
Four Years of Realtime GRB Followup by BOOTES-1B (2005-2008)

Martin Jelínek¹, Alberto J. Castro-Tirado¹, Antonio de Ugarte Postigo²,
Petr Kubánek^{3,1}, Sergei Guziy¹, Javier Gorosabel¹, Ronan Cunniffe¹,
Stanislav Vítek⁴, René Hudec^{4,5}, Victor Reglero³, and Lola Sabau-Graziati⁶

¹ Instituto de Astrofísica de Andalucía CSIC, Granada, Spain

² Istituto Nazionale di Astrofisica, Milano, Italy

³ Image Processing Laboratory, Universitat de Valencia, Spain

⁴ Fakulta Elektrotechnická, ČVUT v Praze, Czech Republic

⁵ Astronomický ústav Akademie věd (ASÚ AV ČR), Ondřejov, Czech Republic

⁶ Instituto Nacional de Técnica Aeroespacial, Torrejón de Ardoz, Madrid, Spain

Four years of BOOTES-1B GRB follow-up history are summarised for the first time in the form of a table. The successfully followed events are described case by case.

Further, the data are used to show the GRB trigger rate in Spain on a per-year basis, resulting in an estimate of 18 triggers and about 51 h of telescope time per year for real time triggers. These numbers grow to about 22 triggers and 77 h per year if we include also the GRBs observable within 2 hours after the trigger.

1 Introduction

BOOTES-1B (see also Castro-Tirado et al. 1999 [1], Castro-Tirado et al. 2004 [2]) is an independent robotic observatory with a 30 cm aperture telescope dedicated primarily to follow-up of gamma-ray burst (GRBs). Since 2003 it has used RTS2 [3] as an observing system. It is located at the atmospheric sounding station (Estación de Sondeos Atmosféricos — ESAAt, INTA) of El Arenosillo in Andalucía, Spain (at lat: 37°06′16″N, long: 06°43′ 58″W). A nearby, older dome (BOOTES-1A) is used for complementary wider angle instruments.

We present results of our GRB follow-up programme. In a large table, we show a 4 year long follow-up log of BOOTES-1B GRBs — all triggers available in real time which were, or should have been received and processed by the system. This selected sample of GRBs is then used to provide a basic idea of how much time is needed at the telescope to observe GRB optical afterglows.



Fig. 1. Four historic BOOTES-1B configurations.

2 Robotic Telescope Configuration

The telescope is built mostly from commercially available components — a Paramount ME from Software Bisque and a D=30 cm Schmidt-Cassegrain optical tube assembly from Meade. Over time, four distinct system configurations were used, including also two 8 inch S-C telescopes.

2.1 Original Meade — stereoscopic system

The original BOOTES project idea of a new generation of robotic telescopes was very simple, BOOTES-1B would — simultaneous with an identical setup at BOOTES-2 for parallax ability — look for optical transients in an extended area of the sky with wide field cameras. Both systems would use a commercial 12-inch Meade LX-200 "robot". The wide-field cameras were considered a primary instrument, while the ability to follow-up with a large telescope was an option. Between 1998 and 2002 the wide-field system provided simultaneous limits for several *CGRO*/BATSE and *BeppoSAX* GRBs, most notably the candidate afterglow for the short GRB 000313 [4]. The 30 cm telescope was successfully used to follow-up GRB 030329.

Although we made the original system able to observe, it kept having problems. It required an operator presence several times per week and, despite



Fig. 2. The building of ESA with domes of BOOTES-1A and BOOTES-1B (2002).

a notable effort, the fork mount's electronics had to be exchanged several times. Because of that, we decided to purchase another mount.

2.2 The Prototype

The new incarnation of BOOTES-1B was in preparation since mid-2002, and the first prototype was put together in November 2002 in order to follow-up *INTEGRAL* bursts. The most important change was the mount to be used — the Paramount ME from Software Bisque. The system was still carrying a wide field camera, but a shift had been made in priorities — the wide field camera performed monitoring of satellite field of view and the telescope pointed when a trigger was received. The early stage was, however, plagued with technical and organizational problems which eventually delayed the first real-time real-GRB follow-up until early 2005.

The prototype carried three instruments on a large aluminium base plate: The 30 cm telescope with a field spectrograph [5] plus an SBIG-ST8 camera, the 20 cm Meade (originally BOOTES-1A) telescope with an SBIG-ST9 camera observing in a fixed V-band filter, and an unfiltered wide-field 18 mm/1:2.8 with an SBIG ST-8 CCD ($43^\circ \times 29^\circ$).

BOOTES-1B was operating with this setup for about a year — on June 2004 it was dismounted and sent to the Workshop in Ondřejov for a definitive solution.

2.3 Triple Telescope

The prototype was very heavy and from the beginning had some problems. In September 2004 BOOTES-1B finally received an upgrade — together with the

30 cm telescope, there were also two 20 cm telescopes⁷ for direct imaging in different filters. The system was completely redesigned with many mechanical improvements and was built to be as light as possible to allow the mount working at its maximum slewing speed. In belief that the rapid dissemination and fast followup after the launch of *Swift* would lead into relatively frequent detections of bright optical counterparts, the 30 cm telescope was equipped with a field spectrograph and two 20 cm telescopes with fixed V&I-band filters. The limiting magnitude of all three instruments was $V \sim 16$ for a 60 s exposure. The wide-field cameras were moved from BOOTES-1B to BOOTES-1A.

Later, during the telescope operation it became clear that the GRB optical transients were not as bright as had been expected and so the spectrograph on the 30 cm telescope was replaced with a direct imaging CCD with R-band filter — improving the limiting magnitude but losing the spectroscopic ability.

On April 23, 2006, The ESAt building was struck by lightning during a storm, destroying a major part of BOOTES-1B electronics. It took more than a year to get BOOTES-1B definitively back online.

2.4 Single 30 cm telescope

During the lengthy reconstruction of BOOTES-1B, the followup strategy was reconsidered: in the interest of detecting more optical transients the filter(s) were abandoned ($\sim 2.5\times$ or 1 magnitude gain in sensitivity). The limiting magnitude of an unfiltered 120 s exposure would be about 18.0 — effectively doubling the likelihood of getting an optical transient in comparison with the R-band imaging (cf. Fig. 4). Both 20 cm telescopes were dropped because of lack of suitable CCD cameras available for them. Since then, BOOTES-1B has only a single 30 cm telescope.

Any observations obtained after June 15, 2007 have been obtained without filter (W for white). We calibrate them against R-band, which, in the case of no color evolution of the optical counterpart, is expected to result in a small constant offset in magnitude.

3 Real Time GRB followup

BOOTES-1B could have received during the past 4 years (since January 2005 until December 2008) 86 GRB triggers via GCN, which could have been followed in real time or would become observable within the following two hours. Table 4 summarizes these triggers, noting, among BOOTES-1B status of the followup, also the brightness of the GRB optical counterpart, if it is known. The magnitude estimation search was done with a heavy use of GRBlog [6]. We use these data to construct a "limiting magnitude vs. likelihood of detection" graph (Fig. 4).

⁷ One of them lent personally by AJCT

3.1 GRB triggers followed by BOOTES-1B

GRB 050215B

GRB was discovered by *Swift*/BAT at 02:33:43.2 UT. BOOTES received the notice, but because of a software error waited with the slew until ~ 22 minutes after the GRB. We coadded 600 s exposures taken by both 20 cm telescopes to obtain limits of $V > 16.5$ and $I > 15.0$ [7].

GRB 050505

First image of this *Swift*-discovered GRB [8] was obtained at 23:32:30 UT, i.e. 609 s after the trigger and 70 s receiving the coordinates. No optical afterglow was detected [9].

GRB 050509A

At the time of this trigger, the dome was still operating independently on the rest of the system - we obtained the first image 23 s after the GRB trigger (6 s after receiving the alert). The dome was closed due to what we consider a false trigger on the rain sensor. The first useful 10 s exposure was obtained 63.8 min after the burst and has a limiting magnitude of $V > 14.9$. A coadd of first 112×10 s exposures with an exposure mean time 88.0 min after the GRB has a limit of $V > 18.1$.

GRB 050509B

This was a *Swift*-detected short gamma-ray burst [10]. Starting 62 s after the trigger, BOOTES-1B seems to have obtained the world-first data set of this short duration GRB. However, bad luck caused that the location of the GRB on the sky coincided with the tip of a nearby antenna and its signalling light. The limiting magnitude is thus seriously degraded. The first 10 s exposure has a limiting magnitude $V > 11.5$, a combination of the first 12×10 s exposures provides $V > 12.5$.

GRB 050525A

GRB 050525A [11] was the first BOOTES-1B burst for which a detection was obtained. The telescope started the first exposure 383 s after the GRB trigger (28 s after receiving the notice). An optical afterglow with $V \simeq 15.0$ was detected.

GRB 050528

We observed the errorbox [12] at 04:07:56 UT, ie. starting 71 s after the burst and 28 s after receiving the trigger in a light twilight, setting the limit to the possible GRB counterpart to $V > 13.8$ and $I > 13.0$ during the first 60 s after the beginning of our observation [13].

GRB 050730

Located at 19:58:23 UT, this GRB was very low above horizon in real time, BOOTES-1B obtained few exposures starting 233.4 s after the GRB, when the system failed. The images did not provide detection of the 17.0 mag optical transient discovered by both *Swift*/UVOT [14] and 1.5 m telescope at OSN [15].

GRB 050805B

This short burst was localized by *Swift* at 20:41:26 UT, BOOTES obtained first images 62.2 s after the trigger (7.2 s after receiving the trigger). No optical transient was detected. The first 10 s exposure has a limiting magnitude $R > 16$, combination of first five images (exposure mean time 118 s after the GRB) has a limit $R > 17.0$.

GRB 050824

The optical afterglow of this GRB was discovered with the 1.5 m telescope at Sierra Nevada [16, 17]. BOOTES-1B was, however, the first telescope to observe this optical transient, starting 636 s after the trigger with $R \simeq 17.5$. The weather was not stable and the focus not perfect, but BOOTES-1B worked as expected. Eventually, several hours of data were obtained.

GRB050904

BOOTES-1B reacted to this GRB, starting 124 s after the trigger. There was a hot pixel close to the GRB location, which made us believe we might have a detection in the *R*-band, which was issued in the first BOOTES-1B circular. Later, the observation revised as a limit ($R > 18.2$) which was used to compute the record redshift of this GRB [18]. The I-band camera of the 20 cm telescope, unluckily, failed.

GRB 050922C

This bright burst was detected by *Swift*/BAT at 19:55:50 UT. BOOTES was not very lucky - the weather on the station was bad. Instead of a limiting magnitude of ~ 17.0 for a 30 s exposure we got 12.9. The afterglow was eventually detected with the *R*-band camera (at the 30 cm telescope) on few occasions between flying clouds. The first weak detection was obtained 228 s after the GRB trigger gave $R \simeq 14.5$.

GRB 051109A

This is the only GRB ever detected by BOOTES-1B simultaneously in more than one filter. The first images were obtained 54.8 s after the burst in *R* and *I* bands [19].

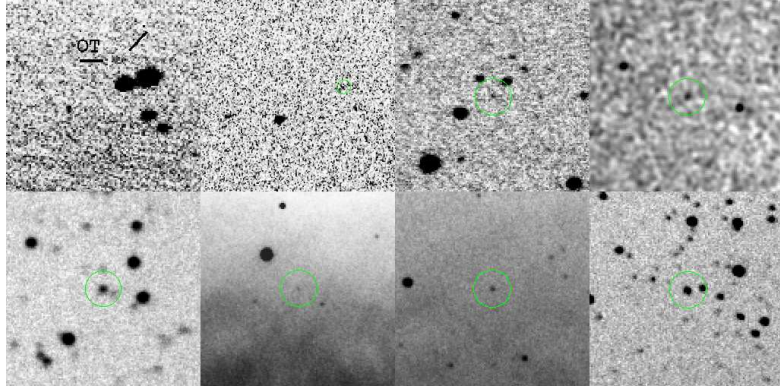


Fig. 3. GRB optical transient detections by BOOTES-1B: first row: GRB 050824, GRB 050922C, GRB 051109A, GRB 080330. Second row: GRB 080413B, GRB 080430, GRB 080602B, GRB 080605.

GRB 051211B

Observation of this burst started 42 s after the burst. A 30 s R-band exposure was obtained, but the camera failed after getting this image. Only useless defocused I-band images were taken with the 20 cm telescope [20].

GRB 051221B

This GRB was detected by *Swift*/BAT at 20:06:48 UT [21]. BOOTES-1B slewed to the position and started obtaining images 27.8 s after receiving the alert (234.8 s after the burst). We did not find any new source in our images [22]. 30 min after the trigger, a faint 21 magnitude afterglow was discovered elsewhere [23].

GRB 060421

BOOTES-1B reacted to this GRB within 61 s after the trigger. Images were not of a great quality, yielding a limit of $R > 14$ for the first 10 s exposure and $R > 16$ for the combination of 30 images (exposure mean time 547 s after the trigger).

GRB 061110B

The GRB was detected by *Swift*/BAT at $T_0 = 21:58:45$ UT, but the notices were delayed by 626 s because *Swift* was performing downlink. BOOTES-1B started to slew immediately after reception of the trigger, obtaining the first image 698 s after the burst (72 s after the GCN notice). When seven 60 s exposures were obtained, a communication error with the mount occurred. The communication was later restored and further 19 images were obtained

starting 22:49:49 UT (0.85 h after burst). Last image was obtained at 23:36:20 (1.62 h after burst).

Combination of the first 7 images (limiting magnitude ~ 17.2 mag each) with the exposure mean time 938 s after the GRB trigger was found to have a magnitude limit ~ 18.0 . Combination of 11 images obtained between 22:49:49 UT and 23:03:45 UT (lim ~ 16.9 mag each) yields a limit of ~ 18.2 with mean time $T_0 + 3452$ s.

GRB 071101

First successful followup of a GRB after installation of the 30 cm telescope in BOOTES-2 site at La Mayora. The GRB trigger [24] was at 17:53:46 UT. BOOTES started imaging 54.8 s after the burst (23.3 s after receiving the coordinates). No afterglow was detected, an unfiltered, R-band calibrated limit of $W > 17.0$ was estimated [25].

GRB 071109

INTEGRAL detected this GRB at 20:36:05 UT [26]. BOOTES followed up 58.5 s after the GRB (30.9 s after receiving the alert). Because of high altitude clouds, the telescope performance was reduced, yielding an unfiltered limit of ~ 13.0 in the first 10 s exposure [27].

GRB 080330

This GRB [28] happened during the first day recommissioning of BOOTES-1B after its move from BOOTES-2 site in La Mayora. The GCN client was not yet operational and at the time of the GRB we were focusing the telescope. First image was obtained 379 s after the GRB trigger and the optical afterglow was detected with magnitude ~ 16.3 on the first image. A bug in the centering algorithm caused a loss of part subsequent data. Further detections were obtained starting 21 min after the GRB when the problem was fixed.

GRB 080413A

BOOTES-1B started obtaining images of the GRB 080413A [29] starting 60.7 s after the trigger (46.3 s after reception of the alert). A $W \simeq 13.3$ magnitude optical afterglow was found [30].

GRB 080430

BOOTES-1B obtained the first image of this GRB [31] 34.4 s after the trigger. An optical transient was found with a magnitude $W \simeq 15.5$ [32].

GRB 080603B

This GRB happened at BOOTES-1 site during sunset. We obtained first useful images starting one hour after the trigger. An $W \simeq 17.4$ optical transient was found.

GRB 080605

GRB 080605 was observed starting 41.9 s after the trigger. A rapidly decaying optical afterglow with $W \simeq 14.8$ was found [33].

GRB 081003B

INTEGRAL detected this GRB at 20:36:05 UT [34]. BOOTES started obtaining unfiltered images at 20:48:49 UT (41 s after the GRB trigger and 17.4 s after the GCN notice), single images have a detection limit of $W > 14$ mag. The combination of the first 32 images with an exposure mean time of 80 s after the GRB has a limit of $W > 17.6$ mag (calibrated against GSC2). Neither shows any new sources within the GRB errorbox [35].

GRB	$T_{\text{obs}} - T_{\text{trigger}}$	$T_{\text{obs}} - T_{\text{notice}}$	mag
050215B	22 min		V>16.5, I>15.0
050505	609 s	70 s	V>14.0
050509A	63.8 min		V>18.1
050509B	62 s	48 s	V>12.5
050525A	383 s	28 s	V $\simeq$ 15.0
050528	71 s	28 s	V>13.8, I>13.0
050730	233 s	172 s	R>16
050824	636 s	55.8 s	R $\simeq$ 17.5
050805B	62 s	17 s	R>16.0
050904	124 s	43 s	R>18.2
050922C	228 s	62.3 s	R $\simeq$ 14.5
051109A	54.8 s	27 s	R $\simeq$ 16.2
051211B	42 s	48.4 s	I>14.0
051221B	234.8 s	27.8 s	V>13.3
060421	61.2 s	47.6 s	R>16.0
061110B	698 s	72 s	R>18.0
071101	54.8 s	23.3 s	W>17.0
071109	58.5 s	30.9 s	W>13.0
080330	379 s		W $\simeq$ 16.3
080413A	60.7 s	46.3 s	W $\simeq$ 13.3
080430	34.4 s	22.1 s	W $\simeq$ 15.5
080603B	60 min		W $\simeq$ 17.4
080605	41.9 s	29.3 s	W $\simeq$ 14.8
081003	41 s	17.4 s	W>14.8

Table 2. Summary of GRBs successfully followed by BOOTES-1B.

4 Implications

4.1 Success rate

Of the 89 triggers, 45 were processed in realtime and observed if possible, in 44 cases the system could not respond. This makes the overall failure rate quite high (50 %). 29 triggers were, however, lost due to long-term failures resulting from the telescope being struck by lightning. 8 more triggers failed during first 6 months of operation, when the system was not yet fully stable and one was lost during maintenance (and followed manually). 6 triggers out of 47 (13 %) were lost unexpectedly during the 963 nights of telescope operation if we do not count the first semester of 2005.

4.2 Planning

When specifying the GRB follow-up needs, the number of nights (hours) spent observing GRBs has to be estimated. Under various follow-up strategies we may derive different results.

Due to various instrumental effects (like a passage through the South Atlantic Anomaly) related to the satellite *Swift*, an offset from the overall triggering statistic which would depend on a geographical location could be found.

In Table 4, the fourth column has the time in hours until the first set of the event location below 10° of altitude or until the Sun rises above -15° of altitude. For non-realtime events, this is the time the location spends on the night sky, for real-time triggers, it is the time between the trigger and the moment when the target becomes unobservable.

For a small telescope, we assume that once the GRB is real-time triggered, it is unlikely to detect it the following night (i.e. after ~ 24 h), so we assume the following simple follow-up strategy: Let the telescope observe the GRB once it becomes accessible for the first time (which is immediately for real-time triggers) and let it observe until the GRB sets or the night ends. Do not observe any further nights. Under the given assumptions we get the following observing needs (assuming perfect weather):

Real time triggers

There have been 72 real time triggers during the studied 4 years, during their first nights they accumulated 202 hours.

So if we allow only real-time followable triggers to be observed, we would need ~ 18 triggers per year (once per 20 days) and on average 2.8 h (max. 8.0 h) of observing time per trigger, 50.5 h per year. Such a program would consume about 2 % of the telescope time.

Extended set

In the extended set, we assume that GRBs that would become observable within 2 hours after the event would also be followed. We would need ~ 22 triggers per year, each with an average length of 3.5 h. In total we would need 78.5 h per year, or about 3 % of the telescope time.

	Real time only	Up to 2 h
triggers/year	18	22
hours/year	50.5	78.5
hours/trigger	2.8	3.5
days/trigger	20.3	16.6

Table 3: Results of the GRB-planning statistic

4.3 Optical Afterglow Brightnesses

As a representative value of GRB optical transient brightness, important for real-time follow-up, we have chosen its magnitude at 300 s after the trigger. It turns out that it is not easy to find a uniform sample and available magnitudes and limits are a mixture of different passbands, mainly V,R and unfiltered CCD magnitudes. For a general idea of how bright an OT could be this is, however, good enough. Fig. 4 shows a cumulative probability of detecting an OT five minutes after the trigger with a telescope able to detect a given magnitude. For many GRBs the brightness at this early time is unknown, or only a limit from small telescopes has been established, so this curve is actually a slight underestimation.

For example BOOTES-1B, which could detect mag ~ 18 at an unfiltered 60 s exposure, may detect an OT in about one third of the GRB triggers.

5 Conclusions

We have shown in a small historical retrospective the evolution of the telescope of BOOTES-1B, as it developed from the wide-field survey telescope to a dedicated GRB follow-up telescope.

Four years of BOOTES-1B GRB follow-up history are summarised for the first time transparently in the form of a table, which includes not only the observation status of BOOTES-1B, but also the time for which the object could have been observed, and a magnitude (or a limit) of the GRB optical afterglow 5 minutes after the trigger found in the literature. Every existing

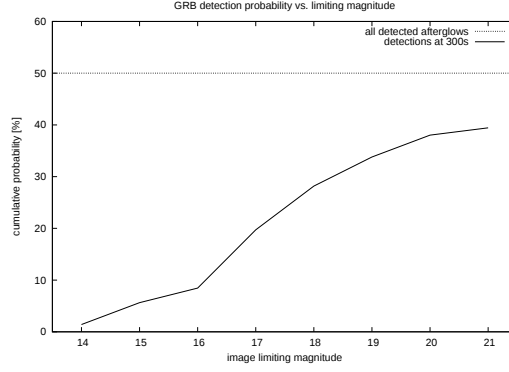


Fig. 4. The graph (based on T_{300} data from Table 4), showing the likelihood of detection of an optical afterglow of a GRB as a function of the magnitude the telescope can detect (in the time interval discussed here). The dotted line delimits 50 % — the ratio of GRBs in our data for whose there was eventually discovered an optical transient.

GRB trigger which was, or could have been observed by BOOTES-1B within 2 hours after the trigger is included. Twenty four successfully followed events are described case by case in a separate chapter. Many of these are published for the first time.

The data collected are also used to show the GRB trigger rate in Spain. By simply counting the triggers and the days during which they were collected, we estimate 18 triggers and about 50.5 h of telescope time per year for real time triggers. These numbers grow to about 22 triggers and 78.5 h per year if we include also the GRBs observable within 2 hours after the trigger. We also derive the likelihood of the optical afterglow detection five minutes after the GRB trigger depending on the limiting magnitude of the telescope.

Object	Target	t_1 [h]	t_{obs} [h]	m_{300} [mag]	dT	observation status
050128	-	+0.0	1.8	-	-	No link to GCN
050208	-	+0.0	4.2	-	-	No link to GCN
050215B	5064	+0.4	10.0	$\gtrsim 16^\dagger$ [36]	22 m	V,I limits [7]
050306	5075	+0.2	1.8	>16 [37]	86 s	w/roof closed
050416B	5109	+0.0	2.8	-	-	grbd failure
050421	5112	+0.0	0.2	>18.4 [38]	-	hw problems
050502A	-	+0.0	1.8	16.3 [39]	-	grbd failure
050505	5123	+0.0	2.2	†	609 s	clouds, V,I limits
050509A	5129	+0.0	2.2	>18.2 [40]	23 s	hw problems, later limit
050509B	5130	+0.0	0.0	>20.8 [41]	62 s	OK, $V > 12.5$, antenna hit!
050520	-	+0.0	3.6	>16.6	-	GCN connection lost
050525A	5136	+0.0	3.6	14.7 [42]	383 s	OK, V-band lightcurve
050714A	1037	+0.0	3.6	†	10 m	manually, later limit

050730	50008	+1.2	1.6	17.4[14]	1 h 40 m	limits
050805B	50015	+0.2	7.2	-	62 s	limits
050824	50032	+0.0	5.2	17.5[17]	636 s	detection [17]
050904	50055	+0.0	2.8	- [†]	124 s	R-band limit [18]
050922C	50090	+0.0	6.2	15.5[44]	228 s	detections between clouds
051109A	50126	+0.0	1.4	16.8	54.8 s	detection in R,I
051111	-	+0.0	4.6	14.9[45]	-	GCN connection lost
051211A	50144	+0.0	3.2	- [†]	-	CCD failure
051211B	50146	+0.0	4.8	>14.0	50 s	OK, limits [20]
051221B	50151	+0.0	3.8	>18.2[46]	235 s	OK, limits [22]
051227	50155	+1.6	10.6	>19.2[47]	59 m	bad weather
060111A	50162	+0.0	2.0	> 18.3[48]	296 s	during maintenance, limit
060121	-	+0.0	7.8	- [†]	-	telescope OFF
060123	50171	+0.0	7.6	-	-	bad weather
060130	50173	+0.0	1.2	-	-	bad weather
060203	-	+0.0	6.2	-	-	bad weather+no GCN
060204C	-	+0.0	9.6	> 18.7[49]	-	bad weather+no GCN
060206	-	+0.0	1.4	16.5[50]	-	GCN connection lost
060219	50185	+1.0	6.0	>18.6[51]	-	bad weather
060319	50190	+0.0	4.4	>19 [†] [52]	-	bad weather
060418	50207	+0.0	1.4	14.2[53]	-	bad weather
060421	50208	+0.0	3.8	>16.8[54]	61.2 s	limit
060424	-	+0.0	0.0	- [†]	-	hw failure
060502A	-	+0.0	1.0	18.7[55]	-	hw failure
060507	-	+0.0	2.0	> 15.5 [†] [56]	-	hw failure
060512	-	+0.0	4.6	17.15[57]	-	hw failure
060515	-	+0.0	1.4	>16.2[58]	-	hw failure
060522	-	+0.0	1.6	19.65[59]	-	hw failure
060602A	-	+0.0	1.2	>15 [†] [60]	-	hw failure
060602B	-	+0.0	3.6	-	-	hw failure
060712	-	+0.2	3.0	> 14.5[61]	-	hw failure
060814	-	+0.0	0.8	>17.4[62]	-	hw failure
060825	-	+0.0	1.4	>18.3[63]	-	hw failure
060901	-	+1.6	5.2	- [†]	-	hw failure
060904A	-	+0.0	0.2	>19.5[64]	-	hw failure
060904B	-	+0.0	2.2	~17[65, 66]	-	hw failure
060929	50212	+0.0	1.2	>17.0[67]	-	bad weather
061019	50220	+0.0	1.0	>14.8 [†] [68]	-	bad weather
061110B	50228	+0.0	2.2	>17.8 [†] [69]	11 m38 s	> 18.1 OK
061217	50240	+0.0	2.6	>19.2[70]	-	mount failure
061218	50242	+0.0	2.0	>18.6[71]	-	mount failure
061222B	50245	+0.0	0.6	18.0[72]	-	mount failure
070103	50246	+0.0	2.8	>19.6[73]	-	mount failure
070129	50253	+0.0	0.4	>19.2 [†] [74]	-	mount failure
070219	-	+0.0	4.8	>20.0[75]	-	mount failure
070220	50258	+0.0	1.2	>19.6[76]	-	mount failure
070223	50259	+0.0	4.6	>21.4 [†] [77]	-	mount failure
070224	50260	+1.4	8.0	>20.1 [†] [78]	-	mount failure

070406	50277	+0.0	4.0	-	-	mount failure
070411	-	+0.0	3.2	~ 18.3 [79]	-	mount failure
070412	-	+0.0	3.2	> 20.7 [80]	-	mount failure
070429A	50286	+1.6	1.0	> 18.0 [81]	-	mount failure
070531	-	+0.0	1.4	> 19.9 [82]	-	mount failure
070610	-	+0.4	6.2	~ 19 [83]	-	mount failure
070704	-	+1.4	6.2	> 21.2 [84]	-	manually disabled
070714A	50010	+0.0	1.0	- [†]	52 s	bad weather
071025	50033	+0.0	0.4	17.3[85]	-	bad weather
071101	50038	+1.0	10.6	> 19.7 [86]	56 s	limit[25]
071109	50040	+0.0	1.0	> 15.5 [87]	59 s	thick cirrus, limit [27]
071112C	50044	+0.4	11.0	17.5[88]	64 s	bad weather
080320	50076	+0.0	0.6	> 20 [89]	-	bad weather
080330	50079	+0.0	1.2	16.8[90]	400 s	manual, detection
080413A	50082	+0.0	1.6	15.0	60.7 s	detection [29]
080430	50090	+0.8	7.4	17.5	34 s	detection [31] [32]
080517	50098	+0.0	2.4	> 18.5 [91]	3 h 22 m	weather delay
080603B	50113	+1.6	6.4	16.5[92]	1 h 15 m	detection
080605	50115	+0.0	3.8	17.9[93]	43 s	detection [33]
080727C	-	+0.0	4.8	> 19.9 [94]	-	dome failure
080903	-	+0.0	4.4	19.2[95]	-	dome failure
081001	50159	+0.0	1.4	-	-	bad weather
081003B	50167	+0.0	3.6	> 17.6 [35]	41 s	OK, limit [35]
081126	50181	+0.0	4.0	> 18.0 [96]	-	bad weather
081128A	50184	+1.2	9.8	20.9[97]	-	bad weather
081210	50188	+0.0	8.0	19.9[98]	45 m	weather delay, out of focus
081228	50195	+0.0	2.0	19.8[99]	-	bad weather
081230	50197	+0.0	3.2	19.1[100]	-	bad weather

Table 4: The Great Table of BOOTES-1B GRBs. "Target" is the RTS2 target number at BOOTES-1B. t_1 is the time delay between the GRB trigger and the possible start of observation. t_{obs} is the amount of time for which the GRB can be followed until it sets for the first time. m_{300} is the known brightness of the GRB optical transient 300 s after the event. dT is the delay of BOOTES-1B followup.

[†] denotes discovered optical counterparts where there are not enough data to estimate the brightness 300 s after the GRB.

Acknowledgment.

The Spanish side was supported by Spanish Ministry of Science and Technology by projects AYA 2004-01515, AYA 2007-63677, AYA2007-67627-C03-03, AYA2008-03467/ESP and AYA2009-14000-C03-01. The Czech participation is supported by grants of the Grant Agency of the Czech Republic 205/08/1207, 102/09/0997 and PECS 98023. MJ was supported by the Ministry of Education and Science (MEC) grant AP2003-1407.

References

1. Castro-Tirado, A.J. et al., A&A Supl. Ser. 138, p.583, 1999
2. Castro-Tirado A.J. et al., AN 325, 679, 2004
3. Kubánek, P. et al., SPIE Conference Series, vol. 6274, 2006.
4. Castro-Tirado A.J. et al., A&A 393, L55, 2000
5. de Ugarte Postigo, A., Ph.D. Thesis, Univ. de Granada, 2007
6. Quimby, R. et al., astro-ph/0312314v1, 2003
7. Jelínek, M. et al., GCN Circ. 3023, 2005
8. Hurkett, C. et al, GCN Circ. 3360, 2005
9. de Ugarte Postigo, A. et al., GCN Circ. 3376, 2005
10. Castro-Tirado et al., A&A 439, L15, 2005
11. Band, D., GCN Circ. 3466, 2005
12. Holland, S. T., GCN Circ. 3496, 2005
13. Jelínek, M. et al., GCN Circ. 3500, 2005
14. Blustin, A.J. et al., GCN Circ. 3717, 2005
15. Pandey, S. et al., A&A 460, 415, 2006
16. Gorosabel, J. et al., GCN Circ. 3866, 2005
17. Sollerman, J. , A&A 466, 839-846, 2007
18. Haislip, J.B. et al., Nature 440, 181-183, 2006
19. Jelínek M., et al., GCN Circ. 4227, 2005
20. Jelínek, M. et al., GCN Circ. 4333, 2005
21. Boyd, P. et al., GCN Circ. 4376, 2005
22. de Ugarte Postigo, A. et al., GCN Circ. 4379, 2005
23. Halpern, J.P. & Tyagi, S., GCN Circ. 4381, 2005
24. McBreen, S. et al., GCN Circ. 7030, 2007
25. Jelínek, M. et al., GCN Circ. 7032, 2007
26. Mereghetti, S. et al., GCN Circ. 7046, 2007
27. de Ugarte Postigo, A. et al., GCN Circ. 7047, 2007
28. Mao, J. et al., GCN Circ. 7537, 2008
29. Kubánek, P. et al., GCN Circ. 7603, 2008
30. Jelínek, M et al., in preparation
31. Jelínek, M. et al., GCN Circ. 7648, 2008
32. de Ugarte Postigo, A. et al., in preparation
33. Jelínek, M. et al., GCN Circ. 7837, 2008
34. Gotz, D. et al., GCN Circ. 8317, 2008
35. Jelínek, M. et al., GCN Circ. 8320, 2008
36. Yost, S.A. et al., GCN Circ. 3022, 2005
37. Quimby R.M. et al., GCN Circ. 3107, 2005
38. Rykoff, E.S. et al., GCN Circ. 3304, 2005
39. Guidorzi, C. et al., APJ 630, L121-L124, 2005
40. Poole, T. et al., GCN Circ. 3394, 2005
41. Wozniak, P. et al., GCN Circ. 3414, 2005
42. Blustin, A.J. et al., ApJ 637, 901, 2006
43. Monfardini, A. et al., GCN Circ. 3497, 2005
44. D. Hunsberger, S.D. et al, GCN Circ. 4041, 2005
45. Mundell, C.G. et al, GCN Circ. 4250, 2005
46. Klotz, A. et al., GCN Circ. 4386, 2005
47. Roming, P. et al., GCN Circ. 4411, 2005

48. Klotz, A. et al., GCN Circ. 4483, 2006
49. Melandri, A. et al., GCN Circ. 4665, 2006
50. Guidorzi, C. et al., GCN Circ. 4693, 2006
51. Breeveld, A. & Moretti, A., GCN Circ. 4798, 2006
52. Melandri, A. et al., GCN Circ. 4889, 2006
53. Jelínek, M. et al., GCN Circ. 4976, 2006
54. Lipunov, V. et al., GCN Circ. 4988, 2006
55. Poole, T. S. & La Parola, V., GCN Circ. 5068, 2006
56. Jelinek, M., et al., GCN Circ. 5092, 2006
57. Pasquale, M. D. & Cummings, J., GCN Circ. 5130, 2006
58. Klotz, A., Boer, M., & Atteia, J. L, GCN Circ. 5134, 2006
59. Holland, S. T., GCN Circ. 5158, 2006
60. Vítek, S., et al., GCN Circ. 5201, 2006
61. Lipunov, V., et al., GCN Circ. 5303, 2006
62. Klotz, A., Boer, M., & Atteia, J. L, GCN Circ. 5448, 2006
63. Gomboc, A., GCN Circ. 5476, 2006
64. Klotz, A., Boer, M., & Atteia, J. L, GCN Circ. 5506, 2006
65. Rykoff, E. S. et al, ApJ, 2009 [astro-ph/0904.0261]
66. Jelínek, M. et al., in preparation, 2009
67. Nekola, M. et al., GCN Circ. 5658, 2006
68. Klotz, A. et al., GCN Circ. 5731, 2006
69. Mikuz, H., GCN Circ. 5808, 2006
70. Klotz, A. et al, GCN Circ. 5942, 2006
71. D'Avanzo, P. et al, GCN Circ. 5937, 2006
72. de Ugarte Postigo, A. et al, GCN Circ. 5968, 2006
73. Holland, S. T. & Sakamoto, T., GCN Circ. 5993, 2006
74. Chester, M. M. & Godet, O., GCN Circ. 6066, 2007
75. Breeveld, A. & Sakamoto, T., GCN Circ. 6111, 2007
76. Stamatikos, M. et al., GCN Circ. 6114, 2007
77. Landsman, W. et al., GCN Circ. 6134, 2007
78. Holland, S. T. et al., GCN Circ. 6152, 2007
79. Mikuz, H. et al., GCN Circ. 6288, 2007
80. Mikuz, H. & Dintinjana B., GCN Circ. 6284, 2007
81. Rykoff, E. S. et al., GCN Circ. 6356, 2007
82. de Pasquale, M. & Markwardt, C.B., GCN Circ. 6481, 2007
83. Stefanescu, A., et al. GCN Circ. 6492, 2007
84. Meshcheryakov, A., et al, GCN Circ. 6617, 2007
85. Rykoff, E.S. et al., GCN Circ. 6992, 2007
86. Uemura, M. et al., GCN Circ. 7037, 2007
87. Klotz, A. et al., GCN Circ. 7052, 2007
88. Dintinjana, B. et al., GCN Circ. 7078, 2007
89. Williams, G.G. & Milne, P.A., GCN Circ. 7492, 2008
90. Klotz, A. et al., GCN Circ. 7543, 2008
91. Parsons, A.M. et al., GCN Circ. 7742, 2008
92. Kuin, N.P.M. et al., GCN Circ. 7808, 2008
93. Rumyantsev, V. et al., GCN Circ. 7833, 2008
94. Hoversten, E. A. & Parsons, A. M., GCN Circ. 8043, 2008
95. Marshall, F.E. et al., GCN Circ. 8179, 2008
96. Gendre, B. et al., GCN Circ. 8555, 2008
97. Xin L.P. et al., GCN Circ. 8572, 2008
98. Immler, S. et al., GCN Circ. 8654, 2008
99. Afonso, P. et al., GCN Circ. 8752, 2008
100. Yuan, F. et al., GCN Circ. 8754, 2008