GNN Monthly
The Global Neutrino Network
91th Edition December 31, 2024

## All the best for 2025!

The GNN Board wishes all members of the GNN collaborations (the existing and the coming) a happy and successful year 2025: more neutrino sources, another tens-of-PeV-event, or, to take it to the extreme, a galactic Supernova. But first of all, of course, more peace on Earth and health!

## Call for the 2024 GNN Dissertation Prize

This is the eighth year the prize will be awarded, with the following conditions:

1) All involved in supervising PhD theses can send nominations.
2) Only 1 candidate can be nominated per proposer.
3) The thesis must have been successfully defended.
4) The date of the defense must have been in the period July 1, 2023 to December 31, 2024.
5) The proposer should submit a laudation detailing why she/he proposes the thesis.
6) Accepted languages are defined by the availability of reviewers from other countries and institutes. We expect to accept English, French and Italian as thesis languages (assuming that German, Danish, Swedish and Dutch theses are in English and those from Morocco and Belgium in English or French). In case of candidate theses outside this range of languages, please contact GNN Board.
7) If not contained in the thesis, a 2-page English summary written by the candidate is required.
8) The main criterion will be the quality of the thesis, not just the best limit or most spectacular result. It is thus also possible to receive the prize for a technical thesis or e.g. for a thesis on improving the event reconstruction.

Nominations, including a (link to the) electronic version of the thesis in PDF format and the documents specified above, should be sent by email until Jan 30, 2025 to gnn-board@googlegroups.com.

## News from the Experiments

### KM3NeT

During the last Collaboration meeting, the KM3NeT Collaboration has elected a new Management Team, who will serve for the two coming years. In addition to the new Institute Board Chair, Antoine Kouchner, elected last June, the following people will be leading the Collaboration:

- Spokesperson: Paul de Jong (Nikhef and University of Amsterdam, The Netherlands)

Paul de Jong

- Deputy Spokesperson: Damien Dornic (CPPM/CNRS, France)
- Physics and Software Manager: Rosa Coniglione (INFN-LNS, Italy)
- Technical Project Manager: Antonio D'Amico (Nikhef, The Netherlands)

The transition from the current to the new Management Team will happen at the next Collaboration meeting at the end of January.

## Baikal GVD

Grigory Vladimirovich Domogatsky, spokesman of the Baikal neutrino telescope project, passed away on December 17, 2024 at the age of 83. See the obituary at the end of the newsletter.

## IceCube

IceCube is in the midst of the second of three consecutive field seasons with the goal of drilling seven holes in 2025/26 (i.e. next year!) and installing detector strings for the IceCube Upgrade. These three field seasons are more like three sprints of ~10 weeks each at the South Pole. Last season the focus was on commissioning the drills and setting up drill camp; this season the focus is on completing the commissioning of the main hot water drill; making initial “firn” holes for the seven Upgrade holes that will be drilled during the next (and final) field season; receiving and testing two strings worth of optical modules, and installing the readout systems and cables for the seven additional Upgrade strings. (thanks to Kurt Studt and Vivian O’Dell and Albrecht Karle for providing the information!)

Here are some pictures:

*Left: the heated firn drill positioned over the pilot hole, right: the firn hole at around 15 meters depth (illuminated with a flashlight on a rope).*

*IceCubers standing around the first part of the hole through the firn layer that will become string 87.*

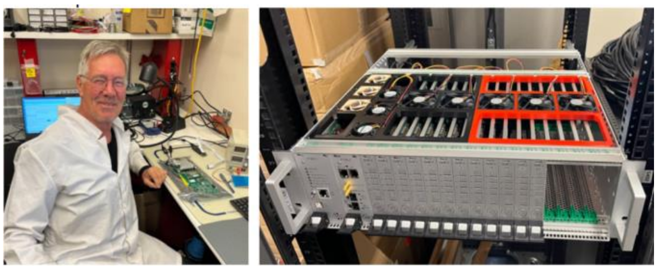
*The drill team on December 16*

Among the many parallel activities is testing the optical sensors and electronic components:

*The "HazBarn" where the optical sensors are tested.*

*Testing of the first IceCube Upgrade string of D-Egg and mDOM sensors was started: Sarah Mechbal (DESY) in front of the boxes containing the sensors under test.*


*John Kelley and Kayla DeHolton (UW Madison) holding the new power supplies that will power the IceCube upgrade strings.*

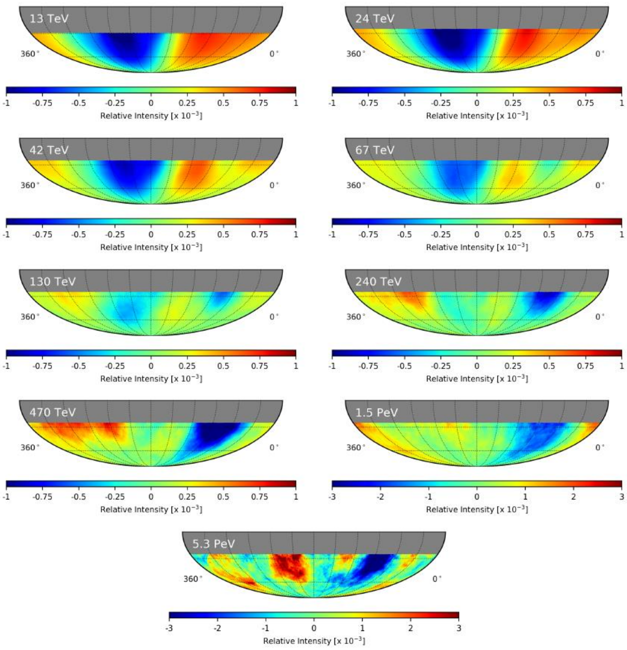


*A veteran at Pole: Kalle Sulanke (DESY) has designed the DOR card for IceCube, almost 20 years ago. Right now, he is at the Pole, has just assembled and tested the FCON (controller) cards and the FSEB (service board) cards for the Upgrade FieldHubs and started assembling and testing the complete FieldHubs.*

## Publications

The IceCube collaboration has submitted a paper *Observation of Cosmic-Ray Anisotropy in the Southern Hemisphere with Twelve Years of Data Collected by the IceCube Neutrino Observatory* to ApJ (posted at 2412.05046). The study was led by Paolo Desiati (WIPAC Madison), Frank McNally (Mercer Univ., Macon, Georgia), Rasha Abbasi (Loyola Univ., Chicago) Abbasi, and Juan Carlos Díaz Vélez (WIPAC Madison).

$7.92\times10^{11}$ cosmic-ray-induced muon events have been analyzed, which have been collected by IceCube from May 13, 2011, when the fully constructed experiment started to take data, to May 12, 2023. This dataset provides an up-to-date cosmic-ray arrival direction distribution in the Southern Hemisphere with unprecedented statistical accuracy covering more than a full solar cycle. Improvements in Monte Carlo event simulation and better handling of year-to-year differences in data processing significantly reduce systematic uncertainties below the level of statistical fluctuations compared to the previous results.



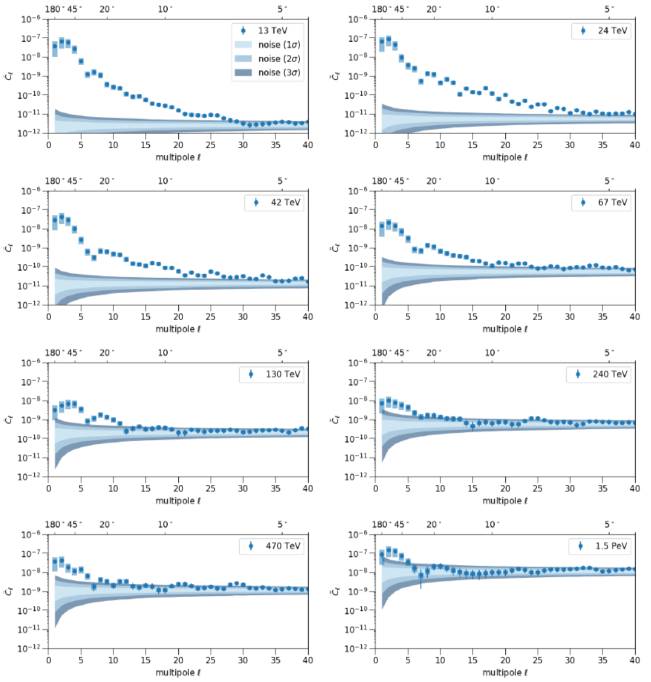

*Relative intensity sky maps as a function of primary cosmic-ray energy. The median energy of the data shown in each map is indicated in the upper left. Maps are all in J2000 equatorial coordinates and smoothed with a 20° smoothing radius for visualization purposes. The final two maps are shown on a different relative intensity scale. The FoV is limited to a zenith angle of 65° (-25° in equatorial declination). The FoV is further limited to a zenith angle of 60◦ (-30◦ in equatorial declination) for the 13 TeV map. The primary cosmic ray energy estimation is done on a statistical basis using the number of DOMs triggered and the muon trajectory's reconstructed zenith angle.*

The analysis confirms the observation of a change in the angular structure of the cosmic-ray anisotropy between 10TeV and 1PeV, more specifically in the 100–300 TeV energy range, see the previous picture. For the first time, the angular power spectrum at different energies has been analyzed. The observed variations of the power spectra with energy suggest relatively reduced large-scale features at high energy compared to those of medium and small scales.
The next picture shows the angular pseudo-power spectra as a function of energy, i.e. the dependence of the "pseudo power spectra" $\widetilde{C}_l$ as a function of multipole number $m_l$. $\widetilde{C}_l$ takes into account that the measurement is not sensitive to the north-south

anisotropy component, different to an exact power spectrum

$$\mathcal{C}_\ell = \frac{1}{2\ell + 1} \sum_{m=-\ell}^{\ell} |a_{\ell m}|^2$$

with $a_{lm}$ being the multipole moments. See the paper for details.




*Angular pseudo-power spectra as a function of energy. The shaded boxes represent systematic uncertainties from calculating the power spectrum; the other error bars are statistical, produced by calculating power spectra for Poisson-fluctuated data maps. The large, blue bands indicate the 68%, 95%, and 99.7% spread in $\widetilde{C}_l$ for a large sample of scrambled maps. The highest energy bin is omitted, as its power spectrum is consistent with an isotropic background at all multipoles.*

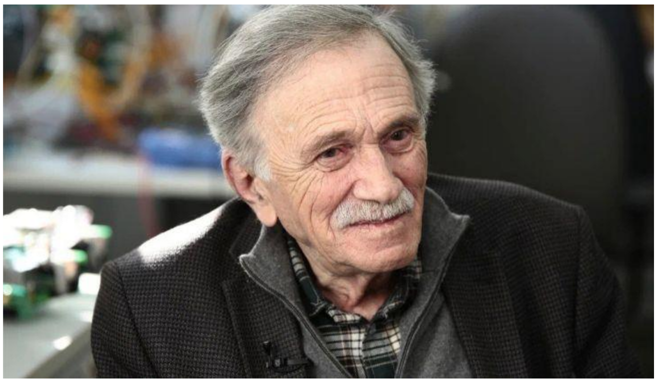
The decrease of the angular pseudo-power $\widetilde{C}_l$ for structures with $\ell \leq 3$ appear to follow a similar trend as the amplitude of the dipole component, while the power of smaller structures of $\ell \geq 6$ appears to remain relatively constant.

Current efforts include a follow-up study with the IceTop surface array on anisotropy observations. IceTop is sensitive to a per-mille anisotropy across various energy bands around the PeV region. Examining IceTop data in the 1-10PeV region enables a direct comparison of energy-dependent cosmic- ray anisotropy with the IceCube in-ice array, and it also allows for a comprehensive exploration of potential correlations between arrival direction anisotropy, energy spectrum, and chemical composition of the cosmic-ray flux. This, in turn, will allow us to study the effect of the increasing magnetic rigidity of the primary particles on the strength and angular distribution of the anisotropy. A next goal would be a full sky map derived together with detectors on the Northern hemisphere. It would allow a better understanding of cosmic rays' pitch-angle distribution beyond the heliosphere's influence.

The authors also plan to extend investigations of cosmic-ray anisotropy to the time domain and search for possible localized variations of the cosmic-ray flux on the sky map. By analyzing the time variations in the distribution of cosmic ray arrival directions, they hope to identify any potential correlation with heliospheric modulations at the boundary with the interstellar medium.

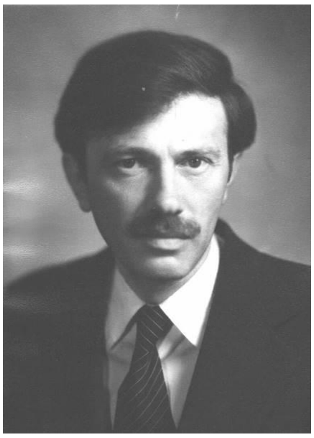
## Grigory Vladimirovich Domogatsky

**Obituary … and some recollections**



Grigory Vladimirovich Domogatsky, spokesman of the Baikal neutrino telescope project, passed away on December 17, 2024 at the age of 83. With his leadership in the Baikal project, he shaped the scientific image of his own institute, INR Moscow, and of the field of neutrino astronomy as a whole. He will be remembered as pioneer of the field, as carefully weighing scientist, as a person of incredible stamina, and as the unforgettable father figure and soul of the Baikal project. Grigory was Corresponding Member of the Russian Academy of Sciences and recipient of many prestigious awards, most notably the Bruno Pontecorvo Prize and the Pavel Cherenkov Prize.

Born in Moscow in 1941, Grigory obtained his PhD in 1965 at the Moscow Lomonosov University and then worked at the Lebedev Institute. There, he studied the processes of interaction of low-energy neutrinos with matter and the neutrino emission during the gravitational collapse of stars. His work was essential for defining the scientific program of the Baksan Neutrino Observatory. Already at that time he put forward the idea to create a network of underground detectors to register neutrinos from supernovae, something which decades later has been realized with the present SuperNova Early Warning System, SNEWS. Together with his co-author Dmitry Nadyozhin he showed that neutrinos released in star collapses are drivers in the formation of isotopes like Li -7, Be-8 and B-11 in the Supernova shell, and that these processes play an important role for cosmic nucleosynthesis.


G.V.Domogatsky, ~ 1975

In 1980 he obtained his doctor of science (equivalent to the German habilitation) and in the same year became the head of the newly founded "Laboratory of Neutrino Astrophysics at High Energies" at the Moscow Institute of Nuclear Research, INR. The central goal of this Laboratory was, and is, the construction of an underwater neutrino telescope in Lake Baikal, a task to which he devoted all his life since then.

A first professional contact with Lake Baikal he had a year before. Nikolaj Budnev from Irkutsk University remembers: "*My first acquaintance with Grigory Vladimirovich took place at a workshop in August 1979 in Listvyanka* [a village at the outflow of Angara river from Lake Baikal, C.S.]*, when plans for joint work on the DUMAND project were discussed with a large delegation from the USA headed by John Learned. At the workshop A. Chudakov proposed to use the ice on Lake Baikal for methodical experiments on deep-sea Cherenkov detection (he talked about methodical experiments only!). And then, it was thanks to the efforts of Grigory Vladimirovich that our team was created at Irkutsk University."* John Learned also remembers his first encounter with Grigory at the 1979 meeting: *"I always recall the image of first meeting him on our way to Baykal... late night in some uninspiring location and Domogatsky walking around, cigarette dangling and handing out sheaves of Rubles* [the daily allowance for conference participants,C.S.]". Indeed, one can't imagine Domogatsky without his beloved Papyrossi, a Russian type of cigarette with a paper mouthpiece.

Grigory, himself a theoretical physicist, created a team of enthusiastic experimentalists, most notably among them Leonid Bezrukov. The team started site explorations in the following year and obtained first physics results with test configurations later in the 1980s. At the end of the 1980s, the plan for NT200, a neutrino telescope comprising about 200 photomultipliers was born and – meanwhile also together with German collaborators – realized over the 1990s. This was the time after the breakdown of the Soviet Union, followed by an economic crisis which presumably would have been the end of the project if not Grigory had led it with an unshakable will and strong leadership. At that time, we from DESY tried to help with large amounts of cash money which I illegally transported, against any custom rules, and handed over to Grigory who changed it to rubles and distributed it among the Baikal colleagues according to a strict key. Actions like this are only possible on the basis of absolute trust in each other. Sometimes he commented: "*Christian, the situation is disastrous. The good thing: it can't get any worse."* But the next year – alas! – it *got* worse. Year after year. Grigory didn't give up a and cited the parable of the frog who falls into a bucket of milk. What does he do? He struggles until the milk turns into butter, from which he climbs out. And indeed, this was what happened at the very end!

Despite all these problems, in 1996 first neutrino candidates could be identified in the data taken with the partial configuration of the project deployed in 1994. Grigory informed me about that with a telefax, which nicely reflects his cautiously weighing character, averse to any rash reports of success, and his memorable way to formulate: *"Dear Christian, first the most interesting: When analyzing the 1994 data, one event stubbornly withstands all tests, and it seems to be a neutrino. Naturally, I would not like to decide whether we declare this event as the first clear neutrino in an underwater detector. But it can be called a very neutrino-like event".* This, and the results obtained soon after with the data taken in 1996, delivered the first proof of concept for underwater neutrino telescopes! It was a breakthrough.

*G.V. Domogatsky at Lake Baikal, 1990s*

NT200 was shut down a decade ago, while a new telescope of cubic kilometer size was already under construction. This project was christened Baikal-GVD, with GVD standing for Gigaton Volume Telescope (but could also be red as Grigory's initials!). Right now, as GNN readers know, it has reached about half of the size of the IceCube neutrino telescope at the South Pole and has delivered first important results.

Grigory was born to a family of artists. His grandfather was a famous sculptor, his father a painter, woodcrafter and book illustrator. His brother went in his father's footsteps, while Grigory himself married Svetlana, an art historian. So, he was surrounded by an artistic atmosphere since the beginning of his life. He possessed an outstanding literary, historical and artistic education, and whoever met him (in particular if he/she talked Russian!) must have been caught by his knowledge, his old-fashioned noblesse and his intellectual charm.

One can't count the expressions of sympathy which have been sent to the Baikal colleagues, to Grigory's family (and partially also to me with the request to forward them to the Baikal-Collaboration).

Leonidas Resvanis writes: "*Grigori was a wonderful warm person and a pioneer scientist. I will cherish warm memories.",* John Learned recollects: "*He was a remarkable character, a good friend and someone who enriched many of our lives."* and Francis Halzen remembers: "*He was such a nice person enjoying physics under challenging circumstances!"*

Meeting him at Lake Baikal during the yearly winter expedition was a special experience:

Els de Wolf: "*What a sad news! It brings back precious memories to a remarkable man in a complex country. In particular, I remember the Baikal lake where we spent a long evening discussing both physics and life. For me he was a gentle and charming person."*

Giorgio Riccobene: "*He was an exceptionally talented scientist and head, and a real gentleman. I will never forget him."*

Albrecht Karle: "*Prof. Grigory Domogatsky was one of the great pioneers in our field. I have very fond memories of my travels to Dubna and to Baikal … where I was received with great hospitality and support by him and the group and where I had the privilege to be part of one season."*

Fedor Simkovitch and Ivan Stekl: "*We felt privileged to have the opportunity to work with him. … His significant achievements will endure, and history will remember him."*

Cao Zhen: "*Professor Grigory was an eminent scientist in the field of neutrino astronomy. … In the past few years, Grigory had been highly enthusiastic about and actively involved in supporting China's engagement in neutrino experiments in Lake Baikal."*

For me, Grigory was a close friend, and although we were only 7 years apart, an almost fatherly friend. Never I would have addressed him simply by his first name Grigory, but only by first name and patronymic, Grigory Vladimirovich, as it is common in Russia with elder or respected people. The war prevented me from attending his funeral. But on December 20, the day of the funeral, I repeated part of the ceremony that we often celebrated when we met: Grigory offered me a papyrossi and I offered him a cigarillo. Then we smoked together, gazing out at the frozen Lake Baikal, at the shore of the Volga river or at the court of his institute, rejoicing in our friendship and mutual trust.

This time I had to smoke my cigar alone, but in memory of him...

Christian Spiering

*G.V Domogatsky in his "command center" at Lake Baikal, around 2010*

Impressum
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