# actividades del IFIC 2006
# Departamento teórico

**José W. F. Valle**

**http://ific.uv.es/**

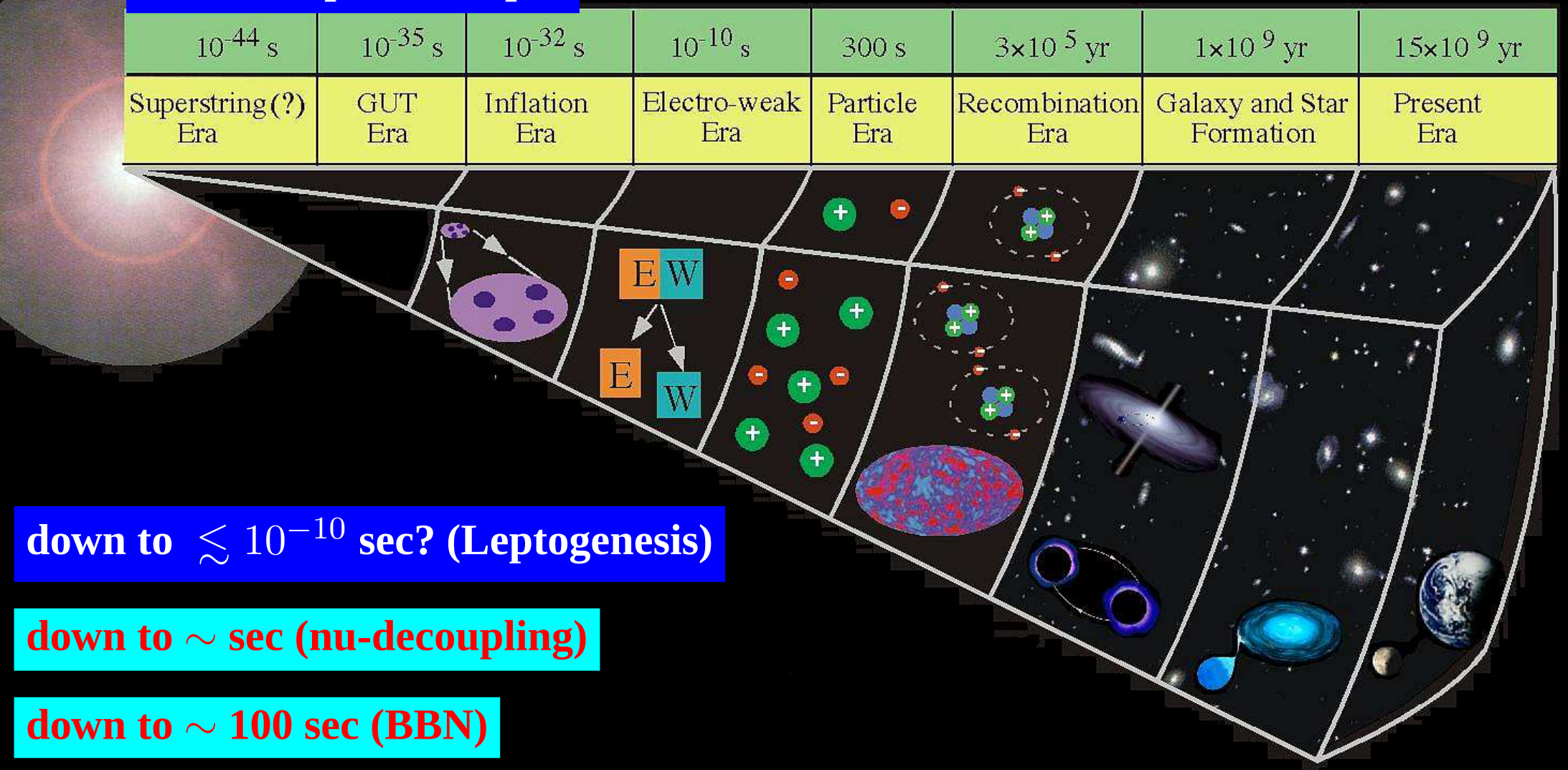
**Instituto de Física Corpuscular-CSIC/U. Valencia**

Big Bang

# COSMOLOGY Nobel Prize 2006

time

**neutrinos probe deeper**




**down to $\lesssim 10^{-10}$ sec? (Leptogenesis)**

**down to $\sim$ sec (nu-decoupling)**

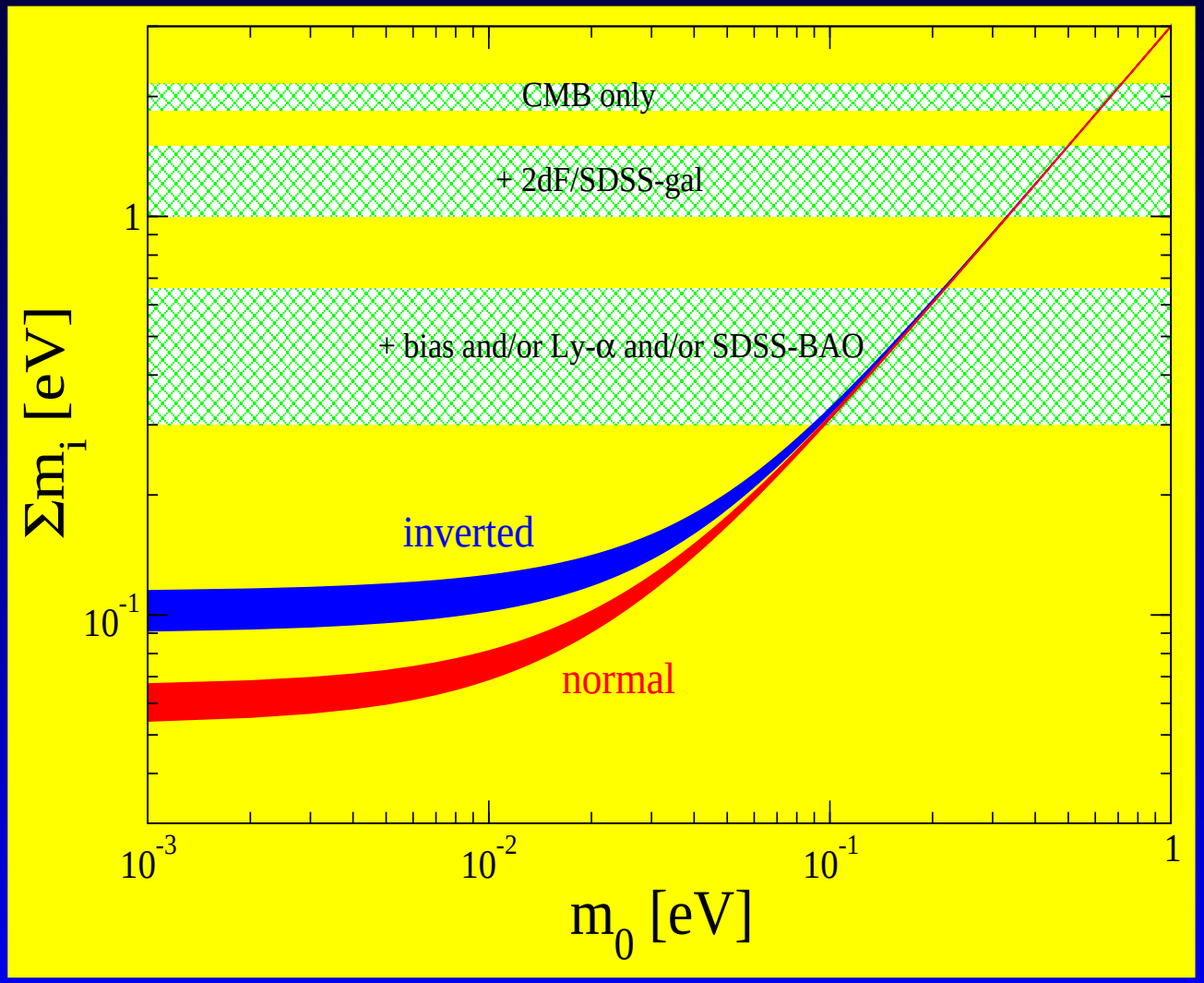
**down to $\sim$ 100 sec (BBN)**

**CMB & LSS**

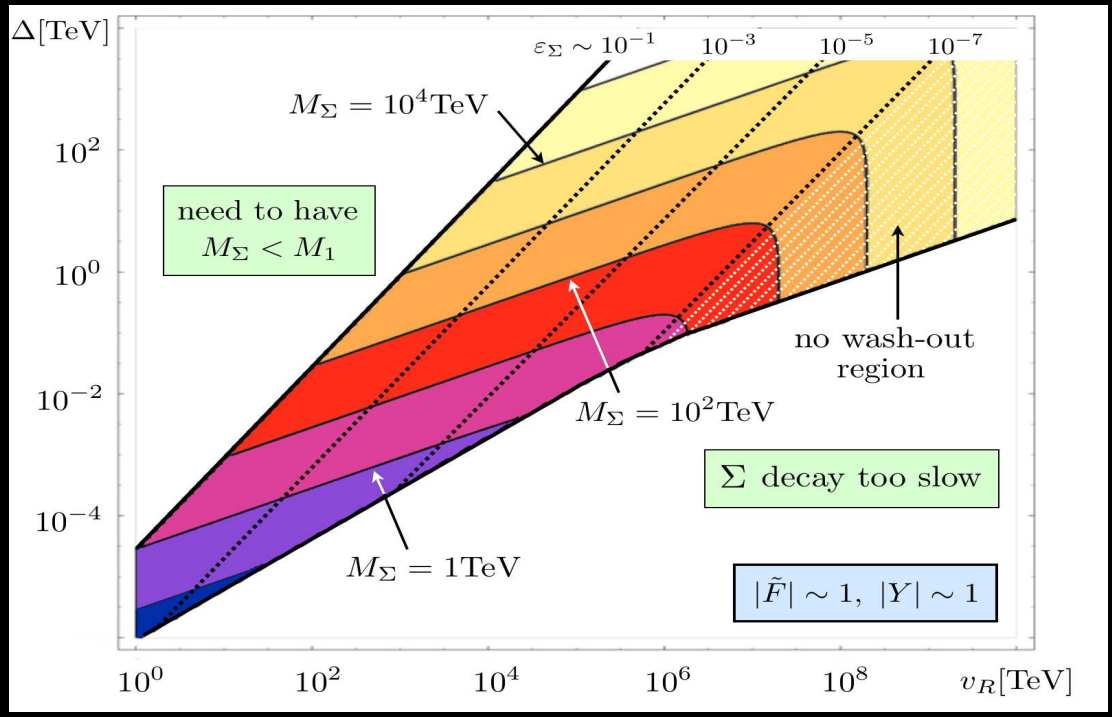
# NEUTRINO COSMOLOGY

**Pastor** ...

**Phys. Rep. 429, 307 (2006)**



# Leptogenesis




Hirsch et al ..

## Leptogenesis soft en el modelo seesaw inverso

Julia Garayoa, Nuria Rius, Concha González García

Neutrino masivos $\Rightarrow$ leptogenesis via desintegracion de particulas pesadas fuera del equilibrio termico (right-handed (s)neutrino, tripletes)

Soft leptogenesis $\Rightarrow$ fases de CP, splitting de masa $y$ mezcla de sneutrinos debido a terminos soft de rotura de supersimetria

Mecanismo seesaw inverso: dos singletes extra por generacion $(\nu_L, N, S)$

$\Rightarrow$ Asimetria de CP en la desintegracion de los sneutrinos pesados $(\tilde{N}, \tilde{S})$

- Efecto termico, $\propto (1+n_B)^2 - (1+n_F)^2$

  $n_{B,F} \Rightarrow$ distribuciones de Bose − Einstein y Fermi-Dirac
- Importante para diferencias de masa muy pequeñas $\Delta M \sim \Gamma$

## $\sim$ 30 líneas de investigación PE

- **AHEP**

  **Astroparticle and High Energy Physics**

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  **Dynamics of Complex Systems**

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  **Phenomenology of the Standard Model and its Extensions**

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  Hadronic Models and Fundamental Interactions
- **NUCTHEO**
  Hadronic and Nuclear Theory at Intermediate Energies
- **PARSIFAL**
  Particles and Interactions: Flavour and Colour Dynamics

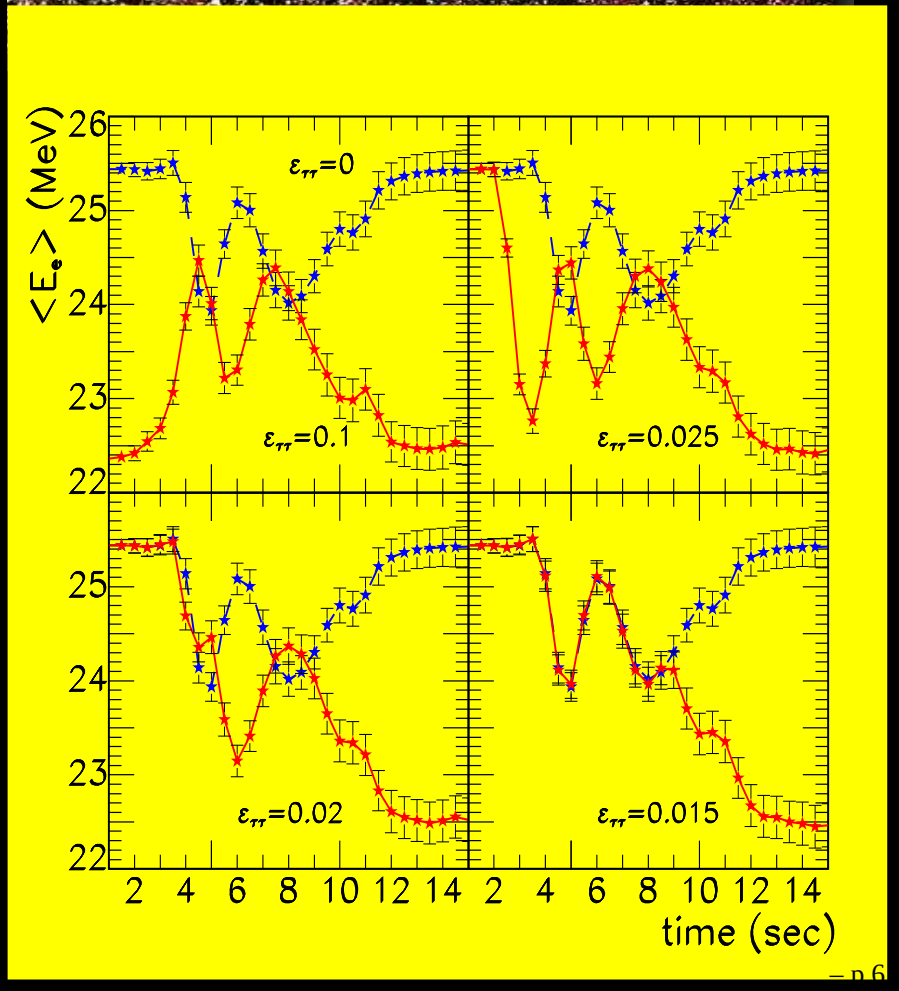
AHEP

Hirsch, Joshipura, Pastor, Porod*, Rius, Valle,
+ Bazocchi, Kaneko, Lattanzi, Tomas
+ Aristizabal, Esteban, Franca, Pinto, Villanova-del-Moral...
+ miembros externos


- **aceleradores: LHC, ILC, ...**
- **hibridos, K2K, MINOS, NuFact ...**
- **varios telescopios:**

**gamma & neutrino**

**underground/water/ice+surface**



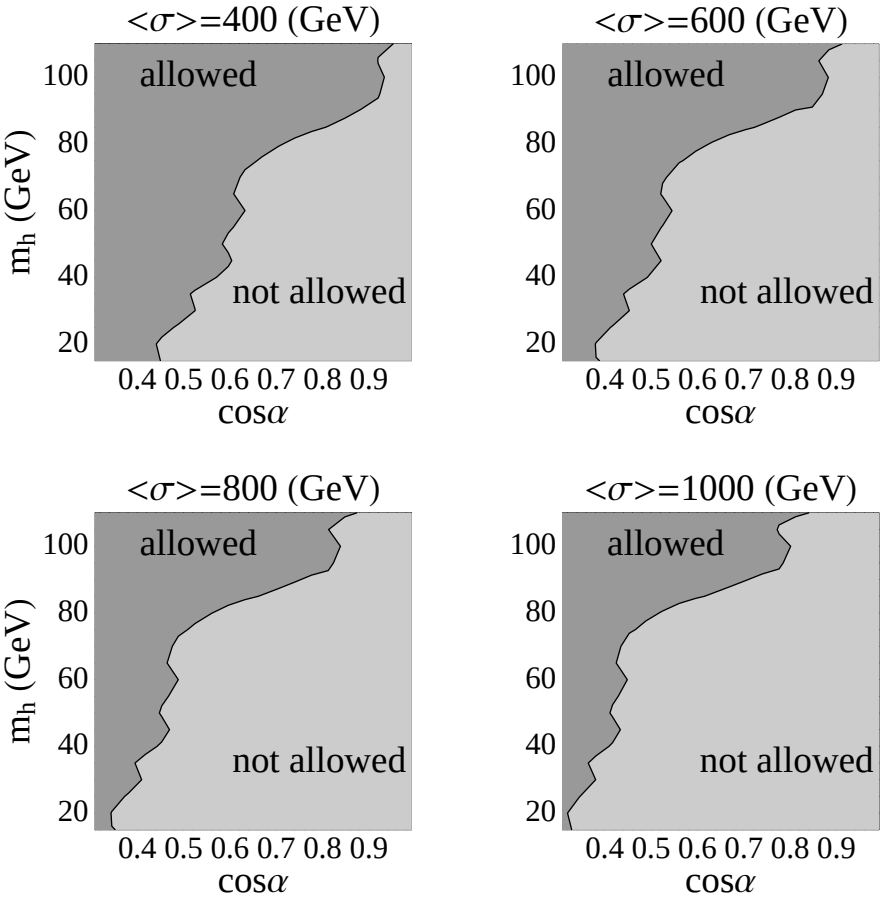

- **ILIAS/N6 WG1 Meeting (April, 2006)**
- **EC RTN MRTN-CT-2004-503369, many other international, national & local grants** **~ 22+13 pubs**

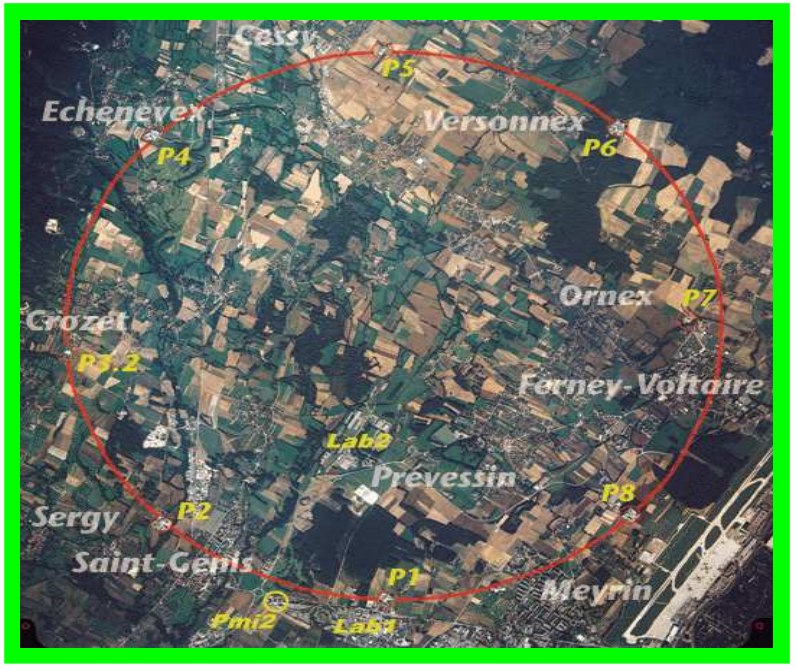
**~ 20 talks** **3 courses** **+ reviews**

# invisibly decaying Higgs boson

Neutrino mass generation may affect the basic structure of the electroweak symmetry breaking sector when neutrinos get mass at a low mass scale.

**Bazzocchi, J.V., Hirsch et al**

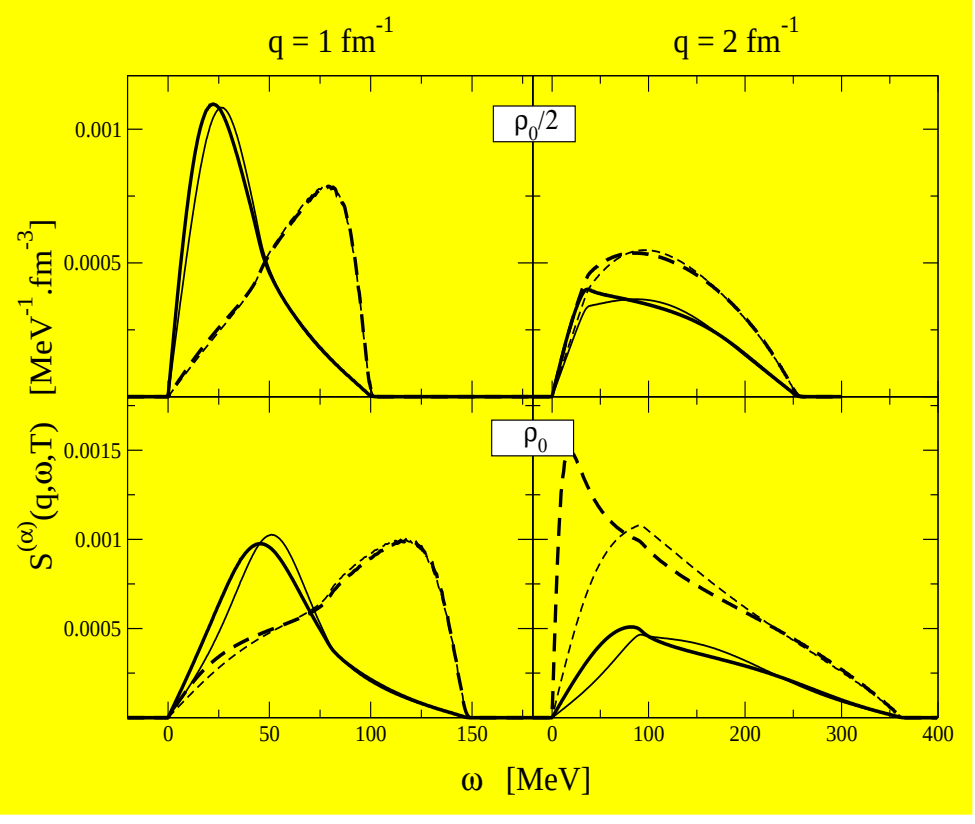


# COMPHYS

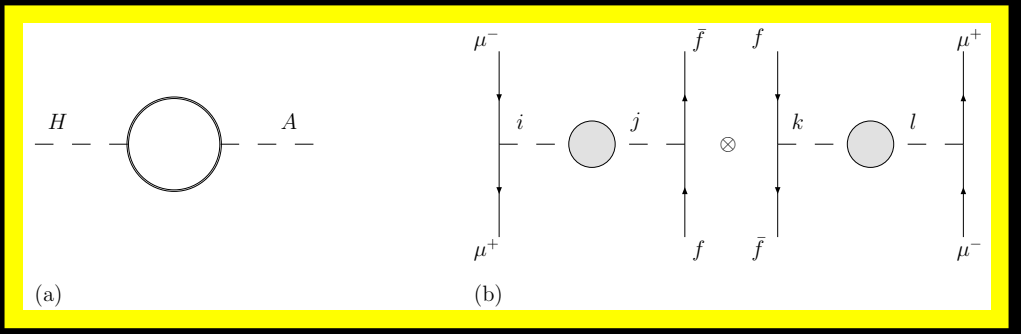
Navarro , Ros + miembros externos

nuclear response and neutrino mean free path Skyrme interaction for symmetric nuclear matter and pure neutron matter. Numerical results for neutron matter. Effects of spin-orbit interaction remain small, even at momentum transfer larger than the Fermi momentum. The neutrino mean free paths are marginally affected



# FMME

Bernabéu, Bordes, Botella, Barenboim, Hernández, Papavassiliou, Peñarrocha, Sanchis-Lozano, Vidal, Vives + postdocs & becarios

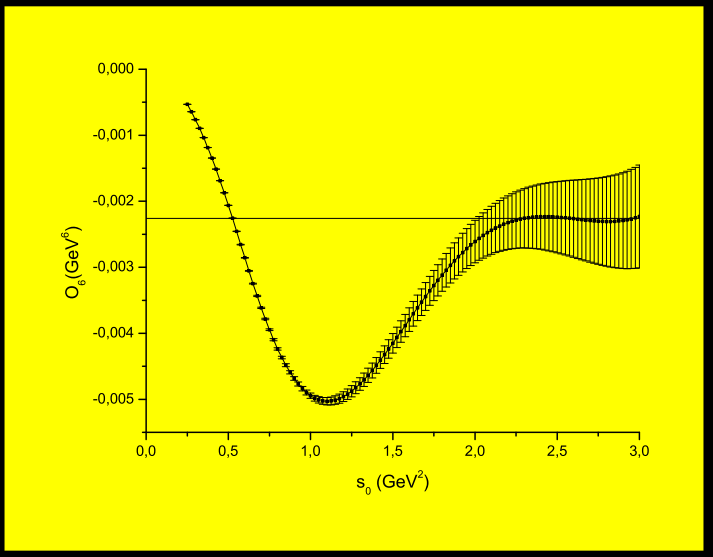



We consider the possibility of looking for CP-mixing effects in two-Higgs doublet models (and particularly in the MSSM) by studying the lineshape of the CP-even ($H$) and CP-odd ($A$) neutral scalars. In most cases $H$ and $A$ come quite degenerate in mass, and their $s$-channel production would lead to nearly overlapping resonances. CP-violating effects may connect these two Higgs bosons, giving origin to one-loop particle mixing, which, due to their mass proximity, can be resonantly enhanced. The corresponding transition amplitude contains then CP-even and CP-odd components; besides the signal of intereference between both amplitudes, leading to a CP-odd asymmetry, we propose to look for the mixing probability itself, a quantity which, although CP-even, can originate only from a CP-odd amplitude. We show that, in general, the effect of such a mixing probability cannot be mimicked by (or be re-absorbed into) a simple redefinition of the $H$ and $A$ masses in the context of a CP-conserving model. Specifically, the effects of the CP-mixing are such that, either the mass-splitting of the $H$ and $A$ bosons cannot be accounted for in the absence of CP-mixing, and/or the detailed energy dependence of the produced lineshape is clearly different from the one obtained by redefining the masses, but not allowing any mixing. This analysis suggests that the detailed study of the lineshape of this Higgs system may provide valuable information on the CP nature of the underlying theory.

# FMME

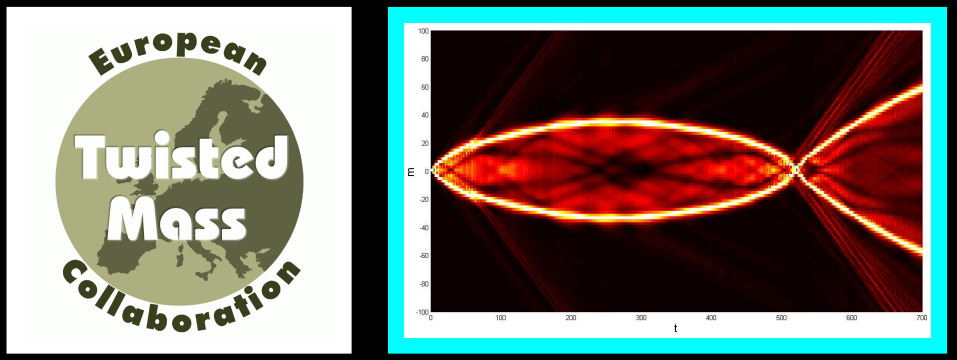
Saturation of QCD chiral sum rules is reanalyzed in view of the new and complete analysis of the ALEPH experimental data on the difference between vector and axial-vector correlators (V-A). Ordinary finite energy sum rules (FESR) exhibit poor saturation up to energies below the tau-lepton mass. A remarkable improvement is achieved by introducing pinched, as well as minimizing polynomial integral kernels. Both methods are used to determine the dimension d=6 and d=8 vacuum condensates in the Operator Product Expansion, with the results: $O_6 = -(0{,}00226 \pm 0{,}00055)\mathrm{GeV}^6$, and $O_8 = -(0{,}0053 \pm 0{,}0033)\mathrm{GeV}^8$ from pinched FESR, and compatible values from the minimizing polynomial FESR. Some higher dimensional condensates are also determined, although we argue against extending the analysis beyond dimension d = 8. The value of the finite remainder of the (V-A) correlator at zero momentum is also redetermined: $\Pi(0) = -4\bar{L}_{10} = 0{,}02579 \pm 0{,}00023$. The stability and precision of the predictions are significantly improved compared to earlier calculations using the old ALEPH data. Finally, the role and limits of applicability of the OPE in this channel are clarified.

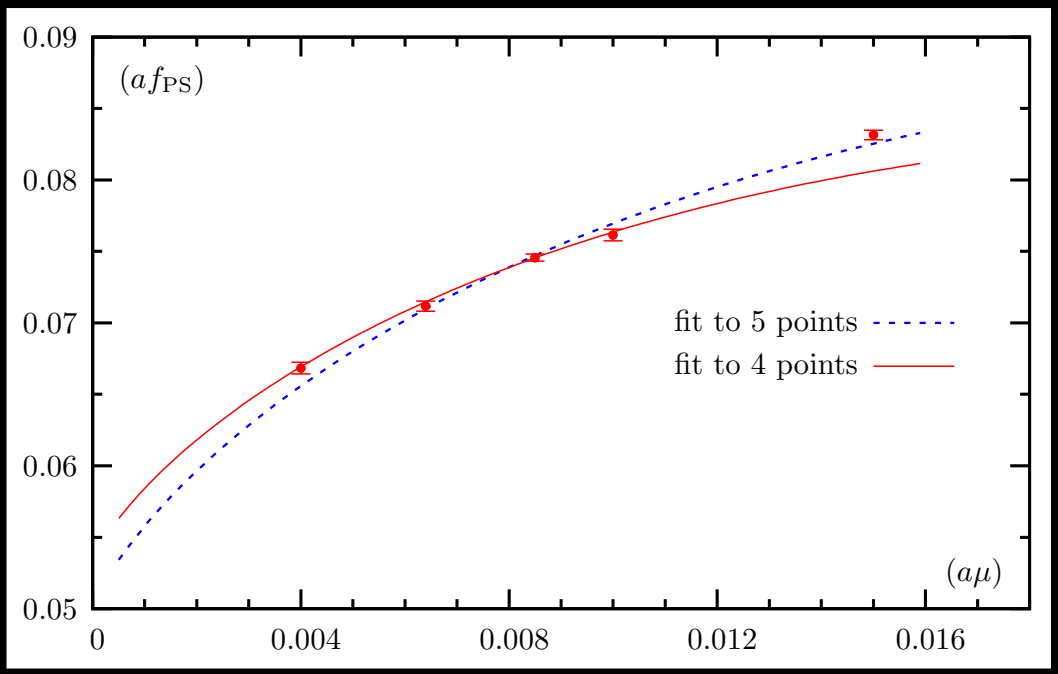
Bordes, Dominguez, Penarrocha, Schilcher



# ‘Lattice group’

pion masses and decay constant from the lattice Gimenez, Perez, Santamaria, Vidal, D. Palao + external





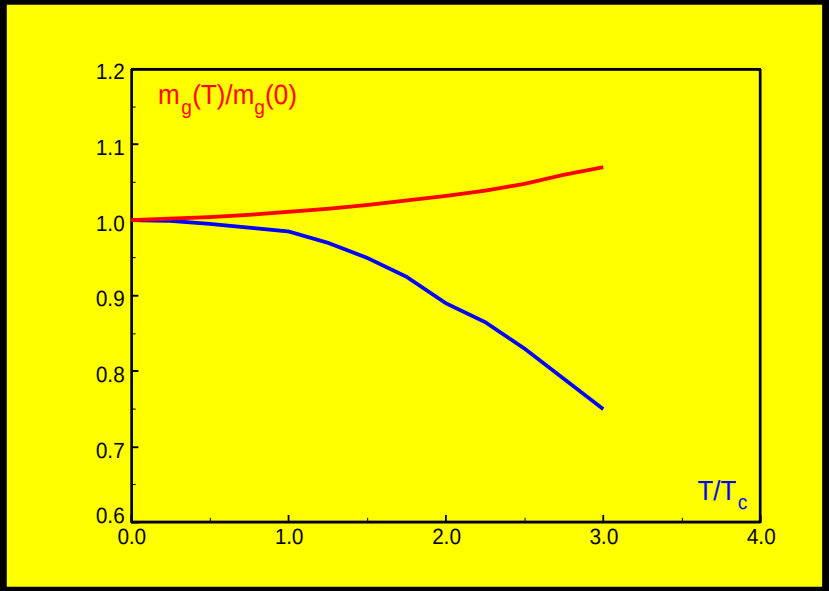

another research topic was
radiative majorana neutrino masses

Santamaria, Vidal, Oliver, Palao

# HADMOD

González, Noguera, Vento + becarios

- Glueball enhancement by color de-confi nement. High energy heavy ion collisions lead to the formation of a strong coupling de-confi ned phase in which the lightest glueballs are numerous and stable




- baryon dynamics

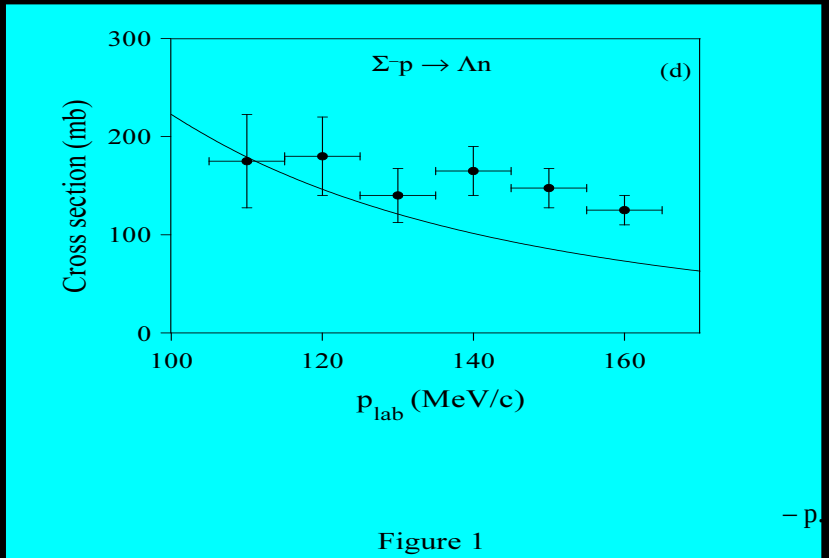
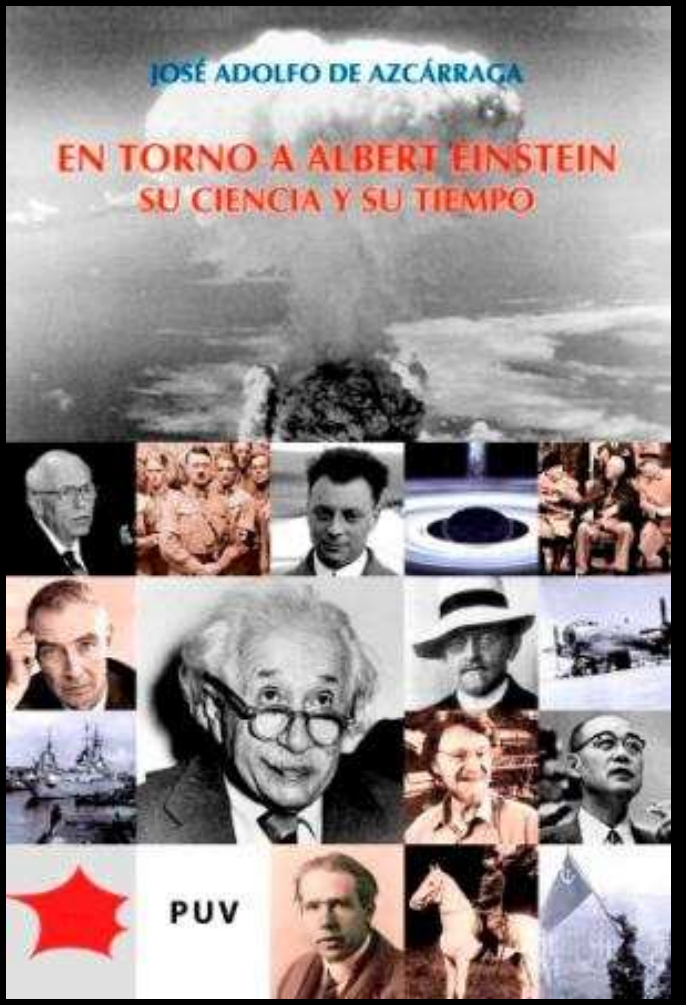



Figure 1

# MATHEPTH

Azcárraga, Bandos, Isidro, Sorokin, Miquel, Picón, Varela




teoría de supercuerdas/teoría M, soluciones supersimétricas de la supergravedad, correspondencia AdS/CFT, soluciones de la supergravedad de tipo preónico, propuestos en Valencia en 2001, estructura espacio-temporal de las cuerdas twistoriales propuestas por Witten para una descripción alternativa de los diagramas de la teoría de campos de gauge. aspectos matemáticos de las teorías cuánticas y de la propia cuantización

además de pubs, preprints, ponencias, el grupo obtuvo importantes logros divulgativos con un premiado libro sobre la vida y el legado de Einstein

EC RTN Constituents, fundamental forces and symmetries of the universe, MRTN-CT-2004-005104

# MATHEPTH PUBS

- I.A. Bandos, J.A. de Azcárraga and O. Varela, On the absence of BPS preonic solutions in IIA and IIB supergravities, JHEP 0609, 009 (2006) [arXiv:hep-th/0607060].
- J.P. Gauntlett, E. O Colgain and O. Varela, Properties of some conformal field theories with M-theory duals, [arXiv:hep-th/0611219].
- I.A. Bandos, J.A. de Azcárraga and C. Miquel-Espanya, Superspace formulations of the (super)twistor string, JHEP 0607, 005 (2006) [arXiv:hep-th/0604037]
- E. Bergshoeff, R. Kallosh, A.-K. Kashani-Poor, D. Sorokin, A. Tomasiello The Dirac Operator on Branes with Fluxes and Super-Potential Generation, in: Proceedings of the International Workshop on "SUPERSYMMETRIES AND QUANTUM SYMMETRIES", Editors E.A. Ivanov, B.M. Zupnik, Dubna, 2006, p.p. 17-25.
- I. Bandos and D. Sorokin, Aspects of D-brane dynamics in supergravity backgrounds with fluxes, kappa-symmetry and equations of motion. IIB, Nucl. Phys. B759, 399 (2006) [arXiv:hep-th/0607163].
- J.M. Isidro, Dirac brackets from magnetic backgrounds, arXiv:hep-th/0611026.
- J.M. Isidro and M.A. a. de Gosson, A gauge theory of quantum mechanics, arXiv:quant-ph/0608093.
- J.M. Isidro and M.A. a. de Gosson, Abelian gerbes as a gauge theory of quantum mechanics on phase space, arXiv:hep-th/0608087.
- J.M. Isidro, A quantum-gravity perspective on semiclassical vs. strong-quantum duality, Int. J. Geom. Meth. Mod. Phys 3, 1293 (2006) [arXiv:hep-th/0507150].

# Black holes

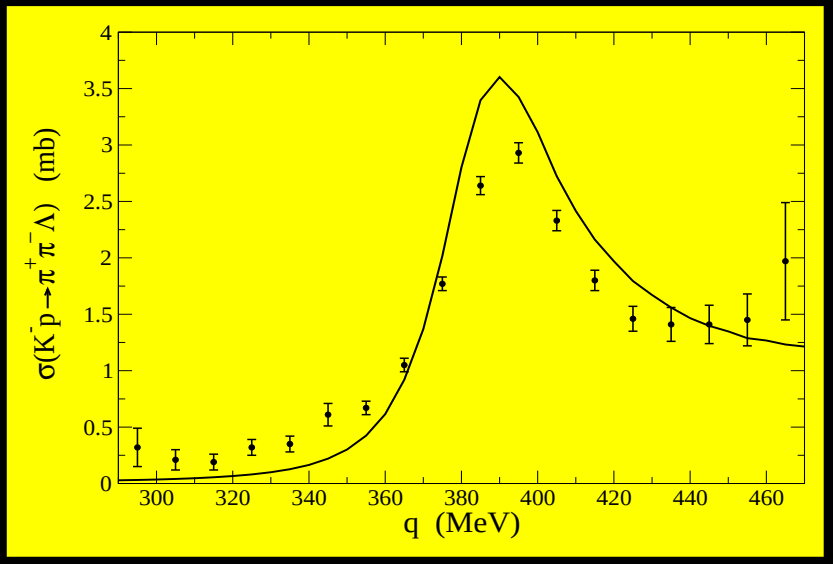
Navarro-Salas, Fabbri, Anderson, Olmo, Farese, Agulló 11 + 4 pubs, e. g.

- Acoustic black holes Review paper: R. Balbinot, A. Fabbri, S. Fagnocchi and R. Parentani, Hawking radiation from acoustic black holes, short distance and back-reaction effects, Rivista del Nuovo Cimento 28N3, 1-55 (2006)
- Black holes and quantum information A. Fabbri and A. Perez, Black hole evaporation in a thermalized final-state projection model, hep-th/0611152
- Quantum corrections to gravitational potential P.R. Anderson and A. Fabbri, Universality of semiclassical gravity in the far field limit, gr-qc/0612018
- Transplanckian problem in black holes and TeV gravity I. Agullo, J. Navarro-Salas and G.J. Olmo, Black hole radiance, short distances, and TeV gravity, Phys. Rev. Lett. 97, 041302 (2006)
- I. Agullo, J. Navarro-Salas, G.J. Olmo and L. Parker, Short-distance contribution to the spectrum of Hawking radiation, hep-th/0611355
- Cosmology and equivalence principle G.J. Olmo, Violation of the equivalence principle in modified theories of gravity, gr-qc/0612002
- Divulgación A. Fabbri y J. Navarro-Salas, Energía de vacío y agujeros negros. Revista Española de Física (2007)

# NUCTHEO

Oset, Vicente Vacas, Alvarez-Ruso, Napsuciale, Sasaki, Khemchandani, Geng + Doering, D. Gamermann, A. Martinez, J. Martin

1 EU I3 project HADRONTH , 15 + 15 pubs , 1 Tesis ...

- Estudios sobre hypernucleos $\Lambda$
- Autonergía de kaones on onda s y p en un medio nuclear
- Generación dinámica de resonancias
- 

- Colisión de neutrinos con núcleos Se utilizan técnicas de Cuántica de muchos cuerpos para hacer evaluaciones muy precisas de secciones efi caces de neutrinos con núcleos, esenciales para el análisis de datos en Super-K y otros experimentos

Parsifal

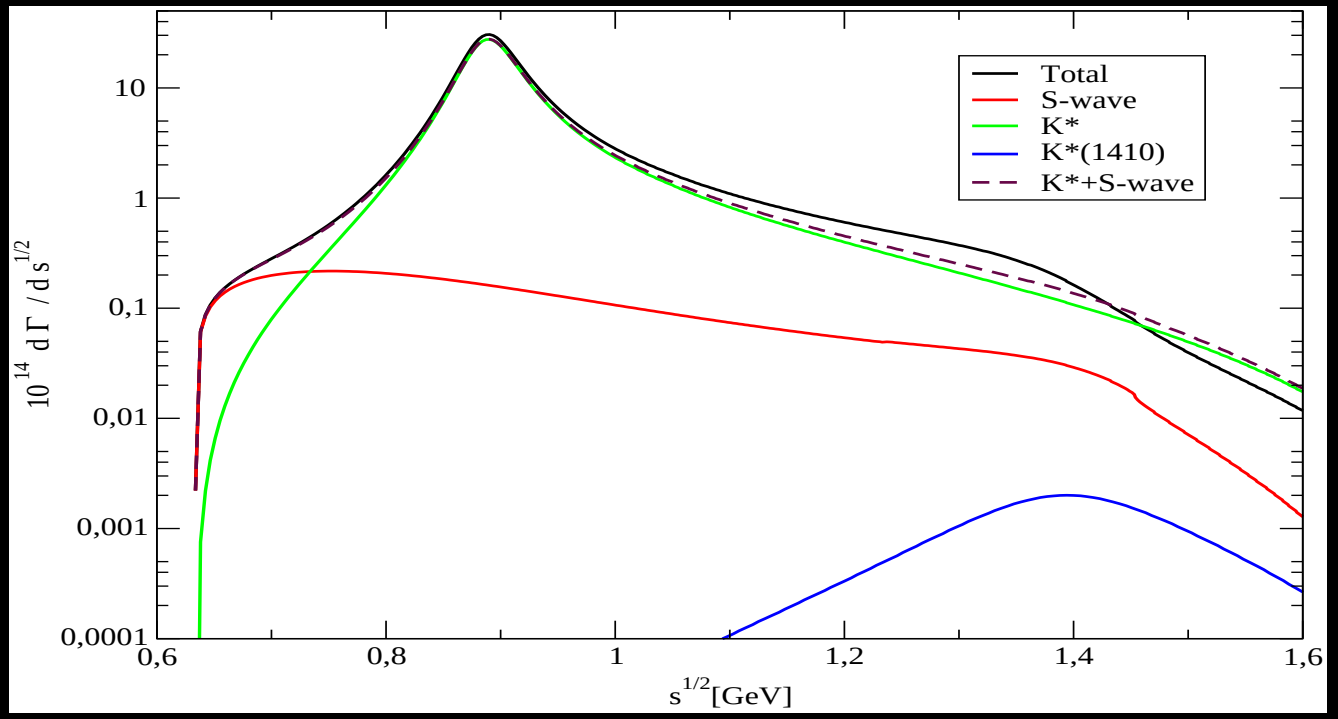
Tau decays into hadrons | Chiral Pert. Theory

Pich, Bonciani, Greynat, Haefeli, Hernández, Necco, Peña Garay, Peñaranda, Portolés, Rius, Rodrigo

**Electroweak Hadronic observables**

**Phenomenology of Hadronic processes ..**

**Spectral distribution of $\tau^- \to K\pi\nu_\tau$ contributions of different states are shown**




- Determination of the spectral distribution for $\tau^- \to K\pi\nu_\tau$ (Phys. Lett. B640 (2006) 176). To be employed in the analysis of Belle and BaBar data.

- Update of the scalar K$\pi$ form factor and evaluation of the masses of light quarks (Phys. Rev. D74 (2006) 074009).

- New version of the PHOKHARA event generator (http://cern.ch/german.rodrigo/phokhara/) with the new channels and improved treatment of radiative corrections.

- Development of twistor techniques for the evaluation of multipartonic scattering amplitudes (Phys. Rev. Lett. 96 (2006) 182001).

- Study of resonance contributions to the Low-Energy Chiral Constants of $\mathcal{O}(p^6)$ Chiral Perturbation Theory (Nucl. Phys. B753 (2006) 139).

# Hitos 2006 Dpto Teorico

- **referente en investigacion**

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- **frutos del Plan Estrategico 2005-2009**

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- acuerdo IDAPP-UVEG
- GRACIAS