# Host Galaxies of Cosmic Gamma-Ray Bursts

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**Abstract.** The discovery of gamma-ray burst (GRB) host galaxy back in 1997 brought confirmation of GRBs cosmological origin. Nowadays investigation of the host galaxies often is the only way to estimate the cosmological redshift of GRB sources. The morphology of host galaxies gives clues to the nature of the environment, where the GRBs were born, and allows estimating physical parameters of the circumburst medium. The number of GRB host galaxies with known redshift is still insufficient for large statistical analysis and adding to a sample GRB hosts a few more is important. We present methods of GRB host investigations, results of a modeling of GRB host galaxies from IKI GRB-FuN database and discuss the results in a framework of known host galaxies. Increasing the statistics of GRB host galaxies including short duration GRBs will be helpful in the process of selection of target galaxies in search for counterparts of gravitational wave events in next runs of LIGO/Virgo/KAGRA.

**Keywords:** Gamma-ray Bursts, Host Galaxy, Databases, Photometry, Redshift, Circumburst Medium.



## 1 Introduction

Cosmic Gamma-Ray Bursts (GRBs) are of the most luminous and yet the most mysterious events in the Universe. Many of the aspects of their nature are still unclear or even unknown. Since these events are transient and fade out in optics in several days (rarely weeks), the problem of their observations and investigations is to collect as many data as possible. After the GRB's afterglow fades away, the only way to get more data is to study its environment. And this means to discover and investigate the host galaxy of the GRB. Also, the study of a host galaxy may be the only way to determine the distance to the object, which is crucial for estimates of many physical parameters.

The study of a single galaxy usually requires the collection and joint analysis of a lot of various information from catalogues, archival observational databases and, if possible, new observations in different spectral ranges. This information may be diverse and be stored in different formats, from ordinary journal paper to catalogues with machine-readable tables. Despite the relatively large number of discovered and studied GRB host galaxies (~250 at the beginning of 2021), one of the main problems remains a collection and systematization of their properties into a single database which would be useful for their statistical study. There are very detailed studies which include only one or a few galaxies, and there are large observational programs that include dozens of galaxies with only a few parameters estimated. However, every new single GRB host galaxy added to this list is valuable for statistics of these events and thus helps to enlarge our knowledge about their nature and physics.

In this paper we give a brief overview of modern scientific context of GRB host galaxies, discuss methods of their investigations, observe published surveys and catalogues of discovered host galaxies, and provide some examples of single host galaxy investigations of sources from IKI GRB-FuN database based on our own observations and modeling.

## 2 GRB Host Galaxies: Scientific Context

The first GRB host galaxy discovered was the host of GRB 970228, which was detected after the optical afterglow when the burst faded [1]. This discovery has strongly supported the extragalactic nature of the phenomenon. The confirmation came with the direct spectroscopic measurement of the redshift of the afterglow of GRB 970508 [2]. Since 1997, about 250 of GRB host galaxies were discovered and investigated in one way or another [3], and only ~50 of them were observed with the spatial resolution enough to clearly detect the position of the GRB source in relation to the host galaxy structure [4]. These numbers suggest, that every new discovered host galaxy of the GRB enlarges the statistics of properties of these events. By studying the population of galaxies that produces GRBs and the locations of the GRBs inside their hosts, we hope to identify the GRB progenitor and how it is formed.

The distance to the object is always a key parameter to determine the nature of what we see: knowing the distance allows us to determine whether the object is faint and close or bright and distant. GRBs are extragalactic objects forming on any distances at any cosmological epoch, and the estimate of the distance to the GRB progenitor helps to estimate its energetics and derive many other physical parameters of the outburst, its surrounding matter, and the nature of the progenitor itself. In the case of GRBs, the phase of optical emission may be relatively short-living, faint or even absent (like in 30-40% of cases known as dark bursts; see, e.g., [5]), and the spectroscopy of the optical afterglow may be difficult or even impossible. Discovery and observations of the GRB host galaxy may be the only way to determine the distance to the object and to try to obtain an insight into its nature [6,7]. Redshifts of detected GRB host galaxies vary in a wide range from $z = 0.0085$ (GRB 980425 [8]) to $z \sim 6$ ($z = 5.913$ for GRB 130606A, $z = 6.295$ for GRB 050904, and $z = 6.327$ for GRB 140515A [9]) with a median redshift of about 2.5. The search of galaxies with $z > 2.5$ and their observations is a non-trivial problem. In this sense GRBs attract researchers' attention to faint galaxies, which may never be included in any unbiased sky survey, and thus GRBs may be used to understand distant galaxies. Spectroscopy of a GRB optical afterglow provides rich details of the properties of the absorbing system in a way that is not possible with other observational methods.

The GRB population may be divided in two big groups following the nature of their progenitors: long duration bursts emerge from the collapse of a massive star (e.g. [10]), and short duration bursts link to the merging of a compact binary system with at least one neutron star (NS) [11-13]. Two different types of GRBs trace different host galaxies. The long GRB host population is predominantly young and overwhelmingly star forming, and the burst locations trace this star formation, as measured through host offsets (the distance from the site of the GRB to the center of its host galaxy) [14-16]. Long GRB progenitor locations are consistent with the expected distribution of massive stars, which is in an agreement with their nature of an explosion of a massive star during a core collapse [17,18]. Most of the galaxies are compact and tend to be less luminous [19], which indicates low stellar mass [20] and low metallicity hosts compared to field galaxy samples [21], sometimes interacting with other galaxies [22,23]. Recent researches demonstrate that low metallicity is important for long GRB formation, at least at redshifts $z < 2$ [24]. However, many of dark GRBs are hosted by galaxies which are more massive, dustier and more chemically enriched than the wider population [25].

The host galaxies of short GRBs include late-type and early-type galaxies, and have a large median offset, about five times larger than long GRBs, which is in a good agreement with NS binary mergers [26]. The majority of short GRB hosts are indeed star-forming galaxies, but with moderate amounts of star formation of $\approx 0.1 - 1\ M_{Sun}\ yr^{-1}$, with $\approx 1/3$ in early-type galaxies with limits on their star formation of $< 0.1\ M_{Sun}\ yr^{-1}$ [27]. There are three short GRBs associated with massive quiescent galaxies with no trace of recent star formation at al [28]. There is a subset of ~ 10% of short GRB host galaxies associated with galaxy clusters [29]. But short GRBs are less numerous than long ones (~25% of the whole GRB population), so the increase of their host galaxy statistics is a very important problem.

## 3 Investigation Methods

Once the GRB host is discovered, there may be two different tactics of investigation, depending on the brightness of the galaxy and available instruments.

The first and the most efficient is a spectroscopy. Spectroscopic studies are the most informative, however, they have their natural limitations. The issue is to obtain the optical spectrum of the galaxy with well resolved emission lines with high enough signal-to-noise ratio. So, the distance to the galaxy may be determined with a good precision by measuring the observational wavelength of identified spectral lines and comparing it to the rest frame values. Physical properties of the galaxy may be derived comparing the obtained spectrum with that of well-studied galaxies of the local universe or with modelled synthetic spectral energy distributions (e.g., [31]). The ratio of flux in the emission lines of heavy elements like oxygen and nitrogen to flux of lines of hydrogen series allow to determine the galaxy average metallicity – a key parameter of interest from the point of view of distinguishing GRB models, and so spectroscopy is critical to establish a firm understanding of GRB formation (e.g., [32]). In case of the close, spatially resolved galaxy the optical spectrum may be obtained for different slit positions, which allows to investigate the structure of the galaxy, and estimate the metallicity and star formation rate for its different regions [33].

However, detailed spectroscopic observations of GRB hosts remain challenging, in particular at $z > 1$: prominent tracers of the physical conditions in the hot gas are redshifted into the NIR where spectroscopy traditionally is much less efficient. Spectroscopic data for $z > 1$ GRB hosts from emission lines is therefore available for only a handful of cases (e.g., [34]), and even at $z < 1$ there are only couple of dozens of events with detailed information on the host's gas properties [35, 22].

The second way and the most easily available one is a broad-band photometry. In fact, photometrical observations are the basis for the host galaxies discovery, and telescopes with a diameter of 1-meter can effectively discover galaxies as faint as $\sim 22^m$. Unfortunately, these observations give only positional information and cannot tell anything about the distance to the object, besides that it is closer than $z \sim 4$. This limitation comes from the Lyman-cutoff, that effectively absorbs the light with wavelength less than $912(1 + z)$ Å, as it passes through intergalactic medium. However, if the galaxy is observed in several optical filters, each filter, combined with each other along the wavelength, may be presented as a "spectrum" with very low resolution of couple of hundreds of Angstroms (a typical full width at half maximum of a broad-band optical filter is ~ 200-300 Å). Thus, the flux of the galaxy in different filters draws a silhouette of a galaxy's spectral energy distribution (SED) and may give clues to some galaxy properties, even help to estimate its distance.

This idea lies in the basis of the photometric redshift techniques. Back in 1962 Baum was the first who applied it to the measure of redshifts for elliptical galaxies in distant clusters [36]. Photometric redshift estimate is based on the detection of strong spectral features, such as the 4000 Å break, Balmer break, Lyman decrement or strong emission lines. In general, broad-band filters will allow to detect only "breaks", and they are not sensitive to the presence of emission lines, except when their contribution to the total flux in a given filter is higher or of the same order of photometric errors. All realizations of this idea include the same algorithm [37-39]: the magnitudes in each filter are converted to flux at the middle wavelength of the filter, and then the resulting broad-band SED is fitted with the synthetic spectra from the libraries, simulated based on the theory of stellar and galactic evolution. The model spectrum may be shifted by redshift, absorbed with additional galactic extinction, and normalized to the observed flux. The model best-fitted to the observations gives the estimate of the redshift, the extinction of the host galaxy, and its main physical parameters, set up for the synthetic spectrum: absolute magnitude, UV and NIR luminosity, morphological type, main extinction law, mass, age, and average star formation rate.

Spectroscopic observations give more precise value of the galaxy distance and help to obtain many valuable physical parameters, however, the distance measurement is highly restricted in NIR, and it often involves large telescopes, like Keck, Gemini, GTC, VLT [40,22], which observational time is expensive in many senses. Photometric observations, in many cases, provide only imprecise estimates of parameters, and some of them cannot even be estimated (e.g., metallicity), however, they may effectively use instruments of medium size of 1-3 meters, and observe in NIR galaxies with very high redshifts of ~6-9 [41,9].

## 4 Catalogues of GRB Host Galaxies

In this Section we observe some collections of GRB host galaxies: both dedicated surveys and compilations of publications. Building a unified database of properties of GRB host galaxies remains one of important and yet unresolved problems of astronomical data arrangement.

Vergani et al. [20] and Japelj et al. [42] used a complete sample of 58 host galaxies from the *Swift*/BAT [43] to study the low-redshift host population (z < 1), while Palmerio et al. [44] extended that to $1 < z < 2$. The galaxies were observed with GROND, TNG, Gemini, VLT, *Hubble Space Telescope*, and *Spitzer*. They compared the luminosities and stellar masses of the GRB host galaxies to those of star-forming galaxies in the UltraVISTA [45] survey within the same redshift range. They found that LGRBs tend to avoid massive galaxies and are very powerful in selecting a population of faint star-forming galaxies, and that the properties of LGRB host galaxies evolve between $z < 1$ and $1 < z < 2$. Their median stellar mass increases from $<\log(M_*/M_{Sun})> = 9.0^{+0.1}_{-0.2}$ to $9.4^{+0.2}_{-0.3}$, their median star formation rate increases from $<SFR> = 1.3^{+0.9}_{-0.7}$ to $24^{+24}_{-14}$ $M_{Sun}$ yr$^{-1}$, while their median metallicity remains constant at $<12 + \log(O/H)> \sim 8.45^{+0.1}_{-0.1}$[1]. The stellar mass evolution was found for LGRB host galaxies to be weaker than that expected following their SFR evolution, which supports the hypothesis of a certain threshold of metallicity preferred by GRBs [46].

The Optically Unbiased GRB Host (TOUGH) survey [47,48] is the first such survey to make use of the strategic advantage of Swift to realize the production a sample of 69 long GRB host galaxies selected by accurate X-ray localization, VLT observability, redshift completeness, and unbiased by optical criteria such as afterglow detection or brightness. The authors observed all 69 GRBs localization sites and searched for host galaxies in *R* and $K_s$ filters. The host was discovered in 80% of cases, and for them the luminosity function was investigated. It was found, that the luminosity function is most compatible at all redshifts a model containing both a metal-independent (binary progenitor) and metal-dependent (single star collapsar) channels with a relatively high level of bias toward low-metallicity hosts.

The Swift Gamma-Ray Burst Host Galaxy Legacy Survey (SHOALS) is a multi-observatory high-redshift galaxy survey targeting the largest unbiased sample of long GRB hosts yet assembled (119 in total) [19,49]. In fact, SHOALS is the largest, most redshift-complete, unbiased host galaxy sample available and extends out to $0.03 < z < 6.29$. The selection criteria were almost like in TOUGH survey, but the observatories used were not limited to VLT only: the survey gathers photometric and spectroscopic data from Keck I, Gemini North and South, GTC, VLT, GROND, and *Hubble Space Telescope*. The survey also includes NIR observations from *Spitzer* space observatory. The estimates of redshift allowed to measure the evolution of the GRB rate with cosmic

[1] Note, that solar metallicity in these units is 12+log(O/H) = 8.69.

time, which shows a rise in the GRB rate from z ~ 6 to z ~ 2, followed by a drop of an order of magnitude from z ~ 2 to the present time – the same pattern seen by traditional metrics of the cosmic SFR density. Also, the median host NIR luminosity does not evolve much between z ∼ 5 and z ∼ 1.5, but at lower redshifts (z < 1.5) the average luminosity drops by over a factor of 10.

Krühler et al. [22] obtained VLT/X-Shooter emission-line spectroscopy of 96 galaxies of long GRBs at 0.1 < z < 3.6. They found the evolution of some host parameters with the redshift. The intrinsic host extinction $A_V$ tend to be higher at larger redshifts, which is consistent with a similar behavior observed for GRB afterglows. The authors also found a strong evolution of the median SFR with redshift, which evolves from $SFR^{med}$ = 0.6 $M_{Sun}$ $yr^{-1}$ at z ∼ 0.6 up to $SFR^{med}$ = 15 $M_{Sun}$ $yr^{-1}$ at z ∼ 2, above which it does not increase significantly any further. This result is consistent with that of TOUGH survey. Also, there was found, that > 80% of the studied hosts have metallicity twice lower than a solar one.

Lyman et al. [50] presented *Hubble Space Telescope* WFC3/F160W Snapshot survey of the host galaxies of 39 long GRBs at z < 3. The sample is fainter than a distribution expected from a field galaxy population. Morphologically, the population is shown to be comprised mainly of spiral-like and irregular-like galaxies but with some fraction of elliptical-like and merging systems. Also, hosts become more concentrated and less luminous at lower redshift, consistent with the cosmic downsizing of star formation. Authors found that long GRBs are strongly biased towards exploding in bright regions of their hosts. This bias exists for LGRBs at all offsets (i.e. larger offset bursts preferentially explode on the brighter outer regions of their hosts).

Chrimes et al. [25] present a study of 21 dark GRB host galaxies, predominantly using X-ray afterglows obtained with the *Chandra* X-Ray Observatory to precisely locate the burst in deep *Hubble Space Telescope* imaging of the burst region. A concentration and asymmetry analysis provides marginal evidence that dark GRB hosts are more concentrated than the hosts of optically-bright GRBs. Otherwise, the morphologies of these galaxies are consistent with the wider GRB host population. In agreement with previous studies, the authors have shown that dark gamma-ray bursts occur preferentially in galaxies which are larger and more luminous that those hosting optically bright bursts. Dark bursts trace their host light in a similar way to bright GRBs, with no evidence for a smaller offset bias.

GHostS – GRB Host Studies [3] contains the list of publications, which presents studies of GRB host galaxies in the period from 1997 to 2015. It collects 432 papers about 245 host galaxies of 230 GRBs and 15 X-ray flares.

## 5 GRB Host Galaxies from IKI GRB-FuN Database

The Space Research Institute Gamma-Ray Burst Follow-up Network (IKI GRB-FuN [30,51]) started operation in 2001. It is an is overlay network spread on the existing facilities and using dedicated time of telescopes of many different observatories in Russia and several other countries. Nowadays the network comprises of about 25 telescopes with aperture from 0.2 to 2.6 meters located in different observatories all over the world; the IKI GRB-FuN is also collaborating with ISON network [52] and other observatories by submitting proposals for large aperture telescopes. Database counts more than 500 GRBs with at least one observation available, and 20% of the objects have light curves with more than 10 photometry data. The observations are obtained in different phases: search for optical counterpart, a few prompt observations, early and late time afterglow observations (most of data), supernovae (13) and candidate in supernovae associated with GRBs (4), kilonovae (3), and host galaxies of GRBs (48). Here we present some results of photometric investigations of several GRB host galaxies, extracted from our database.

**GRB 181201A.** GRB 181201A was a powerful long (~180 s) burst detected by INTEGRAL on the southern hemisphere. The observations of the optical afterglow revealed the flux decay according to simple power law, and the spectroscopic redshift of z = 0.45 [53] suggested the search of presence of the supernova feature in the late light curve [54]. The host galaxy of the burst was observed 8 months and ~1.7 years later with 2.6-meter ZTSh telescope of Crimean Astrophysical Observatory and 10-meter SALT telescope of South-African Astronomical Observatory. We detected the host galaxy in *BVRI* and *g'r'i'z'* filters and also used archival observations from Legacy Surveys (Data Release 8, [55]). Based on the observations of the host galaxy of GRB 181201A, we simulated its emission using the *Le Phare* code [38,39] developed to fit the spectral energy distribution of galaxies and to compute their physical parameters, with the PEGASE2 population synthesis model library [56]. The best model at fixed z = 0.45 suggests that the host galaxy of GRB 181201A is an irregular young dwarf galaxy, its age and mass are less than those of the Large Magellanic Cloud (a dwarf companion of our Galaxy) by an order of magnitude (Table 1). Fig.1. presents the photometry of the galaxy with the best-fitted SED. The photometry of the galaxy is crucial for modeling the supernova contribution in the light curve [54].

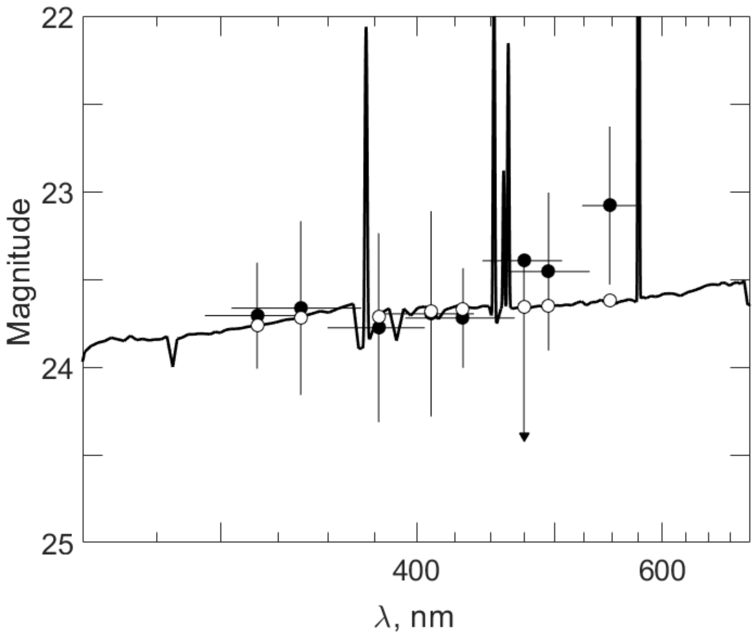


**Fig. 1.** Comparison of the observed *g'Vr'RIi'z'* magnitudes of the host galaxy of GRB 181201A (filled circles from left to right) with the best spectral model (solid line and open circles) [54]. All magnitudes are in AB system.

**GRB 130702A.** GRB 130702A was an ordinary long GRB discovered by Fermi/GBM. We observed the optical afterglow of the burst starting 1.3 days after the trigger with the last observation held in ~90 days after the trigger. The accurate modeling of the emerged bright supernova required the observations of the host to subtract its flux from the supernova light curve, along with the afterglow contribution [57]. The redshift of z = 0.145 of the burst [58] is consistent with the neighboring bright spiral galaxy SDSS J142914.57+154619.3, and in [59] it was suggested, that the host of GRB 130702A is a dwarf satellite of an adjacent massive spiral galaxy. We observed the galaxy in *BR* with ZTSh of CrAO and took *u'g'r'I'z'JK*$_s$ magnitudes from [60]. We also used *Le Phare* code with the PEGASE2 library to model the best SED of the host galaxy and derive its parameters. The host is a relatively old irregular dwarf galaxy with small mass and almost absent SFR and negligible dust extinction (Table 1), which is in a good agreement with results of [59].

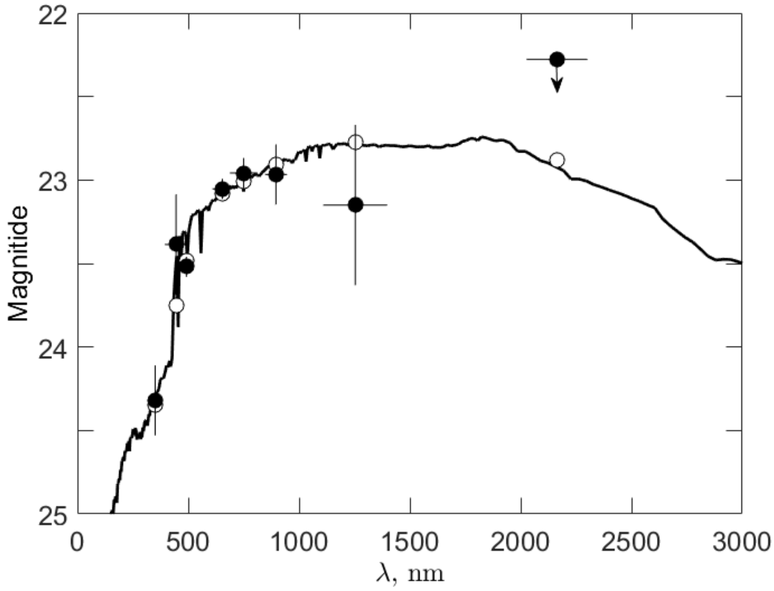


**Fig. 2.** Comparison of the observed magnitudes of the GRB 130702A host galaxy in *u*'*Bg*'*r*'I'*z*'*JK*$_s$ filters (filled circles from left to right) with the best-fitted spectral model (solid line and open circles) [57]. All magnitudes are in AB system.

**GRB 130603B.** GRB 130603B is a short burst discovered by *Swift*/BAT which had the first reliable connection to the kilonova [61]. We combined our observational *BgrR*$_C$*izJHK*$_s$ data obtained with GTC, CAHA, and DOT telescopes with ultra-violet data in *uvw2*, *uvm2*, *uvw1*, and *U* bands from *Swift*/UVOT to construct the broad-band SED of the host galaxy fixing the redshift of z = 0.356 [62]. We used *Le Phare* code with the PEGASE2 library to model the best SED of the host galaxy and derive its parameters. According to the best fit, the host is a young massive spiral galaxy of Sd type with bright luminosity, moderate bulk extinction similar to Milky Way, and it has significant star formation of several solar masses per year. All parameters are listed in Table 1. These results are in a good agreement with other independent spectroscopic studies [63].

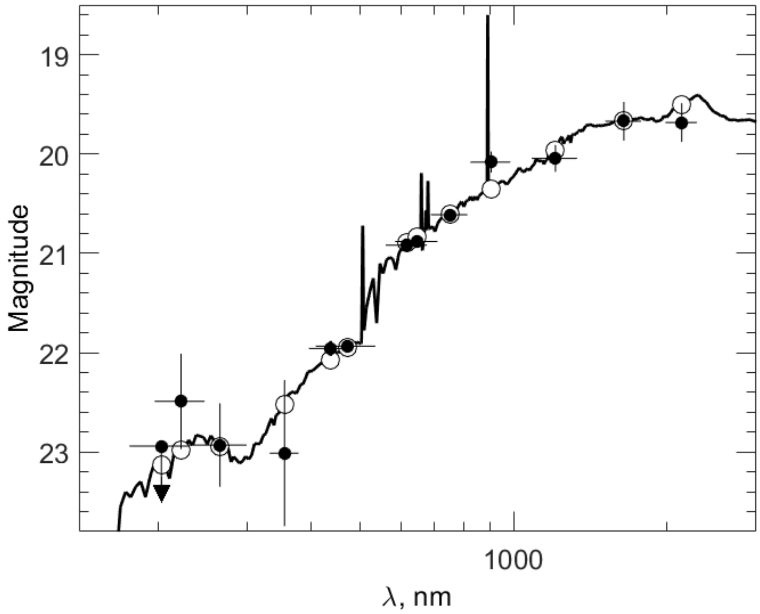


**Fig. 3.** The SED of the host galaxy of SGRB 130603B with fixed redshift z = 0.356 (solid line and open circles). Filled circles depict respectively the data points in the filters *uvw2*, *uvm2*, *uvw1*, *U* from *Swift*/UVOT, and *B, g, r,* $R_C$*, i, z, J, H,* $K_s$ from original observations [62]. All magnitudes are in AB system.

**GRB 051008.** GRB 051008 was a long GRB with absent optical afterglow, so it was classified as a dark burst [23]. Thus, the observations of the host galaxy were the only way to estimate the distance to the source. We discovered the host galaxy with 2.6-meter ZTSh of CrAO and observed it with Keck I and Gemini North telescopes obtaining images in *UBg'VRiIZK'* filters to create a broadband SED of the galaxy. We also tried to make a spectroscopy of the host galaxy using LRIS camera on the Keck I telescope, but the resulting sky-subtracted spectrum of three exposures of 900 s had no obvious line features. We used the *Le Phare* package with the PEGASE2 synthetic library to find the best-fitted modelled SED of the galaxy, also varying the redshift. We found that the host of dark GRB 051008 is a Lyman-break galaxy located in a gravitationally bound cluster at a common redshift of $z = 2.77^{+0.15}_{-0.20}$ with two neighboring galaxies of almost the same size and mass. The host itself is a young bright Lyman-break galaxy with a moderate dust extinction and a substantial burst of star formation (Table 1). The investigations of the host galaxy SED allowed to determine, that the GRB 051108 was dark because of the presence of additional extinction on the line-of-sight [23].

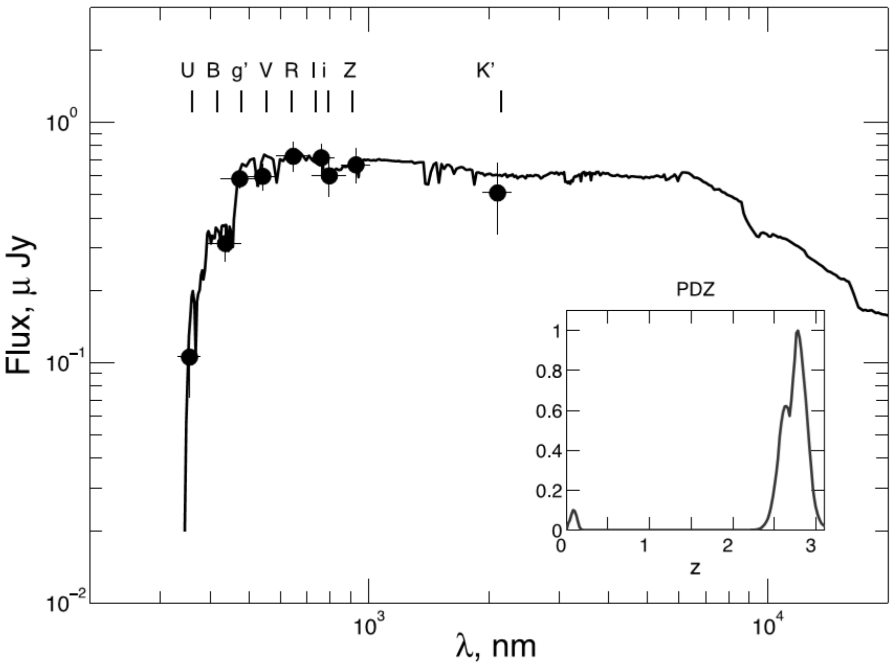


**Fig. 4.** SED of the host galaxy of the GRB 051008 in the observer frame (solid line and open circles). Observed flux in *UBg'VRiIZK'* filters is shown by black circles. The associated Probability Distribution Function of the redshift is shown in the inset [23].

**Table 1.** Summary of the physical properties of GRB host galaxies from IKI-GRB FuN database. GRB type is a final classification of the burst as long duration (collapasar origin) or short duration (compact binary merging), *z* stands for the redshift, SB stands for a starburst type of the galaxy, SFR stands for star formation rate, and *E(B-V)* is a color excess that represents bulk extinction in a galaxy. Age column corresponds to the age of the dominant stellar population.

| GRB name | GRB Type | *z* | Host absolute magnitude, $M_R$ | Host type | Age, Gyr | Mass, $M_{Sun}$ | SFR, $M_{Sun}$/yr | *E(B-V)* |
|---|---|---|---|---|---|---|---|---|
| 181201A | long | 0.45 | -18.5 | Irr | 1.7 | $1.2 \times 10^9$ | 1.0 | 0.2 |
| 130702A | long | 0.145 | -16.2 | Irr | 4.3 | $1.3 \times 10^8$ | 0.05 | 0 |
| 130603B | short | 0.356 | -20.8 | Sd | 0.7 | $11 \times 10^9$ | 5.9 | 0.2 |
| 051008 | long | 2.77 | -22.8 | SB | 0.07 | $1.2 \times 10^9$ | 60 | 0.1 |

## 6 Conclusions

Studies of GRB host galaxies provide information about burst environment and sometimes may be the only way to estimate the distance to its source, like in the case of optically dark GRBs. GRBs attract attention to very distant galaxies up to z ~ 6, where spectroscopic methods become inefficient. The method of photometrical redshift estimate based on the shape of the broad-band spectral energy distribution in comparison with simulated one will always be useful for faint galaxies and suitable for instruments with moderate size of 1-3 meter.

The statistics of GRB host galaxies properties allowed to conclude that long GRBs tend to choose irregular dwarf hosts with low metallicity, intense star formation and mostly young stellar population, which is in an agreement with the nature of long GRBs as a result of massive star collapse. Short GRBs do not show any preferences and pick-up all types of hosts, since binary neutron stars may be presented in the galaxy of any morphological type. Our studies, presented in this paper, add 3 new galaxies to the list of well-studied long GRBs hosts, and 1 galaxy to the list of those of short GRBs. There is 1 new studied host galaxy of a dark GRB, which increase its total number by ~5% (from 21 to 22). Our investigations follow the results of previous studies, confirming that long GRBs prefer young galaxies with relatively high star formation rate. Short GRBs, in turn, does not show any preferences and may occur in the galaxy of any morphological type.

There are several large surveys of GRB host galaxies, overviewed in this work, however, building a joint systematic database of all these objects remains an important problem of modern arrangement of astronomical information. Nevertheless, adding detailed information about every new studied galaxy is valuable for the investigation of GRBs physics.

Increasing the statistics of GRB host galaxies properties provides better understanding of which galaxies are picked-up by GRBs more often. This may be helpful in choosing target galaxies during the search of optical counterparts of the gravitational wave events in the error boxes of LIGO/Virgo/KAGRA detectors.

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