ASTROPARTICLE AND HIGH-ENERGY PHYSICS

http://ahep.uv.es

Valle Madrid 27 Mayo 2008

ahep.uv.es

Project leader: Valle (PI-CSIC)

Senior staff : Hirsch - Pastor (CT-CSIC)

Visiting professors : Bartl – Miele (sabbaticals MEC)

[26 sabbaticals in the group]

Postdocs: Bazzocchi (FPA) - Kaneko (RTN) - Morisi (FPA) - Palazzo (I3P)

Ph.D. Students: Esteban França Pinto Vicente (2FPU+GV+I3P/CSIC)

[18 PhD thesis & TS]

13 EDP (local members) + 16 External Members

3 postdocs finish in 2008: 2 funded by FPA and 1 by EU-RTN

2 students complete their PhD

new research line on Auger

two new staff members

NO FPI & NO PhD student in 2007 & 2008

this grant builds up upon 5 previous ones, PB92-0084, PB95-1077, PB98-0693, BFM2002-00345 & FPA2005-01269 (205.000 Euro, 2/3 spent by yr-2)

if not the biggest, ahep is one of the most productive & **internationalized** astro-particle physics groups in Europe

we have coordinated European grants, such as **EU training site** HPMT-2000-00124 *Particle Physics beyond the Standard Model* and the ESF **network** *neutrino astrophysics* (2000-2004)

We have (co)-organized **many int. conferences**, such as trento ect*-04, **ilias**-entapp-05, **ilias**-dbd06, **aspen**-07, **ilias**-entapp-08, etc & several **isapp training schools:** munich-sorrento-06, paris-07, spain-08, etc

We coordinate the **Renata** network of the Spanish APP community

in the period 2003-2007 we have put out 102 pubs with **3104 citations**, **80 talks** published in international conference Proc.

1.Basic neutrino Properties and future experiments

2. Neutrinos as messengers in **astrophysics &** cosmology

Planck, Borexino, D-Chooz, T2K, NOvA, DBD & DM expts …

5. Participation in the Pierre Auger Observatory

3. Origin of neutrino mass, mixings and CP violation

LHC, ILC, nufact …

AHEP group research lines

4. New physics In the era of LHC

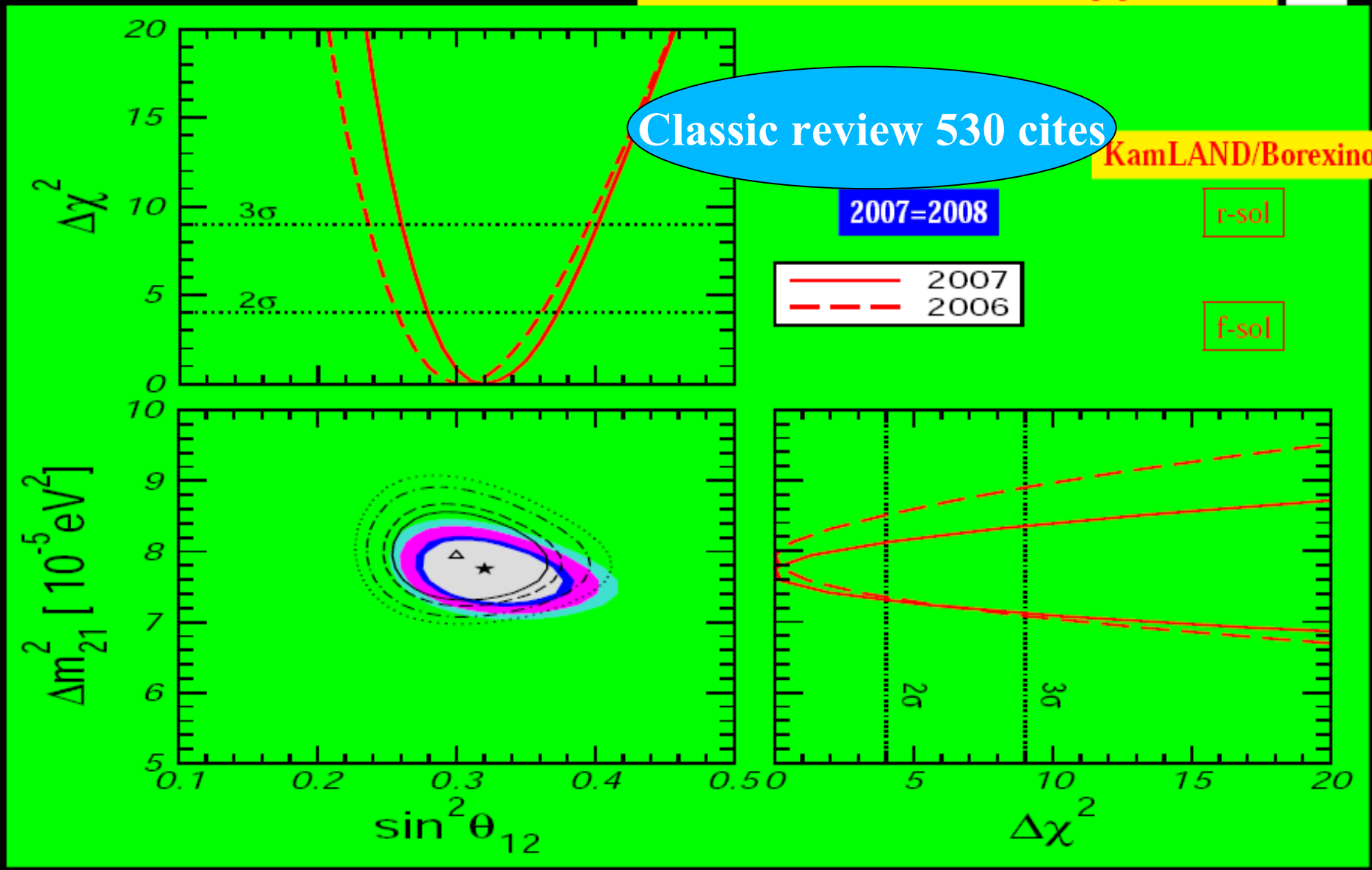
Basic neutrino properties and future experiments

1

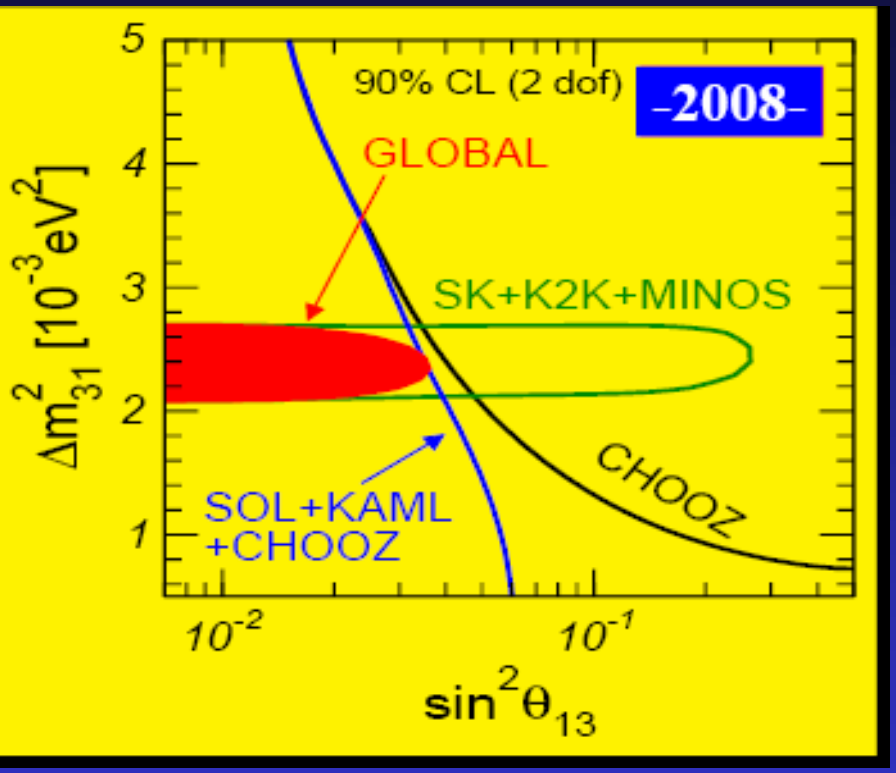
Valle Esteban Palazzo Miranda Nunokawa Tomàs Tortola ...

SOLAR NEUTRINOS

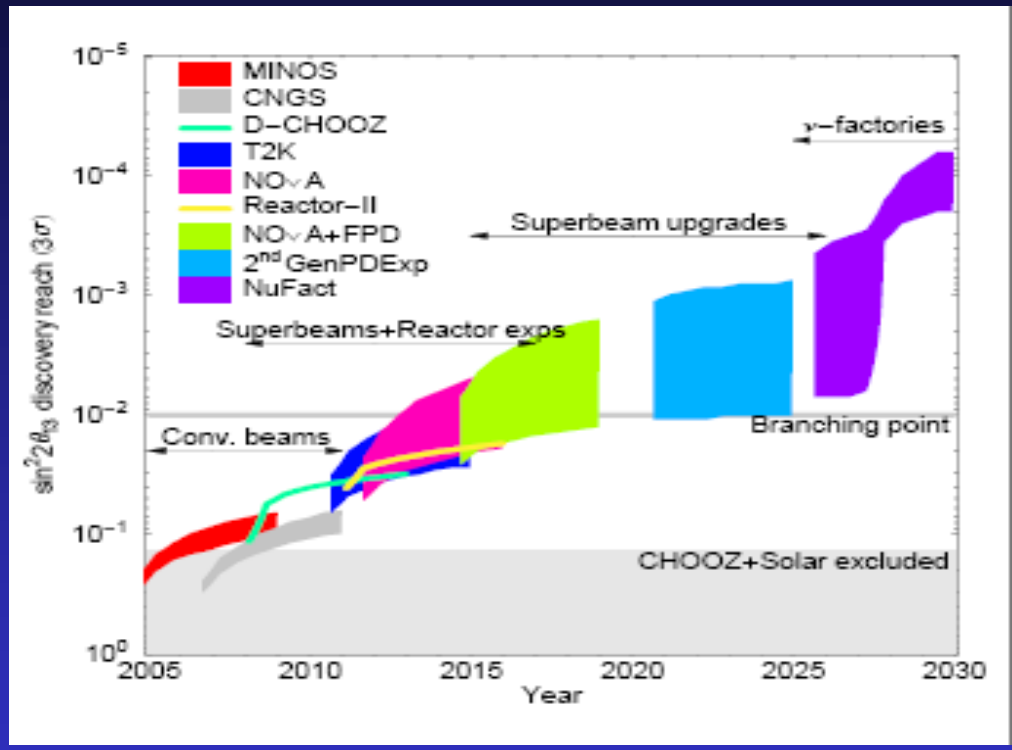
Maltoni et al, NJP 6 (2004) 122 hep-ph/0405172 v6



neutrino properties and future experiments



LS : LENA, LAr : GLACIER, WC : MEMPHYS, UNO, HS, HK .



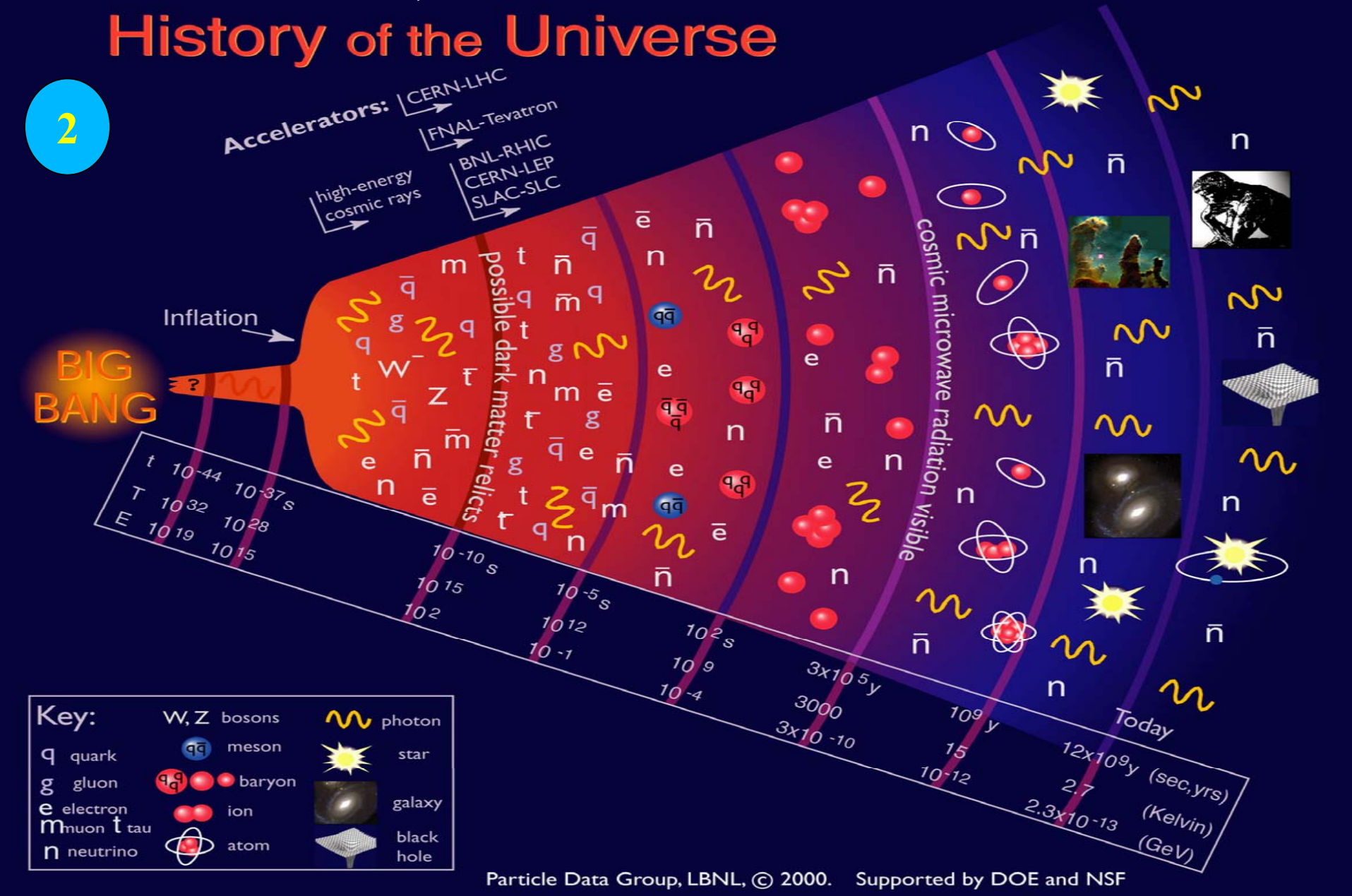
Not only oscillations … Constraining non-standard neutrino interactions

with OPERA … **Esteban Huber Valle arXiv:0803.1790 [hep-ph]**

Using nu-e scattering … **Miranda et al PRD (2008) & Phys.Rev.D73 (2006) 113001**

Neutrinos as messengers in astrophysics & cosmology

PASTOR, VALLE, ESTEBAN, FRANÇA, PINTO, FORNENGO, LESGOURGUES, MIELE, PISANTI, RAFFELT, SEMIKOZ, TOMÀS

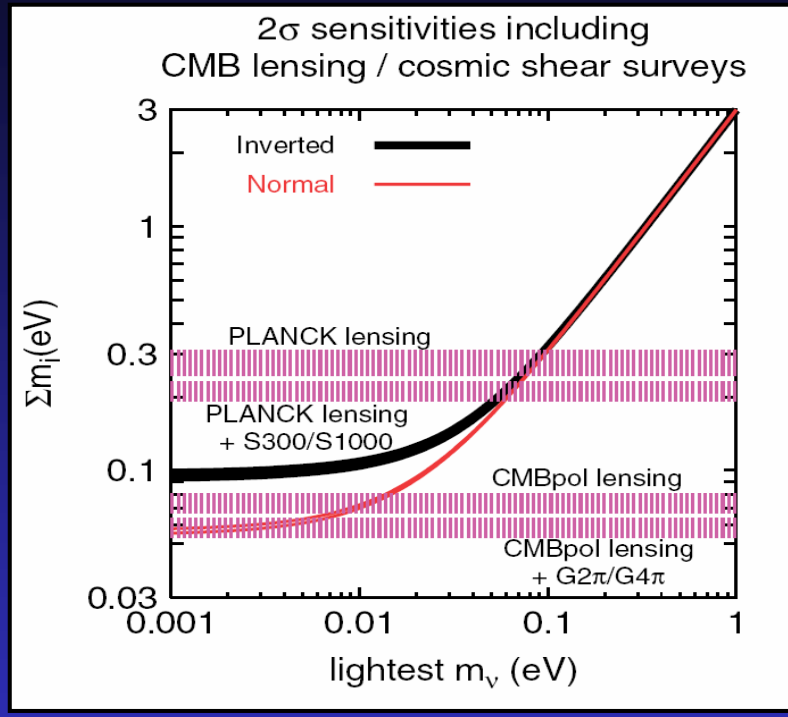


2 Neutrinos as ideal tool to explore the Universe and the interior of stars

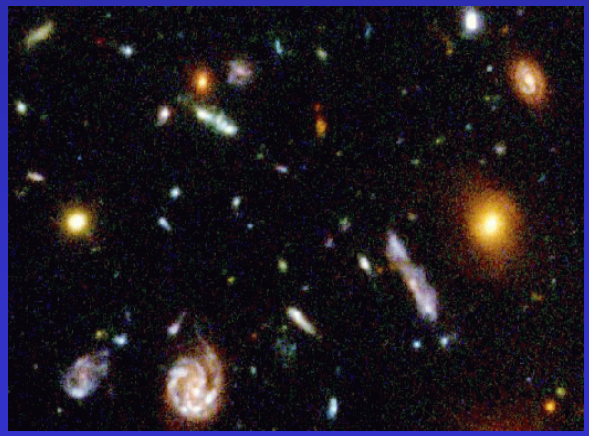
cosmology very sensitive to absolute m_ν scale (PLANCK, CMB lensing, …)

Complements tritium & 0νDBD experiments

Lesgourgues, Pastor Phys.Rept. 429 (2006) 307-379



Cosmological relic neutrinos

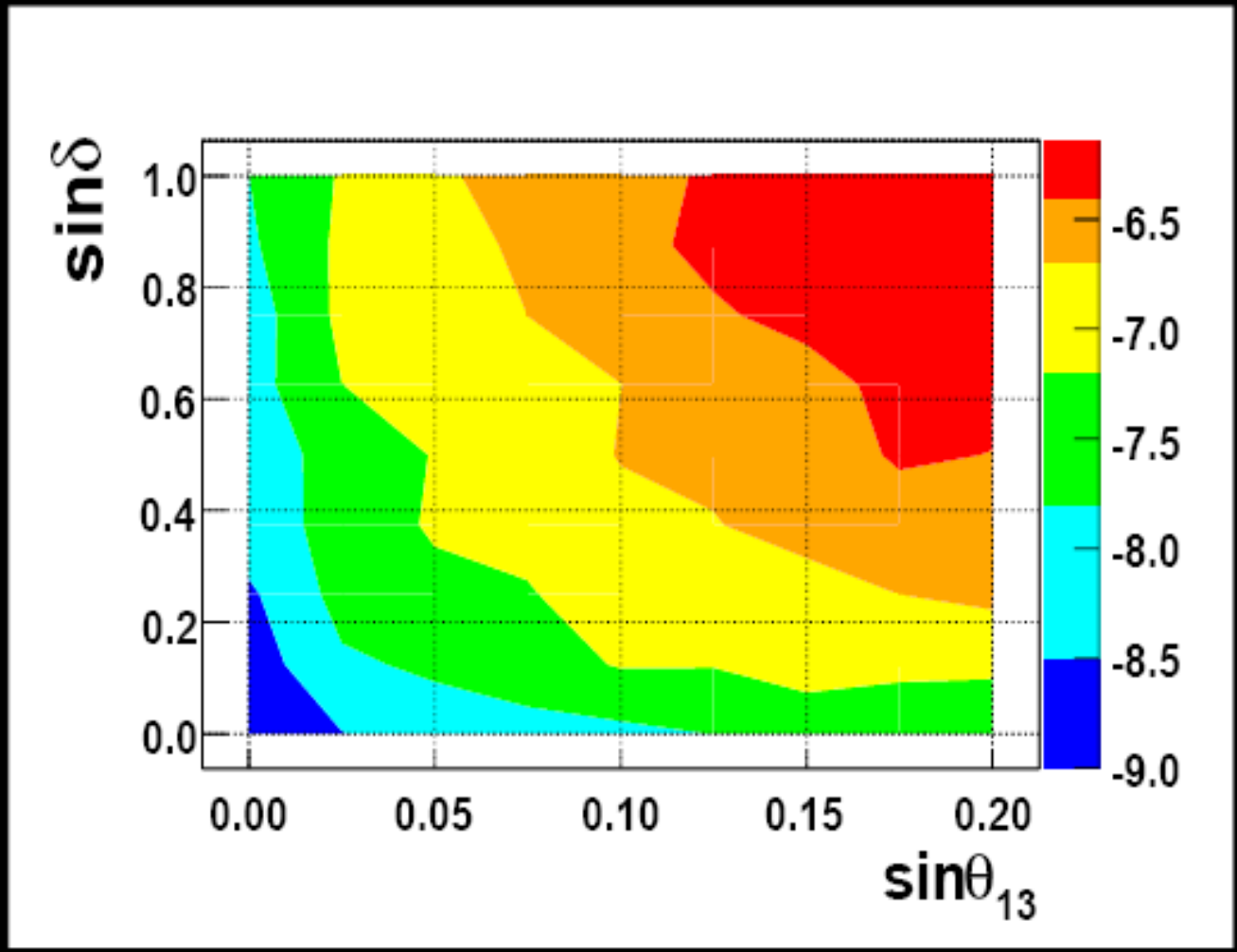


- Probe basic cosmology on time scales much **earlier** than accessible with photons (BBN, etc)
- **Leptogenesis** scenarios
- **Dark Matter** & neutrino mass generation

Thermal seesaw leptogenesis & oscill phase

Fukugita, Yanagida 86

Romao et al Phys. Rev. D77 (2008) 055002



DIRAC NU-OSCILLATIONS PHASE IS ENOUGH

B-L SCALE CAN BE LOW

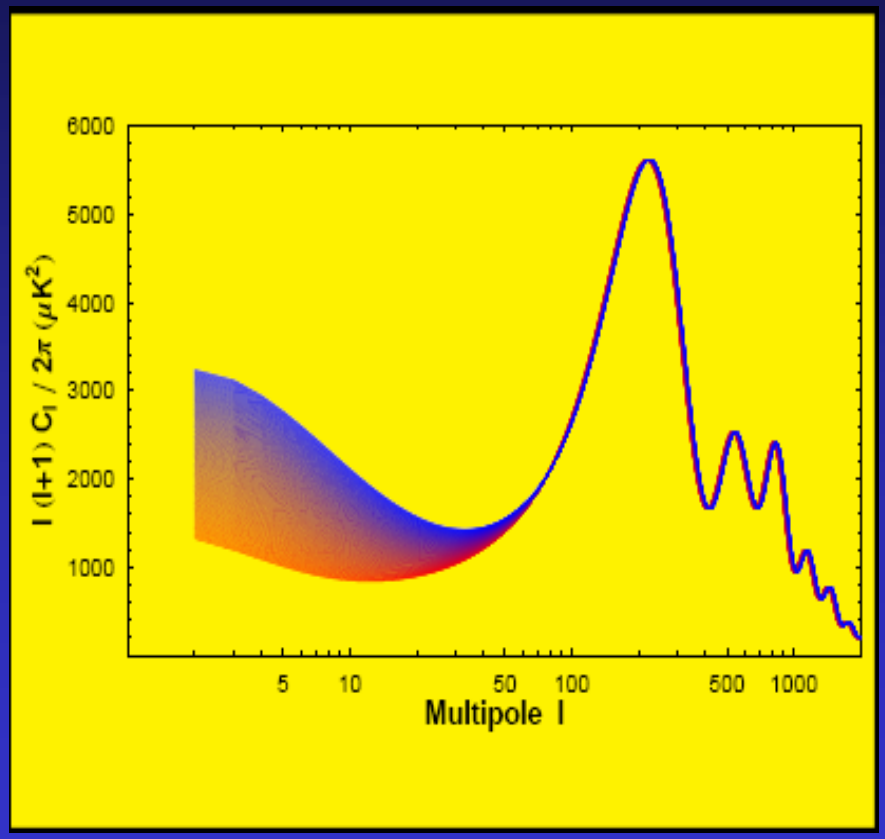
Hirsch et al PRD75 (2007) 011701

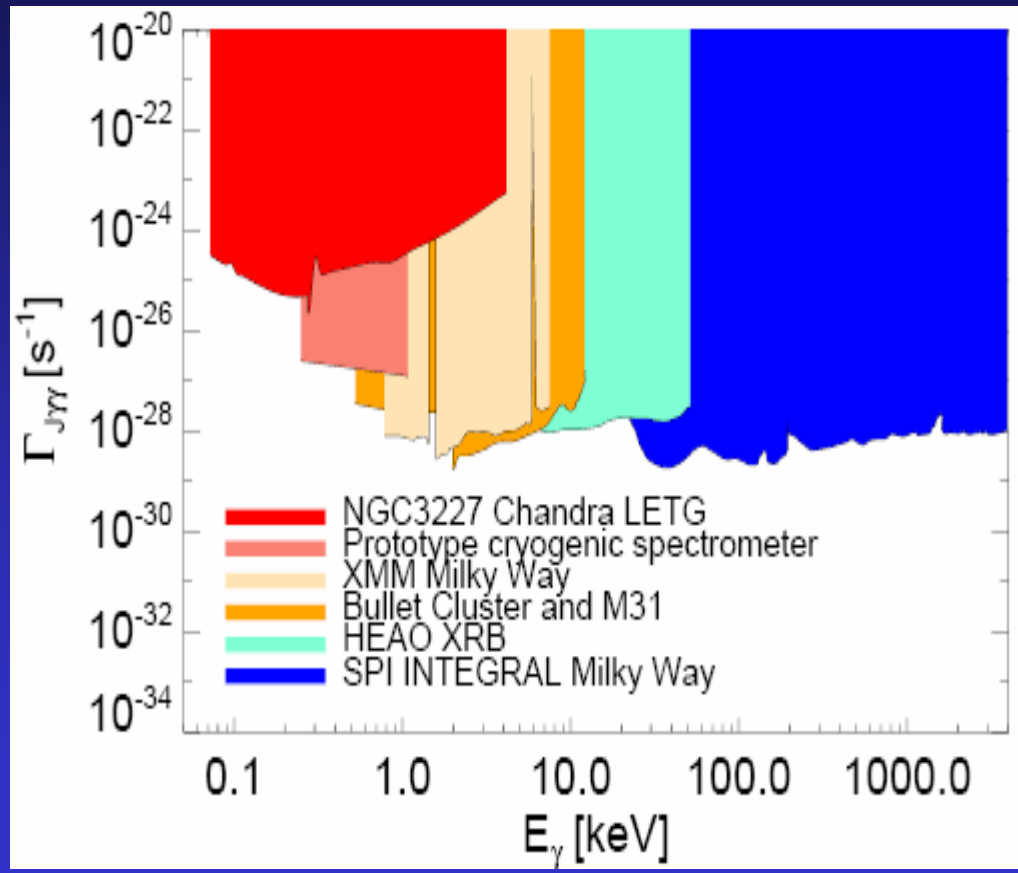
2

Late-decaying majoron dark matter

Lattanzi & Valle PRL 99 (2007) 121301

Bazzocchi, Lattanzi, Riemer-Sorensen, Valle
arXiv:0805.2372 [astro-ph]

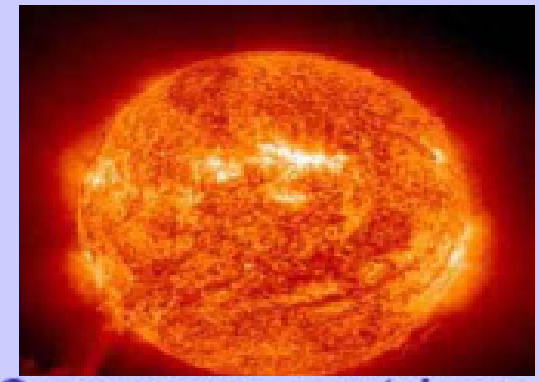




CMB

X-rays from dark matter decays

Solar neutrinos

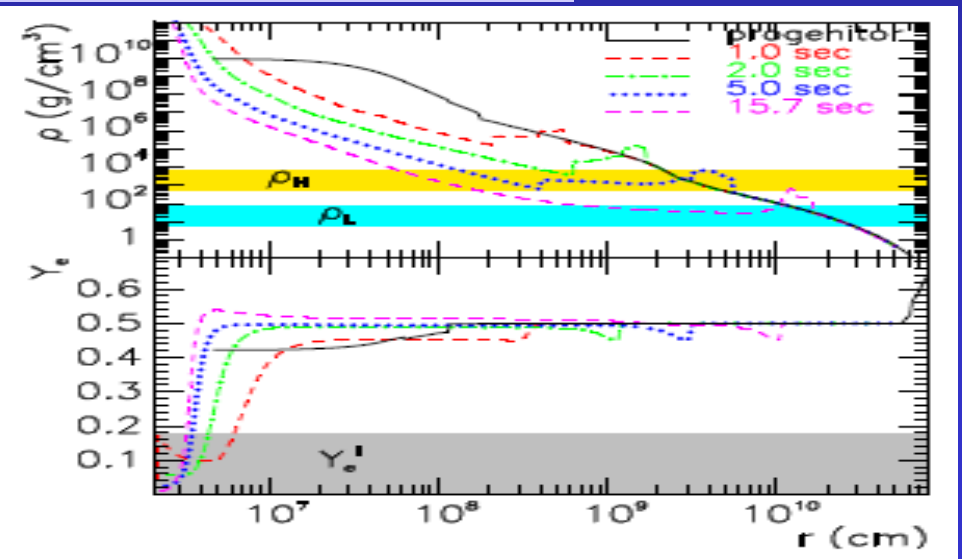


Supernova neutrinos

Use precise solar neutrino data to probe:

- Solar physics beyond helioseismology
- Sub-leading effects to flavour oscillations

Measuring a large number of neutrinos from a future galactic supernova will give us important information on neutrino properties and explosion



theta13
mass hierarchy
NSI …

we found new collective nu-flavor conversion & NSI effects near the core

Origin of nu-masses, mixings and CPV

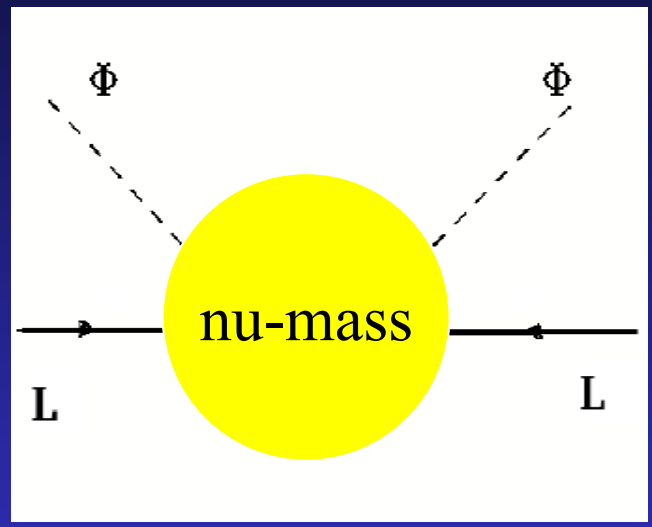
Hirsch Valle Bazzocchi Morisi Kaneko Vicente Romao Villanova …

Discrete flavour symmetry @ unification

TRI-BI-MAXIMAL MIXING

Hirsch Morisi & Valle arXiv:0804.4072 [hep-ph]

$$U_{HPS} = \begin{pmatrix} \sqrt{2/3} & 1/\sqrt{3} & 0 \\ -1/\sqrt{6} & 1/\sqrt{3} & -1/\sqrt{2} \\ -1/\sqrt{6} & 1/\sqrt{3} & 1/\sqrt{2} \end{pmatrix}$$



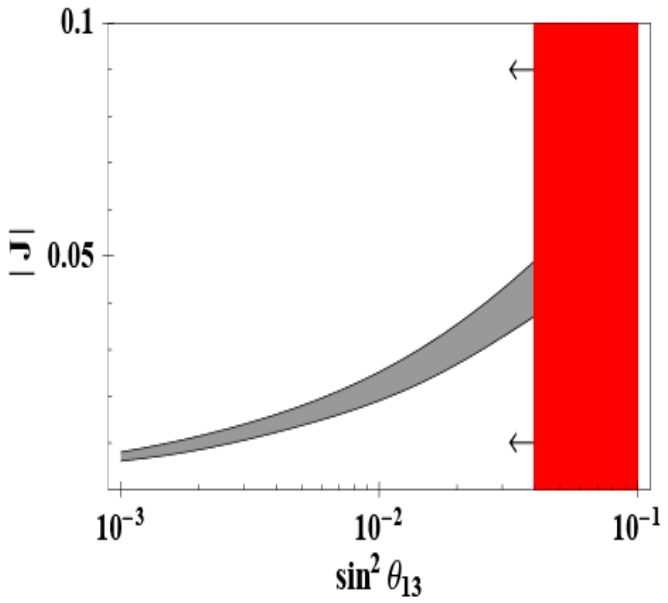
low energy nu-properties

Possible tests

Nu-oscillations
LFV rates
new particles…

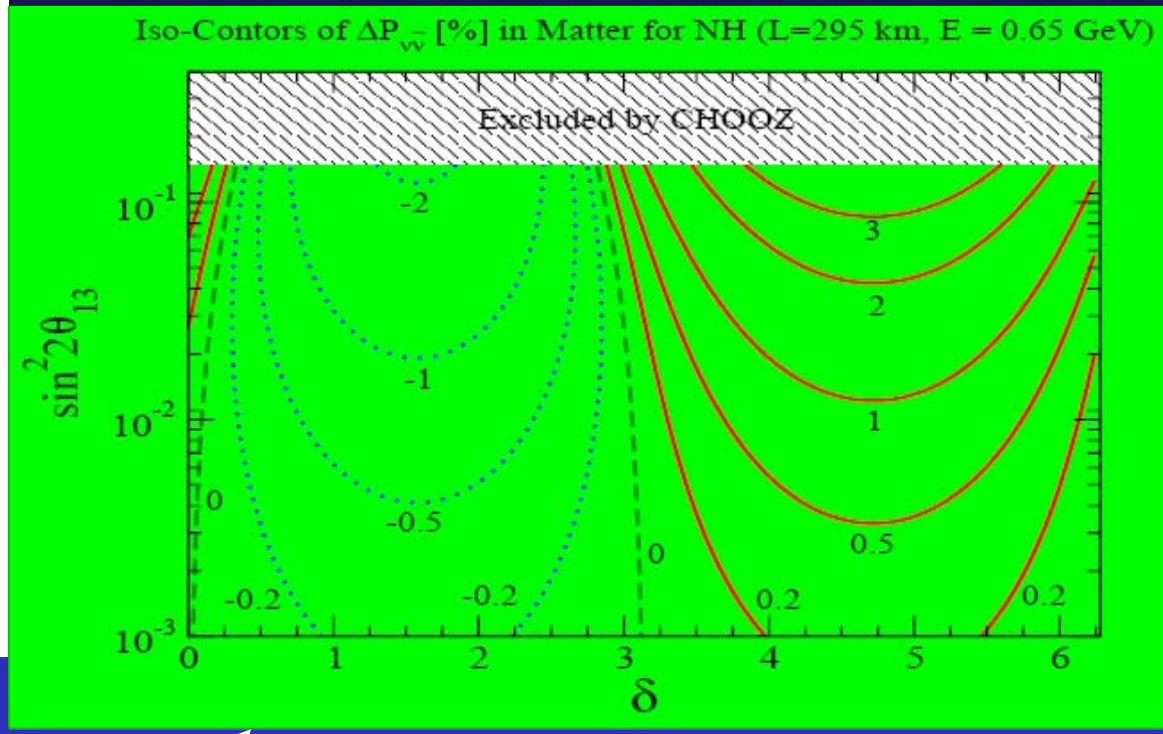
3 CPV & NU-OSCILLATIONS AT LONG BASELINES

Theory of CPV



Hirsch et al PRL 99 (2007) 151802

Analysis & simulations



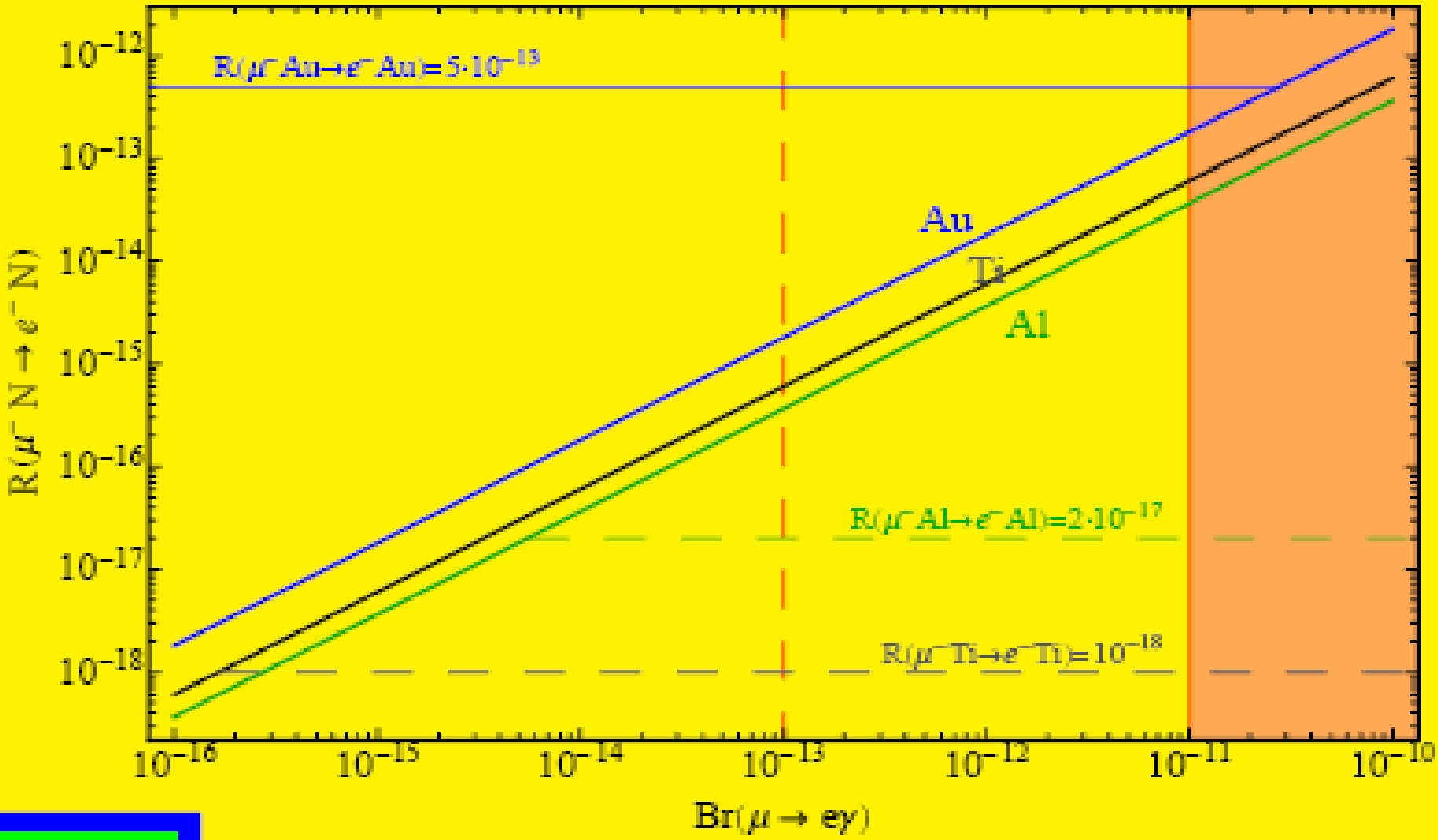
2 recent ahep reviews

Nunokawa et al. Prog in Part Nucl Phys 60(2008)338 | ISS Physics Working Group arXiv:0710.4947 | Phys.Rep.

3

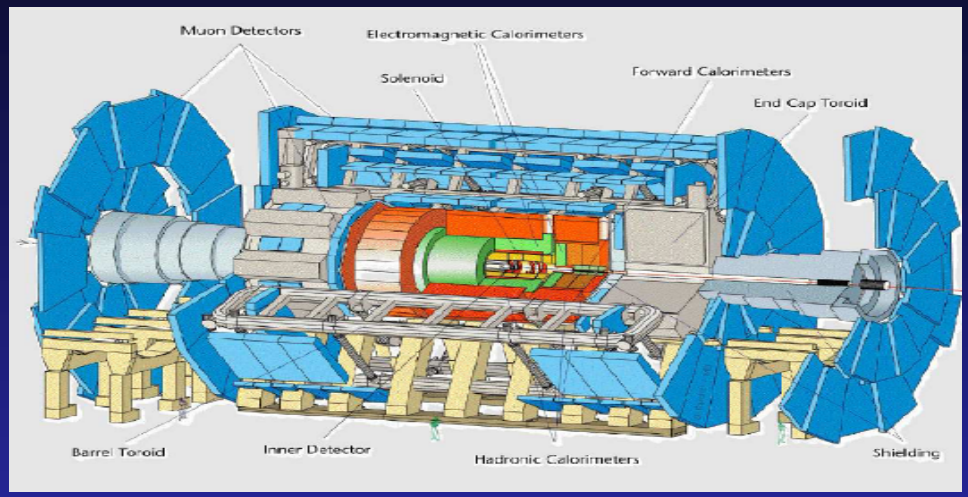
LEPTON FLAVOR VIOLATION

Deppisch, Kosmas & Valle NPB752 (2006) 80



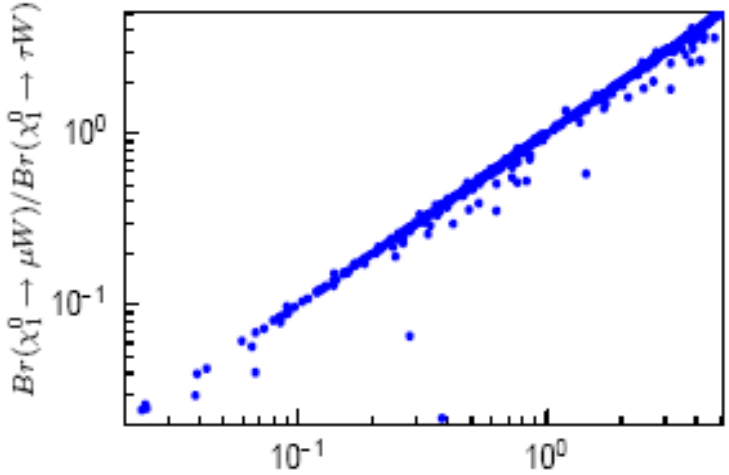
New physics in the era of LHC

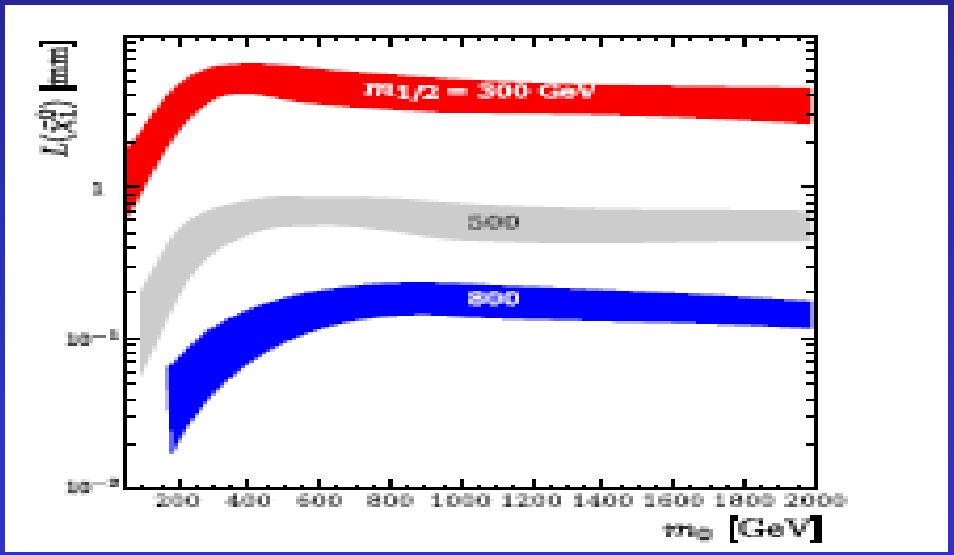
Hirsch Bartl Valle Vicente Campos, Eboli, Magro, Porod, Restrepo …



testing neutrino angles at LHC

Hirsch et al Phys.Rev.D77 (2008) 075005



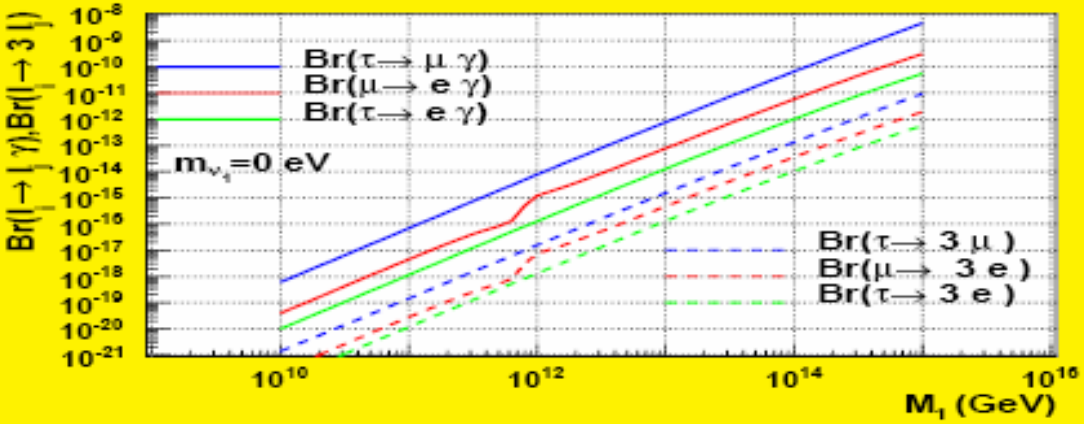


Tevatron & LHC DV simulation

Phys.Rev.D71(2005) 075001
JHEP0805 (2008) 048

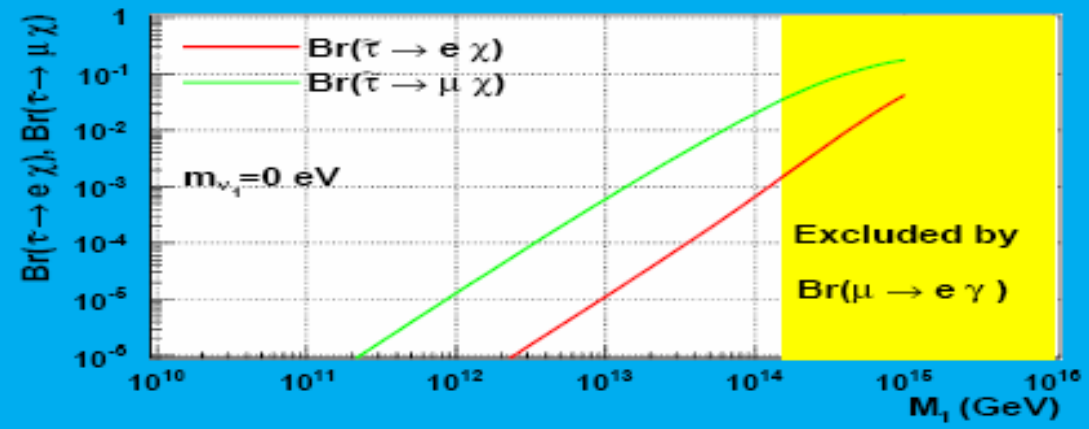
LHC CORRELATION ANALYSIS NEEDED

Interplay of Flavor & Collider physics



LFV @ low energy

Hirsch, et al arXiv:0804.4072



LFV @ LHC

need to replace postdoc!

CERN Workshop ***Flavor in the Era of the LHC*****: arXiv:0801.1800** [hep-ph]
Supersymmetry parameter analysis: SPA convention and project **Eur.Phys.J.C46 (2006) 43-60**

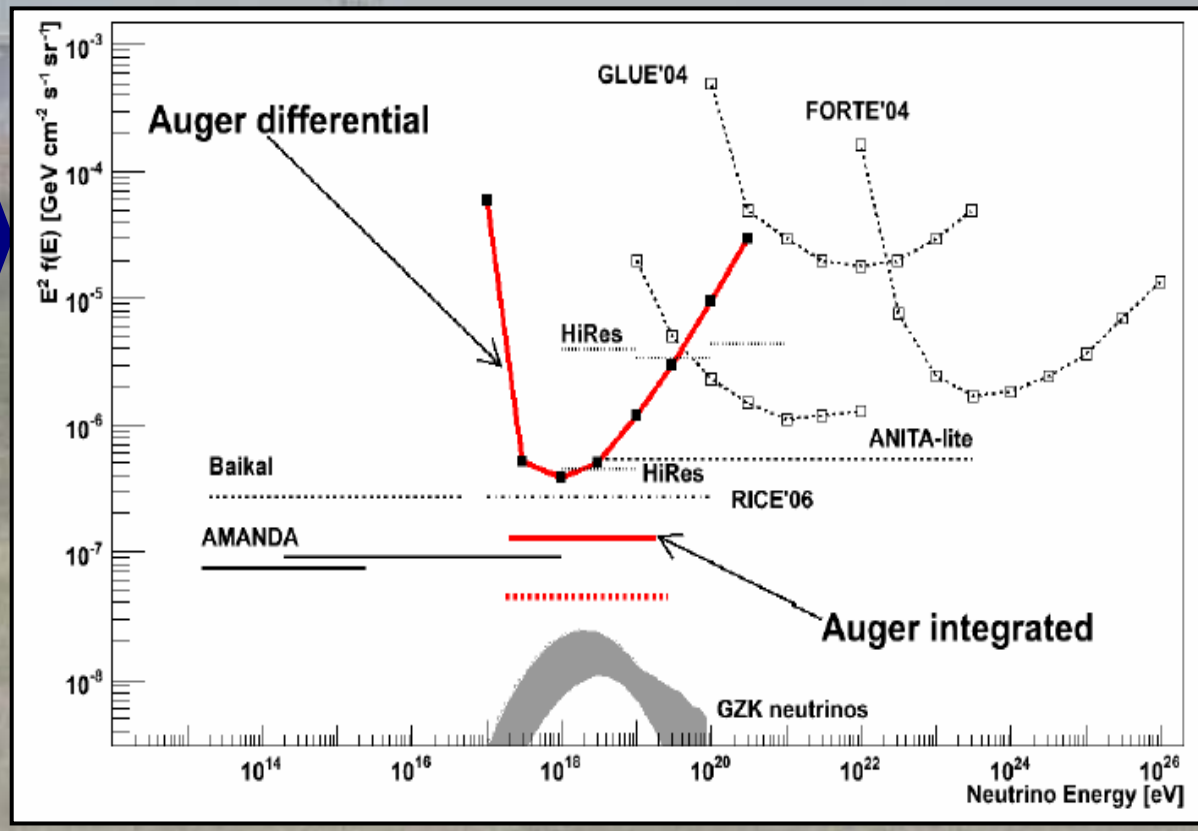
5

Participation in the Pierre Auger Observatory

Pastor+Pinto+Miele+Pisanti+ Tomàs

AHEP has members in Auger since 2007 (associated to the USC), involved in the "**Neutrino task**": look for **UHE neutrinos from down-going events**

Limit on UHE tau neutrinos from non-observation of Earth-skimming events (PRL)



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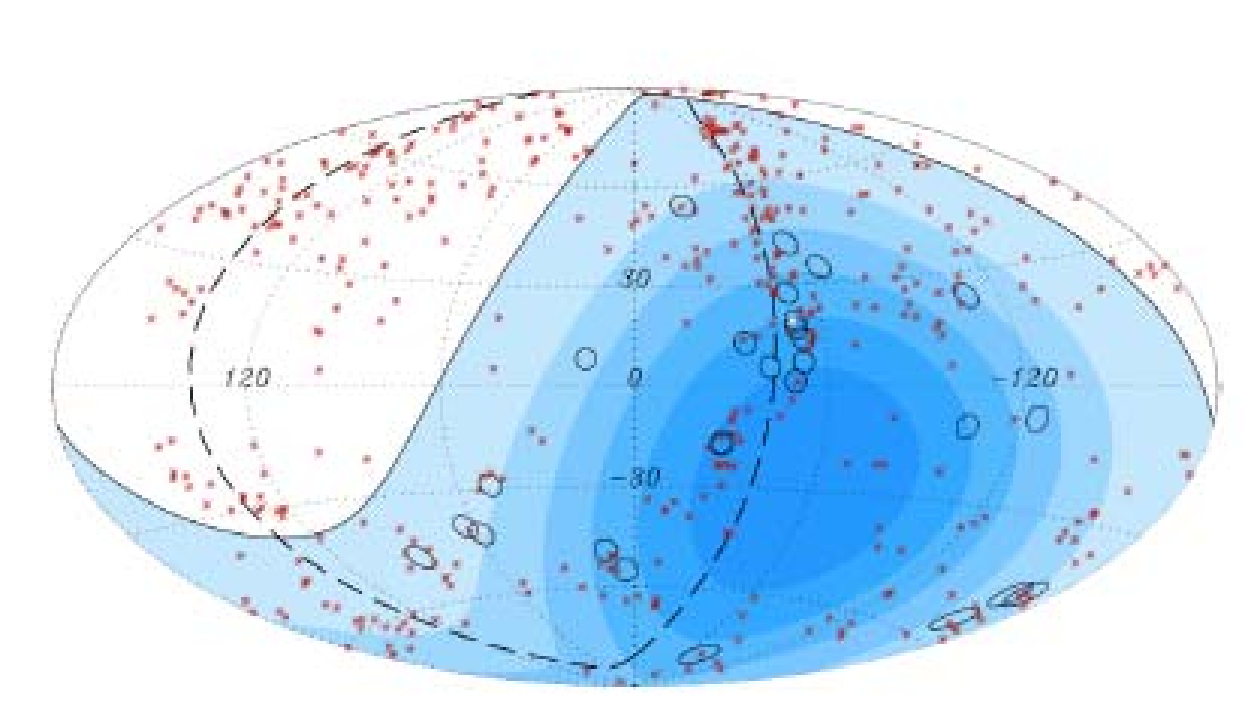
anisotropy in **UHECR** arrival directions



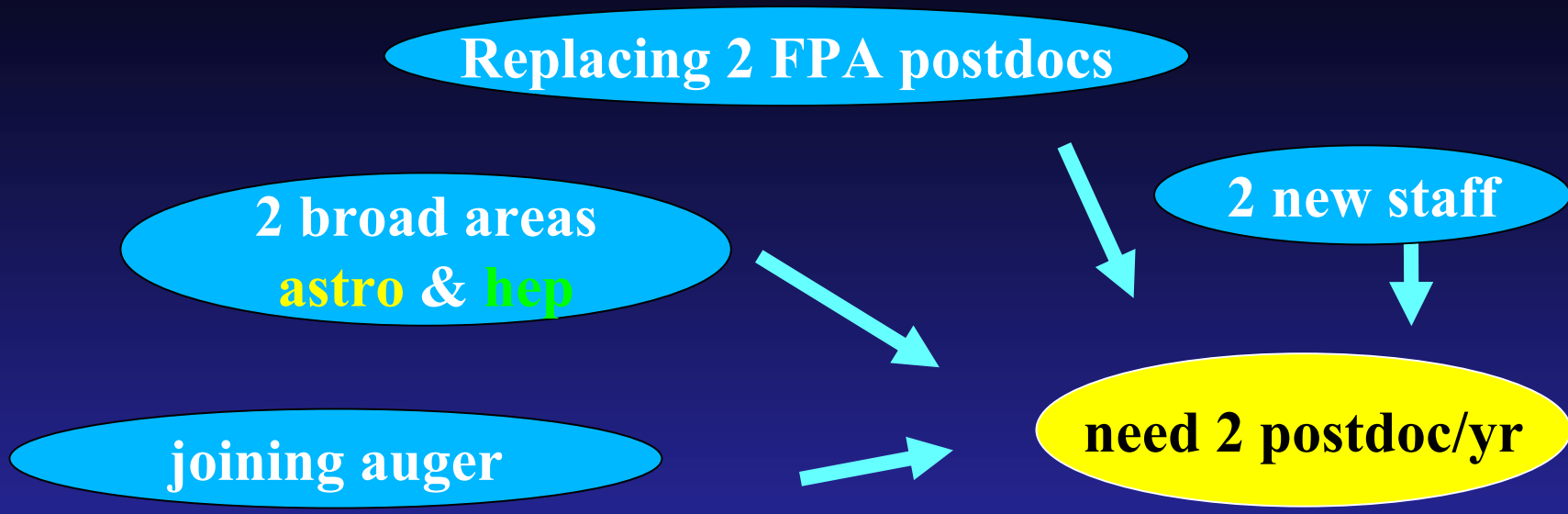
Correlation of the highest energy cosmic rays with nearby AGNs

Pastor et al

Science 318 (2007) 938-943
Astropart.Phys.29 (2008) 188

- funding needs: annual **collaboration** costs, meetings & **shifts in Argentina**
- **PhD student to finish in 2008**: **manpower** needed (student & postdoc)

ahep postdoc needs in next 5-yr period



1 in astro & 1 in hep

though recently EU support has become more difficult for particle physics, we commit to seek for 2 other postdoc/yr from other sources

ahep has hosted 24 postdocs, eg Deppisch, Diaz, Dimopoulos, Fornengo, Hugonie, Kachelriess, Lattanzi, Maltoni, Miranda, Nunokawa, Porod, Paes, Peres, Rashba ... with int. recognition

ahep FPI needs in 5-yr period

1 requested FPI for **astro** and **1 requested FPI** for **hep** research

One of the existing PhD students to be replaced is from auger

Note that all our staff members are directly engaged in the UV master program as well as training activities of isapp (we were the first Spanish members of isapp) & we are the only current Spanish idapp member

Partial list of the PhD THESES we have (co)directed since yr 2000, partly in the context of the EU training site ahep has run in 2000-04:

Aristizábal (Frascati), **Deppisch** (Manchester), **Ferrandis** (US), **Holanda** (Campinas), **Huber** (Virginia), **Kernreiter** (Lisbon), **Kittel** (Bonn), **Moura** (Naples), **Peña-Garay** (IFIC), **Restrepo** (Antioquia), **Schwetz** (CERN), **Tortola** (Lisbon/Bonn), **Tomàs** (Bonn), **Villanova** (Lisbon), etc

other ahep funding needs

To strengthen **astro** research lines, supporting the collaboration with Brazil, Italy, Japan, Mexico, Germany, Russia & US and the participation in the **Auger** experiment in Argentina

To match experimental progress expected **LHC** we need to support **hep** research & participation in WGs, eg at **CERN**

To further strengthen the collaboration with **Latin America**, in both areas, including Argentina, Brazil, Chile, Colombia & Mexico.

ahep has excellent track record in training LA PhD students & postdocs, many of which are now settled staff. Our contacts are partly kept through the EU project **Helen** subscribed by IFIC

To strengthen group's international profile by promoting organization of **confs, schools & outreach activities**

Summary of requested 5-year budget

GENERAL CONCEPT		DETAILS
PERSONNEL	Euros	Euros
one 3-year postdoc contract for research lines 1, 2 & 5 (astro)	120.000	3x40.000
one 2-year postdoc contract for research lines 1, 2 & 5 (astro)	80.000	2x40.000
one 3-year postdoc contract for research lines 3 & 4 (hep)	120.000	3x40.000
one 2-year postdoc contract for research lines 3 & 4 (hep)	80.000	2x40.000
salary complement	70.000	5x14.000
TOTAL PERSONNEL	470.000	
EXECUTION COSTS		
TRAVEL, PERDIEM & Conf. Fees 13 EDP + 16 external members	200.000	5x40.000
small equipment, biblio, AUGER quota, consumables & others	110.000	5x22.000
TOTAL EXECUTION	310.000	
TOTAL DIRECT COSTS	780.000	

Based on our global 15 yr track record and especially on the last 5 yr

5/20 predocs

6/24 postdocs

7/28 sabbaticals

AHEP 2003-2007

10 confs org.

5/18 PhD thesis

102 pubs

3104 citations

80 inv. talks

WE COMMIT TO PUBLISH AT LEAST 100 PAPERS IN THE ISI OVER THE 5-YR PERIOD