GNN Monthly
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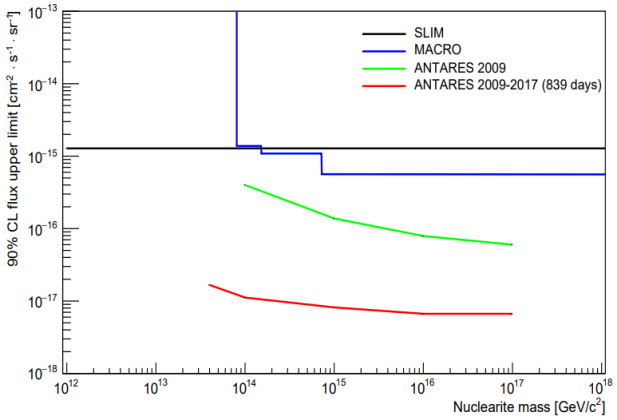
This will a "summer emergency edition": no essential news from the collaborations. There is one paper posted by the IceCube Collaboration and another one from the ANTARES collaboration. Moreover, Yu. Kovalev, A. Plavin, and S. Troitsky have posted a paper on possible correlations of IceCube high-energy neutrino tracks events with the galactic plane. Due to time constraints I will only very shortly present the three papers. I am glad to have the permission of IceCube winterovers to include some of their wonderful aurora pictures.

Publications

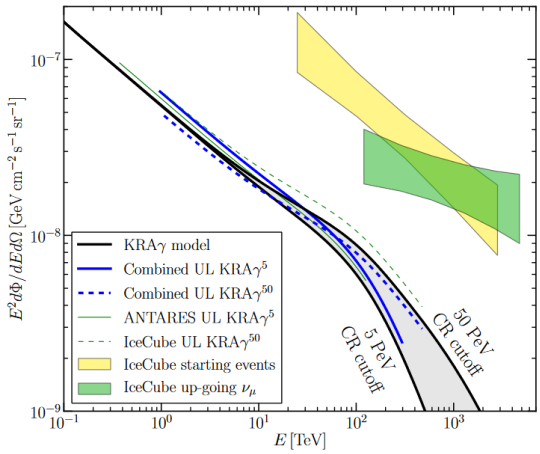
A paper *IceCube search for neutrinos coincident with gravitational wave events from LIGO/Virgo run O3* has been posted at https://arxiv.org/pdf/2208.09532.pdf. First, a low-latency follow-up on the public candidate events released during the third observing run of the two GW detectors and an archival search on the 80 confident events reported in GWTC-2.1 and GWTC-3 catalogs. An extended search was also conducted for neutrino emission on longer timescales from neutron star containing mergers. Also, follow-up searches on the candidate optical counterpart of GW190521 were conducted. The authors used two methods; an unbinned maximum likelihood analysis and a Bayesian analysis using astrophysical priors, both of which were previously used to search for high-energy neutrino emission from gravitational-wave events. No significant neutrino emission was observed by any analysis and upper limits were placed on the time-integrated neutrino flux as well as the total isotropic equivalent energy emitted in high-energy neutrinos. The analysis has been performed by Aswathi Balagopal, Raamis Hussain (both UW Madison) and Doğa Veske (Columbia U. New York).

The ANTARES paper *Limits on the nuclearite flux using the ANTARES neutrino telescope* has been posted on https://arxiv.org/pdf/2208.11689.pdf. Nuclearites are condensates of strange quark matter ("stranglets", "quark nuggets"). The authors used nine years of ANTARES data taken in the period 2009-2017. The passage of nuclearites through matter is simulated taking into account a detailed description of the detector response to these particles and of the data acquisition conditions. A down-going flux of cosmic nuclearites with Galactic velocities ($\beta = 10^{-3}$) was considered for this study. The mass threshold for detecting these particles at the detector level is 4×10^{13} GeV/c^2. Upper limits on the nuclearite flux for masses up to 10^{17} GeV/c^2 at the level of $\sim 5 \times 10^{-17}$ cm^{-2} s^{-1} sr^{-1} are obtained. These are the most stringent ever set for Galactic velocities (see figure). The analysis was performed by Mohammed Bouta from Oujda University (Morocco), and the paper submitted to JCAP.

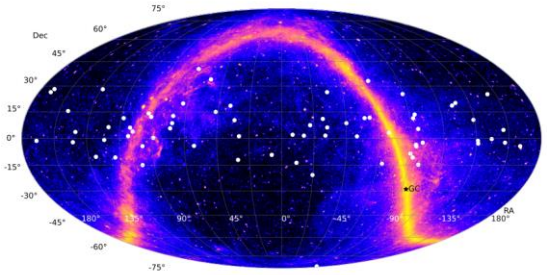


Upper limit on the flux of nuclearites with Galactic velocities ($\beta = 10^{-3}$), red line, using 839 days of ANTARES livetime. The green line corresponds to a previous ANTARES result obtained with a smaller data sample. Also shown are results from the experiments MACRO and SLIM.

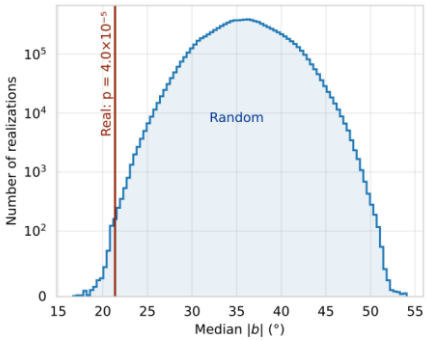
The paper *Galactic contribution to the high-energy neutrino flux found in track-like IceCube events* by Yuri Y. Kovalev, Alexander Plavin, and Sergey Troitsky (Moscow) has been posted at [2208.08423.pdf (arxiv.org)](). Cosmic-ray interactions in the Galactic disk guarantee a diffuse neutrino flux. The most popular model for the expected flux is the KRA model, see the joint constraints from ANTARES and IceCube in https://arxiv.org/pdf/1808.03531.pdf and in the figure below.



The authors analyze 70 public track-like IceCube events with estimated neutrino energies above 200 TeV and examine the distribution of arrival directions of these neutrinos in the Galactic latitude b with the help of a simple unbinned, non-parametric test statistics, the median |b| over the sample. This distribution deviates from that implied by the null hypothesis of the neutrino flux isotropy, and is shifted towards lower |b| with the p-value of 4×10^{-5}, corresponding to the statistical significance of 4.1σ.



Arrival directions of the 70 IceCube events, superimposed on the all-sky gamma-ray map (Fermi) in equatorial coordinates. The black star denotes the Galactic center.



Distribution of the median Galactic latitude, $|b|_{med}$, for 10^7 samples simulated under the assumption of the null hypothesis (isotropic neutrino). The orange line indicates the value of $|b|_{med} = 21^\circ$ for the sample of observed events.

The effect is only visible at energies larger 200 TeV while most of the events in the ANTARES/IceCube analyses are below 200 TeV. Assuming a KRA shape, the flux derived from this analysis would overshoot the ANTARES/IceCube limits by more than an order of magnitude and favor a higher cut-off than KRA. Also, the large median latitude of ~20° appears puzzling. At present, the result is scrutinized by IceCube members and cross-checked with different data samples. More on that in the next GNN Monthly.

The sky at the South Pole

For a long time, I haven't sent pictures from the South Pole, where the winterovers not only keep the detectors running with typically 99.9% duty time, but also take nice photographs of the winter sky. Here are some of them.

photo: Dennis Perkins

Aurora with long exposure (Aman Chokshi)

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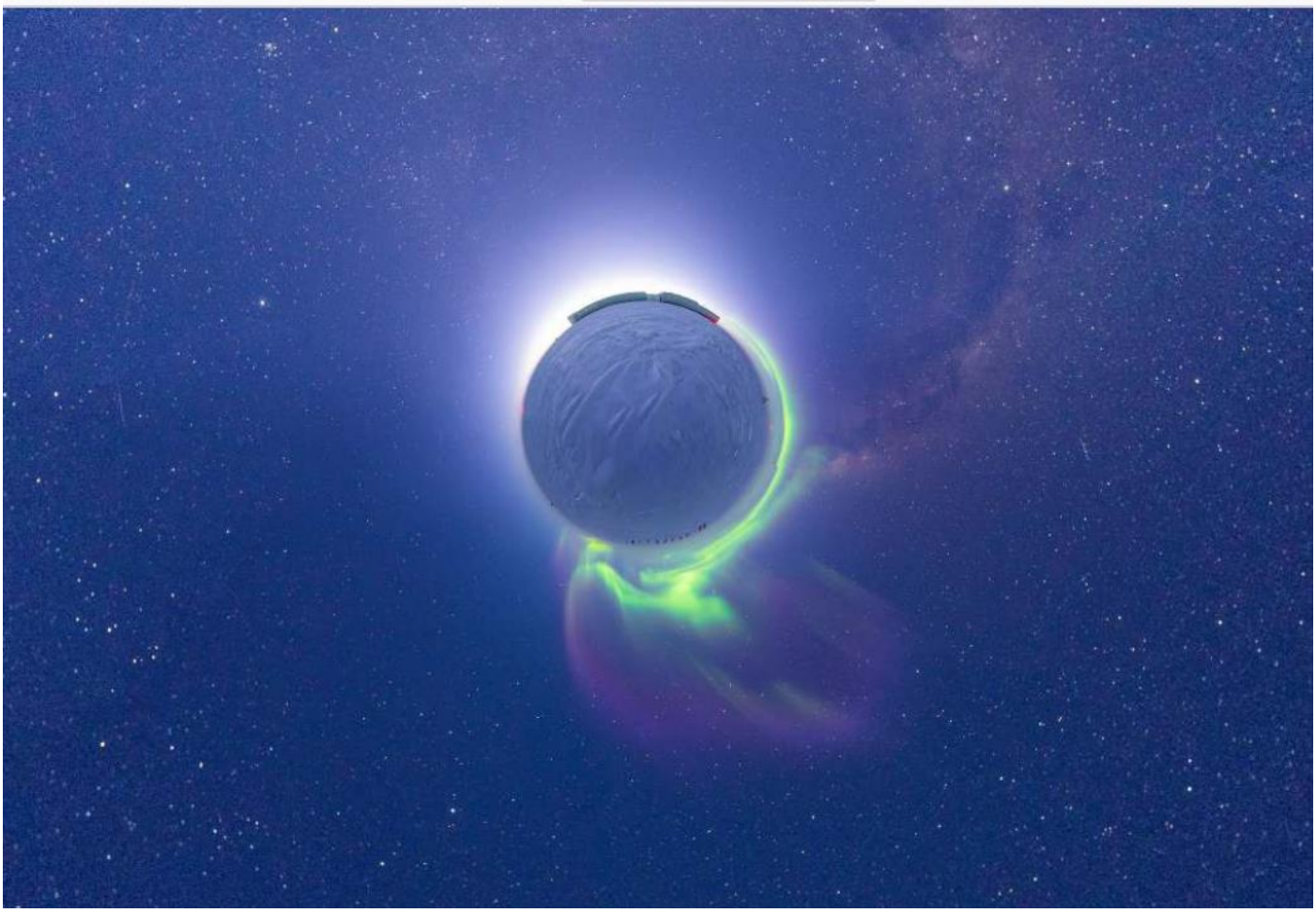
Aurora with a short exposure (Dennis Perkins)

Full moon and cloudy sky over the IceCube Laboratory (Moreno Baricevic)

LIDAR at ARO (Atmospheric Research Observatory) with aurora (Aman Chokshi)

LIDAR at ARO building few hours later, with clear sky and twilight (Aman Chokshi)



360° panorama: South Pole Station and dawn, Ceremonial Pole and aurora (Aman Chokshi)

The photographers:

Moreno Baricevic is one of the two IceCube winterovers.

Aman Chokshi is a winterover for the South Pole Telescope (SPT).

Dennis Perkins is a winterover for the Center for Polar Medical Operations.