Neutrino (new secret) Astronomy #85

Daniele ***Fargion*** [(1)], *Pier Giorgio* ***De Sanctis Lucentini*** [(2)], *M.Yu.* ***Khlopov*** [(3)]

[(1)] *Rome University "La Sapienza" and* MIFP, *Rome, Italy.*

[(2)] *National University of Oil and Gas «Gubkin University», Moscow, Russia.*

[(3)] *National Research Nuclear University "MEPHI", Moscow, and Institute of Physics, Southern Federal University, Rostov on Don, Russia.*

Astronomy or Atmospheric?

Since 2013 IceCube discovered a sudden flavour change in the events above the energy of 30 TeV.
On 2017 a rare but unique high-energy-muon-track seemed to correlate toward an AGN.
However, a long list of puzzles and missing signals made most of us questioning: **did IceCube events discovered any Neutrino Astronomy or mostly a new Atmospheric noise?**

A charmed neutrino dominance

The Atmospheric prompt charmed neutrino dominance in IceCube data was first considered in *"A charming ICECUBE discover?"* - D,Fargion, et all [5]: https://pos.sissa.it/331/007/pdf

Lack of correlation

IceCube UHE signals are quite smeared events **uncorrelated** to most of the main gamma, X, radio sources. They are, moreover, in disagreement with TeVs-PeVs gamma sources in Hawc and LHAASO.

IceCube events do not show any **galactic plane signature**. Only Cosmic Rays do show such a smeared maps.

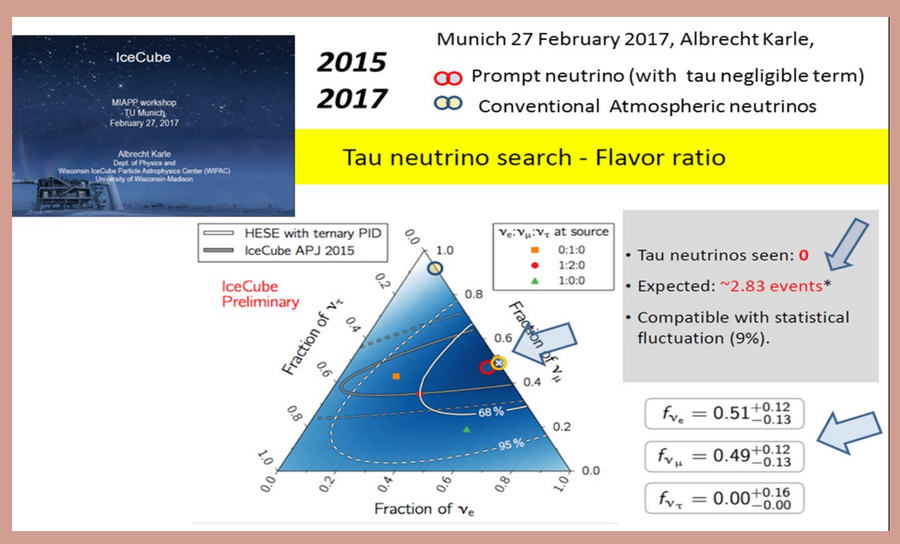
The Neutrino Flavor imprint

Considering the above lack of correlations, are IceCube events therefore just **atmospheric**?

We believe that this is the case for a longer list of arguments, see ref [5]. Indeed, among the other, the neutrinos **flavor signature**, their ratio and abundances (nu-e: nu-mu: nu-tau), are quite different for the Astrophysical (1:1:1) and for the **Charmed Atmospheric** case **(1:1:0)**.

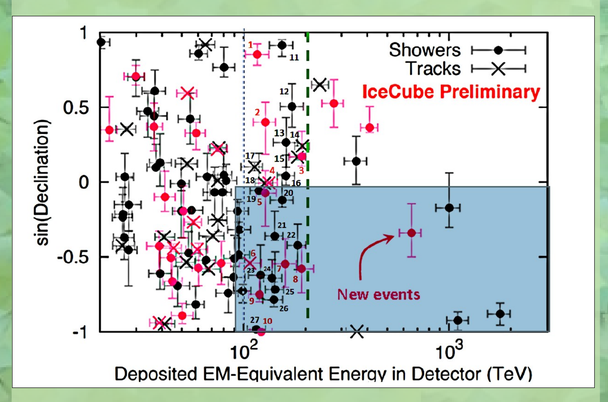
These flavors may be plotted in a unitary triangle flavor map. On early 2015-2017 IceCube itself discovered their main signature (1:1:0) as for the charmed atmospheric ones (see the figure below); back then the **Tau flavor was missing**.

The Tau presence had been expected as the key proof of Astronomy as well as was expected at horizon, by giant tau airshower. As in Jem-EUSO, Poemma, AUGER, GRAND, [see ref 1-3,4].

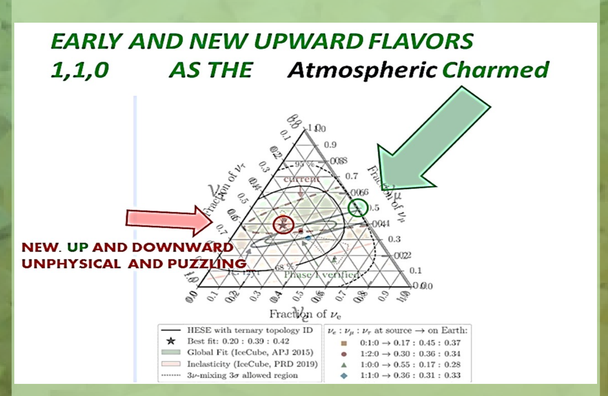


HESE upward and downward events

The high energy starting events, HESE, above hundred TeVs are well consistent with such charmed signature (1:1:0) for all upward signals. In the figure below see the sin-declination range 0-1.



HESE downward signals are ruled by almost all cascades events and had showing a dramatical changes as in later, recent flavour-puzzling figure. This occurred also because a very questionable 2 rare tau signals claimed by IceCube.



Why there is a such a large cascade-track upward-downward asymmetry in first figure?

Even most recent IceCube HESE article shows such down-ward overabundance of by cascades (17) with respect to the unique (1) muon track (see arrow below).

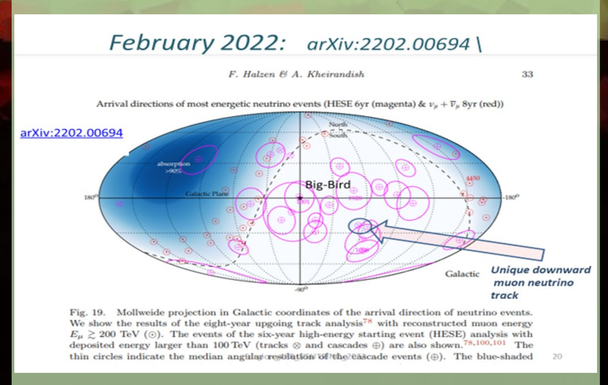


Fig. 19. Mollweide projection in Galactic coordinates of the arrival direction of neutrino events. We show the results of the eight-year upgoing track analysis[78] with reconstructed muon energy $E_\mu \gtrsim 200$ TeV (⊙). The events of the six-year high-energy starting event (HESE) analysis with deposited energy larger than 100 TeV (tracks ⊗ and cascades ⊕) are also shown.[78,100,101] The thin circles indicate the median angular resolution of the cascade events (⊕). The blue-shaded

For the upward HESE events the ratio cascades-tracks is 5 to 3, as in the charmed case.

Considering the downward events instead, being the cascades 3.6 times more abundant, one would expect more than 10 downward tracks instead of the single observed one: a very unprobable rate(<1%).

Daniele Fargion thanks the Professor P.De Bernardis for support on present research activity.

The downward Muon absence

There is a long list of absences in present IceCube "Neutrino Astronomy":

- GRBs candidates sources
- brightest AGN gamma flare, such as June 2015 from 3C 279,
- lack of HESE track self clustering and, finally
- nearly zero tau traces.

However, **the Muon Downward absence** is the most eye-catching one: Neutrino Astronomy cannot explain it.

On the other hand, the **Atmospheric Charmed Astronomy may explain it**, via the following veto role: any charmed meson decay leads to both neutrinos and their charged leptons. For the electron flavor, their sudden interaction in the high atmosphere causes to lose direction and trace.

In IceCube, even atmospheric HESE electron Neutrino may arise.

The muon downward presence and its sharp directionality cannot be hidden.

At Ten TeVs the neutrino-muon angular splitting is large: sometime the muon hit outside the IceCube, allowing a few HESE muon to arise.

But above hundreds TeV energy muon and their neutrino angles are nearly parallel and overlapping. The muon veto hide therefore its companion appearance, explaining its (almost) absence.

Conclusions

The simplest and obvious conclusion is that, as the upward HESE signals teach us, IceCube found the atmospheric charm noises expected at the same energies.

However, the rarest and most unique downward muon may be a very first, weak, signal of a new real Neutrino Astronomy, till now unnoticed or secret.

References

[1] "Discovering ultra-high-energy neutrinos..." - D.Fargion ApJ 570, 909 (2002)

[2] "Tau Air Showers from Earth" - D. Fargion, P.G. De Sanctis Lucentini, M. De Santis, and M. Grossi. ApJ. Vol 613, 1285,(2004)

[3] "Signals of HE atmospheric..." D. Fargion et all.; International Journal of Modern Physics D, Vol. 27, No. 06, 1841002 (2018)

[4] "Neutrino signals by Upward Tau airshowering..." D. Fargion et al. Pos.Sissa.it/395/1208

[5] "A charming ICECUBE discover?" D. Fargion et all. PoS(FRAPWS2018)007

daniele.fargion@fondazione.uniroma1.it