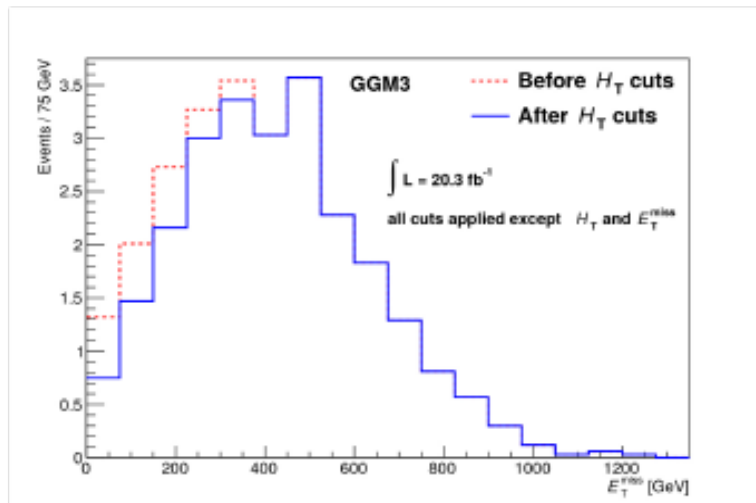
- * Naturally small neutrino masses with predictions.
- * Short distance contributions to neutrinoless double beta decay.
- * Discrete parity keeps σ stable: DM candidate.
- * Doubly charged scalars can be discovered at the LHC.
- * Testable!

METing SUSY on the Z peak

G. Barenboim, J. Bernabeu, V. A. Mitsou, E. Romero and O. Vives, arXiv:1503.04184

ATLAS observes **29** l^+l^- plus MET events on the Z-peak.

Expected background: **10.6 ± 3.2**

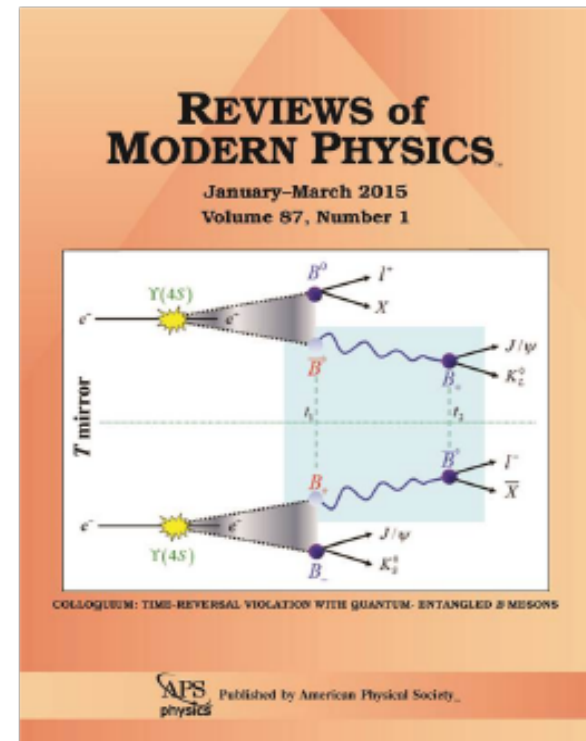


Possible explanation in **General Gauge Mediation** with lightest **neutralino NLSP** decaying to **Z** -boson plus **LSP**.

Colloquium:

Time-reversal violation with quantum-entangled B mesons

J. Bernabeu and F. Martinez-Vidal, Rev. Mod. Phys. **87**, 165 (2015)



Sum Rules with Legendre Polynomial Kernels

(J. Bordes, J. Peñarrocha)

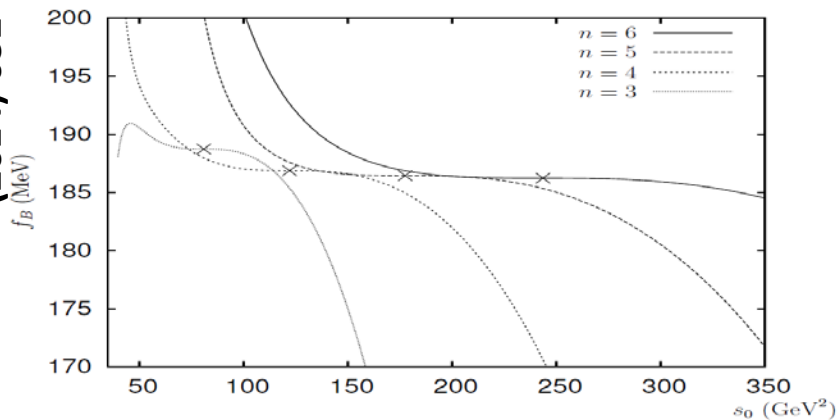
$$\frac{1}{\pi} \int_{s_{phys}}^{s_{eff}} P_n(s; s_{eff}, s_0) [\text{Im } \Pi^\Gamma(s)]_{Data} ds$$

$$\approx \frac{1}{\pi} \int_{s_{QCD}}^{s_{eff}} P_n(s; s_{eff}, s_0) [\text{Im } \Pi^\Gamma(s, m)]_{QCD} ds$$

$P_n(s; s_{eff}, s_0)$ defined in $[s_{eff}, s_0]$

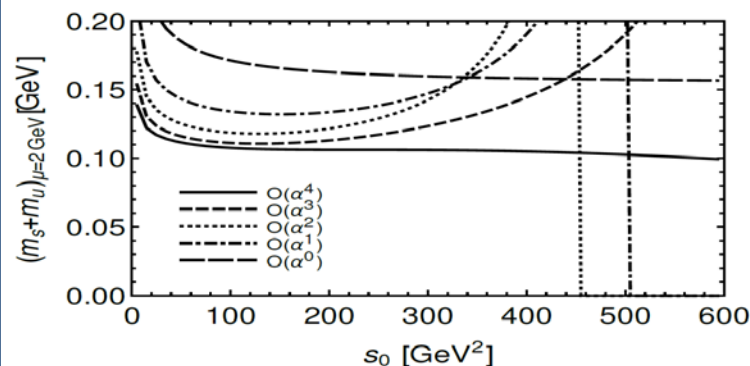
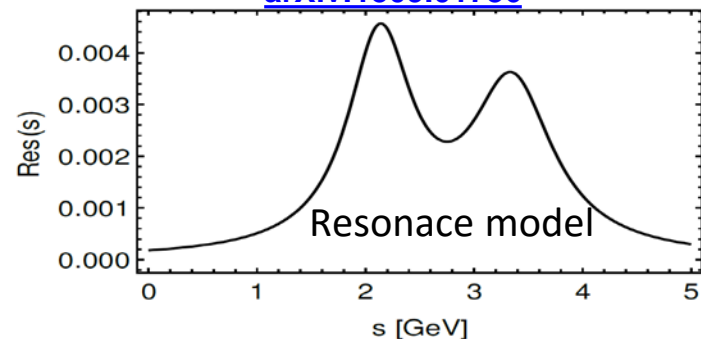
- Study stability of $m(s_0)$ parameter with s_0 (for s_{eff} around $s_{phys,cont}$)

JHEP 1407
(2014) 032



Strange quark mass

[arXiv:1509.01736](https://arxiv.org/abs/1509.01736)



N. Carrasco and V. Giménez et al. (ETMC)

Lattice QCD study of B-meson decay constants from ETMC

Presented at CKM2014, arXiv:1411.5566

A high precision lattice QCD computation of the B-meson decay constants has been performed by the ETMC collaboration. The ratio method is used where suitable ratios allow to reach the bottom quark sector by combining simulations around the charm-quark mass with an exactly known static limit.

Results:

$N_f=2$

$f_{B_s}=228(8)$ MeV $f_B=189(8)$ MeV $f_{B_s}/f_B = 1.206(24)$

$N_f=2+1+1$

$f_{B_s}=235(9)$ MeV $f_B=196(9)$ MeV $f_{B_s}/f_B = 1.201(25)$

No significant effects from strange and charm sea quarks can be observed at this level of precision.

Leptonic decay constants f_K , f_D and f_{D_s} with $N_f=2+1+1$ twisted-mass lattice QCD

Phys.Rev. D91 (2015) 5, 054507

The decay constants f_K , f_D and f_{D_s} are computed on the lattice with $N_f=2+1+1$ dynamical quarks: two light mass-degenerate, the strange and the charm quarks. We use data simulated at three different values of the lattice spacing in the range 0.06–0.09 fm and at pion masses in the range 210–450 MeV. Using the latest value of $|V_{ud}|$ from superallowed nuclear β decays the unitarity of the first row of the CKM matrix is fulfilled at the per mille level.

Results:

Decay constants:

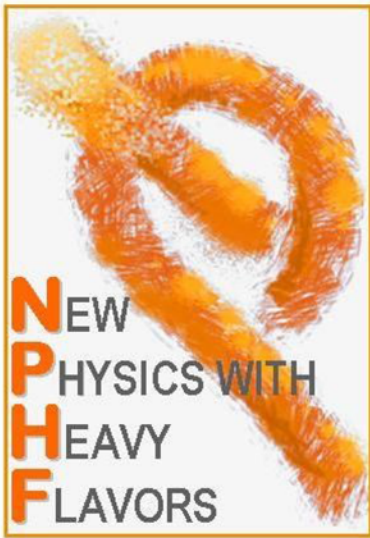
$f_{K^+}/f_{\pi^+} = 1.184 (16)$
 $f_{K^+} = 154.4 (2.0)$ MeV
 $f_D = 207.4 (3.8)$ MeV
 $f_{D_s} = 247.2 (4.1)$ MeV
 $f_{D_s}/f_D = 1.192 (22)$

CKM matrix elements:

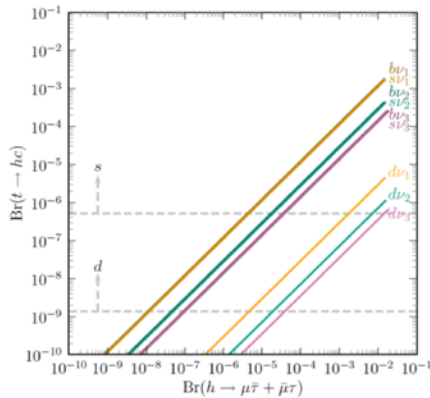
$|V_{us}| = 0.2269 (29)$
 $|V_{cd}| = 0.2221 (67)$
 $|V_{cs}| = 1.014 (24)$
 f_{PS} combined with the experimental measurements of the leptonic decays

APROXIMACION TEORICO-EXPERIMENTAL A LA BUSQUEDA DE NUEVA FISICA CON SABORES PESADOS

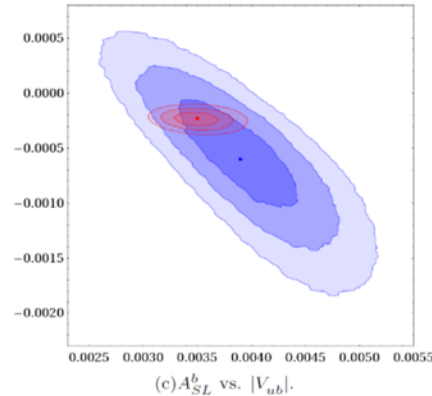
GVPROMETEOII2014-049



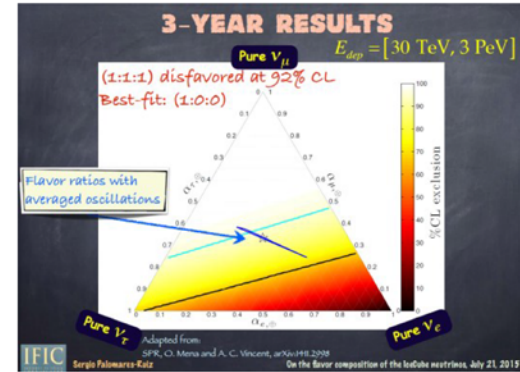
FRANCISCO J. BOTELLA, JOSE M. BORDES, FERNANDO MARTINEZ(*, %), ARANTZA OYANGUREN (*, %), SERGIO PALOMARES, JOSE PENARROCHA Y MIGUEL ANGEL SANCHIS. JOSE MAZORRA DE COS (%) Y PABLO RUIZ (%).
Colaboradores: M. Nebot, G. Branco, M. Rebelo, etc..



Flavor Higgs , top and lepton Sector.
arXiv:1508.05101



Flavor B Sector. Phys.Rev. D91 (2015) 3, 035013



Flavor Neutrino Sector.
Phys.Rev. D91 (2015)
10, 103008

(*)



BABAR

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Collaboration Home Page

(%)





Astropartículas y Física de Altas Energías

IP: José W.F. Valle

Equipo: M. Hirsch, S. Pastor, M.A. Tórtola (RyC)

Postdocs: R. Lineros, R. Fonseca, F. González-Canales, A. Rojas, C. Vaquera-Araujo, N. Rojas

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



MULTIDARK CSD2009-00064



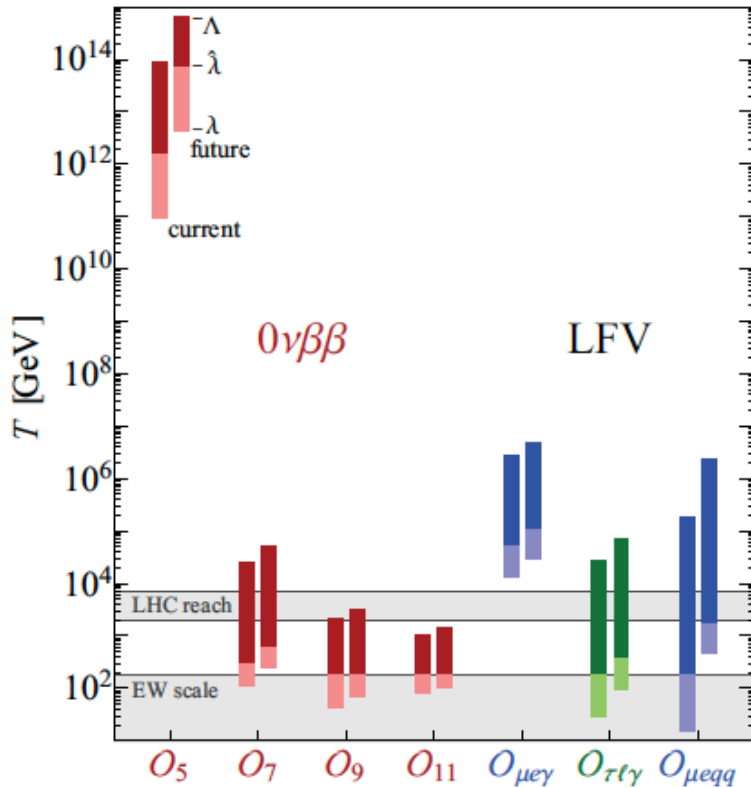
FPA2014-58183-P



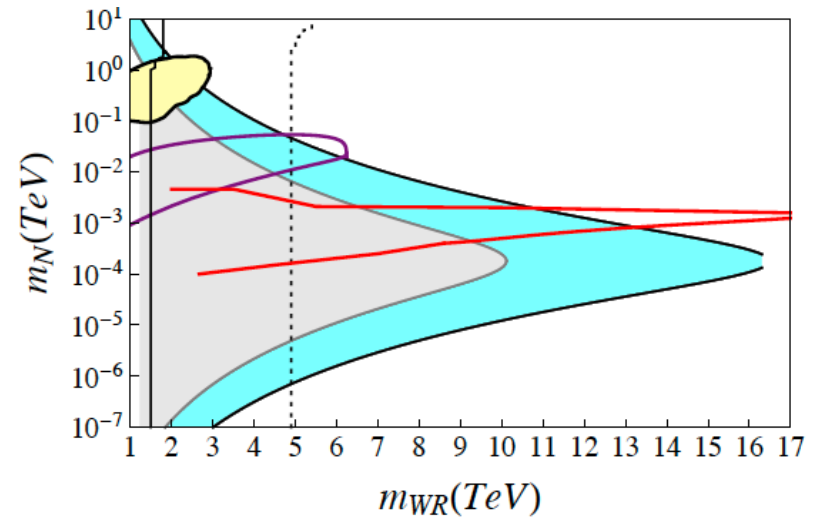
PROMETEO II/2014/084

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

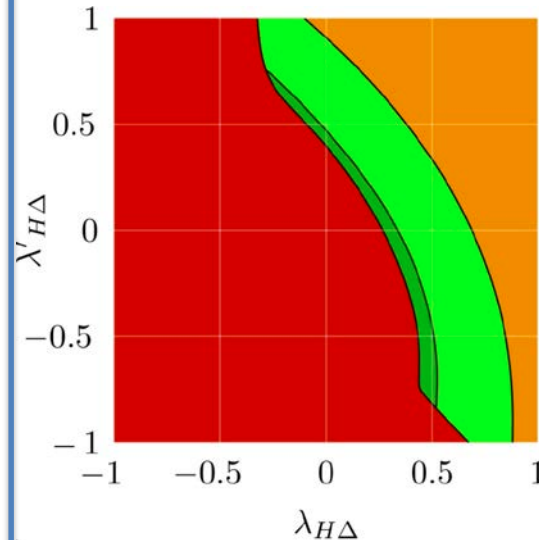
Algunos ejemplos de resultados en 2015 (I)



PRD 92, 036005: Escala de los **operadores** de la desintegración $0\nu\beta\beta$: si se observara a través de O_7 , O_9 u O_{11} , **descarta** la leptogénesis a gran escala



PRD 92, 073017: Limites a un modelo left-right de la **desintegración $0\nu\beta\beta$** y LHC



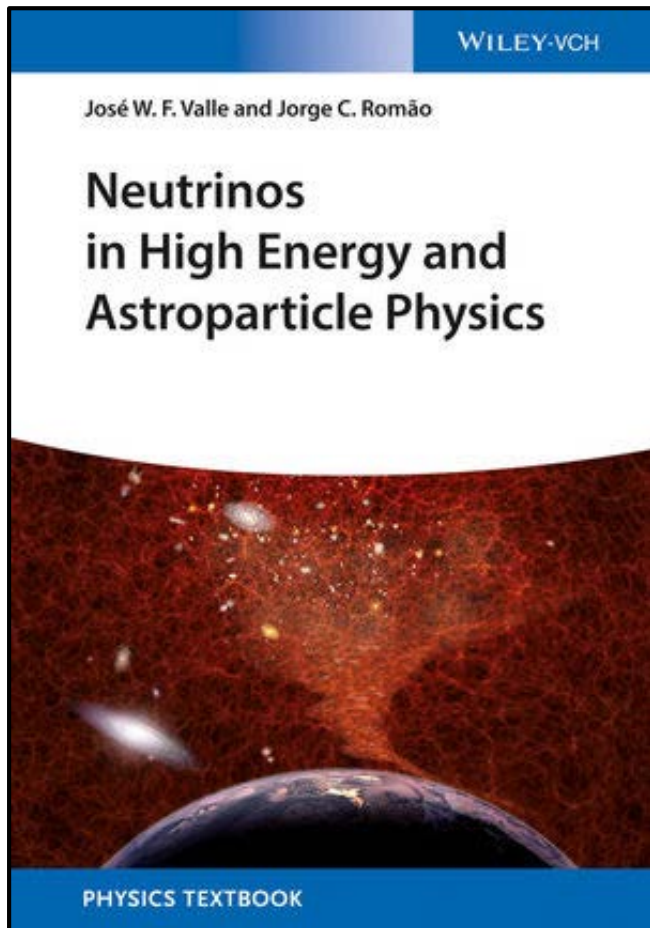
PRD 92, 075028: Triplet seesaw, proporciona **masa a los neutrinos** y estabiliza el vacío

En números...

Artículos originales JCR (sin actas): 23
Congresos internacionales / nacionales: 19/4
(sólo participación activa: charla)

Otros artículos en revistas: 5
Libros completos: 1
Seminarios/coloquios: 11

Formación: **clases de M. Hirsch** (Pontecorvo school, Eslovaquia), **S. Pastor** (CINVESTAV, Cat. A.G.González)



CERN Courier Apr 2015

The book mainly serves as a **detailed and concise, thorough and pedagogical introduction to the relationship of neutrinos to physics beyond the Standard Model**, and in particular the related particle-physics phenomenology. This subject is highly topical and will be more so in the years to come. As such, *Neutrinos in High Energy and Astroparticle Physics* does an excellent job and belongs on the bookshelf of every graduate student and researcher who is seriously interested in this interdisciplinary and increasingly important topic.

Heinrich Päs, TU Dortmund, and Sandip Pakvasa, Univ. Hawaii

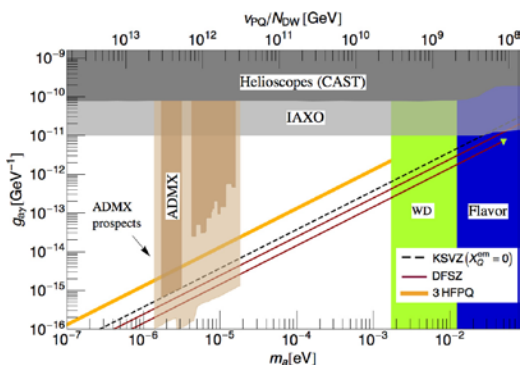


A.Pich, G. Abbas, C. Ayala, M. Deak, R.J. Hernández-Pinto, G. López-Castro, A. Maiezza, J. Papavassiliou, J. Portolés, G. Rodrigo, I. Rosell, G.F.R. Sborlini, L. Wang

Doctorandos: S. Buchta (PhD 2015), F. Driencourt-Mangin, J. Fuentes, H. Gisbert, V. Ilisie, A. Lami, A. Rodríguez, J. Santos, M. Zahiri Abyaneh



A. Celis, J. Fuentes-Martín, H. Serodio
An invisible axion model with controlled FCNCs at tree level, PLB741 (2015) 117



A. Pich, I. Rosell, J. Santos, J. Sanz-Cillero
Low-energy signals of strongly-coupled electroweak symmetry breaking scenarios, arXiv:1510.03114 [hep-ph]
Study of the couplings of the low-energy electroweak effective theory

P. Ruiz-Femenia, M. Zahiri-Abyaneh,
On the minimality of the $O(p^6)$ chiral Lagrangian, PLB751 (2015) 256
Proposed procedure searching the minimal basis of operators of the chiral Lagrangian

G. Abbas, A. Celis, X-Q. Li, J. Lu, A. Pich
Flavour-changing top decays in the aligned two-Higgs-doublet model, JHEP 1506 (2015) 005

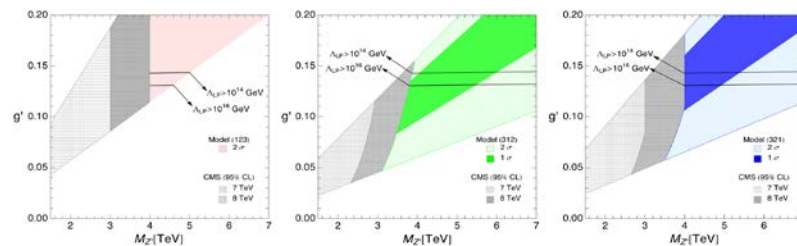
$$t \rightarrow ch, t \rightarrow c\gamma, t \rightarrow eZ$$

A. Maiezza, M. Nemevsek, F. Nesti
Lepton Number Violation in Higgs decay at the LHC, PRL 115 (2015) 081802

A. Rodríguez-Sánchez, M. González-Alonso, A. Pich,
ChPT parameters from tau-decay data, arXiv:1509.08494 [hep-ph]
Determination of couplings L_{10} and C_{87} of the chiral Lagrangian from ALEPH tau decay data

V. Ilisie,
New Barr-Zee contributions to $(g-2)_\mu$ in two-Higgs-doublet models, JHEP 1504 (2015) 077
Sizeable two-loop contributions from the Barr-Zee mode to the anomalous magnetic moment of the muon

A. Celis, J. Fuentes-Martín, M. Jung, H. Serodio
Family non-universal Z' models with protected flavour-changing interactions, PRD92 (2015) 015007





A.Pich, G. Abbas, C. Ayala, M. Deak, R.J. Hernández-Pinto, G. López-Castro, A. Maiezza, J. Papavassiliou, J. Portolés, G. Rodrigo, I. Rosell, G.F.R. Sborlini, L. Wang

Doctorandos: S. Buchta (**PhD 2015**), F. Driencourt-Mangin, J. Fuentes, H. Gisbert, V. Ilisie, A. Lami, A. Rodríguez, J. Santos, M. Zahiri Abyaneh



D.de Florian, R.Sassot, M.Epele, **R.J. Hernández-Pinto**, M. Stratman, **PRD91 (2015) 014035**
New Global fit to fragmentation functions from $e+e^-$, ep and Pp

G. Chachamis, **M. Deak**, M. Hentschinsky, **G. Rodrigo**, A. Sabio, **JHEP 1509 (2015) 123**
 production of **single bottom quark** in the very forward region from high-energy factorization

R.J. Hernández-Pinto, G.F.R. Sborlini, G. Rodrigo, arXiv:1506.04617 summation over degenerate IR states and UV renormalization in 4 dimensions from the Loop-Tree Duality (LTD), **new paradigm beyond Dimensional Regularization**

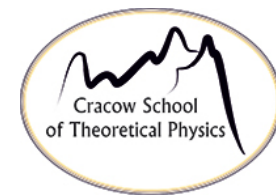
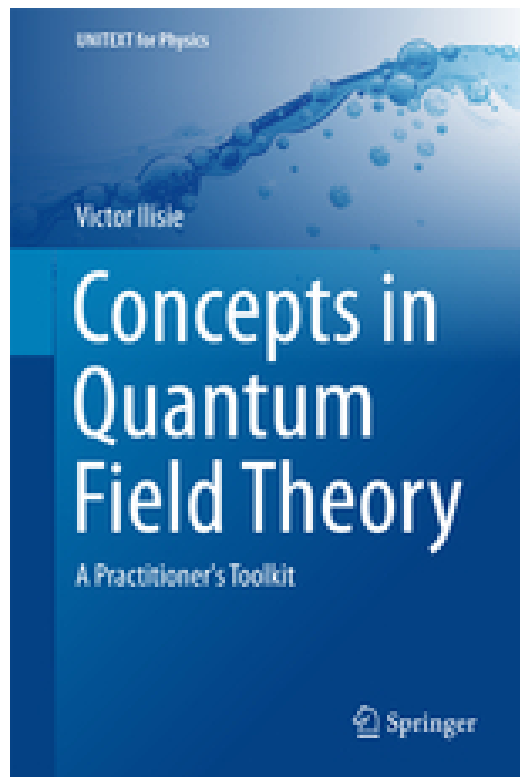
S. Buchta et al., PhD and arXiv:1510.00187
first numerical application of the Loop-Tree Duality (LTD) for multileg loop scattering processes

$$\begin{pmatrix} 0 & H & H & E \\ H & 0 & H & E \\ H & H & 0 & E \\ 0 & 0 & 0 & 0 \end{pmatrix} =$$



A.Pich, G. Abbas, C. Ayala, M. Deak, R.J. Hernández-Pinto,
G. López-Castro, A. Maiezza, J. Papavassiliou, J. Portolés,
G. Rodrigo, I. Rosell, G.F.R. Sborlini, L. Wang

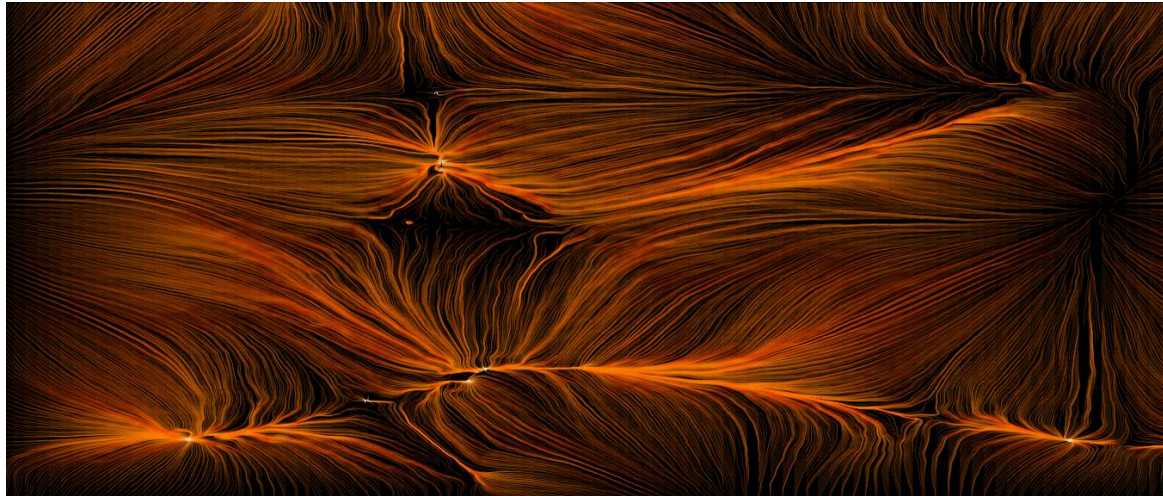
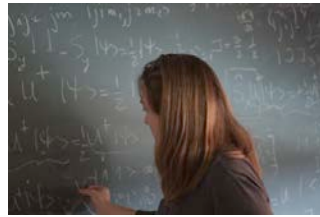
Doctorandos: S. Buchta (**PhD 2015**), F. Driencourt-Mangin,
J. Fuentes, H. Gisbert, V. Ilisie, A. Lami, A. Rodríguez,
J. Santos, M. Zahiri Abyaneh



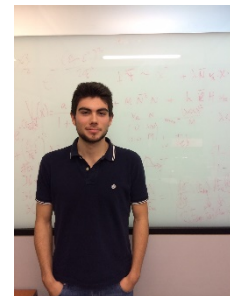
EL PAÍS
“Preguntas sin responder”
7-3-2015

EL MUNDO
“Una ventana en la frontera del conocimiento”, 10-2-2015

- **PhD:** S. Buchta
- **Master Thesis:** A. Sánchez, H. Gisbert

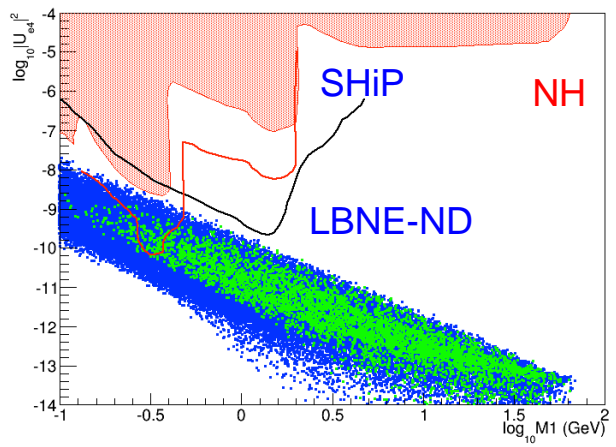


<http://som.ific.uv.es>



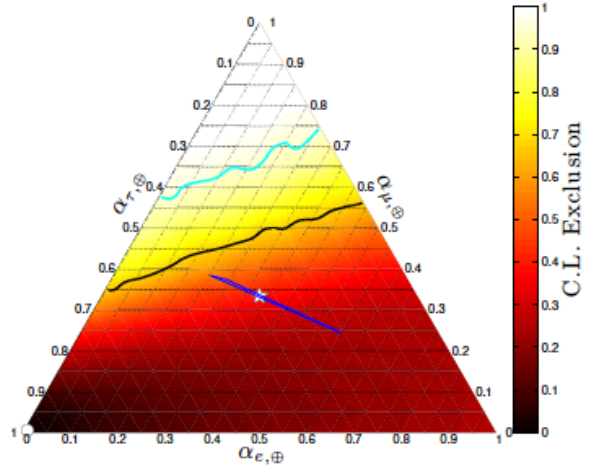
Flavor and Origin of Matter
Sabor y Origen de la Materia

Leptogenesis in GeV-scale see-saw models



Hernández, Kekic, López-Pavón, Racker, Rius, JHEP 1510 (2015)

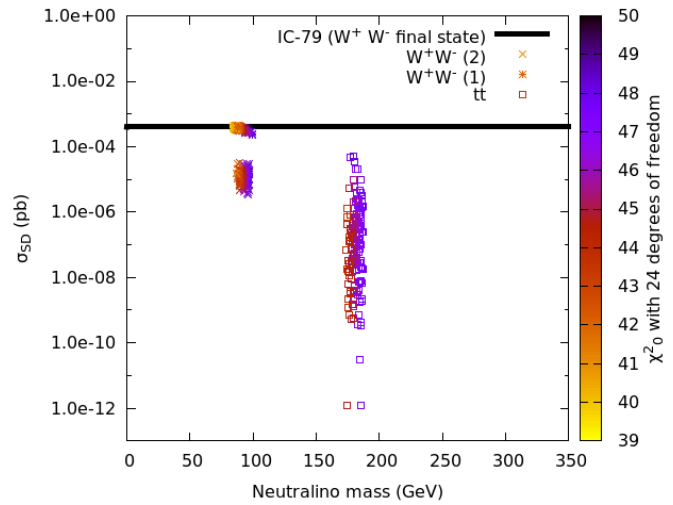
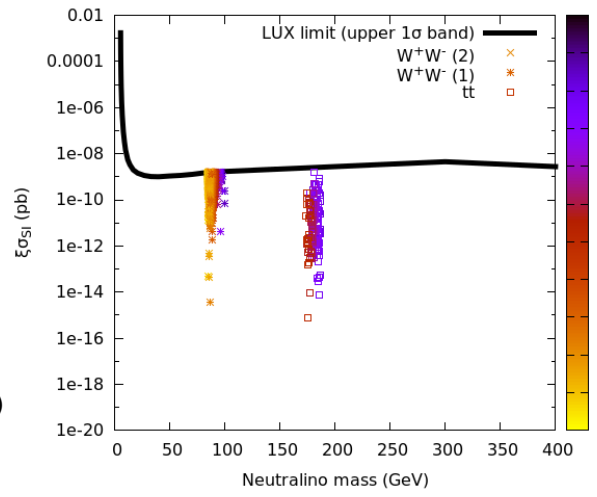
ICECUBE High Energy Neutrinos Flavo



Palomares-Ruiz, Vincent, Mena, PRD 91 (2015)

Galactic center excess in the MSSM

Achterberg et al, JCAP 1508 (2015)



Comparación del espectro de baryones bbb obtenido mediante modelos de potencial de quarks con los resultados de lattice QCD

PHYSICAL REVIEW D 91, 054011 (2015)
Constituent-quark model description of triply heavy baryon nonperturbative lattice QCD data
Javier Vijande, A. Valcarce and H Garcilaso

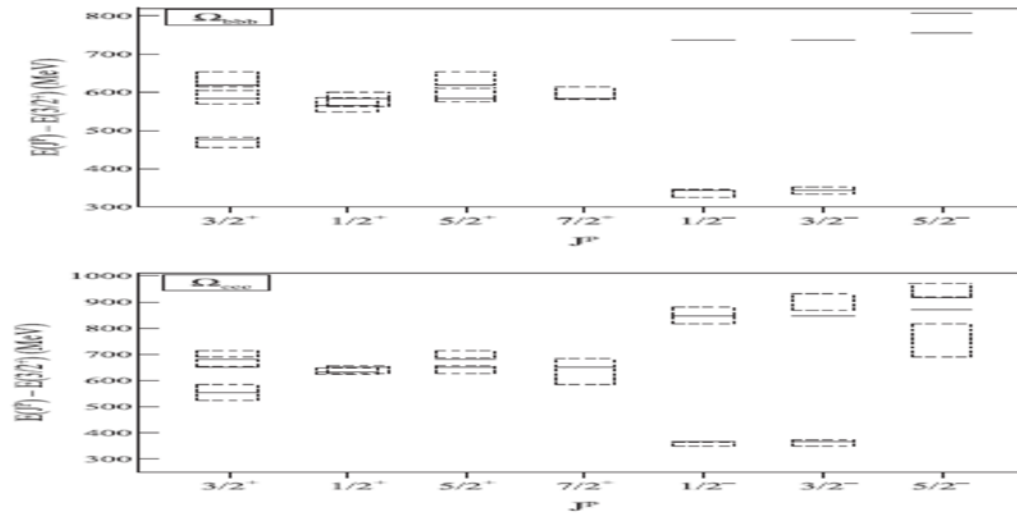


FIG. 1. bbb excited state spectra, solid lines, for the potential of Eq. (2) with $A = 0.2787$ and $B = 0.0925 \text{ GeV}^2$ (upper panel) or $B = 0.1517 \text{ GeV}^2$ and $A = 0.1410$ (lower panel). See text for details. The boxes stand for the nonperturbative lattice QCD results of Ref. [4].

Estudio de la distribución de momento transversal de dos piones mediante un modelo de NJL y su comparación con datos de ciertos observables calculados con lattice QCD

Pion transverse momentum dependent parton distributions in the Nambu and Jona-Lasinio model
Santiago Noguera, Sergio Scopetta
JHEP11(2015)102

Abstract: An explicit evaluation of the two pion transverse momentum dependent parton distributions at leading twist is presented, in the framework of the Nambu-Jona Lasinio model with Pauli-Villars regularization. The transverse momentum dependence of the obtained distributions is generated solely by the dynamics of the model. Using these results, the so called generalized Boer-Mulders shift is studied and compared with recent lattice data. The obtained agreement is very encouraging, in particular because no additional parameter has been introduced. A more conclusive comparison would require a precise knowledge of the QCD evolution of the transverse momentum dependent parton distributions under scrutiny.

Dynamical gluon mass and linear confinement

César Ayala, Pedro González and Vicente Vento

La resolución aproximada de las ecuaciones de Dyson-Schwinger lleva a una constante de acoplamiento quark-quark-gluon que elimina la singularidad de Landau y que puede parametrizarse mediante una función que en el límite de transferencia de momento nula simula una masa de gluón. Modificándola ligeramente para incorporar la singularidad de Gribov conduce a potenciales que reproducen el espectro con una precisión de 50 MeV con un solo parámetro $\Lambda \sim \Lambda_{\text{QCD}}$ que coinciden con el potencial de Cornell en el rango relevante 0.4 fm \rightarrow 5fm pero tienen una diferencia de este el buen comportamiento asintótico para $r < 0.4$ fm.

$$\alpha_s^{(\text{SD})}(q^2) = \frac{4\pi}{\beta_0 \ln \left(\frac{q^2 + m_g^2(q^2)}{\Lambda^2} \right)} \quad m_g^2(q^2) = \frac{m_0^2}{1 + (q^2/\mathcal{M}^2)^{1+p}},$$

J^{PC}	nl	$M_{V(r)_{\Lambda=320 \text{ MeV}}}$ MeV	M_{PDG} MeV	$M_{V^C(r)_{b\bar{b}}}$ MeV
1^{--}	$1s$	9489	9460.30 ± 0.26	9479
	$2s$	10023	10023.26 ± 0.31	10013
	$1d$	10147	10163.7 ± 1.4	10155
	$3s$	10354	10355.2 ± 0.5	10339
	$2d$	10435		10427
	$4s$	10621	10579.4 ± 1.2	10596
	$3d$	10681		10666
	$5s$	10854	10876 ± 11	10825
	$4d$	10903		10883
	$(0, 1, 2)^{++}$	$1p$	9903	$9899.87 \pm 0.28 \pm 0.31$
$(0, 1, 2)^{++}$	$2p$	10254	$10260.24 \pm 0.24 \pm 0.50$	10252
$(0, 1, 2)^{++}$	$3p$	10531	10534 ± 9	10519

TABLE I: Calculated J^{PC} bottomonium masses from $V(r)_{\Lambda=320 \text{ MeV}}$ and $m_b = 4450 \text{ MeV}$. Masses for experimental resonances, M_{PDG} , have been taken from [32]. For $1p$ and $2p$ states the experimental centroids are quoted. For $3p$ states the only known experimental mass is listed. Masses from $V^C(r)_{b\bar{b}}$, the “equivalent” Cornell potential (10) and the same quark mass are also shown for comparison.

MEMORIA (2015) 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.J.Olmo (RyC, UV), I. Agulló (Associate Professor, LSU, USA), A. del Río (FPU).

- ANALOG HAWKING RADIATION IN BOSE-EINSTEIN CONDENSATES:

1. "Quantum signature of analog Hawking radiation in momentum space"
D. Boiron, A. Fabbri, P.-É. Larré, N. Pavloff, C. I. Westbrook and P. Zin.
Phys. Rev. Lett. **115**, no. 2, 025301 (2015)

- QFT AND COSMOLOGY

1. "Equivalence of Adiabatic and DeWitt-Schwinger renormalization schemes"
A. del Río and J. Navarro-Salas. Phys. Rev. D **91**, 064031 (2015)
"Electromagnetic duality anomaly"
I. Agullo, A. del Río and J. Navarro-Salas. ArXiv:1512.xxx to appear
2. "Cascading dust inflation in Born-Infeld gravity"
J. B. Jimenez, L. Heisenberg, G. J. Olmo and C. Ringeval. JCAP **1511**, 046 (2015)
3. "Melvin Universe in Born-Infeld gravity"
C. Bambi, G. J. Olmo and D. Rubiera-Garcia. Phys. Rev. D **91**, no. 10, 104010 (2015)
4. "Tensor perturbations in a general class of Palatini theories"
J. B. Jiménez, L. Heisenberg and G. J. Olmo. JCAP **1506**, 026 (2015)
5. "Brane-world and loop cosmology from a gravity-matter coupling perspective"
G. J. Olmo and D. Rubiera-Garcia. Phys. Lett. B **740**, 73 (2015)

- QUANTUM GRAVITY AND BLACK HOLES

1. "Fourth derivative gravity in the auxiliary fields representation and application to the black hole stability"
S. Mauro, R. Balbinot, A. Fabbri and I. L. Shapiro.
Eur. Phys. J. Plus **130**, no. 7, 135 (2015)
2. "Low frequency gray-body factors and infrared divergences: rigorous results"
P. R. Anderson, A. Fabbri and R. Balbinot.
Phys. Rev. D **91**, no. 6, 064061 (2015)
3. "A scenario for critical scalar field collapse in AdS_3 "
G. Clément and A. Fabbri.
Class. Quant. Grav. **32**, no. 9, 095009 (2015)
4. "Wormholes and nonsingular space-times in Palatini $f(R)$ gravity"
C. Bambi, A. Cardenas-Avendano, G. J. Olmo and D. Rubiera-Garcia.
arXiv:1511.03755 [gr-qc]
5. "Nonsingular Black Holes in $f(R)$ Theories"
G. J. Olmo and D. Rubiera-Garcia.
Universe **1**, no. 2, 173 (2015)
6. "Geodesic completeness in a wormhole spacetime with horizons"
G. J. Olmo, D. Rubiera-Garcia and A. Sanchez-Puente.
Phys. Rev. D **92**, no. 4, 044047 (2015)
7. "Classical resolution of black hole singularities in arbitrary dimension"
D. Bazeia, L. Losano, G. J. Olmo, D. Rubiera-Garcia and A. Sanchez-Puente.
Phys. Rev. D **92**, no. 4, 044018 (2015)
8. "The quantum, the geon, and the crystal"
G. J. Olmo and D. Rubiera-Garcia.
Int. J. Mod. Phys. D **24**, no. 09, 1542013 (2015)

9. "Classical resolution of black hole singularities via wormholes"
G. J. Olmo, D. Rubiera-Garcia and A. Sanchez-Puente.
arXiv:1504.07015 [hep-th]

10. "Crystal clear lessons on the microstructure of spacetime and modified gravity"
F. S. N. Lobo, G. J. Olmo and D. Rubiera-Garcia.
Phys. Rev. D **91**, no. 12, 124001 (2015)

- SUPERGRAVITY AND DEFORMATIONS

1. R. Fiorese and M. A. Lledó, *Deformations of the Minkowski and conformal spaces and superspaces*, World-Scientific, Singapore (2015).
2. Quantum twistors, D. Cervantes, R. Fiorese, M.A. Lledó, F.A. Nadal, "p-Adic Numbers, Ultrametric Analysis and Applications" (to appear)

- MODIFIED GRAVITY

1. "Hybrid metric-Palatini gravity"
S. Capozziello, T. Harko, T. S. Koivisto, F. S. N. Lobo and G. J. Olmo.
Universe **1**, no. 2, 199 (2015)
2. "Astrophysical constraints and insights on extended relativistic gravity"
S. Mendoza and G. J. Olmo.
Astrophys. Space Sci. **357**, no. 2, 133 (2015)
3. "Hybrid $f(R)$ theories, local constraints, and cosmic speedup"
S. Capozziello, T. Harko, T. S. Koivisto, F. S. N. Lobo and G. J. Olmo.
Universe **1**, no. 2, 199 (2015)

- BRANEWORLDS AND HIGHER DIMENSIONS

1. "Robustness of braneworld scenarios against tensorial perturbations"
D. Bazeia, L. Losano, R. Menezes, G. J. Olmo and D. Rubiera-Garcia.
Class. Quant. Grav. **32**, no. 21, 215011 (2015)
2. "Braneworld solutions for modified theories of gravity with nonconstant curvature"
D. Bazeia, A. S. Lobão, L. Losano, R. Menezes and G. J. Olmo.
Phys. Rev. D **91**, no. 12, 124006 (2015)
3. "Thick brane in $f(R)$ gravity with Palatini dynamics"
D. Bazeia, L. Losano, R. Menezes, G. J. Olmo and D. Rubiera-Garcia.
Eur. Phys. J. C **75**, no. 12, 569 (2015)

- CONFERENCES, MEETINGS, AND WORKSHOPS

- **Organization:** First Workshop on String Theory and Gener, 6-7 July, Valencia. M. A. Lledó and G. J. Olmo
- **Talks:**
 - School and Conference *Theoretical Frontiers in Black Holes and Cosmology*, 08-19 Jun 2015. Natal, Rio Grande do Norte, Brazil. G.J. Olmo 4 lectures.
 - School *Einstein on the beach:1915-2015, 100 años de Relatividad General*. Murcia, 9-12 Sept. J. Navarro-Salas 3 lectures, G.J. Olmo 3 lectures.
 - 14th *Marcel Grossmann Meeting*, Rome, July 12-18, 2015. (G.J. Olmo, A. del Río).
 - *Windows on Quantum Gravity: Season 2*, Madrid 28-30, Oct. (G.J. Olmo).
 - A. Fabbri, 'Black Holes: classical and quantum aspects', 3hrs mini course at the conference 'Black holes and their analogues: 100 years of GR', Vitoria (Brasil), April 2015. A. Fabbri, 'Analog Hawking radiation in Bose-Einstein condensates', Workshop 'Quantum Vacuum and Gravitation', Mainz, June 2015. A. Fabbri, 'Black hole evaporation in BECs', First workshop on string theory and gender, Valencia, July 2015

- DIVULGACIÓN

- J. Navarro-Salas, Relatividad y Teoría cuántica, de Einstein a Hawking. Fundación Valenciana de Estudios Avanzados, Valencia, 19/11/2015.

RESULTADOS DESTACADOS



Institut de physique

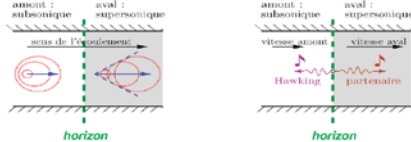
Actualités scientifiques

Caractériser le rayonnement d'un trou noir acoustique dans un condensat de Bose Einstein

Novembre 2015

Des physiciens viennent de montrer que les techniques expérimentales actuelles devraient permettre de détecter et de caractériser la signature quantique du rayonnement émis par l'horizon d'un trou noir acoustique réalisé dans l'écoulement unidimensionnel d'un condensat de Bose Einstein.

L'une des prédictions les plus marquantes du physicien théoricien Stephen Hawking est que les trous noirs gravitationnels émettent un faible rayonnement d'origine quantique. Face aux difficultés théoriques et pratiques posées par l'expérimentation sur un tel objet, les physiciens se sont tournés vers l'étude des systèmes analogues et notamment dans le domaine hydrodynamique. La zone de transition entre une région subsonique et une région supersonique d'un écoulement constitue pour les ondes acoustiques l'analogie de l'horizon d'un trou noir car les ondes acoustiques ne peuvent pas remonter l'écoulement supersonique. Des physiciens du Laboratoire Charles Fabry - LCF (CNRS/IOGS/Univ. Paris-Sud), du Laboratoire de physique théorique d'Orsay - LPT (CNRS/Univ. Paris-Sud), du Laboratoire de physique théorique et de modèles statistiques - LPTMS (CNRS/Univ. Paris-Sud) et du centro Fermi, viennent de montrer dans une étude théorique qu'en choisissant comme fluide un condensat de Bose Einstein il devrait être possible de mettre en évidence un rayonnement sonore émis par l'horizon acoustique qui est l'analogie du rayonnement de Hawking émis par l'horizon d'un trou noir gravitationnel. La méthode proposée, qui consiste à mesurer les corrélations entre les vitesses des particules émises de part et d'autre de l'horizon sonore devrait permettre d'en caractériser les propriétés quantiques en s'affranchissant du bruit thermique. Ce travail est publié dans la revue *Physical Review Letters*.



À gauche : schéma d'un écoulement comprenant une région supersonique. Une onde sonore émise dans la région subsonique (en blanc sur la figure) se propage dans toutes les directions (fronts d'onde rouges). La même onde émise dans la région supersonique (grise sur la figure) est entraînée par l'écoulement et ne peut pas sortir de la région grise qui se comporte donc comme l'intérieur d'un trou noir. À droite : même configuration, mais ici en l'absence d'émetteur sonore. Les fluctuations quantiques au voisinage de la frontière entre les régions sub- et super-soniques (l'horizon sonore) pilotent l'émission de paires de particules corrélées, des "quanta de son" dénotés "Hawking" et "partner" sur la figure.

Pour ce travail, les physiciens ont analysé théoriquement l'écoulement d'un condensat de Bose-Einstein piégé dans une configuration assurant un écoulement unidimensionnel. Un potentiel extérieur jouant un rôle d'obstacle produit dans le condensat un écoulement subsonique en amont de l'obstacle et supersonique en aval. Les chercheurs ont modélisé l'onde de matière que forme le condensat de Bose-Einstein par un champ quantique dont la dynamique est gouvernée par une équation permettant d'analyser les fluctuations quantiques au voisinage de la solution classique qui décrit l'écoulement du condensat. Dans ce cadre ils ont déterminé la matrice de diffusion permettant de relier les fluctuations repartant du système étudié aux fluctuations qui y parviennent. Ceci leur a permis de montrer que la formation d'un horizon sonore se traduit par l'apparition de deux pics distincts dans la distribution des vitesses des particules. Les physiciens ont également analysé les corrélations entre les vitesses des particules émises de part et d'autre de l'horizon, et ont identifié des signaux de corrélation spécifiques, qui n'apparaissent que lorsqu'un horizon sonore est présent. Certains de ces signaux correspondent alors aux corrélations entre les canaux d'émission des paires issues des fluctuations du vide. Ces corrélations entre les vitesses des particules émises de part et d'autre de l'horizon permettent de remonter à l'origine quantique du phénomène et de prouver que les paires émises sont intriquées. Cette intrication est démontrée en comparant l'intensité des corrélations croisées (sur les canaux d'émission "Hawking" et "partner" - voir figure) au simple produit des corrélations intracanal. Ce critère s'avère particulièrement robuste vis à vis des fluctuations thermiques, et devrait pouvoir être accessible expérimentalement avec des condensats dont les caractéristiques sont semblables à ce qui est usuellement réalisé dans les laboratoires.

En savoir plus

Quantum signature of analog Hawking radiation in momentum space, D. Boiron¹, A. Fabbri², P.-É. Laré³, N. Pavloff⁴, C. I. Westbrook¹, et P. Zia⁵, *Physical Review Letters* 15, 025301 (2015)

- Retrouvez l'article sur la base d'archives ouvertes *arXiv*

Contact chercheur

Nicolas Pavloff, professeur de l'Université Paris-Sud

Informations complémentaires

¹Laboratoire Charles Fabry (LCF)

²Centro Studi e Ricerche E. Fermi, Dipartimento di Fisica dell'Università di Bologna, Italy, Dipartimento de Fisica Teorica and IFIC, Universidad de Valencia-CSC, Spain, Laboratoire de Physique Théorique (LPT CNRS)

³INO-CNR BEC Center and Dipartimento di Fisica, Università di Trento, Italy

⁴Laboratoire de Physique Théorique et Modèles Statistiques (LPTMS)

⁵National Centre for Nuclear Research, Warsaw, Poland



Institut de Physique
CNRS - Campus Gérard Mégie
3 rue Michel-Ange, 75794 Paris Cedex 16
T 01 44 96 42 53
inp-communication@cnrs-dir.fr
www.cnrs.fr/inp

Editor's Suggestion

Quantum Signature of Analog Hawking Radiation in Momentum Space

D. Boiron, A. Fabbri, P.-É. Laré, N. Pavloff, C. I. Westbrook, and P. Zia
Phys. Rev. Lett. 115, 025301 – Published 6 July 2015

- **Electromagnetic duality anomaly:**

The difference in the number of right and left circularly polarized free photons is not conserved in spacetimes with a non-zero Chern-Pontryagin invariant

I. Agullo, A. del Río and J. Navarro-Salas, arXiv:1512.xxx to appear

- **Nonsingular black holes with wormhole structure:**

Geodesic completeness in a wormhole spacetime with horizons.

G. J. Olmo, D. Rubiera-Garcia and A. Sanchez-Puente, PRD92.044047.

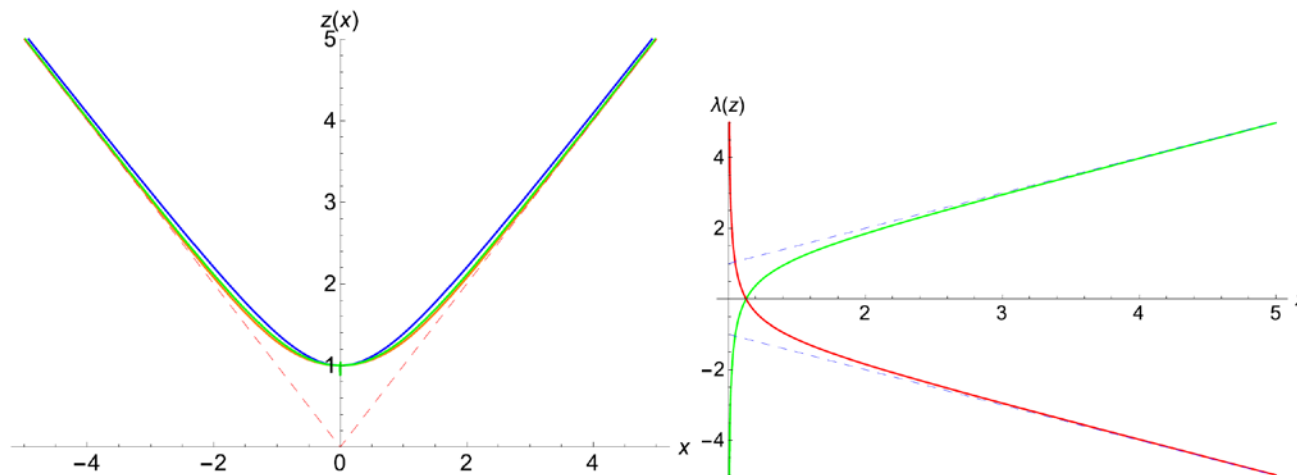


Figure 1: LEFT: bounce of the area function. RIGHT: completeness of null radial geodesics near the throat.

- **A NEW BOOK:**

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

R. Fiorese and M. A. Lledó,

Física Teórica Nuclear y de Muchos Cuerpos

Members: E. Oset, J. Navarro, J. Ros, M. J. Vicente-Vacas, J. Nieves, L. Alvarez-Ruso (RyC), Z.F. Sun (pdoc), T. Uchino (pdoc), M. Albaladejo (pdoc), F. Aceti (doc), A. Hiller (doc), C. Hidalgo-Duque (PhD 2015), V. Rodrigues (doc), P. Fernández (doc), E. Saul (doc)

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- ✓ Resonances in QCD
- ✓ Weak decays of heavy hadrons into dynamically generated resonances
- ✓ Finite volume treatment of scattering of hadrons
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- ✓ Neutrino-nucleon and neutrino-nucleus reactions
- ✓ Chiral perturbation theory with Δ states
- ✓ Heavy quark spin and flavor symmetries: XYZ states
- ✓ Dinámica no-lineal y sistemas complejos
- ✓ Función de respuesta en materia nuclear usando interacciones efectivas

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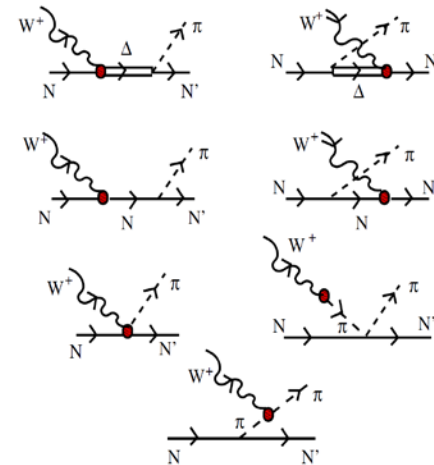
Linear response of homogeneous nuclear matter with energy density functionals

A. Pastore^a, D. Davesne^{b,*}, J. Navarro^c

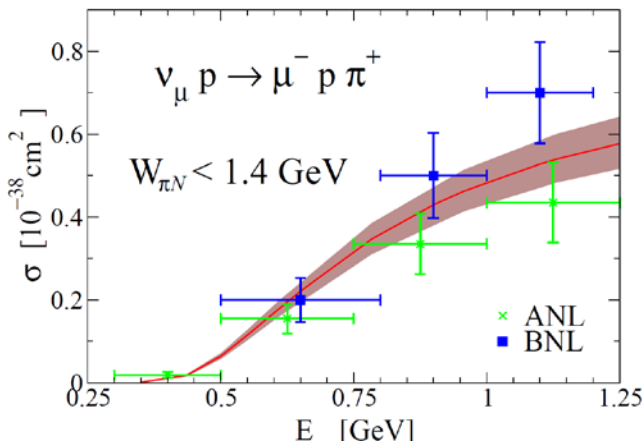
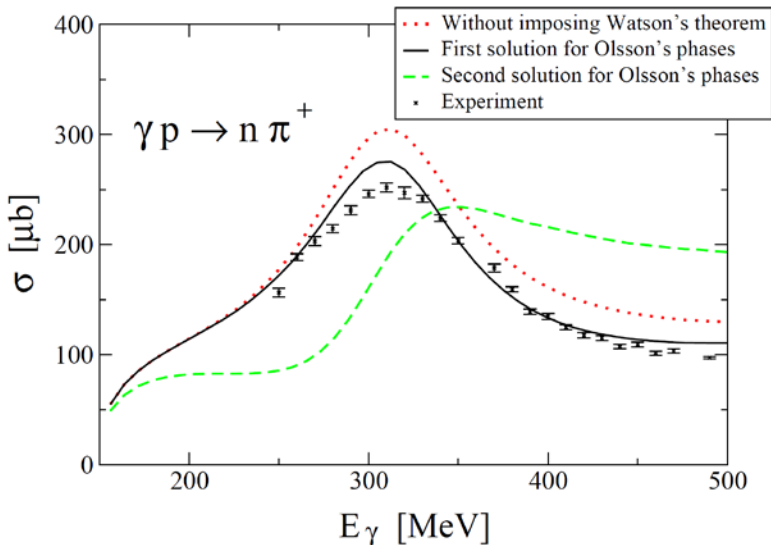
^a Institut d'Astronomie et d'Astrophysique, CP 226, Université Libre de Bruxelles, B-1050 Bruxelles, Belgium

^b Institut de Physique Nucléaire de Lyon, CNRS-IN2P3, UMR 5822, Université Lyon 1, F-69622 Villeurbanne, France

^c IFIC (CSIC University of Valencia), Apdo. Postal 22085, E-46071 Valencia, Spain

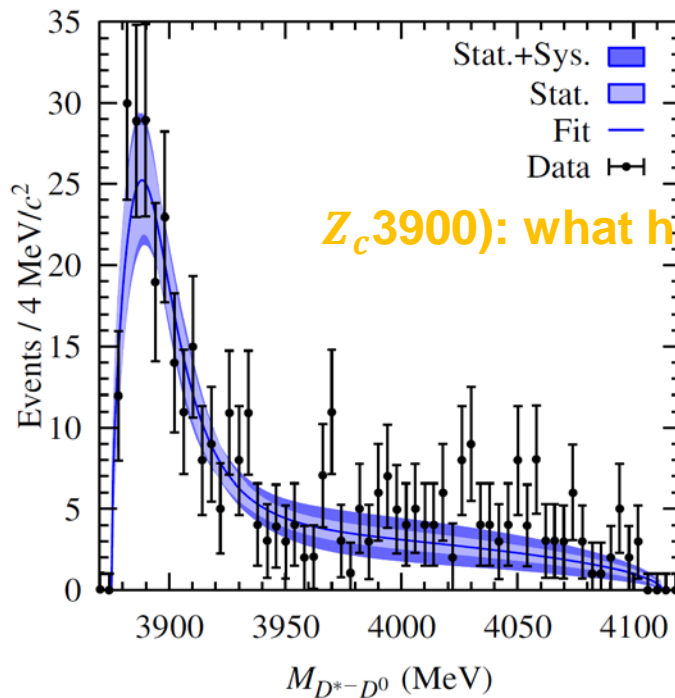
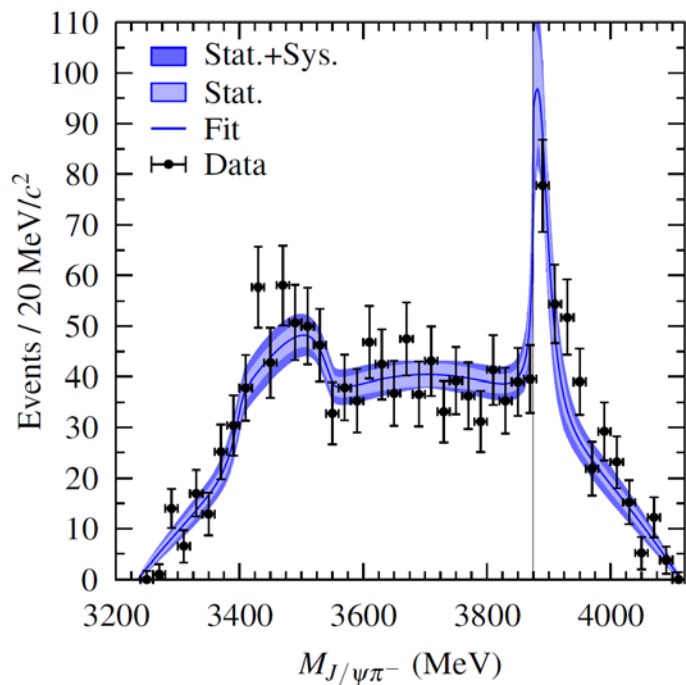
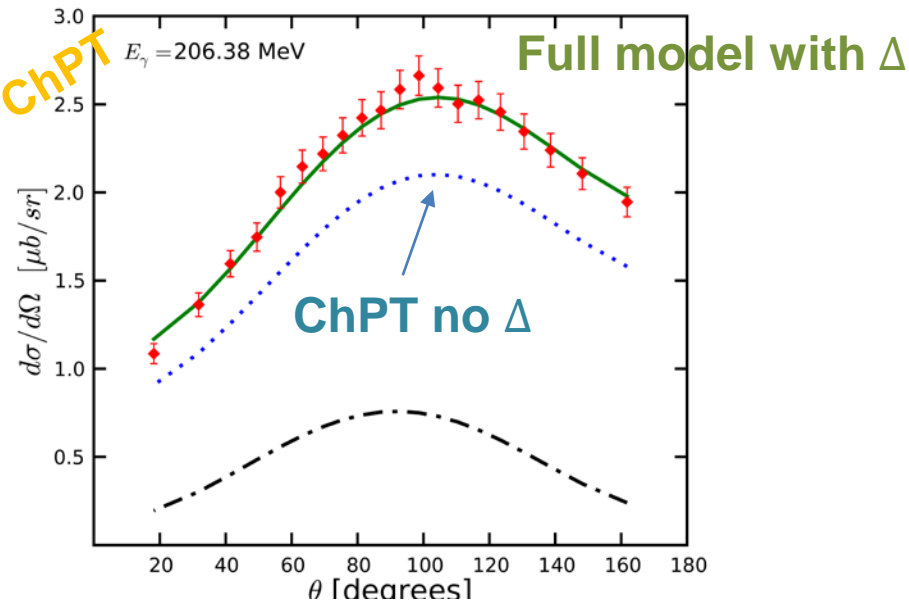
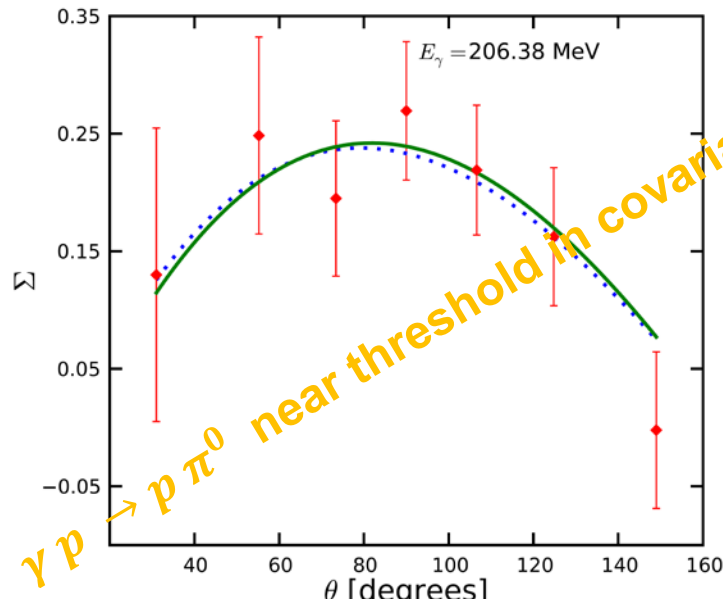


Watson's theorem and the $\Delta(1232)$ axial transition
 L. Alvarez-Ruso, E. Hernández, J. Nieves, M.J. Vicente Vacas,
 arXiv:1510.06266



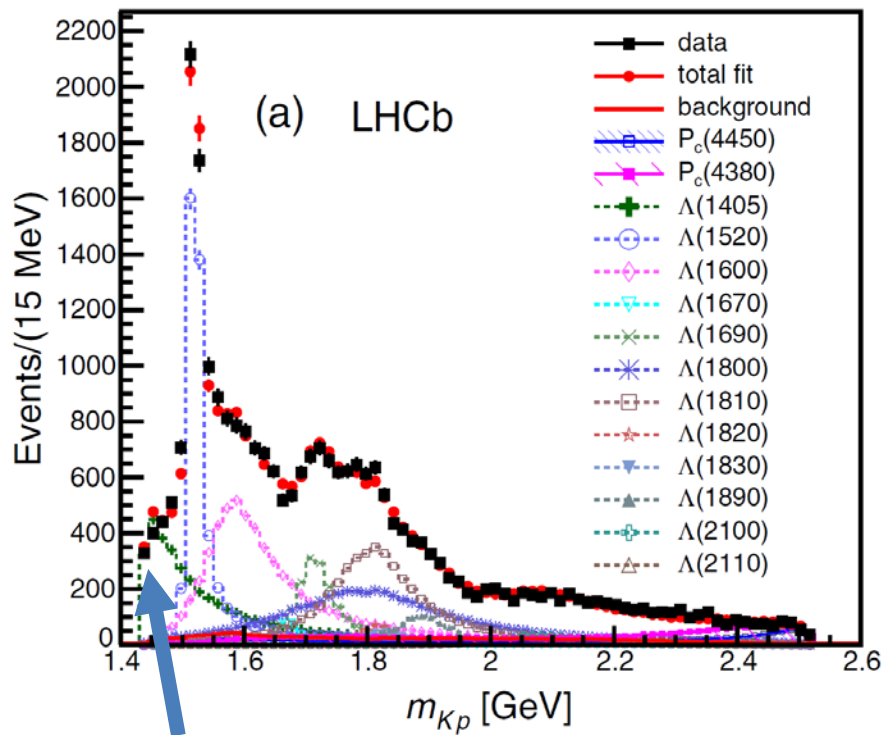
$$C_5^A(0) = 1.14 \pm 0.07$$

Off-diagonal Goldberger-Treiman relation

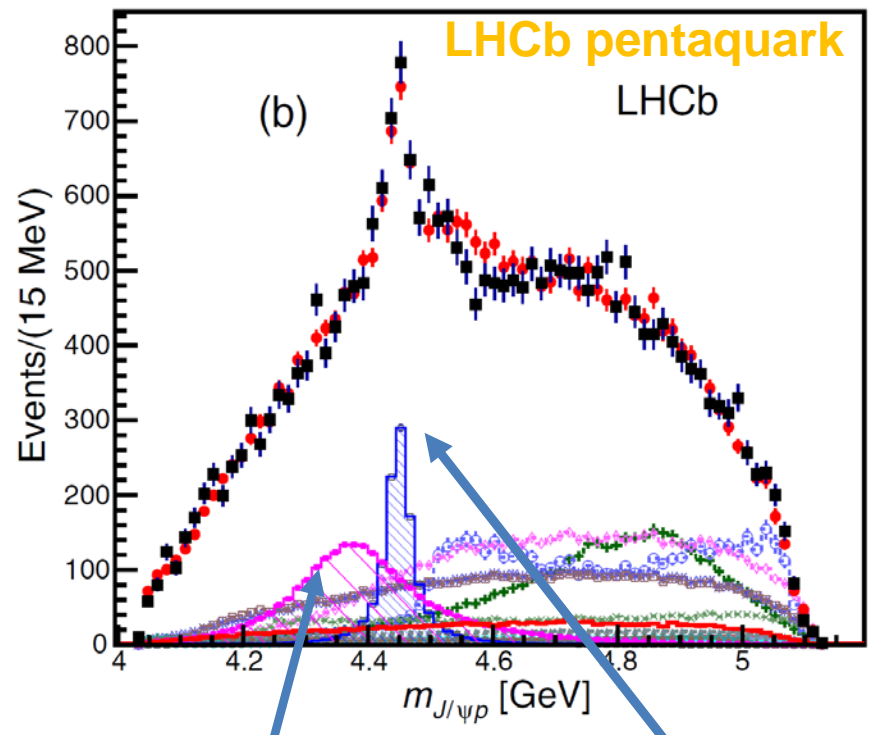


$Z_c(3900)$: what has been really seen?

M. Albaladejo, F.-K. Guo, C. Hidalgo-Duque, J. Nieves, arXiv:1512.03638



$\Lambda(1405)$ shows up in the $K^- p$ spectrum



$P_c^+(4380)$ and $P_c^+(4450)$ show up in the $J_\psi p$ spectrum

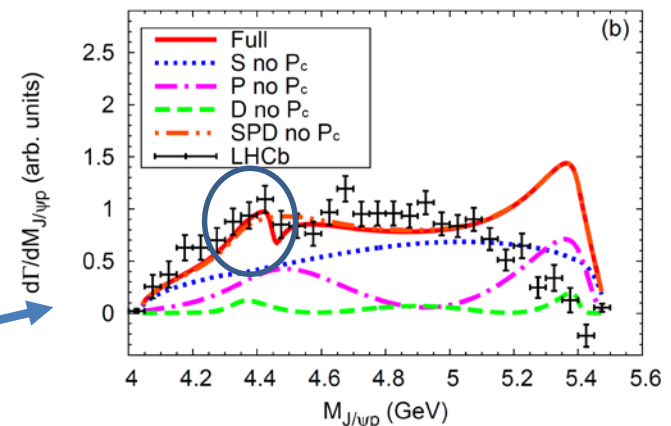
L. Roca, J. Nieves, and E. Oset, Phys. Rev. D 92, 094003 (simultaneous description of the $\Lambda(1405)$ and $P_c^+(4450)$ peaks)



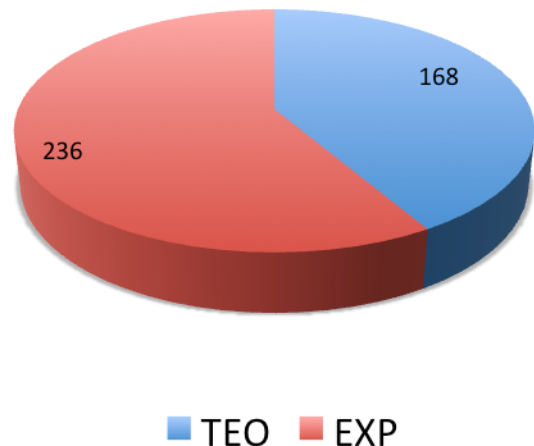
R. Aaij *et al.* [LHCb Collaboration], JHEP 1407, 103 (2014).

Possible signature of the $P_c^+(4450)$ pentaquark

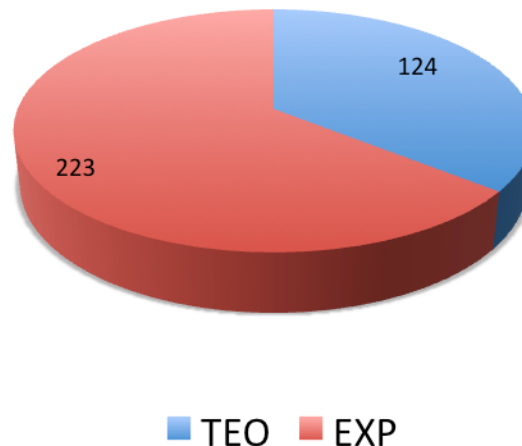
E. Wang, H.-X. Chen, L.-S. Geng, D.-M. Li, E. Oset, arXiv:1512.01959



404 Pub IFIC in 2014
(ISI Web of Science: Article, Review, Letter)



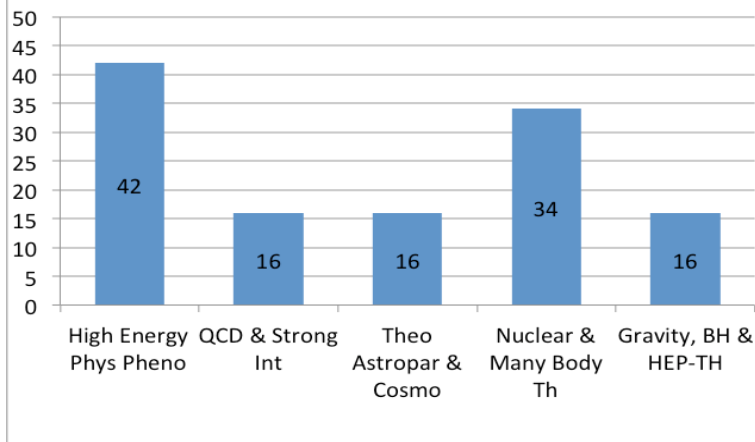
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13 (2014) 3 (2015)
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