PROCEEDINGS OF SCIENCE

Concluding remarks-1

G. S. Bisnovatyi-Kogan*
Space Research Institute, Russian Academy of Sciences,
Profsoyuznaya 84/32, Moscow 117997, Russia
and
National Research Nuclear University MEPhI
(Moscow Engineering Physics Institute), Kashirskoe Shosse 31, Moscow 115409, Russia
E-mail: gkogan@iki.rssi.ru

The most exciting scientific result of recent time was a discovery of the gravitational wave (GW) burst from two neutron stars merging, registered by three GW instruments, and confirmed by accompanying observations in different ranges of electromagnetic spectrum. Other GW bursts were detected from two massive black hole merging, as isolated events, with lower S/N ratio. Important results have been obtained in study of reionization in the universe, high energy particle detection in LHC, Ice Cube, cosmic rays at different CR installations, etc.

Frontier Research in Astrophysics - III (FRAPWS2018)
28 May - 2 June 2018
Mondello (Palermo), Italy

*Speaker.

PoS(FRAPWS2018)089

The most exciting discovery of last years is the detection of gravitational wave (GW) bursts on two LIGO instruments (USA), and VIRGO (Europe, Italy). Most bursts were identified with merging of two massive black holes from the distance ~ 400 Mpc (BH+BH), and one was identified with merging of two neutron stars (NS+NS). The last one was detected by all three instruments, and had a high level of reliability. This GW burst was the only one, accompanied by radiation in different regions of electromagnetic spectrum, from radio until gamma. It came from much shorter distance (~ 40 Mpc), and was theoretically anticipated from the statistical analysis of binary pulsars in our Galaxy, containing two neutron stars. From these multimessage observation follow several restrictions to fundamental physical properties of matter. Merging of neutron stars leads to strong outburst of matter overabundant by neutrons, It is expected in such outbursts, a formation of very heavy elements from gold to uranium, in r-processes, predicted by Mayer & Teller (1949), in their paper "On the Origin of Elements" [1].

There were talks devoted to high energy physics, studied in laboratories (LHC), and in astrophysical experiments (Ice Cube, Pierre Auger et al). The search of dark matter, observations of high energy neutrino and cosmic rays were presented.

Lot of attention was given to X-ray and Gamma-ray astronomy, with dates from space orbital stations and satellites. The observations and their interpretations were presented, concerning gamma ray bursts, extragalactic jets, X-ray binaries and disk accretion.

In the lower energy region was a study, observational and theoretical, of exoplanets, astrochemistry, speculations about the origin of life and its possible existence on Earth type exoplanets.

Future experiments are very interesting, but for most of them we should wait for very long time, up to the year 2060!

Old theoretical problem of stellar dynamic concerns thermodynamic properties of open systems (stellar cluster). New approach to this problem was discussed in the talk of M. Merafina, which is based on the correct statistical approach. It predicts the observational properties of globular clusters much better, in comparison with earlier theories.

Interesting new results in cosmology have been presented, which are are connected with optical and radio observations for a search of the beginning of the epoch of Reionization in the universe. The optical observations of distance quasars were devoted to the search of the absorption in the tail of Lyman α emission line (Gunn-Peterson effect) from the quasar ULAS J1120 + 0641 at redshift z = 7.09 [2].

Bowman et al. An absorption profile centred at 78 megahertz in the sky-averaged spectrum was observed, related to the 21 cm (1420 MHz) hydrogen radio line absorption in the universe [3], see Fig.1.

The form of this absorption line indicates to the start of the REIONIZATION in the universe at redshifts $z \sim 20$!

JOKE ABOUT GW REGISTRATION (information for consideration)

Let me pay attention to the peculiar property of the registered GW bursts from 2 massive Black Hole merging, connected with the time of the day, and with frequencies of their registration. The most energy of these GW burst is related to frequency interval from ~ 100 to ~ 200 Hz.

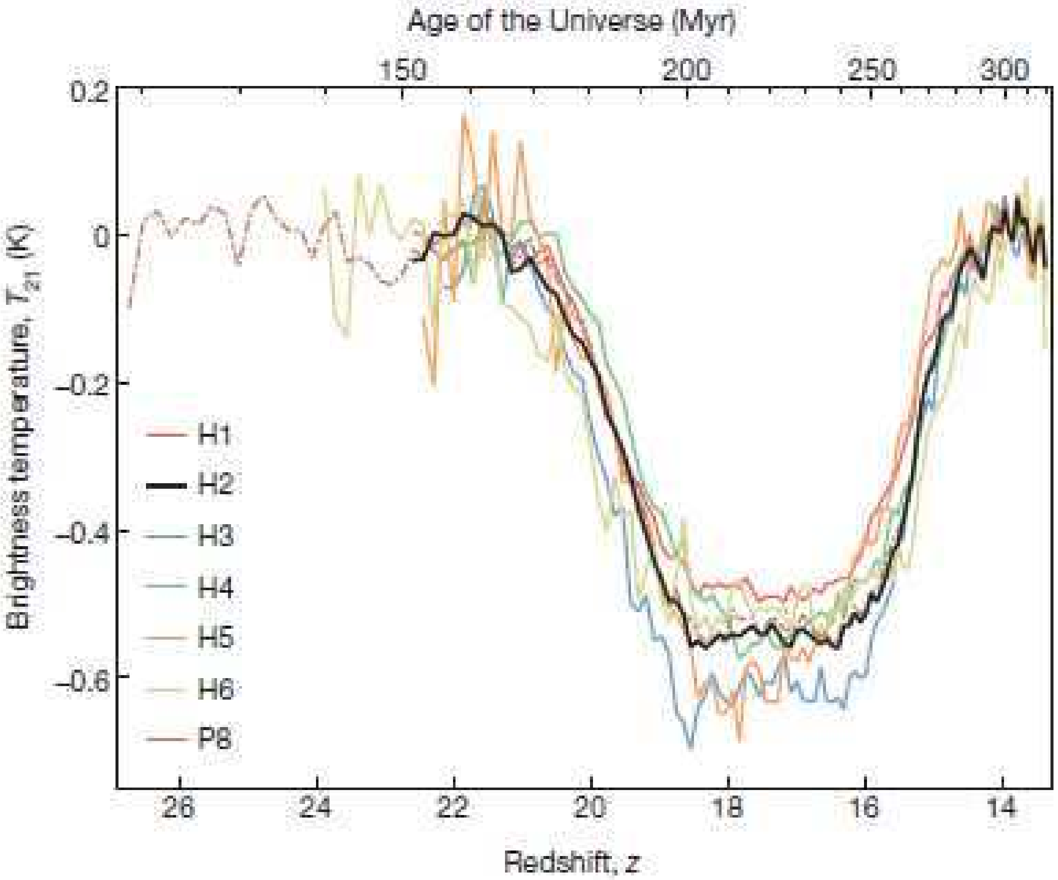

Figure 1: Best-fitting 21-cm absorption profiles for each hardware case. Each profile for the brightness temperature T_{21} is added to its residuals and plotted against the redshift z and the corresponding age of the Universe. The thick black line is the model fit for the hardware and analysis configuration with the highest signal-to-noise ratio, processed using 60 - 99 MHz and a four-term polynomial. The thin solid lines are the best fits from each of the other hardware configurations (H1, H3 - H6). The dash-dotted line (P8), which extends to $z > 26$, is reproduced from Fig. 1e, [3], and uses the same data as for the thick black line (H2), but a different foreground model and the full frequency band.

As indicated in [7], "a modern fuel-injected gasoline engine can achieve remarkable flexibility in automobile applications, and a relatively flat power output from 1,500 to 6,500 RPM", what corresponds to the frequency 25-110 Hz. In presence of any deviations of an axial symmetry this rotation will be accompanied by the GW radiation at double frequencies between 50 and 220 Hz, what in a good coincidence with the above mentioned registered GW frequencies. The properties of all 7 GW, registered to the moment, are listed in Table.1 in order of dates of their registration.

A strange feeling appears after sorting the GW according to the time of day of their appearance, see Table 2. It is clear visible, that majority of bursts (four), detected during years 2015-2017, were all registered during only 40 minutes of the day interval (see Table 2). Two bursts were registered inside 1.5 hour interval, and the only GW burst from merging of two NS, with much higher reliability of GW detection, and numerous confirmations for electromagnetic observations, was registered at the time of the day very different from the others.

Could it be, that police is inspecting on the auto the area around LIGO detectors, at almost the same time of the day, producing a noise, registered as GW burst ?

I would like to express my deep gratitude to the organizers, and first of all, to Franco Giovannelli.

References

[1] Mayer M.G., and Teller E., Phys. Rev., **76**, 1226 - 1231 (1949)

[2] Bañados E., Venemans B.P., Mazzucchelli C. et al. Nature **553**, 473 (2018)

[3] Bowman J.D., Rogers A.E., Monsalve R.A., et al. Nature **555**, 67 (2018)

[4] https://en.wikipedia.org/wiki/List_of_gravitational_wave_observations

[5] Abbott B.P., Abbott R., Abbott T.D., et al. Phys. Rev. Lett. **119**, id.141101 (2017)

[6] Fargion D., Lucentini P.G.S., Oliva P., Khlopov M. PoS(MULTIF2017)009 https://pos.sissa.it/cgi-bin/reader/conf.cgi?confid=306

[7] https://en.wikipedia.org/wiki/Power_band

Table 1: Observational data about gravitational wave events [4, 5, 6]

GW event	Detection time (UTC)	Date published	Luminosity distance (Mpc)	Type	σ (S/N)
GW150914	09:50:45	2016-02-11	440^{+160}_{-180}	BH+BH	5.1
LVT151012	09:54:43	2016-06-15	1000^{+500}_{-500}	BH+BH	1.7 (9.7)
GW151226	03:38:53	2016-06-15	440^{+180}_{-190}	BH+BH	5.3
GW170104	10:11:58	2017-06-01	880^{+450}_{-390}	BH+BH	(13)
GW170608	02:01:16	2017-11-16	340^{+140}_{-140}	BH+BH	(13)
GW170814	10:30:43	2017-09-27	540^{+130}_{-210}	BH+BH	(18)
GW170817	12:41:04	2017-10-16	40^{+8}_{-14}	NS+NS	(32.4)

Table 2: Observational data about GW events, sorted by the time of the day

GW event	Detection time (UTC)	Date published	Luminosity distance (Mpc)	Type	σ (S/N)
GW150914	09:50:45	2016-02-11	440^{+160}_{-180}	BH+BH	5.1
LVT151012	09:54:43	2016-06-15	1000^{+500}_{-500}	BH+BH	1.7 (9.7)
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