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GRB221009A and the absence of the IceCube neutrino: evidence of a prompt charm signal?

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IceCube, the kilometer cube neutrino detector in South Pole, had been recording neutrinos in TeVs-PeVs energy range, since more than a decade. The upgoing TeVs-energy muon neutrinos are well tuned to the expected secondary conventional atmospheric cosmic rays (pions, kaons). These upward TeVs events are governed by muon-neutrino tracks. Their rare cascades from the neutral current or from the very rare atmospheric electron neutrino are well known. However, at the highest energies above fifty TeV, as noted ten years ago, neutrinos cascading at hundreds of TeV-PeV energies outnumbered muon-track neutrinos. This revolution in the flavor ratio of the events has led most authors to claim the rise of an astrophysical neutrino signature. A more recent (2017) track-AGN correlation of the high-energy muon neutrino appears to confirm an astrophysical signature of the neutrino. However, the absence or paucity of tau double bang events, the flavor asymmetry of upward and downward signals, the absence of the highest gamma event with a neutrino companion, led us to suggest an atmospheric prompt nature of most IceCube records. The recent brightest gamma burst GRB221009A and its absence in IceCube, offer further arguments to a such atmospheric charmed model.

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1. Introduction

The recent GRB on October 9, 2022 is the brightest (up to 0.003 erg cm-2 in X-gamma sky) and most energetic hard gamma-ray signal (up to 7 TeV) ever recorded on Earth. The hardness above TeV and the observation of over 60.000 gamma on the LHAASO square kilometer detector [1], naturally offered an ideal opportunity to finally discover a correlated neutrino signal. However, such a very rare LHAASO gamma signals were not observed by IceCube[2]. This can be due to the reduced ($10^{-6} - 10^{-5}$) neutrino cross section compared to the photon ones, or to the main electromagnetic origin of the GRB. In general, the nonappearance of GRBs in all IceCube data from the last decade is already known. A bound on GRB-neutrino correlation had been founded. But the extreme intensity of GRB221009A, and its absence, is still surprising.

The absence of neutrinos also occurred for similar (failed) searches in IceCube on 2009 for such a brightest blazar flare [3] from 3C 454.3: it was the brightest ever recorded gamma-ray blazar flare, twice as bright as Vela: it was not revealed in the South Pole neutrino detectors.

An additional comparable largest AGN gamma flare [4], took place for three days long, a hundred GeV gamma blazing rain from most powerful AGN, 3C279, on 11-17 June 2015. It was also unnoticed in any form by IceCube. Therefore we are foreced to inquire the real nature of IceCube data.

2. Is there any real IceCube neutrino astronomy?

On early 2013 a first argument in favor for ICECUBE neutrino astronomy was the change in > 30 TeVs energy flavor composition. Up to few TeV energy, atmospheric muon track are dominated by Pion-Kaon decay with an expected and observed flavore ratio:$(\nu_e, \nu_\mu, \nu_\tau)$ = (0.05,0.95,0.00); Above a few tens of TeV, IceCube cascade become comparable or more abundant than the muon tracks [5]. This change was hopefully pointing to the presence of a possible astrophysical ratio : a cosmic "democratic" and mixed one, (1/3,1/3,1/3). But such a flavor change could also be mimicked by an atmospheric charmed component signature: $(\nu_e, \nu_\mu, \nu_\tau)$ = (0.5,0.5,0.0), a signature in part well observed in early 2015-2018 flavor triangle by IceCube [6]. Such a ratio is still present even in the most recent upward neutrino signals.

More recent, 2019-2022, IceCube papers proposed new results and an interpretation in contrast to the past one. The discussion and interpretation of these radical changes is beyond the scope of the present work.

The most compelling argument in favor of ICECUBE astronomy was a delayed (few months apart) correlation of an AGN gamma flare (2017) with a single muon track event of hundreds of TeV. An additional, different claim of a neutrino astronomy was the recent due to a clustering of events, around NGC 1068, at the lower TeV energy. Finally a very recent article claimed an association (by tracks and cascades) at tens-hundred of TeV energy events with a wide galactic halo. We do not discuss these persistent new attempts to validate an IceCube neutrino Astronomy.

3. Missing Multiplets and Taus

However, the list of missing evidence in IceCube neutrino astronomy is quite long and severe: the absence of any hard (> tens TeV) neutrino track multiplets (doublet, trplet), negligible Tau

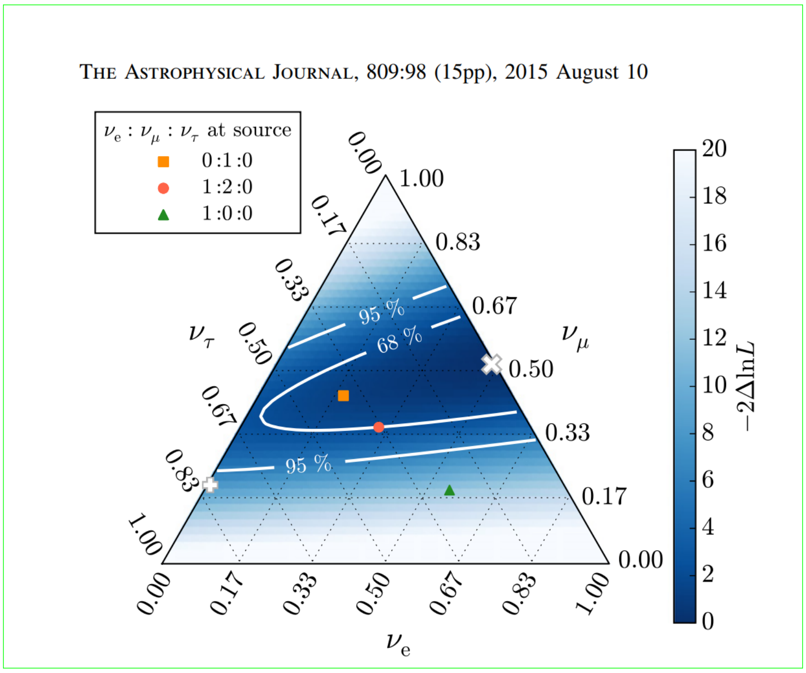

Figure 1: The neutrino flavor triangle , published by IceCube on 2015, on ApJ; the same result had been hold up to 2018. The signature in this triangle has a well defined flavor ratio: $(\nu_e, \nu_\mu, \nu_\tau) = (0.5, 0.5, 0.0)$, exactly as for atmospheric charmed nature.

neutrino traces [7] even after a dozen years of data acquisition, the recalled absence of the brightest AGN gamma flare in ICECUBE observations, the missing of the largest hardest LHAASO TeV signals in GRB221009a, even by any filtered (upward) muon tracks or time correlated cascade, the absence of any X-Radio-gamma trace after any brightest “golden”, or bright “silver” or ” bronze” IceCube allert tracks in last decade (nearly two hundred events), the absence of any thin sharp galactic plane as observed at GeV-TeV gamma sky, by Hawc, over the last decade as well as by last LHAASO maps.

4. Conclusions

Any hadronic TeV gamma photon suffers, during its flight to us, the self-photon opacity by the source or by the cosmic infrared scattering. On the contrary tens of TeV neutrinos are nearly transparent in flight even flying through the Earth. This neutrino overabundance may compensate for their low cross-section, respect to photons in LHAASO, in IceCube?

We underline here that ten TeVs neutrino signals, if hadronic in nature, might be much more abundant than the ten TeV gamma (severely bounded by cosmic Infrared radiations). Their overabundance (respect TeVs gamma) might even compensate their lower cross-section, leading to at least, a few event neutrino, correlated with the huge exeptional GRB221009A gamma burst. Their absence requires a GRB221009A gamma source up to tens of TeVs, mostly of electromagnetic origin, as the ones made by ICS at Klein Nishina boundaries, with a peaked spectra at their edges able to overcome the same IR opacity. This possibility is quite surprising, but possible.[8, 9] It may occur if PeV electrons scatter on IR photons.

Another possibility is based on a precessing gamma jet model where a thin, but wide, conical lepton structure contains in its interior,an inner hadronic jet: it can favour the external gamma ejection in the outer cone, while the hadronic inner cone-jet will be mostly inside its wider lepton one, pointing often elsewhere. Therefore a gamma (leptonic one) jet blazing unrelated to the hadron one associated, but in general off-axis with the neutrino signal. [10].

Or, simply, the non-detection of GRB221009A is related to a low capability of ICECUBE in its threshold detection. If so, what could be the origin of all the observed overabundant cascades at tens TeV-PeV energies in IceCube?

The answer should be [11]: an atmospheric charmed noise that explains at once the cascade overabundance, the absence of multiplets, the main neutrino spread homogeneity (as CR) and the missing astrophysical tau trails, the absence of any gamma signals within a loud atmospheric charmed noise . Any real neutrino astronomy must be still hidden under these noises. The test of this charm model will be given by the exact tau counting in larger ICECUBE data, the exact upward-downward muon track statistics versus cascade ones. Upper ones, with no downward noises, could offer the ideal test for track-cascade statistics. A better signature of any neutrino Astronomy will rise, [12, 13] by the discovery of tau airshowers (often called,erroneusly, skimming neutrinos) in present AUGER and TA array (on the ground) or in future balloons such as Jem Euso in space or future POEMMA satellites experiment. Our ideal detector might be on a top mountain stations (like Etna one), constructed by kilometer, LHAASO like, wide rings array, in a crown-like structure, able to reveal tau airshowers by their Cherenkov, X-gamma and radio flash while airshowering from the Earth horizons or below the same terrestrial edges.

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