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Extreme Universe through the eyes of MASTER Global Robotic Net *

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This paper considers last highlights in synchronous and follow-up optical observations of high energy astrophysical phenomena by MASTER Global Robotic Net.

Such extreme Universe sources includes gamma-ray bursts, gravitational wave events, detected by LIGO/Virgo, fast radio bursts, high energy neutrino sources and others. Some of the neutrinos detected by ground-based facilities owe their births to supermassive black holes - blazars, which are in a special anxious state with high statistical reliability. We discovered the effect of a rapid decrease in the brightness of the blazar PKS 0735+17 at the time of the multiple detection of the high-energy neutrino event IceCube-211208A. This decrease in brightness within several hours was detected with a high confidence (SNR 10) in comparison with a multi-day brightening state of the blazar, which was accompanied not only by a maximum increase in the average brightness, but also by an increase in the amplitude of its brightness fluctuations. Additionally, we analyzed all cases of successful observation of blazars around neutrino events and obtained statistically reliable indications of the relationship between neutrino events and optical activity of blazars in the doubled error box at the 4.2 σ level.

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I. INTRODUCTION

Most of high energy astrophysical sources in the Universe like gamma-ray bursts (GRB), gravitational wave sources (GW), fast radio bursts (FRB) are connected with compact relativistic objects ([1] - [22]). Extreme phenomena such as the most probably sources of generation of neutrinos of high and ultrahigh energies and other also still have many problems and have been studied very intensively in recent years. The effective ways of their studing involve using multi-channel and multi-wavelength observations by fully robotic telescopes with identical equipment and online auto-detection system, distributed by Earth for full time control of near and far space like MASTER Global Robotic Net ([10] - [22]).

MASTER has large experience in discovery and study of extreme sources in Universe, during last years they are:

1) The detection of a strong evidence for high energy neutrino progenitor of the neutrino event IceCube-170922A, when we found the blazar TXS 0506+056 to be in the off-state after one minute from neutrino trigger time and then switched to the on-state no later than two hours after the event. Such decrease in brightness near the neutrino detection time provides complementary and very compelling evidence for the link between the blazar and the IceCube-170922 neutrino event. We analyzed MASTER 16 years archival data, which we found to be consistent with this fact and propose a hypothesis explaining the anticorrelation of the optical and neutrino flux. An increase in neutrino flux means that up to half of the protons disappear. If we assume that these protons produce synchrotron optical radiation, then any increase in neutrino luminosity will lead to a decrease in the optical brightness of the blazar [7].

2) The detection of three-stage collapse of the long GRB 160625B from prompt multi-wavelength observations [14].

3) The GRB221009A optical counterpart discovery and its structured jet explaination [12].

4) The discovery of significant and variable linear polarization during the prompt GRB160625B optical emission [23].

5) The first detection of an orphan burst at the rise phase [15] and GRB trigger time calculation [38] using smooth optical self-similar (SOSS) emission [23]. It is a new type of calibration for the gamma-ray bursts, in which some of their classes can be marked and

share a common behavior. We identify these subclasses of GRBs with optical light curves described by a universal scaling function [23].

6) The most input to the optical support of gravitational wave events, detected by aLIGO, LIGO/Virgo during O1-O3 observational sets, including the first one GW 150914 ([1]-[5], [37]), independent optical detection of the first LIGO/Virgo Neutron Star Binary Merger GW170817-Kilonova MASTER OTJ130948.10-232253.3/SSS17a ([3]-[4]) and the first in history gravitational-wave standard siren measurement of the Hubble constant with LIGO/Virgo collaboration [24].

7) The first large optical monitoring campaign of the closest at that moment radio burster FRB 180916.J0158+65 simultaneously with a radio burst [8].

8) Multiwavelength flare observations of the blazars, including NVSS J141922-083830, S5 1803+784 ([30]-[36]).

9) The discovery of several dozens of optical counterparts of gamma-ray bursts, including the nearest GRB 180728A, the brightest GRB 190530A, prompt multi-wavelength observations of GRB 161017A by Lomonosov MSU observatory and MASTER [18], GRB191221B, GRB 160625B, GRB 221009A, GRB 181201A, GRB 190114C, GRB140629A and other [8-13,22,26-28].

10) MASTER alert and follow-up observations of hundreds high energy neutrino error-boxes, triggered by IceCube, ANTARES detectors including the largest input to optical support of an IceCube multiplet in 2016y. -triplet IC160217 [7,25,39].

11) The probable shape of Near-Earth Asteroid (NEA) 2015 TB145 (conical) calculation and the rotation period of 5.9 hours detection as the results of white-light photometry for a 13.5 hours of observations (1124 measurements) [40].

12) MASTER-OAGH installation in December 2021 [41,42], the 9th MASTER observatory for GRB, GW, FRB and high energy neutrino sources investigations.

II. THE HIGH ENERGY NEUTRINO AND OPTICALY ANXIOUS BLAZARS.

The origin of ultrahigh-energy neutrinos has been one of the most mysterious problems of modern physics for the last 10 years [43]. Here we show with high statistical reliability that some of the neutrinos detected by ground-based facilities owe their births to supermassive black holes - Blazars, which are in a special anxious state. We have discovered the effect of a rapid decrease in the brightness of the blazar PKS 0735+17 at the time of the unique multiple detection of the high-energy neutrino IceCube-211208A [44,45]. This rapid (within several hours) decrease in brightness was detected with high confidence (SNR ~ 10) against the background of an anxious multi-day state of the blazar, which was accompanied not only by a maximum increase in the average brightness, but also by an increase in the amplitude of its brightness fluctuations.

The first candidate to electromagnetic counterpart for an astrophysical high energy neutrino event with MASTER real-time (1 min after trigger) observation was the blazar TXS 0506+0561 located inside the error box of IceCube-170922A event [7]. When combining the available data suggested that TXS 0506+056 was a very promising high energy neutrino source candidate, the temporal resolution of multi-messenger data did not provide conclusive evidence at the time and the object remained just a likely, but still debatable, candidate. However, the MASTER Global Network was able to detect an unexpectedly fast, within a few hours, anticorrelation: the effect of optical fading of the blazar TXS 0506+056 at the time of neutrino activity [7,10].

On the December 8, 2021 at 20:02:51.1 UT, the IceCube Neutrino Observatory detected a high-energy neutrino with a 50% probability of astrophysical origin [43]. For several hours around the IceCube-211208A event and three more probable neutrino events from the Baikal Neutrino Telescope, BAKSAN and Arca (ANTARES/KM3Net) facilities was detected [45-47]. According to our data [7], the blazar PKS 0735+17 was in a dimmed state, against the background of a longer-term increase in optical activity. We also analyzed all cases of successful observation of blazars around neutrino events and obtained statistically reliable indications of the relationship between neutrino events and blazars in the error squared at the 4.2 σ level. MASTER-Amur optical robotic telescope located in Russia (Blagoveshchensk) was pointed to the IceCube-211208A error box 682 sec after trigger [44]. MASTER real time auto detection system [7,10] discovery some brightening flash MASTER OT J073807.40+174219.27,11 coincident with Blazar PKS 0735+17 which brightening up to $14.1^m (0.2^m/12h)$ next nights observations . Afterwards, observations were additionally conducted by MASTER-Kislovodsk, -Tavrida, -OAFA, -IAC, -SAAO and -Tunka (see Fig. 1a). 8 hours after the neutrino event detection, MASTER-OAFA has imaged blazar PKS 0735+17, located slightly outside the 90% localization error-box. As it turned out, it was flaring at the moment and showed a behavior similar to that of TXS 0506+56 immediately

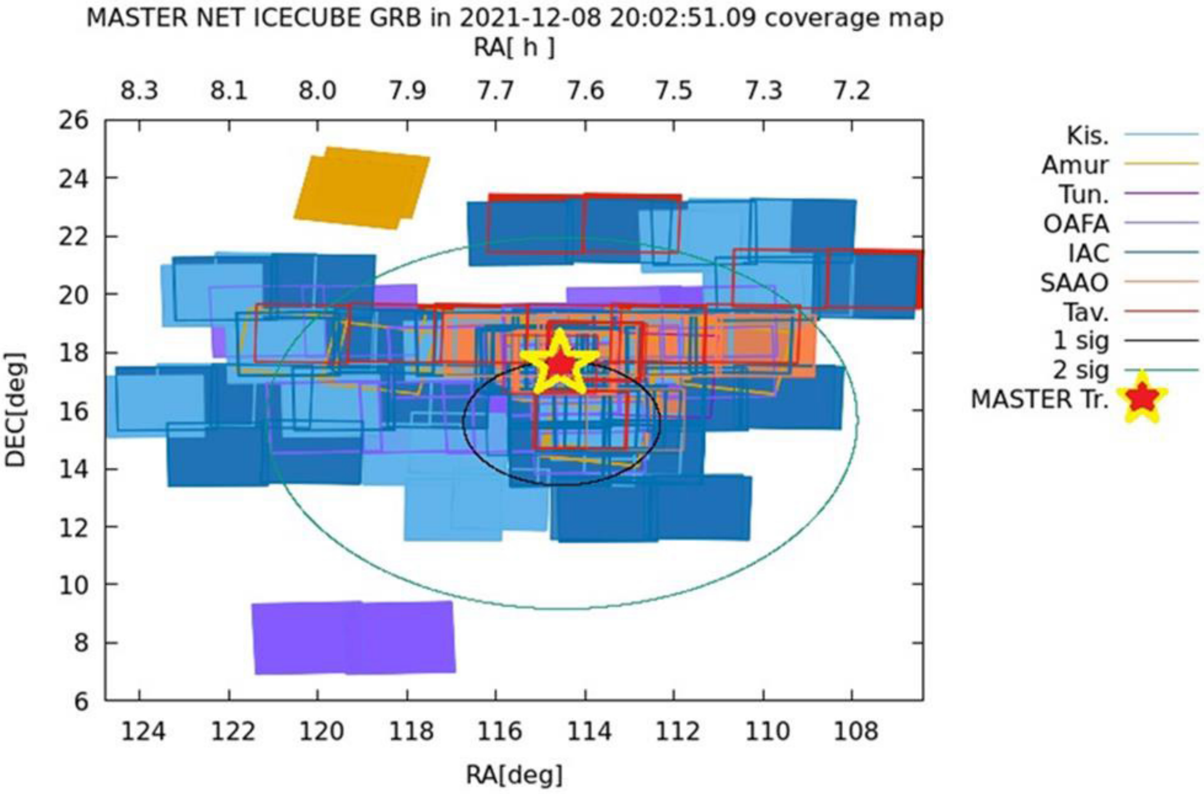

FIG. 1: MASTER observations cover map of IceCube-211208A error-box (1 σ round is 90% localization error-box radius as detailed in GCN notice 136015_21306805), 2 σ figure is 3 times the radius of 1 σ. The star is PKS 0735+178 location.

after IceCube-170922A optical decay before the neutrino event and brightening after it. [7,11]. Observations by other observatories confirmed that the blazar was flaring in gamma, x-ray and radio diapasons [51-60]. One can see the detailed light curve based on MASTER data at Fig. 2.

As inferred from the observations, before the IceCube detection, the blazar has been brightening steadily with small amplitude flares ($\sim$ 0.3 mag) at a rate 0.025 mag per day. A week before neutrino detection, brightening had suddenly accelerated to 0.25 mag per day and 2 days after brightening the blazar as suddenly had started dimming at approximately the same rate (0.2 mag per day). Interestingly enough, this behavior is seemingly symmetrical, as it is repeated in a reversed order afterwards and BUST, IceCube and Baikal-GVD detections are located inside the dimming crevasse, just like TXS 0506+056 during IceCube-170922A10. After the report18 by Fermi-LAT of a gamma-ray flare of the Blazar

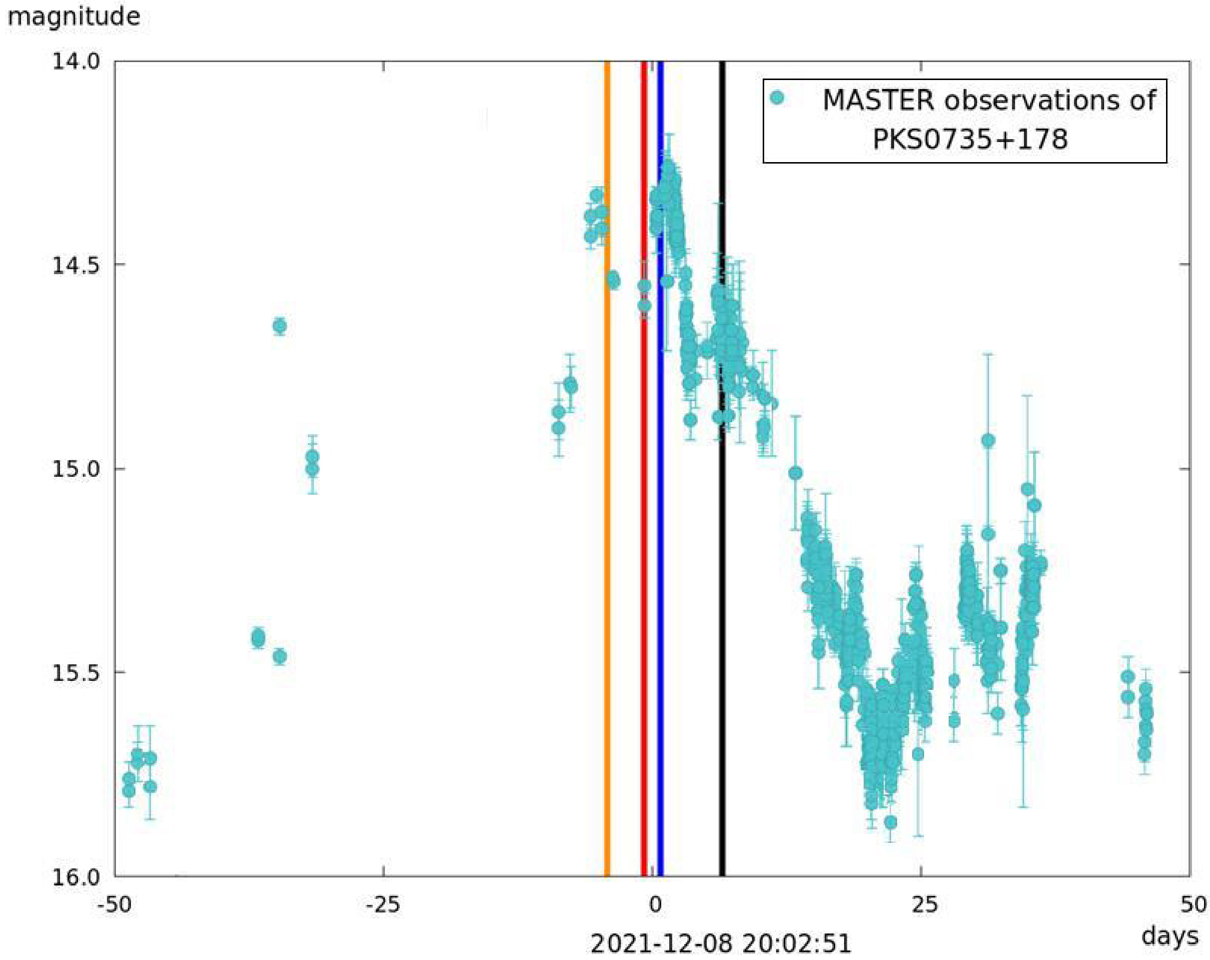

FIG. 2: The light curve of PKS 0735+178 for a 100-day period; red line - IceCube detection of IC-211208A, blue line - Baikal-GVD detection, orange line BUST detection, black line - ARCA detections; cyan dots - MASTER observations

PKS 0735+178 and the observations in the Ks Band24, we observed21 the object in the NIR, on December 27th, 2021 (JD 2459575.8069) and found that its fluxes corresponded to J = 13.53 +/- 0.07, H = 12.74 +/- 0.03 and Ks = 12.04 +/- 0.04. The latter is to be compared with the value Ks = 11.57 +/- 0.03 reported in for December 16th, 202124. Our previous NIR photometry for this object (JD2459326.6632) is J = 14.28 +/- 0.07, H = 13.73 +/- 0.04 and Ks = 12.54 +/- 0.03. Our observations are carried out with the 2.1m telescope of the Guillermo Haro Observatory operated by the National Institute for Astrophysics, Optics, and Electronics (Mexico), equipped with the instrument CANICA a NIR camera [60].

FIG. 3: There are: a) the archival light curve based on the observations of the MASTER and the noise path of 8 comparison stars on the bottom panel, b) the blazar anxiety factor FA.

III. HISTORICAL LIGHT CURVE OF THE BLAZAR PKS 0735+178

We made the first photometric observations of this blazar in 2004 with the first robotic telescope MASTER near Moscow [7]. After a lengthy break, the blazar has been observed regularly and in Fig.3a one can see the historical light curve taken by several telescopes of the MASTER Global Network. The first conclusion is striking: the registration of neutrinos occurred during the period of a record increase in blazar activity in the entire, almost 20-year, history of our observations. We have tried to quantify the concept of blazar "activity" according to the method proposed earlier for the TXS 0506+05610. Of special interest are not even the flux variations themselves, but the rate of their change. To illustrate this, we built a history of the rate of change of the optical flux (Fig. 3).

Rate of change we define as the differential flux multiplied by the signal-to-noise ratio. To remove the noise, we averaged the close points. Thus, we introduce a kind of quantitative description of anxious blazars - the factor of anxiety (FA):

$$FA = SNR \cdot (F_i - F_{i-1})/(T_i - t_{i-1})$$

where SNR is the $(F_i - F_{i-1})/\sigma$, F_i and σ are the optical flux and error of two adjacent measurements at the mid-exposure time t_i respectively.

The event of September 22, 2017 has outstanding characteristics in terms of flux derivation and signal-to-noise ratio [10].

We see the same thing in the case to which this letter is devoted.

In Fig.3a. it can be seen that the brightness of the blazar PKS 0735+178 reaches its record historical value around the moment of multiple neutrino detection.

The repeated discovery of the correlation of neutrinos with optical activity on a short time scale is supported by a statistically reliable result .

IV. STATISTICAL SEARCH FOR OPTICAL FLARES CORRELATION WITH NEUTRINO EVENTS

MASTER telescopes have been observing IceCube neutrino events alerts since the follow-up of a rare IceCube neutrino multiplet in 201526. In total, since the beginning of 2016 to 1st July 2022 the IceCube Collaboration has issued 106 public alerts. Of them, MASTER telescopes have observed 87 in the first day. Motivated by the apparent discovery of a neutrino source outside the 90% localization error-box, we arrived at an idea that a number of neutrino sources might be located outside the 90% error-box since it does not take into account a statistical error. To circumvent it, we decided to look for blazar flares in the error-box with twice the size of 90% error-box, i.e., sides of error-box are enlarged by a factor of 2. Such an error-box should correspond to 99,999% localization. As a blazar catalogue, we decided to use Roma-BZCAT27 as it is one of the more complete blazar catalogues. As for the factors of picking blazars as neutrino source candidates, we chose detection of flare. We will call a blazar optically anxious (or in a flare state) if at the moment of observation, its optical magnitude is less than median$-\Delta_M$, where the median is calculated over the entire observation history of the blazar, and the delta is a number greater than zero which we assumed to be equal to 1m. We found 4 flares out of 36 blazars visible on our frames near neutrino events with long-term optical light curves, including TXS 0506+056 and PKS

0735+178. Due to low optical brightness of blazars from IceCube error box most of the neutrino events were excluded.

We found 4 flares that were imaged by our telescopes in the first day after neutrino event. These are TXS 0506+056/IceCube-170922A, PKS 0735+178/IceCube-211208A, 5BZB J0201+0034 /IceCube-220225A, 5BZU J0242+1742/IceCube-211125A. Of them, TXS 0506+056, PKS 1735+178 exhibited both flare and large amplitude variations. Surprisingly enough, 3 out of 4 blazars are located outside of the 90% localization as defined by SRC_ERROR from AMON notice. If we take into account galactic absorption, 2 of these blazars are at 14-15 magnitude and the rest are dimmer than 16m.

To find whether or not these flares can even be connected to neutrino events, we decided to find a typical background rate for such flares. For that, we analyzed more than 80000 optical observations of 276 blazars from 25th January 2004 to 14th July 2023 combined from MASTER and Catalina (https://catalina.lpl.arizona.edu/) observations. As a result, we found 1452 observations out of 79477, which according to our definition would be classified as flare. Assuming that the observations of blazars were random in time, we get an estimate of the frequency of "random" flare. Comparing this frequency with the frequency obtained for blazars near neutrino events, we get a difference at the significance level of 4.2 sigma (see Methods for more details).

Using this set of sources, we can estimate an average neutrino detection number from blazars optical flares.

Considering that Roma-BZCAT holds 3561 sources and that the average rate of visible background flares is 1452 per 79477 observations of 276 bright blazars, we obtain the average number of 60 optically anxious blazars on the sky at every given moment. Using signalness of neutrino events as a probability of its astrophysical origin we found that 34 out of 87 events are likely astrophysical which means that an astrophysical neutrino arrives, on average, every 47 days. If blazars are responsible for at least a part of measured neutrino flux then the average neutrino detection number from optically anxious blazars is less than $2 \cdot 10^{-4} \nu_{\mu}/day$ from optically anxious blazars.

This neutrino flux is consistent by an order of magnitude with predictions [69] and with a low number of several detections of one source.

V. DISCUSSION

High-energy neutrino events are mysterious events. Although it is believed that a large number of such events are formed as a result of blazar outbursts, for a long-time astronomers could not find evidence of this.

As a result of the analysis of 2 blazars TXS 0506+056, PKS 0735+178 as probable sources of high-energy neutrino events, possible optical manifestations of neutrino flares in blazars were found: a bright optical flare and optical variability at a level of 1 magnitudes. It was found that the study of only 90% of localization leads to the exclusion of possible sources of neutrinos from consideration.

Using these facts, a selection was made of 36 blazars from 25 neutrino events, which the MASTER telescopes aimed at on the first day. Of the 36 blazars, 4 showed the behavior expected from neutrino sources: 2 of them were known before (TXS 0506+056, PKS 0735+178), the rest were not considered as neutrino sources.

It was found that 2 of these blazars were very bright ($\sim 14^m - 15^m$) during the event, the rest were much dimmer. These bright blazars also showed a pronounced variability.

Based on this, we assume that the blazars TXS 0506+056, PKS 0735+178 are the likely sources of the neutrino events IceCube-170922A, IceCube-211208A respectively.

At the same time, there is no doubt that the correlation of neutrino events with the activation of blazars in the optical range at times of several weeks and anti-correlation at the time of neutrino detection at times of several hours are consistent with our earlier interpretation in the framework of the process of photonuclear interaction of PEW protons with target potons [7]. Recall that in our model, "PeV" -protons accelerated at the front of booster shock waves accelerated by a black hole along narrowly directed jets generate neutrinos with an energy of hundreds of TeV.

This occurs through two channels of threshold photon-nuclear reactions:

$$p + \gamma_t \to \left\langle \begin{array}{l} p + \pi^0 \to p + 2\gamma_{\mathrm{Fermi}} \\ n + \pi^+ \to n + \mu^+ + \nu_\mu \end{array} \right. \tag{1}$$

produce neutral and charged pions, which then decay into and γ-ray photons (γ_{Fermi}) and muon neutrinos (ν_μ). Both pion-birth reactions are of the threshold type [70].

So π-mesons are born as a result of collision of protons of relativistic jets with photonstargets γ_t. In this case, neutrinos and photons of gamma radiation carry away several percent of the proton's energy. Thus, the neutrino luminosity of blazars is determined precisely by the rate of production of charged π^+ mesons. The main assumption is that protons accelerated at the front of the shock wave of the relativistic booster are the source of synchrotron optical radiation [7]. Then an increase in the neutrino flux follows, and, consequently, an increase in the probability of its registration should be accompanied by the disappearance of protons in proton-photon reactions. As a result, the optical synchrotron radiation of protons will decrease. The amplitude of the decrease in optical luminosity can reach ~ 2 times, since the reaction branches proceed with approximately the same probability, that we observe.

Returning to our static analysis in the previous section, we emphasize the following. Despite the fact that we managed to find 4 blazars-candidate sources of neutrino events corresponding to 4 events, 32 events with unknown sources remain. Even if we assume that most of these events are ordinary noise, then there are about 10 events with an undetermined source (assuming an average signal strength of 30%).

In addition, we must not forget that blazar outbursts occur all the time, and our list probably contains a certain number of background blazars. To refine the list, it is necessary to know the rate of blazar background flares, which, unfortunately, requires many long-term observations. Nevertheless, it is possible to find out this rate from the MASTER data.

VI. EXTREME UNIVERSE.

Immediately after the discovery of his equations, Einstein solved, at first glance, the applied problem of the radiation of gravitational waves by a system of two material points of arbitrary mass. It turns out that such a system, even without the intervention of external and internal forces, cannot be eternal. It constantly emits gravitational waves, but there was another important consequence. The final formula for the power of GW radiation included an amazing normalization value, which Einstein called the natural power (luminosity) a combination of two fundamental constants - the speed of light and the constant of gravity: $L_E = c^5/G = 6 \cdot 10^{59} erg/sec$.

What kind of universe do we live in? In the last century, it seemed that we discovered all its most powerful processes: supernova explosions, galaxies, quasars, blazars and other.

Are these universal catastrophes so powerful? Are they really the dinosaurs of our huge zoo? How to strictly scientifically evaluate their significance for the Universe? Einstein investigated the issue of weak effects of general relativity in a linear approximation. Let's try to find a powerful process in which the maximum energy is released. Let's turn a body of mass m into photons in the shortest possible time. The maximum energy that can be fished out will be mc^2 and the minimum time (for which this can be done) is equal to the minimum size divided by the maximum speed, i.e. the speed of light. The minimum body size is equal to the gravitational radius of the black hole $R_g = 2Gm/c^2$. Then the maximum generated power in such a machine will be equal to $L_{max} \sim c^5/G = LE$. Of course, this value will depend on the relative speed, and if a particle of mass m in the accelerator flies at us almost at the speed of light, then the light energy will be much greater than the rest energy. Astrophysicists look at the Universe and find macro-objects in it: stars, galaxies, quasars ... while the Universe expands, not contracts, and therefore all the Universal cataclysms only run away from us and seem weaker from that. So, now we can build the Richter scale for the Universe. But we took the formulas from the theory of gravity. But there is also quantum mechanics, which has Planck's constant. What do we take the Planck units:

$m_p = \sqrt{\hbar c/G}$, $t_P = l_P/c = \sqrt{\hbar G/c^5}$.

We divide the Planck energy by the Planck time $m_P c^2/t_P$ and again we get $L_P = c^5/G$. The Planck power L_P turned out to be equal to the Einstein luminosity L_E [73]. The Constant Plank has dropped, natural luminosity comes out and really fits the role of a standard candle for the Universe. But what can be measured with such a candle? Yes, the Universe was born with such power. However, it was 13.7 billion years ago. Now if we see the ratio of the luminosity of the brightest objects in the Universe to the maximum luminosity in a logarithmic (see Fig. 4) scale, we see that it turns out that the brightest objects in the universe are hundreds of billions of times weaker than what can be in nature? In the figure, horizontally - the characteristic lifetime of an object or phenomenon. To the chain of objects from right to left: galaxies, quasars and blazars. The greater their power, the shorter the time of their activity. For example, galaxies themselves do not change their luminosity for billions of years. QSO ones, which are a hundred times more powerful, live a hundred times shorter, and the phenomenon of a blazar flare, during which it becomes hundreds and thousands of times brighter than quasars, lasts only a few months. But can not there be even more powerful phenomena in our Universe, for shorter periods of time?

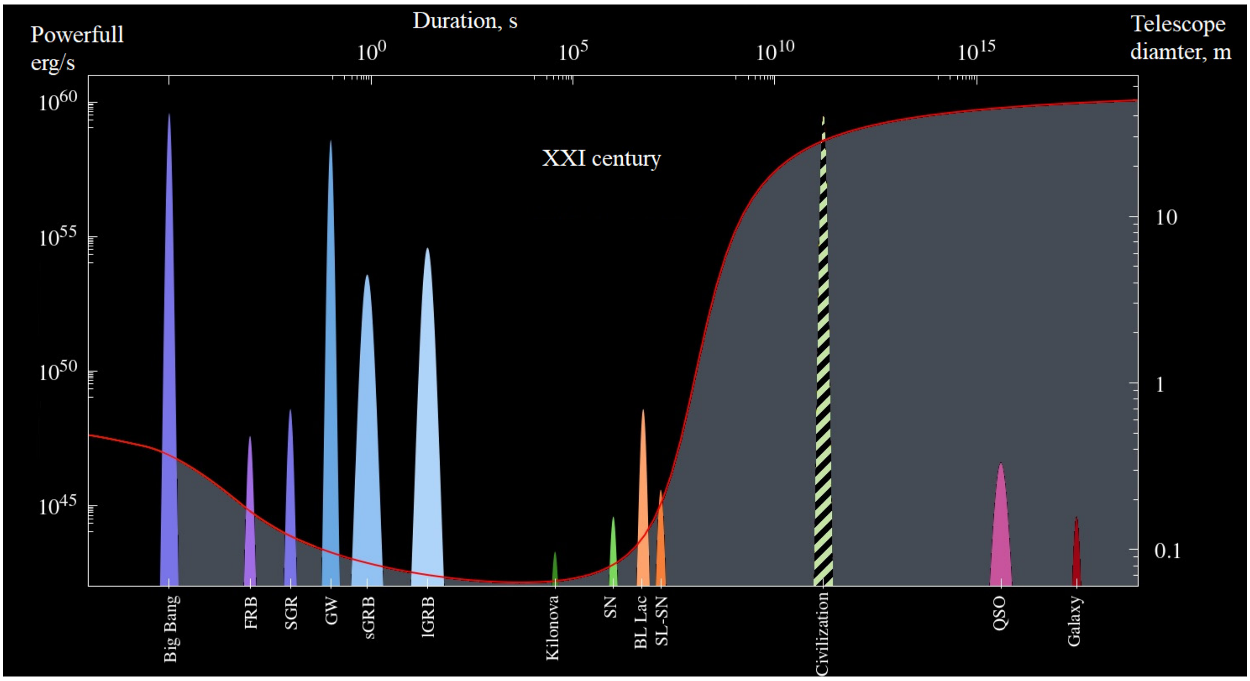

FIG. 4: The Universe in "fifth measurement".There are Fast Radio Bursts, Soft Gamma Repeaters, Gravitational Wave from BH(NS) merging, Short Gamma Ray Bursts, Long Gamma Ray Bursts, Kilonova, Supernovae, Blazars, Superluminous Supernovae

And do we have objects whose power reaches or approaches the maximum limit of c^5/G? It turns out that the processes of collisions of relativistic stars - neutron stars and black holes - are really going on in the Universe. These densest objects in the universe collide in the shortest possible time and are able to radiate a decent part of their rest energy in a fraction of a second. For two neutron stars, the after phase lasts a couple of milliseconds, and black holes are an order of magnitude or two larger and, accordingly, emit gravitational waves at frequencies of hundreds of hertz. What kind of macroscopic reactions take place in the Universe and what is their cross section or, in simple terms, how often do they happen in the Universe?

In the early 80s of the last century, we came up with a special computer code "Scenario Machine" [71,72]. We still do not know for sure the exact laws of the evolution of these objects in the Universe, like, for example, Newton's equation of motion. And there is only a scenario of their birth and life, and sometimes transformation into something new. We did not just try to build a Extreme Universe, but to calculate a whole set of relativistic Universes for different scenarios of evolution and then, compared with what was already discovered by astrophysicists in the sky. And after this comparison, choose the most likely of all reasonable and possible scenarios. We understood that the most interesting thing in the life of relativistic stars happens when they live together. Moreover, a good half of all the stars in the universe are binary. In Scenario Machine program, we filled in all the more or less realistic laws of stellar evolution, the parameters of which made it possible to test different scenarios. The engine of this machine was a two-stroke diesel engine with two blocks of laws of evolution of normal stars and relativistic stars. The initial distributions over masses, orbits, rotational velocities and magnetic characteristics (for relativistic stars) served as gasoline, which were scattered by a random number generator in accordance with the observed characteristics of newborn stars (Monte Carlo method). Thus, we modeled tens of thousands of stellar tracks in a multidimensional space of parameters of orbits, masses, rotations around an axis, and magnetic fields for two components of each system. Especially for programmers, in 1982, when we started this project, we generated by Scenario Machine not harmful carbon monoxide gases, but myriads of relativistic objects never before seen by mankind. There were three reactions of different types and with different products at the end.

$$NS + NS \rightarrow GWB + GRB + BH(NS) + KN \sim 1/10000\, years\, [73]$$

Two neutron stars (NS) are able not only to give rise to powerful gravitational wave (GWB) and gamma-ray (GRB) pulses, but also to give classical astronomers a completely new astronomical phenomenon - the kilonova (KN). In addition, after the merger of neutron stars, an object remains - either a light black hole (BH) or a heavy neutron star. Everything depends on the properties of nuclear matter. The kilonova optical flare accompanying the merger of neutron stars was predicted by Blinnikov et al. (1984) and was later named Kilonova by Bogdan Pachinsky (1998). Gamma-ray burst in 999 cases out of 1000 will miss the Earth. But Kilonova, although it is millions of times weaker than a gamma-ray burst, is omnidirectional and will not fly past us. In addition, it is 1000 times more powerful than the nova flare, and can be observed with small telescopes (up to 1 meter) at distances of hundreds of megaparsecs. Mixed reaction is also prolific, but calculating its probability is much more complicated and took 10 years to develop the Scenario Machine:

$$NS + BH \rightarrow GWB + BH + GRB + KN \sim 1/100000\, years\, [74].$$

It differs little from the previous one in terms of products on the right side and still generates the Kilonova phenomenon. And finally, the third type of reaction is the merger of black holes:

$$BH + BH -> GWB + BH \sim 1/200000 \, years \, [75 - 77].$$

Here, almost all of the released energy is carried away by gravitational waves. And electromagnetic radiation in the standard scenario is unlikely and should not have been expected in the first decade of operation of gravitational wave detectors. Thus, for the first time we managed to predict not only the result of the first successful registration of gravitational waves, but also to determine the distance to the first registration of Kilonova. First we calculated the probability of a collision of neutron stars in a galaxy like ours in 1987. The probabilities of a mixed-pair merger reaction for 1995 and binary black holes in 1997. In addition to these processes, the Scenario Machine made it possible to calculate other processes in our Extreme Universe. It was about the formation of rapidly rotating black holes, which are accompanied by long gamma-ray bursts. In addition, another new phenomenon in the Universe, Fast Radio Flares, was also predicted [78]. All the main processes of the Extreme Universe were modeled, and by the end of the 20th century, the task of experimental research in different electromagnetic ranges arose.

VII. CONCLUSIONS

We presented MASTER Global Robotic Net highlights in gamma-ray bursts, gravitational wave events, fast radio bursts, high energy neutrino events sources investigation. For the IceCube-211208A event we made follow-up observations and found the blazar PKS 0735+17 in a dimmed state, against the background of a longer-term increase in optical activity. We also analyzed all cases of successful observation of blazars around neutrino events time and obtained statistically reliable indications of the relationship between neutrino events and blazars in the error squared at the 4.2 σ level. We also made a short review for extreme Universe processes, that can be observed by MASTER.

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