



Geomagnetic Storms and Recording of Acoustic Signals

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Abstract

Having published three articles in the Journal La Multiapp: “Doppler Effect and Acoustic Trails of Neutrinos”, “Neutrinos above the Earth's surface” and “Algorithm for detecting acoustic traces of neutrino decay”, I already wanted to stop research in this direction, if only because that I do not have enough competencies in astrophysics, and that published data is enough for specialized specialists to evaluate the technical and scientific novelty and understand the capabilities of the new method. But, when on the morning of February 3, 2024 at 07:40:19 I turned on the monitoring system, bipolar acoustic pulses with a visible period of 40 μ s (frequency 25 kHz) began to be observed on the screen with an interval of about 0.3 seconds, the shape of which is very similar to acoustic traces, associated with neutrino decay. The apparent frequency of these pulses was underestimated by a factor of two, probably due to the insufficiently high Nyquist frequency (50 kHz). A similar picture was observed during the next registration at 07:40:38, and at 07:40:57, only five pulses were recorded with a repetition interval of 1 second. On the fourth and fifth of February there were practically no impulses. There was a suspicion that the observed process was timed to coincide with a geomagnetic storm; more precisely, it was the observed processes that caused geomagnetic storms.

Introduction

When recording acoustic noise in a large city, a separate coil of the vertical channel of the MIG-3V geophone was additionally used as an electromagnetic field sensor at the recording site (Attia et al., 2020; Gavrilov et al., 2011). This was necessary to explain the “strange” association of some acoustic events with extrema of electromagnetic field amplitudes (Belyakov, 2024; Rundle et al., 2021; Khatami et al., 2021). There is little confidence that several short (15 seconds) recording sessions will record the same successful moments as February 25, 2023, but not trying to explain the “oddities” detected would be an unforgivable mistake. Ultimately, this turned out to be possible, and high-frequency pulsed events were sometimes detected in short recording sessions (Bergel et al., 2020; Geva-Sagiv et al., 2023). Moreover, these events often coincided with declared periods of geomagnetic storms.

Methods

The basis of the equipment is a unique geophone MIG-3V, the characteristics and capabilities of which are described by me in many journal articles and a book, but it must be recalled that the geophone used has unique characteristics: a frequency range from 0.1 Hz to 50 kHz with a dynamic range of more than 260 dB. Its sensitivity in the high-frequency region exceeds the sensitivity of known geophones by thousands of times. It is these unique characteristics that made it possible to observe acoustic traces of neutrino decay not only deep in the earth's crust, but also against the background noise of a residential area of a large city.

The open coil of the vertical channel MIG-3V, used in the fourth recording channel as a sensor of the vertical electromagnetic field at the observation site, helped to assess the level and fluctuations of electromagnetic interference in the third, vertical channel. However, interference synchronized with the 60 Hz power network is also observed in two horizontal channels, which at the conversion stage have effective built-in protection from external electromagnetic fields. This was strange to me until I remembered a large power transformer, which is installed in a pit at a distance of about 25 meters from the observation site and can emit an acoustic signal with frequencies of 60 and 120 Hz due to residual magnetostriction in its core. This assumption was confirmed by spectral analysis: in the fourth channel, the first and third harmonics (60 and 180 Hz) predominated, and in the first three channels, especially in the third, the first and second harmonics (60 and 120 Hz) predominated, which is inherent in the magnetostriction process with a magnetizing current with frequency 60 Hz.

The recording system consists of ZET 410 preamplifiers with gains of the first and second channels of 1000, and the third and fourth - 10, a ZET 230 ADC module with four 24-bit ADCs, the maximum sampling frequency of which is 100 kHz (Nyquist frequency - 50 kHz) and a control computer with ZETLab software. The module operates in the mode of inputting digital data onto the computer hard drive in the form of *.ana and *.anp files. ZETLab equipment and software allow you to begin the registration process immediately after launching the program. Data from four channels is recorded: 1 – horizontal, directed perpendicular to the southern wall of the house, 2 – horizontal, directed parallel to the wall, 3 – vertical and 4 – sensor of the vertical component of the electromagnetic field. The difference in gain factors is due to the high level of electromagnetic interference at the observation site, which goes beyond the recording range of vertical channels 3 and 4 with a gain of 1000, while the horizontal channels of the geophone, which have internal protection from electromagnetic fields, allow the use of the maximum gain. It is assumed that during the analysis all data will be adjusted taking into account the amplifier coefficients and the sensitivity of the geophone channels. Correction of data amplitudes is necessary when calculating the direction to signal sources. The received data in *.ana-*.anp files is entered into the WinABD program database, which allows visualization of time series, their various transformations, assessments and visualization of analysis results (Desherevskii et al., 2017; Belyakov, 2024). In particular, in relation to the series under consideration, the following are performed: compensation for the shift of the average value, increasing the amplitudes of vertical channels so that all four channels have equal sensitivity, calculating the absolute rate of change in the signal amplitude and spectral analysis of data from selected channels and fragments. The totality of the results obtained is analyzed using the WinABD program and conclusions are drawn about the presence of acoustic traces of neutrino decay or other events.

Results and Discussion

The main questions at the moment to which it was necessary to find answers: why are some high-frequency pulses clearly concentrated (or synchronized) near the extreme points of the “sine wave” of the electrical network? Is this not a coincidence? Is it possible to artificially generate observable pulses in the power grid itself, as a means of monitoring or managing networks along network wires? I will try to justify my answer to these questions by analyzing the next measurement data shown below in Figures 1 and 2. The first measurement was made by chance and it is unknown what happened before it, and Figure 2 was obtained at the end of the process.

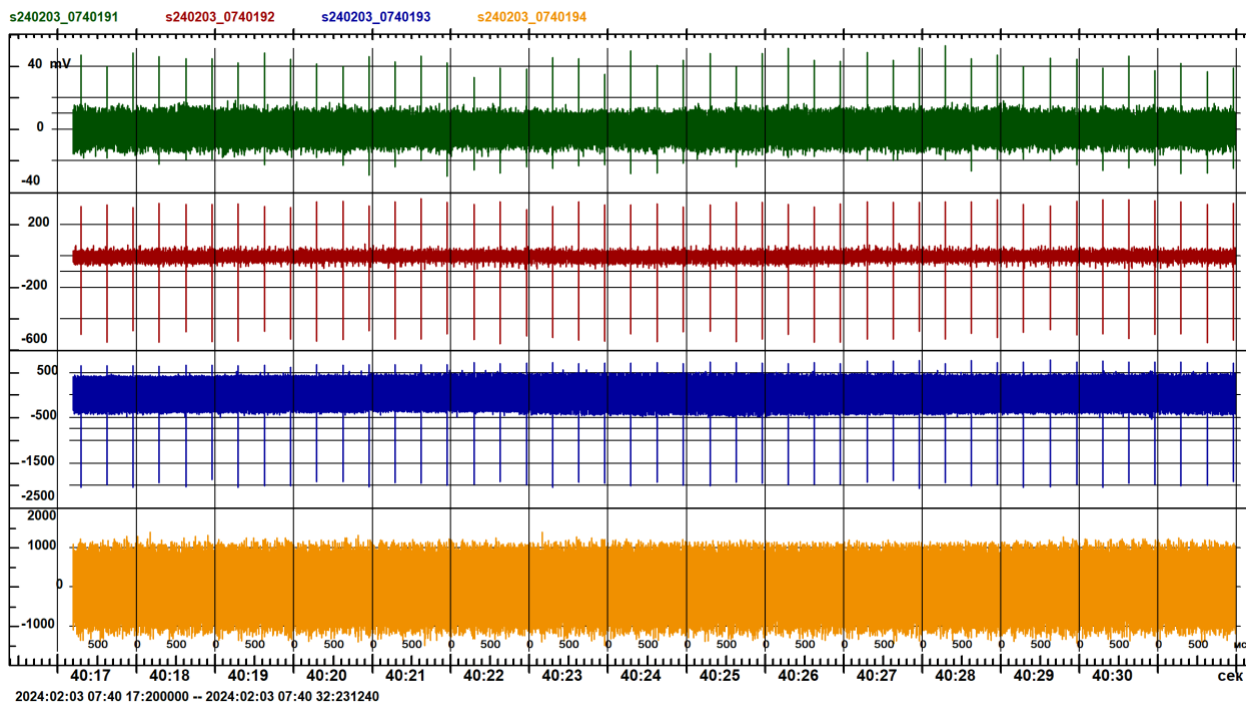


Figure 1. 45 two polar pulses with an interval of about 0.3 seconds

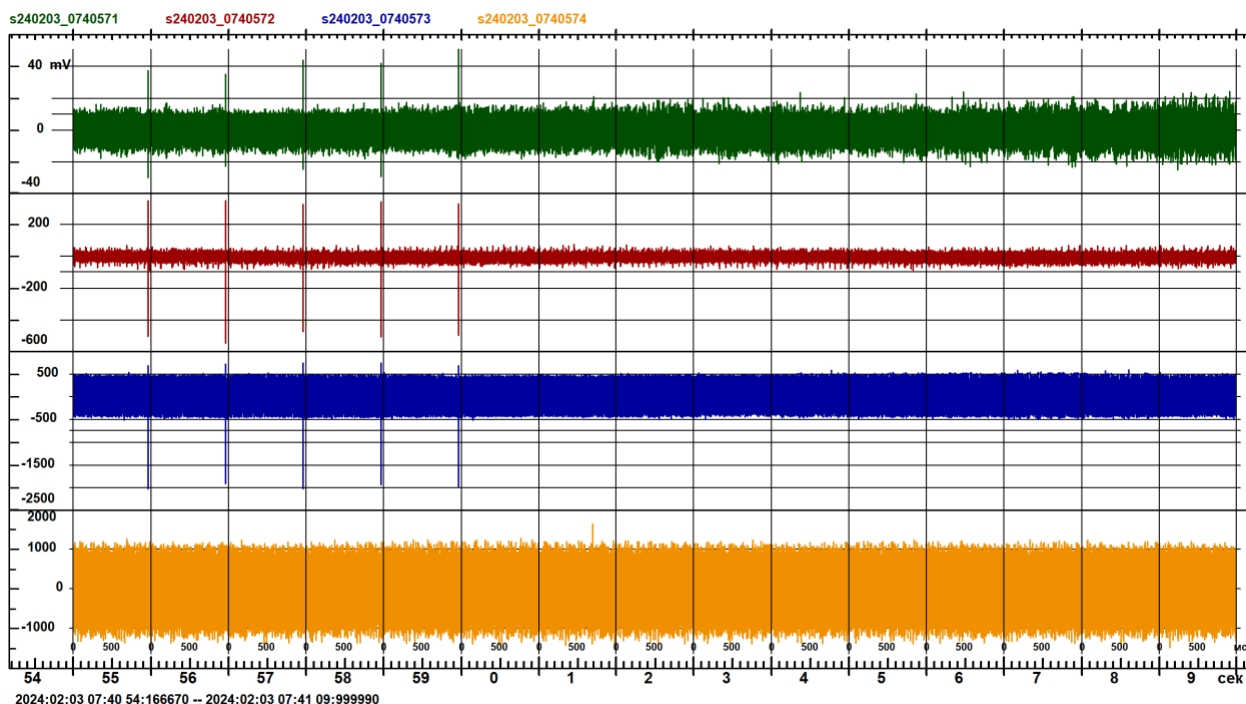


Figure 2. End of the process: five pulses with an interval of 1 second

It is characteristic that the pulse repetition period at the final stage of the process changed from 0.3 to 1 second. This indicates that synchronization between acoustic pulses of this type and the electromagnetic field is not observed. The shape of the pulse (Fig. 3) has differences in the first three channels, and in the fourth, “electromagnetic” channel, the pulse is not observed. This indicates the acoustic nature of the observed pulses, and their shape and duration are distorted due to the insufficiently high Nyquist frequency.

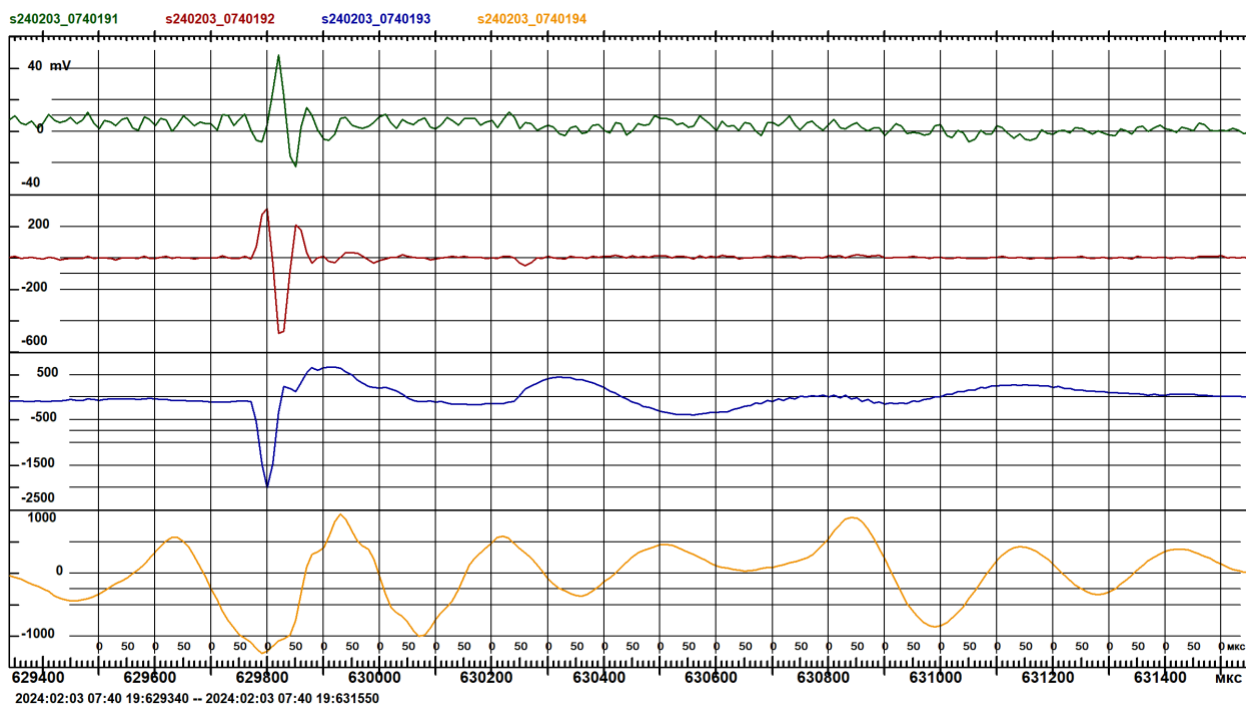


Figure 3. One of the impulses 02/03/2024

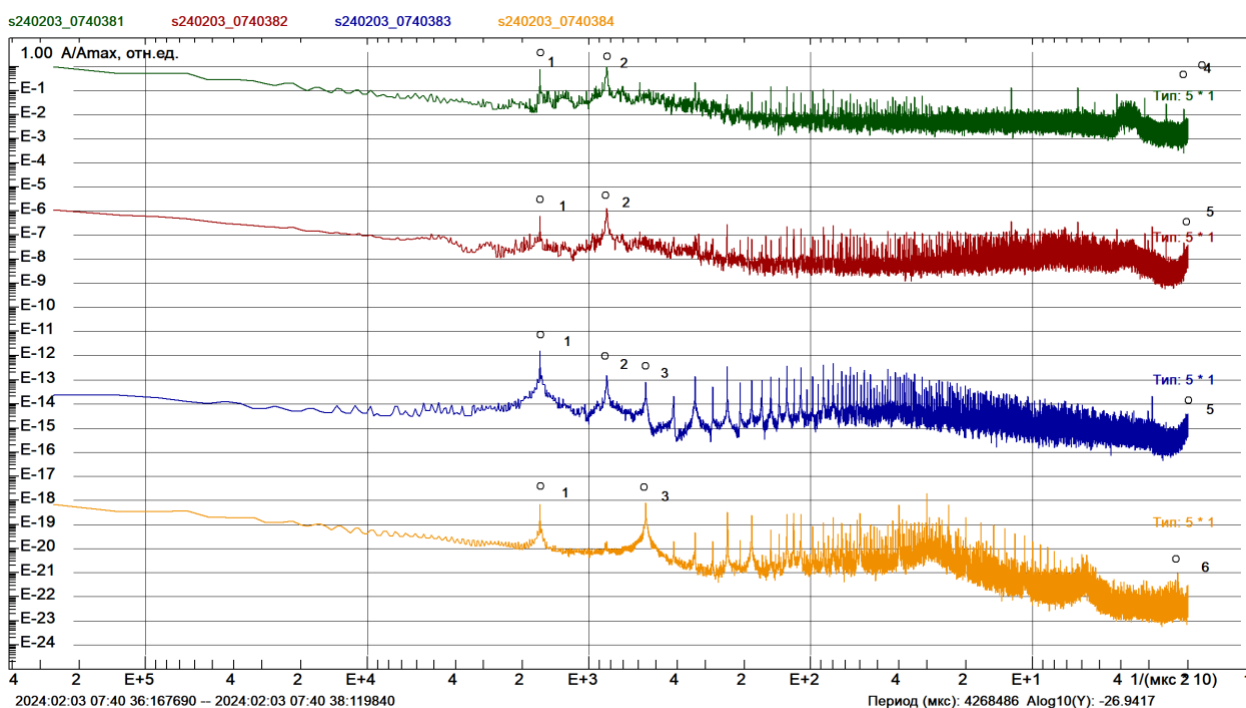


Figure 4. Periodogram of the recording fragment 07:40:36.17 ÷ 38.12

Significant in Fig. 4 periods are indicated by the sign “o”, and the corresponding frequencies are indicated by numbers: 1 (60 Hz), 2 (120 Hz), 3 (180 Hz), 4 (49 kHz), 5 (50 kHz) and 6 (45 kHz). As you can see, the software calculation of periods was more accurate and determined in a fragment of the original signal periods close to the Nyquist frequency (50 kHz), and identified periods corresponding to the magnetostriction process in the first three channels.

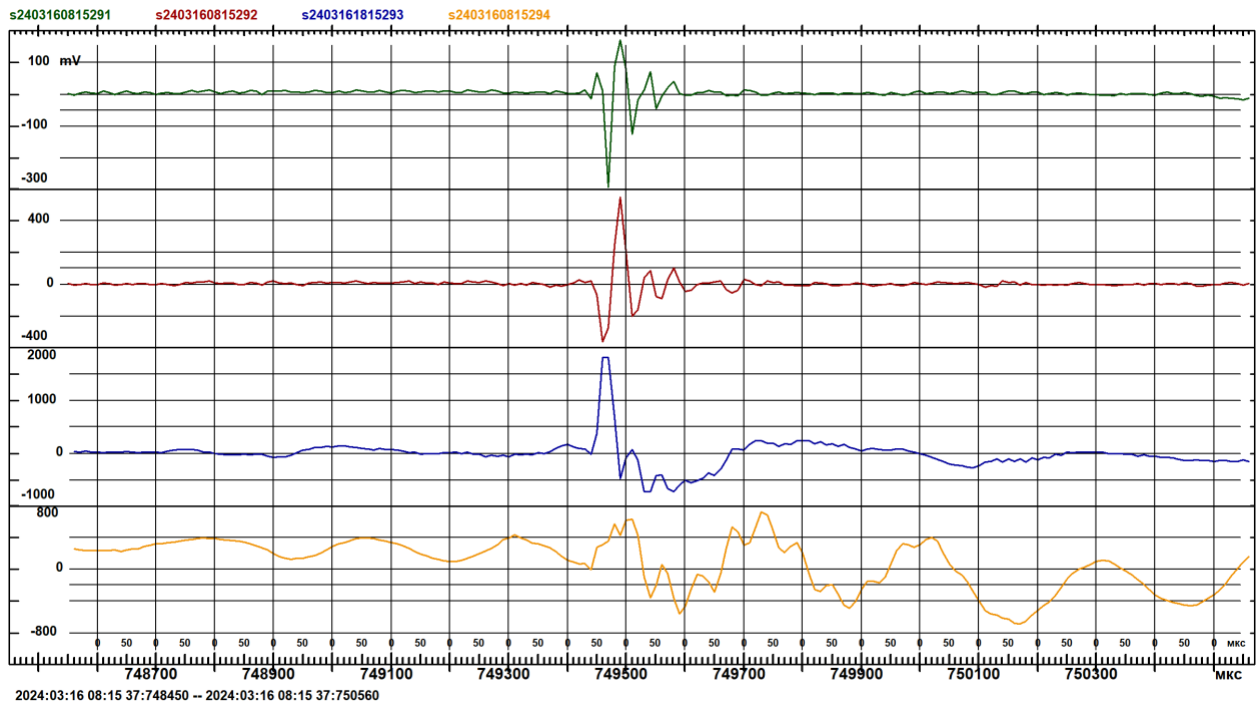


Figure 5. Single pulse recorded on 03/16/24 at 08:15:37.749500.

At first glance, the single pulse in Fig. 5 is similar to the pulse from the series shown in Fig. 3. However, this is not true. The phase of a single pulse was reversed, and the signal levels also changed. Judging by the amplitudes of the first three channels, in February the direction to the signal source was closer to the vertical than in March.

Conclusion

The topic under consideration is very interesting and promising in the case of independent and objective confirmation of the connection between the detected acoustic traces of neutrino decay using a relatively simple and mobile instrument. Acoustic signal registration is confirmed. Asymmetrical installation of a geophone when organizing monitoring is unacceptable.

Acknowledgments

I am sincerely grateful to Alexey Deshnevskii for his excellent **WinABD** program and his creative efforts to improve and update it. Without the **WinABD** program, this and many of my other works that require calculations, transformations and graphics would not exist.

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