GNN Monthly
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VLVνT 2021

The biannual VLVνT Conference (originally planned as face-to-face conference in Valencia for autumn 2020) will now be held from 18 to 21 May 2021 as an on-line meeting. More information under https://indico.ific.uv.es/event/3965.

As usual, the workshop will be a forum where the latest developments in neutrino astronomy are discussed together with the recent progress on the technological and instrumentation aspects of current and future large-scale neutrino detectors in water and ice. The program will include invited talks as well as contributed talks and posters. Abstract submission is now open until February 28th.
Note that VLVνNT will be held in conjunction with the GNN internal MANTS meeting.

Dissertation Prize 2020

The 2020 GNN Dissertation Prize is awarded to René Reimann (University of Mainz, Germany), for his thesis titled "Search for the Sources of the Astrophysical High-Energy Muon-Neutrino Flux with the IceCube Neutrino Observatory". René has graduated at RWTH Aachen under the supervision of Christopher Wiebusch, who has also nominated him.

René's thesis has been selected by the Prize Committee (chaired by Uli Katz) out of six nominations. The high quality of the candidate theses made the choice difficult and required several rounds of assessments by the Committee members.

Congratulations, René!

News from ANTARES and KM3NeT

If you want to learn how DOMs of KM3NeT are assembled, have a look to this nice video on the KM3NeT webpage: https://www.km3net.org/new-video-a-visit-to-the-pimu-hall/. It shows how the DOMs are integrated at Nikhef.

The ANTARES Collaboration has granted the Observer Status to the Lebedev Physical Institute, the Moscow Institute of Physics and Technology, and Moscow Institute of Nuclear Research. Those institutes are hosting the authors of the recent papers on a connection between IceCube data and radio sources A. Plavin, Y. Kovalev, Yu. Kovalev and S. Troitsky (arXiv:2001.00930 and arXiv:2009.08914, see also the Sept./Oct. 2020 edition of GNN Monthly). The Observer status provides access to the ANTARES data.

News from Baikal GVD

The winter expedition comes closer, and in less than three weeks the first group will arrive at Lake Baikal. Due to several reasons, the number of new clusters to be deployed has been reduced from two to one. First of all, COVID-19 has led to some delays, moreover it will require special measures before and during the expedition which may slow down the operations.

Secondly, it is planned to clean up with several problems which have accumulated over the last years and to find appropriate solutions to avoid them for the future. This includes the vulnerability of the detector to lightnings. Last year, for instance, the communication to two clusters broke during the usual summer thunderstorms and lightnings. This problem is going to be cured with a better early-warning system which allows a lockdown of the array before the lightnings arrive, flanked by improved protection measures.

A fantastic spectacle, but not for the best of GVD: a summer lightning over Lake Baikal.

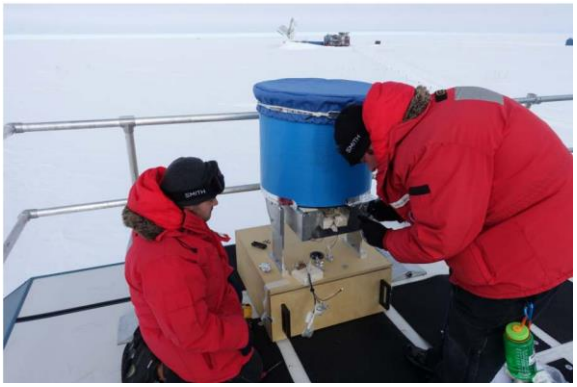
Part of the efforts will be spent for the deployment of two experimental strings. For these strings the data transmission between the section modules (each communicating with 12 optical modules) and the string modules (communicating with the three section modules of a string) will be changed from copper cables to fibers, allowing a -much higher data rate and a trigger on events with lower energies.

News from IceCube

Bruno Rossi Prize The 2021 Bruno Rossi Prize has been awarded to Francis Halzen and the IceCube Collaboration "for the discovery of a high-energy neutrino flux of astrophysical origin".

The Bruno Rossi Prize is awarded annually "for a significant contribution to High Energy Astrophysics, with particular emphasis on recent, original work." See HEAD AAS Rossi Prize Winners | High Energy Astrophysics Division for previous winners.

Impressions from South Pole The following picture shows the two IceCube winterovers removing the IceACT prototype from the roof of ICL in order to clean and repair it.



IceACT (Ice Air Cherenkov Telescope) is a compact imaging air-Cherenkov telescope. It is under consideration as part of IceCube-Gen2.

The next picture shows the winterovers after digging out old ARIANNA field equipment, with everyone standing in their dug-out hole. ARIANNA was a proof-of-concept experiment at South Pole to detect very high energy neutrinos via radio waves.

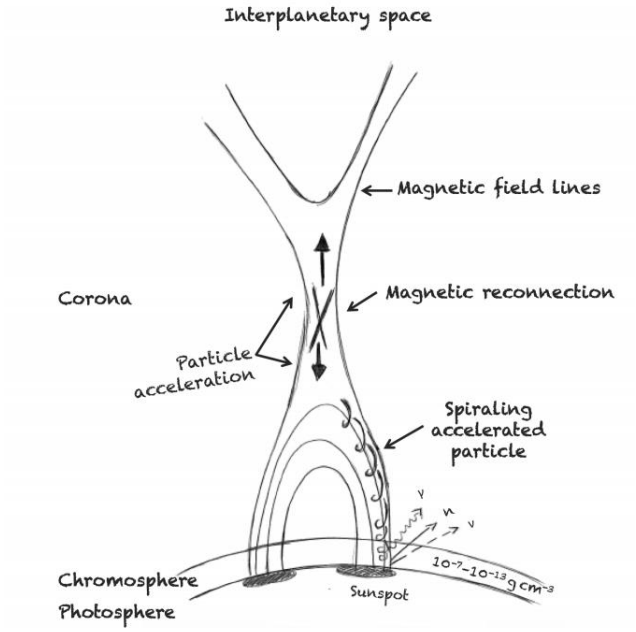
Publications

The IceCube Collaboration has submitted a paper *Search for GeV Neutrino Emission During Intense Gamma-Ray Solar Flares with the IceCube Neutrino Observatory* to Phys. Rev. D (posted at 2101.00610.pdf (arxiv.org)). The analysis was performed by Gwenhaël de Wasseige (now at APC, Université de Paris, CNRS) at Vrije Universiteit Brussel. While standard IceCube analyses address energies > 100 GeV (IceCube), > 10 GeV (DeepCore) and ~ 10 MeV (Supernova trigger), this analysis looks for neutrinos of a few GeV (< 5 GeV). Such neutrinos are expected from solar flares. These flares convert magnetic energy into plasma heating and kinetic energy of charged particles such as protons. Protons leave the coronal acceleration region and interact with the dense plasma in the lower solar atmosphere, generating pions and via their decay neutrinos (see the next figure).

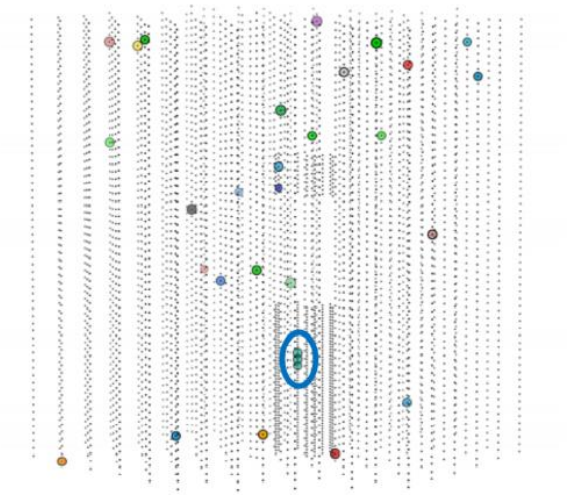
Events of a few GeV would fire only a few optical modules (see the second figure). Therefore, they could not be identified from a steady source, but only from transient sources via an on/off analysis. Here, the on-state is defined by a Fermi-LAT signal (from the direction of the Sun) in the GeV region which indicates that it originates from π^0 decay.

Main steps of the analysis are the rejection of events with E > 5 GeV and of pure noise, a series of cuts to increase the purity of the sample, and the optimization of the time window.

In the analysis of five strong flares between 2012 and 2017, no significant excess has been observed and upper limits have been derived.



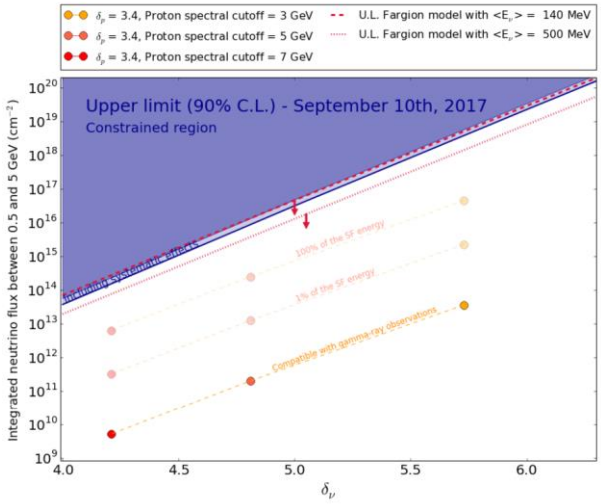
Schematic representation of a solar flare. The cross represents the magnetic reconnection and the two arrows show the direction of the subsequent outflow jets.



A GeV neutrino interaction in Deep Core with only three neighboured DOMs being hit.

The neutrino upper limits are presented as a function of the parameter space (δ_ν, C), where δ_ν is the spectral index (expected between 4 and 6) and C the integrated neutrino flux between 500 MeV and 5 GeV. The next figure shows the upper limit obtained from

the Sept 10th, 2017, together with its systematic uncertainties. The obtained upper limit is compared to two predictions.



Comparison of the experimental upper limit derived for the September 10, 2017 solar flare and the corresponding theoretical predictions. The orange points are derived from Gwenhaëls thesis, using a simulation assuming a proton spectral index of 3.4, derived from gamma-ray observations. The three sets of points are obtained assuming a different amount of energy going to accelerated protons, namely 10^{32}erg (100% of the maximum magnetic energy available is converted into accelerated protons), 10^{30}erg (1% of the magnetic energy is converted into accelerated protons), and 10^{29}erg, which is compatible with gamma-ray observations. The red line shows the predictions (marked as upper limits, since the assumptions are very optimistic) from a paper from Fargion, with $E_{flare} = 10^{32}$ erg and <$E_{\nu e}$> = 140 MeV (dashed) and 500 MeV (dotted).

The IceCube collaboration has posted a paper *IceCube Data for Neutrino Point-Source Searches: Years 2008–2018* at [2101.09836] (arxiv.org). Primarly contributors are Michael Larson (University of Maryland), Will Luszczak (UW Madison), Hans Niederhausen (TU Munich), Steve Sclafani (Drexel U., Philadelphia), plus the Neutrino Sources Working Group Leads Markus Ahlers and Justin Vandenbroucke (both UW Madison).

IceCube has performed several all-sky searches for point-like neutrino sources using track-like events, including a recent time-integrated analysis using 10 years of IceCube data. This paper accompanies the public data release of these neutrino candidates detected by IceCube between April 6, 2008 and July 8, 2018. The selection includes through-going tracks, primarily due to muon neutrino candidates, that reach the detector from all directions, as well as neutrino track events that start within the instrumented volume. An updated selection and reconstruction for data taken after April 2012 slightly improves the sensitivity of the sample. While more than 80% of the sample overlaps between the old and new versions, differing events can lead to changes relative to the previous 7-year event selection. An a-posteriori estimate of the significance of the 2014-2015 TXS flare is reported with an explanation of observed discrepancies with previous results. This public data release, which includes 10 years of data and binned detector response functions for muon neutrino signal events, shows improved sensitivity in generic time-integrated point source analyses and should be preferred over previous releases.

The data can be found at
https://icecube.wisc.edu/science/data/PS-IC40-IC86_VII

Miscellaneous

I just realized that this is the 50th edition of GNN Monthly. Never thought that this series will stay alive over such a long time. For me, it's not only work but also fun. Thanks to everybody who has sent me input, and thanks to Uli Katz for his reliable proofreading and correction of my English errors 😉