Summary of Neutrino-UHECR working group

M. Masip, G. Ros, J.D. Zornoza

Alcalá de Henares, November 8th 2013

New publications

G. Ros, A. D. Supanitsky, G. A. Medina-Tanco, L. del Peral, M. D. Rodriguez-Frias. *"Improving photon-hadron discrimination based on cosmic ray surface detector data".* **Astrop. Phys.** 47 (2013) 10-17

Jem-EUSO Collaboration. *“An evaluation of the exposure in nadir observation of the JEM-EUSO mission".* **Astrop. Phys.** 44 (2013) 76

First Results on Dark Matter annihilation in the Sun using the ANTARES neutrino telescope, S. Adrián-Martínez et. Al, ANTARES collaboration, accepted for **JCAP**

Contamination of dark matter experiments from atmospheric dipoles”, A. Bueno et al., **Phys. Rev. D** 88, 073010, (2013)

Conferences/Proceedings

Héctor Prieto et al. "Multi-Anode Photomultiplier Tube reliability analysis and radiation hardness assurance for the JEM-EUSO Space mission" . **33th ICRC**, July, 2013

"Simulations of extensive air showers produced by UHECRs in cloudy sky to be detected by JEM-EUSO" Guadalupe Sáez-Cano et al. **33th ICRC**, July, 2013

"Towards the Preliminary Design Review of the Infrared Camera of the JEM-EUSO Space Mission." M.D.Rodríguez-Frías et al. **33th ICRC**, July, 2013

"An End to End Simulation code for the IR-Camera of the JEM-EUSO SpaceObservatory" Jose A. Morales de los Ríos et al. **33th ICRC**, July, 2013

“Cosmic Rays from Heavy Dark Matter from the Galactic Center”, J.A.R. Cembranos, V. Gammaldi, A.L. Maroto, Proc. of EPS-HEP2013, Stockholm, July 2013, arxiv: 1310.8230

Conferences/Proceedings

”Results and prospects of deep under-ground, under-water and under-ice experiments”, J.D. Zornoza, Proc. of **RICAP 2013** (to be published in **NIM A**), May 2013, Rome

“Results and prospects of dark matter searches with ANTARES”, J.D. Zornoza, Proc. of **RICAP 2013** (to be published in **NIM A**), May 2013, Rome.

“The KM3NeT Neutrino Telescope: Status and Prospects”, J. J. Hernández, Proc. of **RICAP 2013** (to be published in **NIM A**), May 2013, Rome

” Indirect search for dark matter with the ANTARES neutrino telescope”, J.J. Hernández, **33th ICRC**, July 2013, Rio

“A sterile neutrino at MiniBoone and IceCube”, II Russian-Spanish Congress on Particle and Nuclear Physics at all scales and Cosmology, October 2013, Saint Petersburg

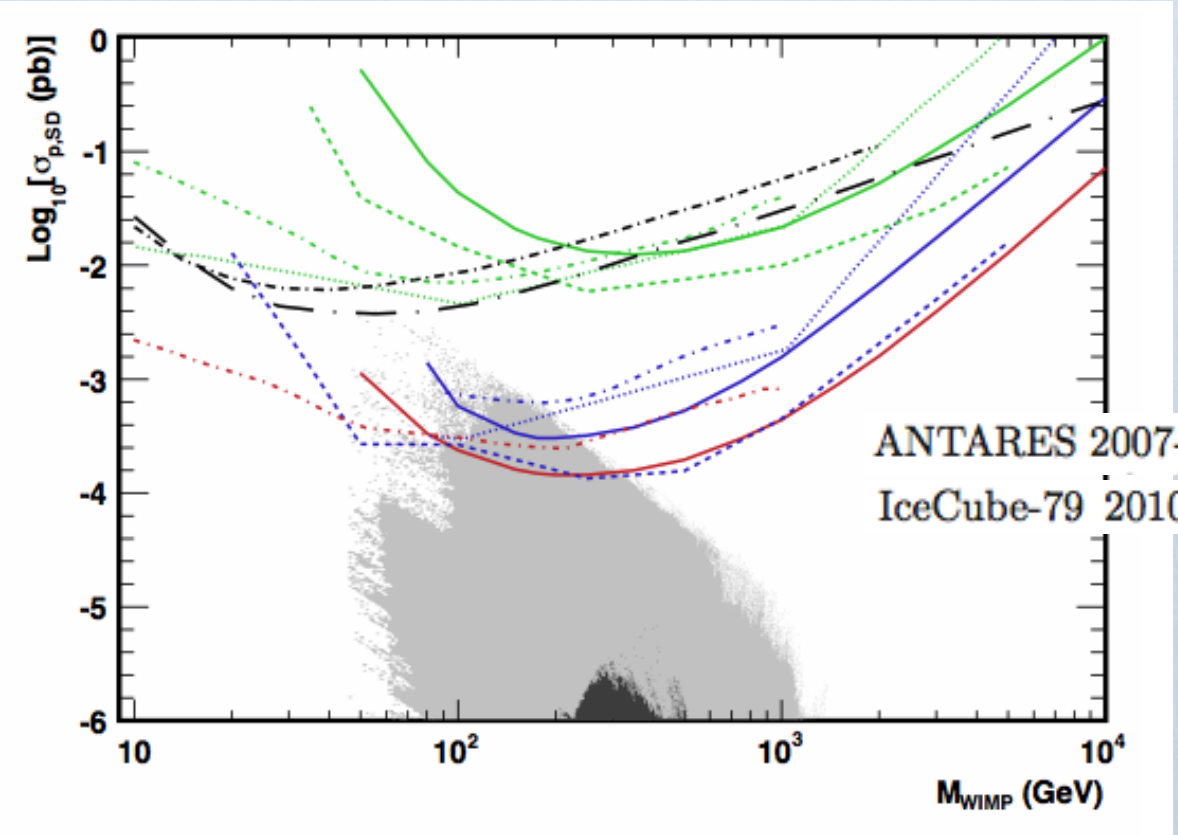
Accepted for JCAP

Prepared for submission to JCAP

First Results on Dark Matter Annihilation in the Sun using the ANTARES Neutrino Telescope

S. Adrián-Martínez[a] I. Al Samarai[b] A. Albert[c] M. André[d] M. Anghinolfi[e] G. Anton[f] L. Anton[f] S. Anvar[g] M. Ardid[a] T. Astraatmadja[h,1] J-J. Aubert[b] B. Baret[i] S. Basa[j] V. Bertin[b] S. Biagi[k,l] C. Bigongiari[m] C. Bogazzi[h] B. Bouhou[i] M.C. Bouwhuis[h] J. Brunner[b] J. Busto[b] A. Capone[n,o] C. Cârloganu[p] J. Carr[b] S. Cecchini[k] Z. Charif[b] Ph. Charvis[q] T. Chiarusi[k] M. Circella[r] F. Classen[f] R. Coniglione[s] L. Core[b] H. Costantini[b] P. Coyle[b] A. Creusot[i] C. Curtil[b] G. De Bonis[n,o] M.P. Decowski[h] I. Dekeyser[t] A. Deschamps[q] C. Distefano[s] C. Donzaud[i,u] D. Dornic[b] Q. Dorosti[v] D. Drouhin[c] A. Dumas[p] T. Eberl[f] U. Emanuele[m] A. Enzenhöfer[f]

2007-2008 ANTARES results



With only 2007-2008 data, already competitive with IceCube-79:

- Better angular resolution
- Better visibility of the Sun
- Energy threshold

Program

“Prospective neutrino flux from annihilating Dark Matter in the J1745-290 Galactic Center region”, Viviana Gammaldi

“ANTARES 2007-2012 latest limits for the Galactic Center: an argument against a leptophilic dark matter interpretation of the electron/positron excesses after FERMI”, G. Lambard

“Unbinned searches for DM in the Sun and the GC with ANTARES”, C. Toennis

“Testing secluded dark matter with ANTARES”, M. Ardid

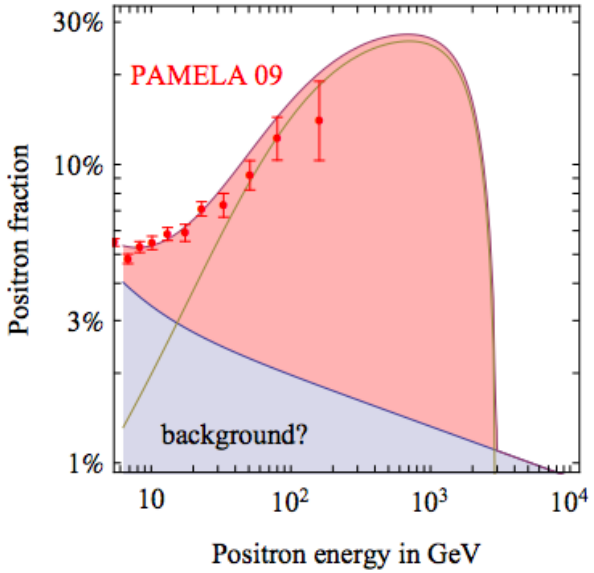
“The Search for Super-Heavy Dark Matter from Ultra-high and Extremely-high energy cosmic rays”, G. Ros

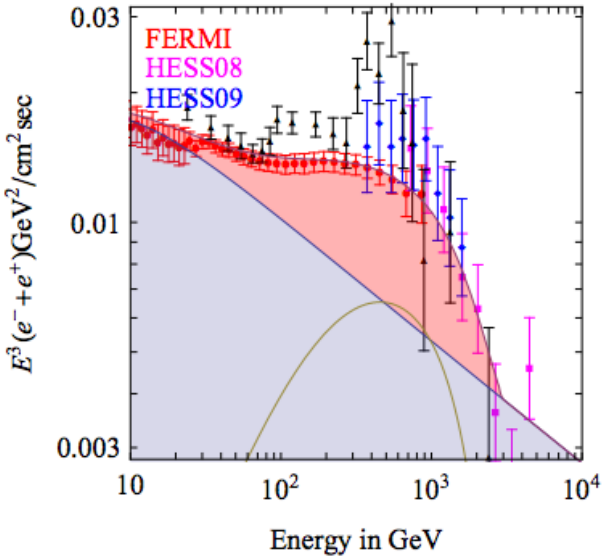
“A search of Dark Matter with the JEM-EUSO Space Mission: Space based Nuclearites detection”, M.D. Rodríguez-Frías

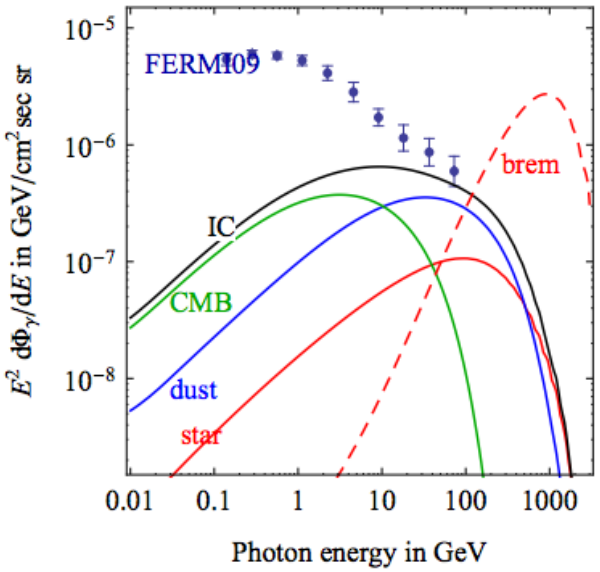
IFIC: constrains on leptophilic models

- Several trials to interpret PAMELA/FERMI/HESS results in terms of dark matter:
  - P. Meade, M. Papucci, A. Strumia, T. Volansky, Dark Matter Interpretations of the e^-/e^+ Excesses after FERMI, arXiv: 0905.0480
- These models also predicts neutrino fluxes that can be tested with neutrino telescopes
- Guillaume will present the constrains of the 2007-2012 data analysis on the GC on these interpretations

DM with $M = 3.$ TeV that annihilates into $\tau^+\tau^-$ with $\sigma v = 1.8 \times 10^{-22}$ cm^3/s







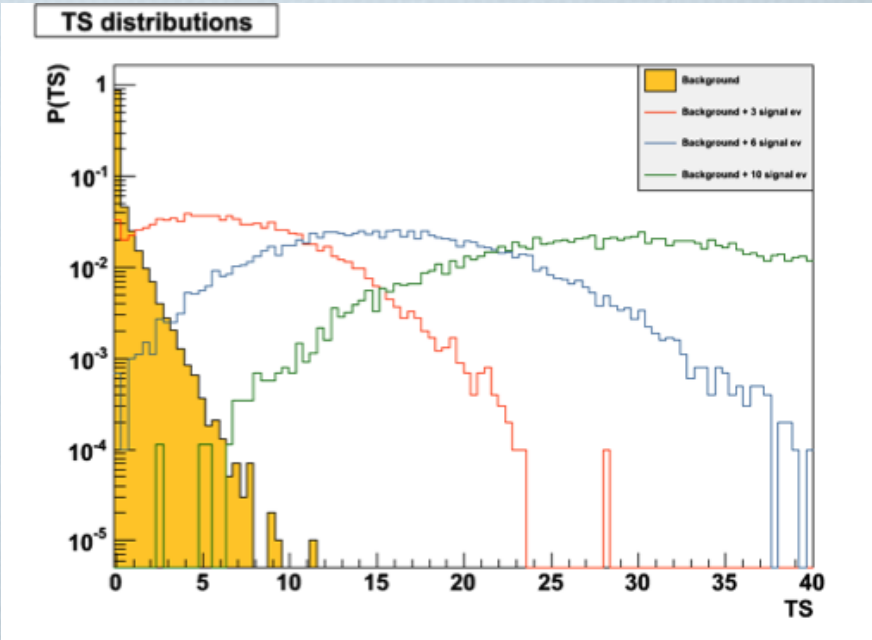
IFIC: unbinned searches with ANTARES

- Analysis strategy (both for Sun and GC) will be improved with unbinned searches (see Christoph's presentation)

$$\log(L) = \log\left(\prod_i P_i\right) = \sum_i \log\left(\frac{n_s}{N} S_i + \left(1 - \frac{n_s}{N}\right) B_i\right)$$

$$TS = \log\left[L^{max}\right] - \log\left[L(n_s = 0)\right]$$

Expected improvement: 30-40% with respect to binned searches



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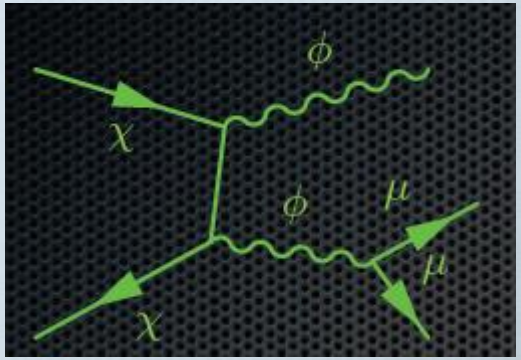
Search for Secluded Dark Matter (SDM) in neutrino telescopes

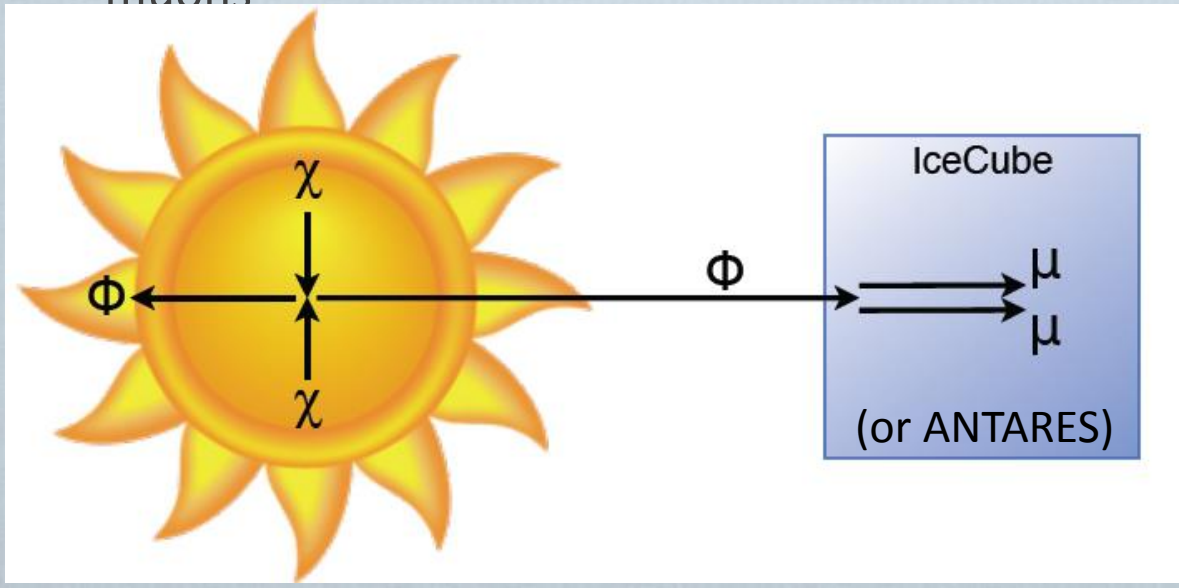
- Leptophilic DM due to interaction with the SM through the kinetic mixing portal
- 'Typical' mediator boosted due to DM mass being greater than mediator mass
- Lifetime of mediator could be long, could decay in the vicinity of the Earth as two co-linear muons



'Typical'

$\chi \sim 1\text{TeV}$

$\phi \sim 1\text{GeV}$



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Search for SDM in neutrino telescopes IceCube vs. ANTARES strategy

- IceCube

  Big detector with deep core.

  Try to distinguish di-muons from single muons looking at energy deposition topology and contained events.

- ANTARES

  Better orientation of the detector, i.e., lower influence of atmospheric neutrinos.

  Optimise selection cuts for di-muons without worrying about muon contamination in the Sun Direction

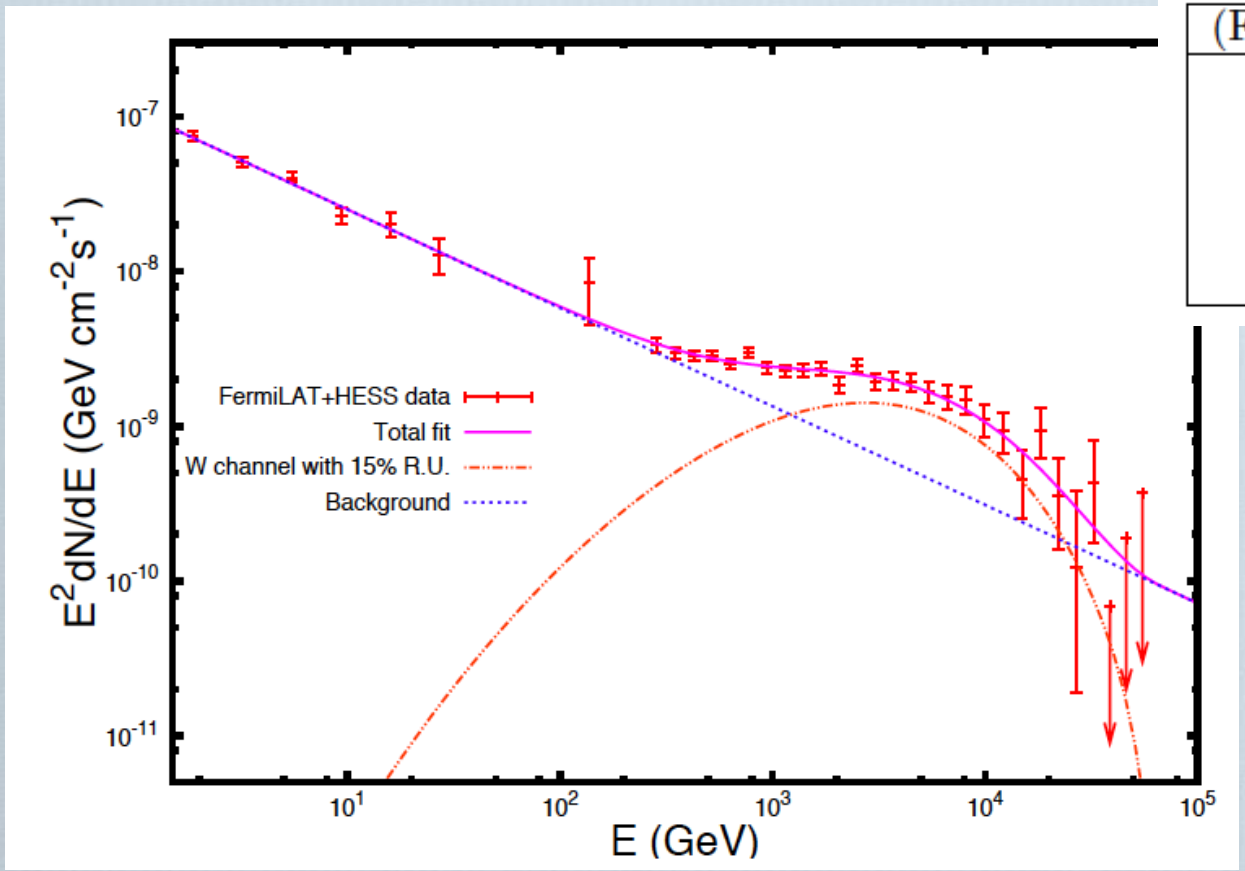
ANTARES status: Montecarlo tools for di-muons produced , first estimation of the sensitivity . Defining the final strategy of the analysis (more information in the talk)

MultiDark
Multimessenger Approach for Dark Matter Detection

Prospective neutrino flux for annihilating Dark Matter in the Galactic Center region

J. A. R. Cembranos, V. Gammaldi, A. L. Maroto

Previous analyses of H.E.S.S. J1745-290 gamma-ray source from the Galactic Center (compatible with Fermi-LAT)



(Fermi-LAT Data)	W^+W^-
M	51.7 ± 5.2
A	4.44 ± 0.34
B	3.29 ± 1.03
Γ	2.63 ± 0.02
χ^2/dof	0.75

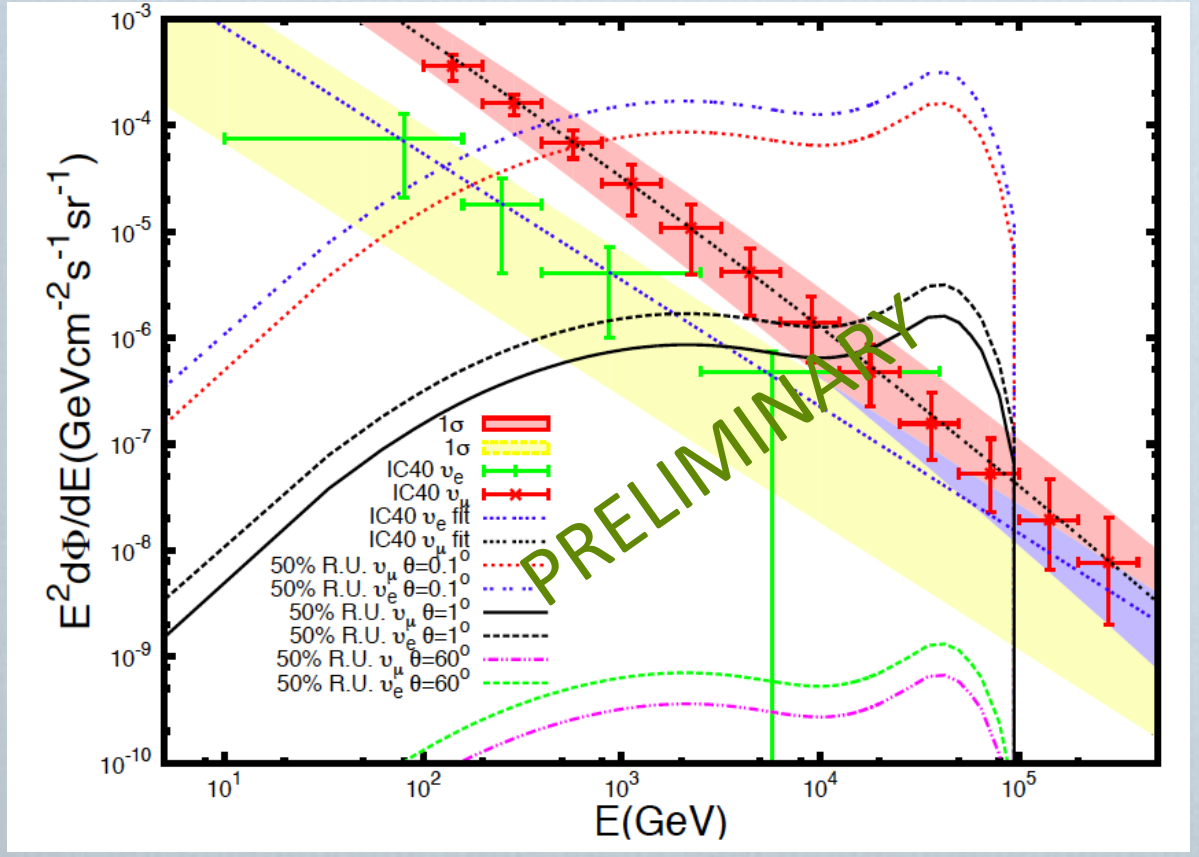
What is the expected neutrino flux?

J. A. R Cembranos, V.G., A.L.Maroto arXiv [1204.0655v1], Phys.Rev.D86,103506(2012), arXiv[1302.6871], JCAP 1304 (2013) 051

For a given annihilation channel, since the DM mass, cross section and dark halo properties are fixed by the previous fit, the neutrino signal is completely determined.

Prospects for detection up the background depends on the detector Effective Area and Resolution Angle.

W^+W^- channel



1σ
1σ
IC40 υ_e
IC40 υ_μ
IC40 υ_e fit
IC40 υ_μ fit
50% R.U. υ_μ θ=0.1°
50% R.U. υ_e θ=0.1°
50% R.U. υ_μ θ=60°
50% R.U. υ_e θ=60°

SPace & AStroparticle Group
Universidad de Alcalá

See talks in the Neutrinos & High-energy cosmic rays WG session by:

- M. D. Rodríguez-Frías
  "Searches of nuclearities dark matter with the JEM-EUSO Space mission"

- Germán Ros
  "The dark side of ultra-high and extremely-high energy cosmic rays"

University of Granada

- The Granada group has studied the possibility of an atmospheric origin for the signals observed at some dark matter experiments. In particular, they have found under what conditions a sterile neutrino produced in a fraction of muon decays could produce the signals at DAMA/LIBRA, CoGeNT and CDMS/Si consistently with the bounds from CDMS/Ge and XENON100.

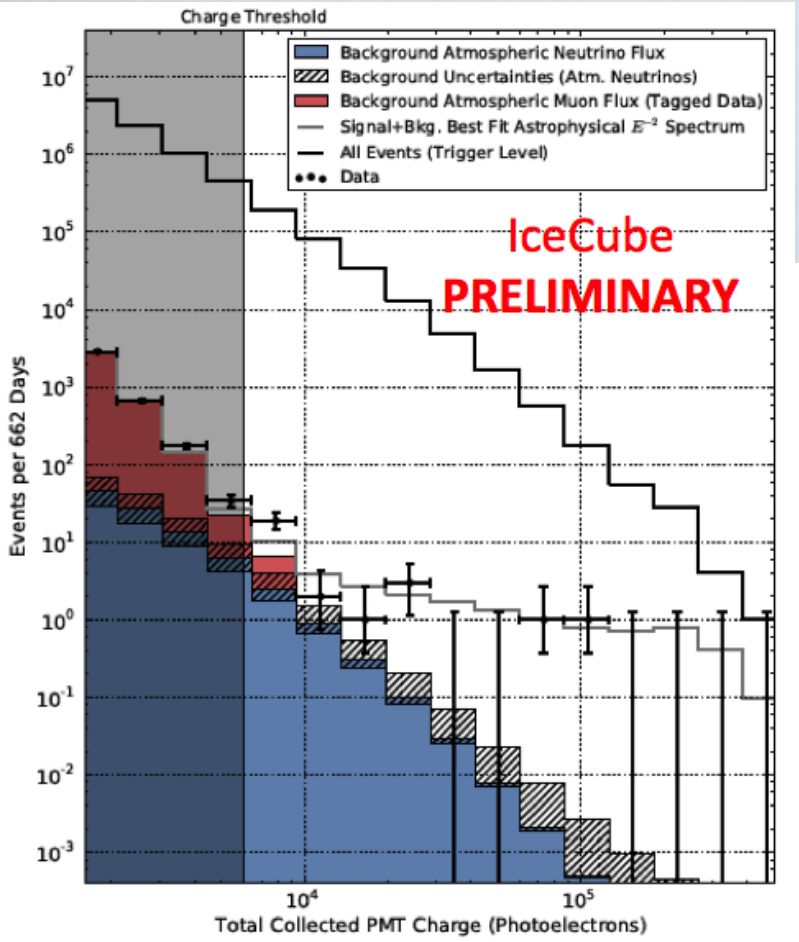
  The results have just been published in PRD

Other news

- C. Toennis started doctorate on dark matter at IFIC_exp group thanks to a Grisolia program grant
- Regular phonecalls UV-UPV MultiDark groups
- Joint IceCube-ANTARES Meeting (MANTS 2013) with specific discussion group on status of dark matter analyses
- Foreseen: IceCube-ANTARES-DM theoreticians to be held in Valencia in early next year

Other news

- A bit off-topic, but worth mentioning: IceCube evidence for high-energy cosmic neutrinos!



28 events found

Total background: $12.1^{+4.5}_{-3.9}$

Joint significance: 4.3 σ