CMB and ultraluminous QSOs – alternative explanations.

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Abstract

The hypothesis of Burbidge & Hoyle based on the equality of CMB energy density and the energy density released in the synthesis of helium from hydrogen in stars, as it was first noticed by Fowler, and the recent observational confirmations of this point of view are discussed.

Several superluminous QSO, namely SDSS J010013.02+280225.8 and J030642.51+185315.8 can be explained as gravitational lensing by globular clusters or dwarf galaxies located at cosmological distances. The luminosities of these and several other similar objects can be amplificated by 5-8 magnitudes because of gravitational lensing. We also made a brief overview of several papers on the alternative hypotheses of the physical nature of redshift, namely the gravitational redshift and tired light.

Introduction

Usually it is accepted that modern cosmology seems to be able to explain the main properties of observed Universe. Of course it will be necessary to make additional observations with next generation of ground based and space telescopes. It was expected that it will be used for confirmation of standard picture of the Universe with higher precision. But the observational results of the last decades, for example the high-redshifts supernovas, gamma-ray bursters, etc. required to accept more and more postulates to explain it. First of all these are the acceleration of expansion and the dark matter.

In this short poster we will try to make only a brief overview of part of our publications dealing with the alternative explanations of well known observational phenomena. No efforts will be made for detailed comparison of these alternatives explanations and standard point of view. We did not try to show the full bibliography, and all our investigations. Only main results will be mentioned, more details and citations can be found in original papers. The first part of the poster describes the CMB, the second deals with recently discovered ultraluminous QSOs,

the third part takes your attention for comparison of several hypotheses on the nature of redshift, namely the hypothesis of gravitational redshift in fractal Universe and tired light.

Cosmic microwave background as an energy output of p-p cycle in stars ?

In the middle of the former century it was realized that the nuclear reactions can be at least one of the main sources of stellar energy. The main part of energy output should be the result of hydrogen to helium transformation (p-p cycle). If you can estimate the mean number of stars in observed Universe and the helium abundance it is easy to predict the energy density released as a result of this transformation. It is natural to expect the detection of this energy density in the form of high-energy photons.

The technical level of that time allowed finding of this background energy, but nothing was detected. As a result it was accepted that main part of helium was created not in stars, but in Big Bang. Burbidge et al. (1957, B2FH here after) constructed the theory of synthesis of chemical elements in stars. This paper was one of the fundamental stones in the construction of modern cosmology. Several years later microwave background radiation was discovered and explained as one the main confirmations of hot phase in the evolution of Universe. The theory is now accepted as a part of standard cosmology.

But it is very interesting to follow B2HF publications. In 1970 Fowler found that the energy density of CMB is equal to the energy density released as a result of p-p cycle in stars, if all helium atoms were synthesized in this process. The title of his paper is "How Now, No Cosmological Helium?". Fowler accepted his own result as a case coincidence (Fowler 1970). At that time the age of the hot Universe was estimated to be of the order of 10^{10} years and this time was not sufficient for transformation of gamma-photons to microwave photons by any reliable physical process.

In the last decade of the former century Burbidge, Hoyle and Narlikar (Hoyle et al. 1996, Burbidge & Hoyle 1998 and reference therein) developed B2FH theory and pointed that the age of the Universe can be much longer than 10^{11} years. If one accepts this time, the CMB energy density can be explained as a result of absorption of p-p cycle gamma-quants by cosmic dust particles and reemission at longer wavelength. Narlikar et al. (2003) showed that the fluctuations of CMB detected by first spacecrafts can be explained by this model.

Yershov et al. (2012, 2014) found the signs of contamination of PLANCK data by radiation of foreground object. The recent publications of other researches also confirm the existence of unpredictable part of dust radiation at high redshift, first of all in HERSCHEL data.

Baryshev & Raikov (1988) proposed another alternative explanation of CMB. The base was the coincidences of big numbers (10^{40}-10^{80}) in the Universe at

Hubble scales. The predicted temperature was close to observed value. Maybe it was the last publication dealing with this topic.

Burbidge (2005) pointed also the possibility of creation of light elements as a result of flare reactions in stellar atmospheres. One of the possible scenarios of lithium synthesis was proposed by Gopka et al. (2014). Havnes (1971a, b) proposed the idea of braking the stellar rotation and the synthesis of low energy galactic cosmic rays (with energy less than 200 Mev/nucleon) as a result of accretion of interstellar gas on the surfaces of main-sequence stars. Yushchenko et al. (2015) found observational confirmations of these hypotheses.

Superliminous QSOs as a result of gravitational lensing by globular clusters at cosmological distances ?

Wu et al. (2015) and Wang et al. (2015) discovered ultraliminous QSOs at redshifts 6.3 and 5.3 respectively. We will not citate many researches who tried to explain the physical nature of these objects. In the frames of standard cosmology the discovered objects have to high luminosity to be explained without exotic hypotheses. Of course we can not exclude that one of the proposed explanations will be a true one.

It is worth to note that gravitational lensing was not used for explanation of these QSOs. It is natural because nor galaxies, nor the stellar content of galaxies (microlensing) can not provide the reliable model of observed sources. But it is necessary to point that there is the third type of gravitational lenses – globular clusters at cosmological distances as well as dwarf galaxies with King mass density profile.

Baryshev et al. (1993), Yushchenko et al. (1998), Baryshev & Ezova (1997), Buchmastova (2001, 2003, 2007) investigations of this type lensing can be summarized as follows. Objects with King mass density profiles can be an efficient gravitational lenses at cosmological distances. The maximum amplification can be of the order the ratio of observed angular squares of the lens and the source. If the source is a small object at high redshift the amplification can be as high as 5-8 magnitudes. This type of lensing was used for explanations of QSO-galaxies associations discovered by Arp.

Later Yushchenko et al. (2001) and Yushchenko et al. (2003) pointed that microlensing can decrease the pointed amplification and even make it negative at certain, but not at all redshifts and found the possible observational confirmations of this phenomenon. But the expected probability of proposed high amplification was not high and the observations allowed other explanations. It was one of the reasons of interruption of our investigations.

The quick increase of observed high redshift objects in the last decade allow us to point that even the cited low probabilities are sufficient to expect for detection of several objects with very high amplification due to lensing by King mass objects now, when we detect of the order of one million QSOs.

Raikov & Orlov (2016b) pointed the sufficient propability of lensing for explanations of several superluminous QSOs, including SDSS J010013.02+280225.8 and J030642.51+185315.8.

In the nearest future we are going to investigate in more details the influence of microlensing and to find the range of possible redshifts for lenses. The observational detection of globular clusters in the direction of ultraluminous QSOs will be very difficult, but our estimates of the probability of high amplification are consistent with observed number of these type QSOs and allow the exclusion of other hypotheses.

Redshift – is it Doppler effect ?

The physical nature of redshift is still not clear. Of course it can be explained by Doppler effect, but other possibilities are discussed. Here after we will overview only two of them – gravitational shift of frequency and tired light mechanism.

The change of photon's energy in the gravitational field was observed in the laboratory and should be described by any theory of gravitation. As it was pointed by Coleman & Pietronero (1992) and Baryshev et al. (1994) the observed Universe is a fractal, and the dimension of this fractal can be close to 2. In this case the shift of photon's energy can be explained as the result of gravitation, without expansion (Baryshev et al. 1994).

The only one, but very important problem is the sign of this shift. It can be red or blue. At present time there is no clear understanding of the sign of gravitational shift at cosmological distances. Recently Raikov et al. (2010), Raikov & Orlov (2011) and Raikov et al. (2014) proposed the new method to find fractal dimension and used it to find the fractal dimension of the distribution of gamma-ray bursts and supernovas. It allows estimation the fractal dimension at redshifts as high as 2 or 3.

Several tests were proposed to accept or reject the reality of expansion. It is worth to note the Alcock-Paczyński cosmological test - an evaluation of the ratio of observed angular size to radial/redshift size (López-Corredoira 2014).

Tired light hypothesis is the decrease of photon's energy as a result of interaction with unknown very small particles, which can take the photon's energy but can not change it's direction. Tired light effect was not observed in laboratory, but it is easy to understand the physical nature of this phenomenon. At least it is much easier than, for example, the inflation.

Several cosmological tests were discussed for tired light model by Traunmüller (2014) and Raikov & Orlov (2016a). It was shown that the tired light mechanism is able to explain the main properties of observed objects at high redshifts. It can be one of the very few reliable physical effects for explanation of redshift.

Conclusion

In recent century a lot of new remarkable discoveries were made in cosmology – from redshift, QSOs and large-scale structure to gamma-ray bursts. Most of them were unpredictable. The explanations of these phenomena were made by introducing the new postulates in standard cosmology – expansion, inflation, evolution, acceleration, …

Is it compatible with Occam's razor principle? It is better to explain new observations without accepting new postulates. If our theory is a true one, we should predict the observations. Only small part of discoveries was really predicted, another small part was explained without new postulates. Is it time to predict something new for confirmation of one of the existing cosmological models or we will wait for new discoveries and accept new postulates?

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