



MOSCOW STATE UNIVERSITY

Sternberg Astronomical Institute



MASTER prompt and follow-up GRB observations

2002-2009



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Behalf of the MASTER-team

<http://observ.pereplet.ru>

Moscow-Vostryakovo since 2002



The main telescope is Richter-Slefogt,
D=355 mm, D/F=2.3
CCD is Apogee Alta U16
that give us 6 sq.deg.

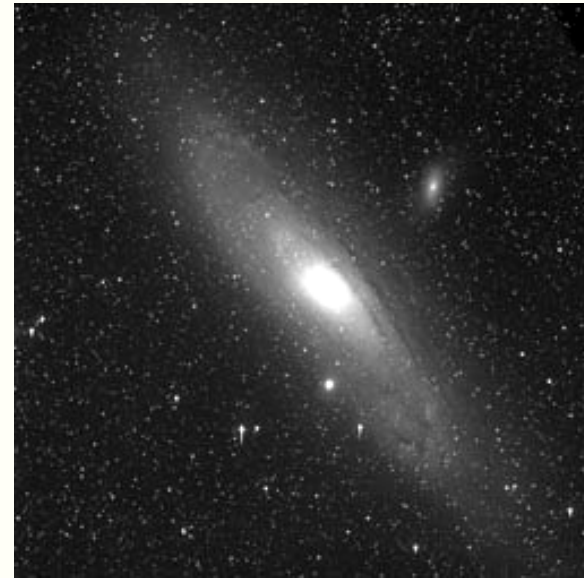


MASTER-I (MOSCOW-VOSTRYKOVO)

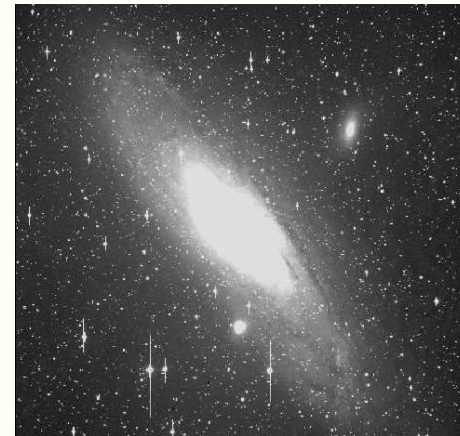
- Very bad astro climate
- 2 km from airport (light sky)
- Less than 70 nights per yr (most of them are in summer white nights)
- **Plus** is the only position near to Moscow, that let us to automatize this telescope without financial support, and (the most important) to write a software.

Field of view

- One of the first images at main telescope (355mm) with CCD AP16E (2003year)
- Andromeda by ROTSE III
<http://www.rotse.net>

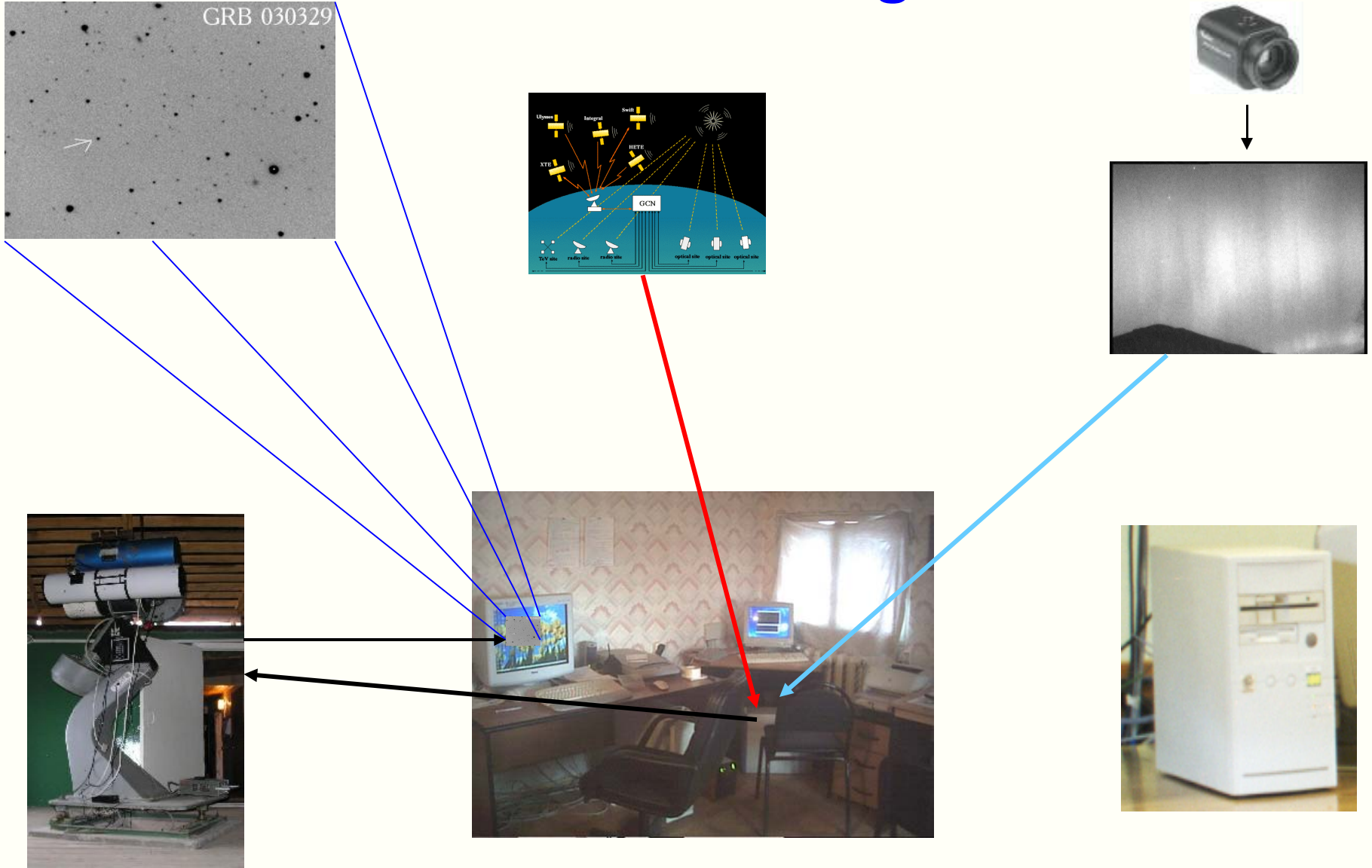
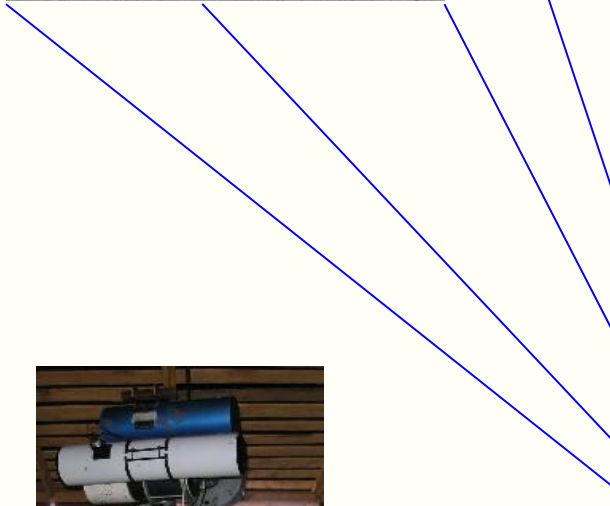
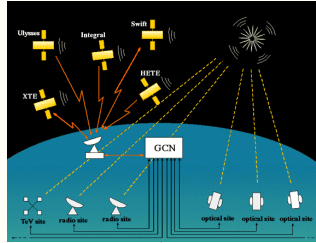
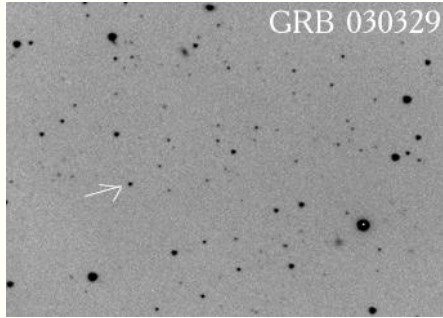


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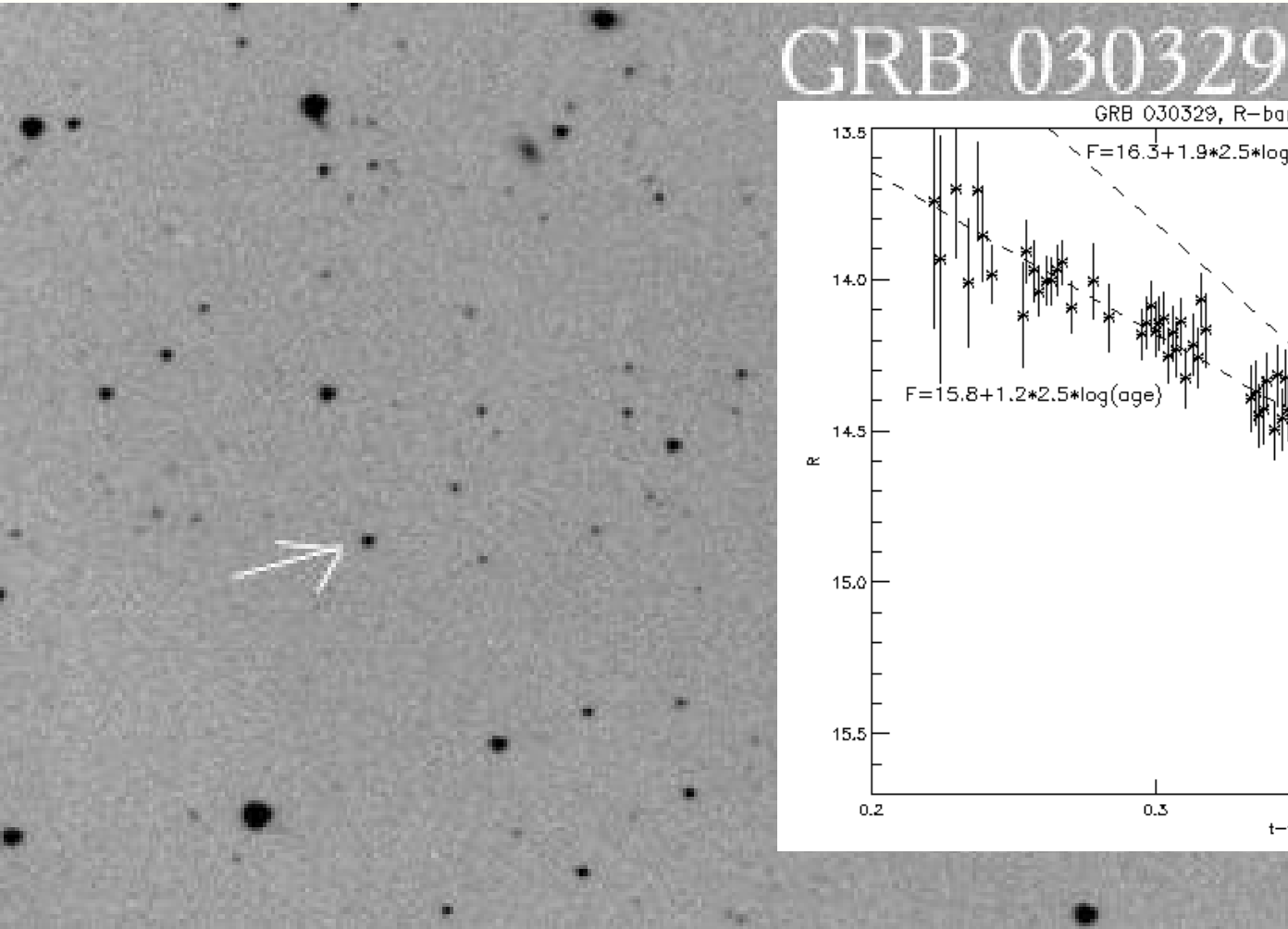


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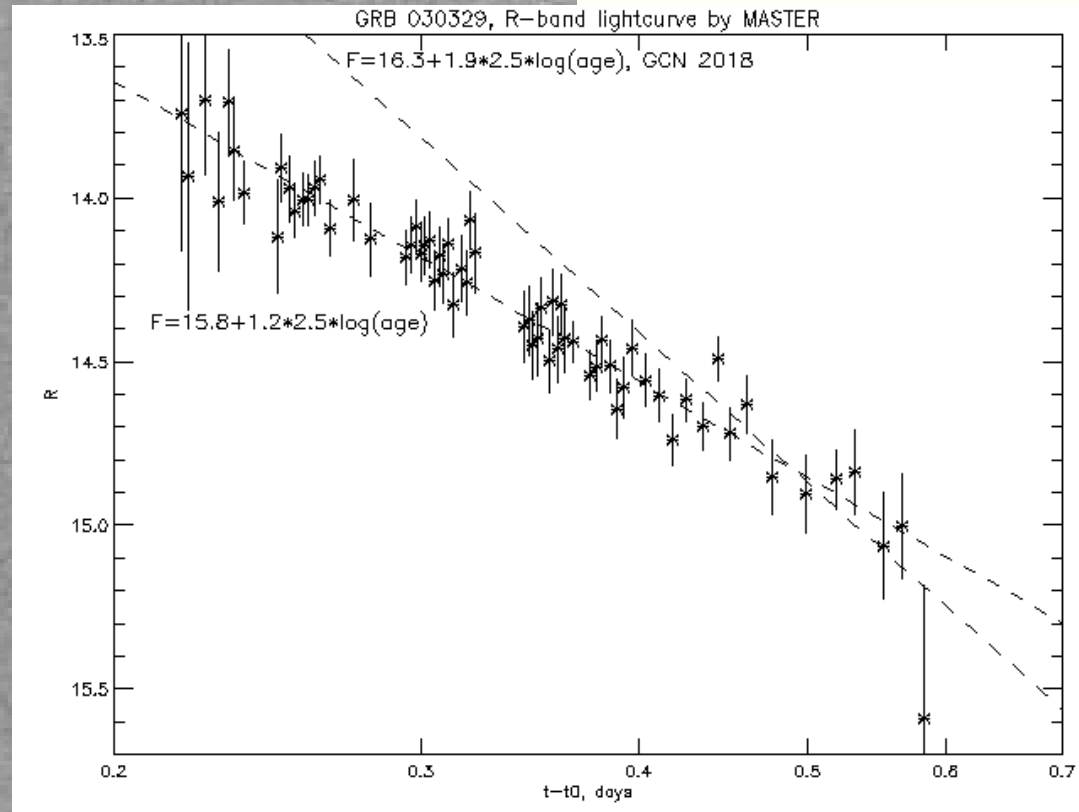
MASTER Alert-regime



GRB 030329



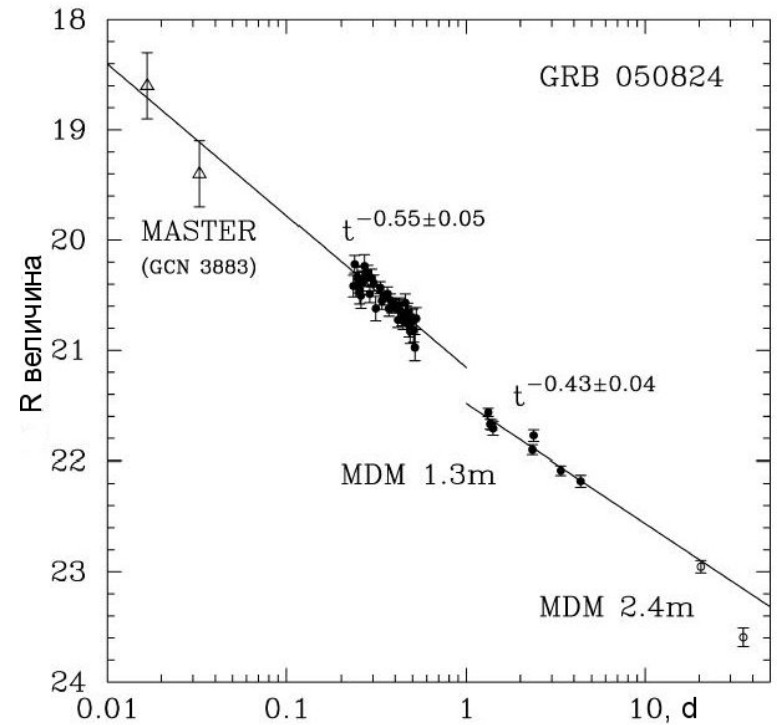
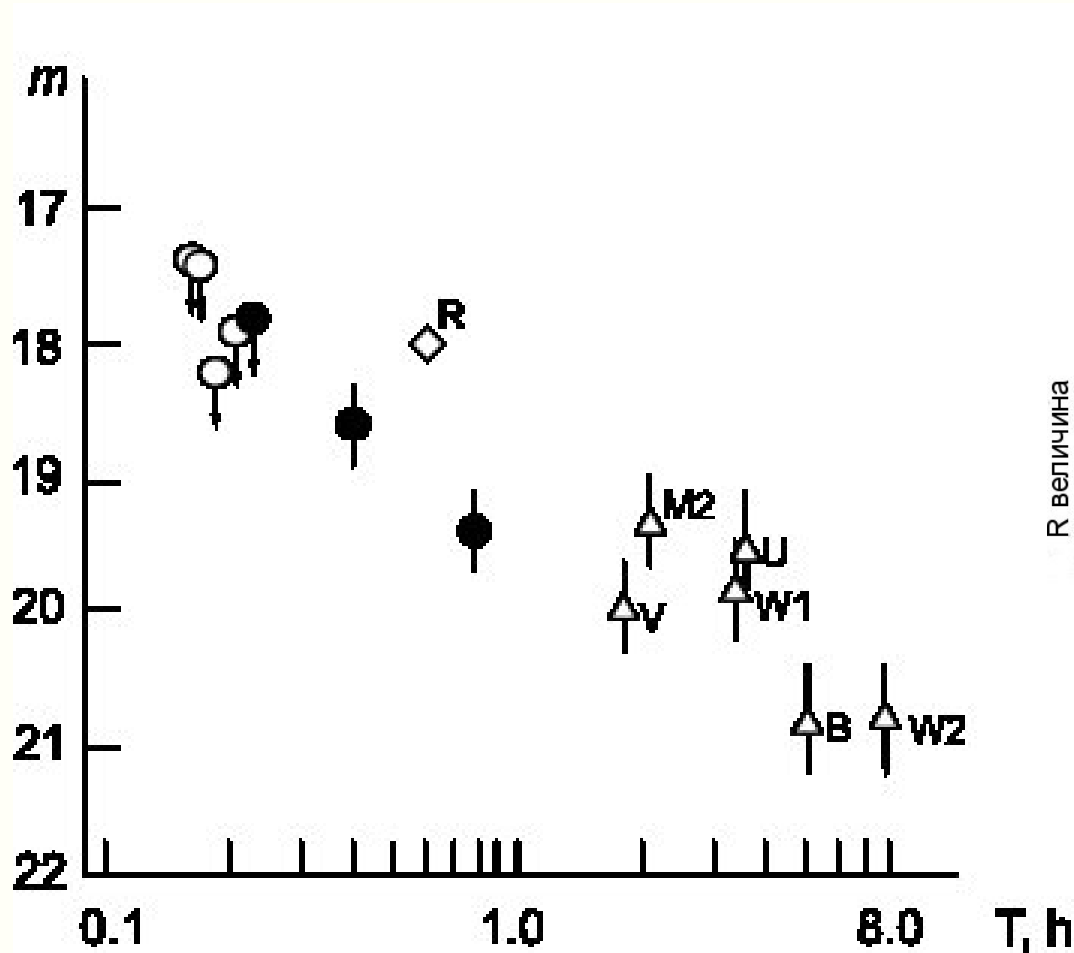
GRB 030329



Starting at the beginning of 2002, the Moscow-Vostroyakovo MASTER station carried out observations of 80 GRBs (Table 2). In about 30 cases, we obtained the first upper limits on the optical fluxes of the GRBs, i.e., fluxes brighter than which no optical candidate for the GRB was detected.

GRB 050824

we have first images

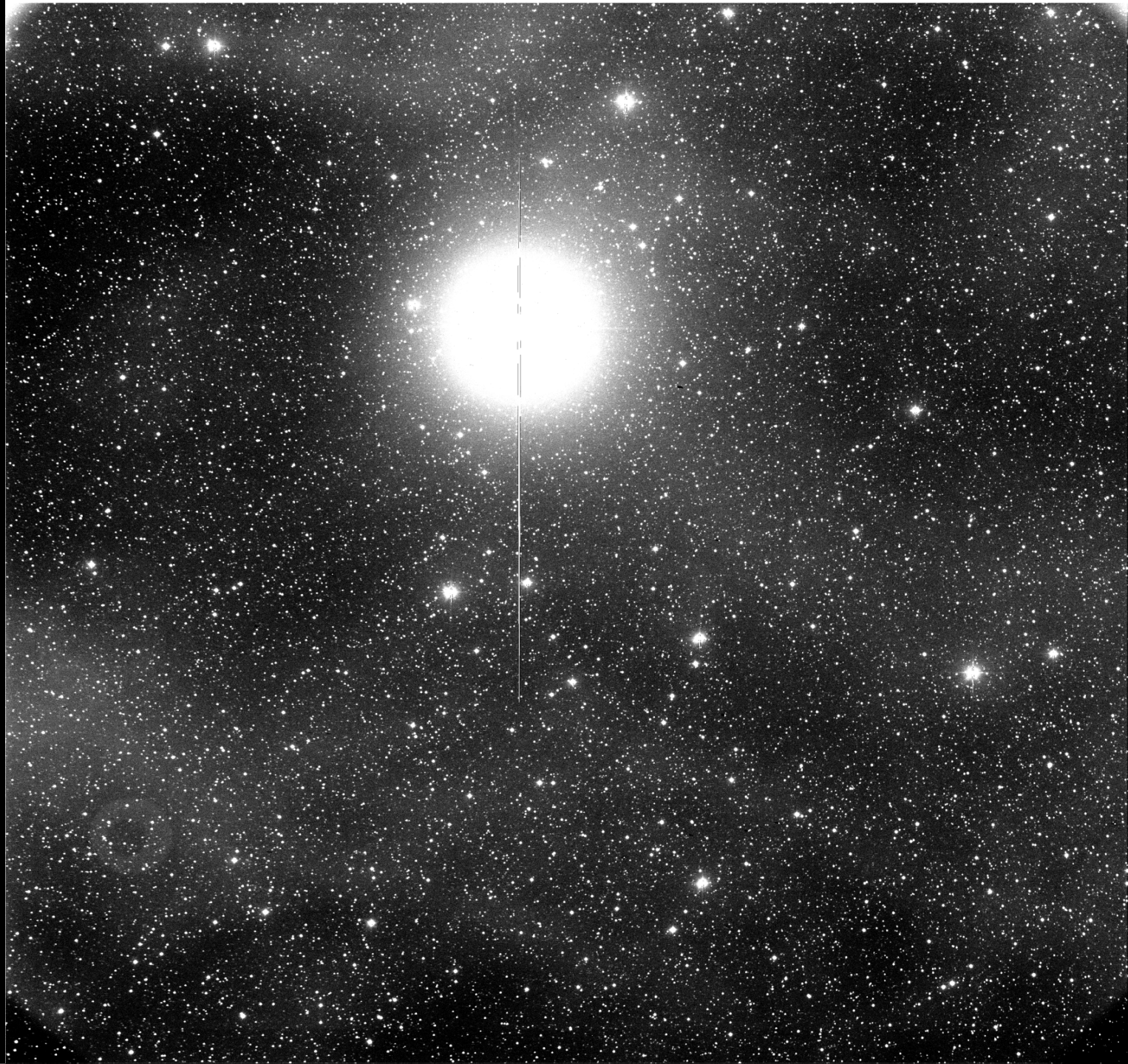


GRB 060926

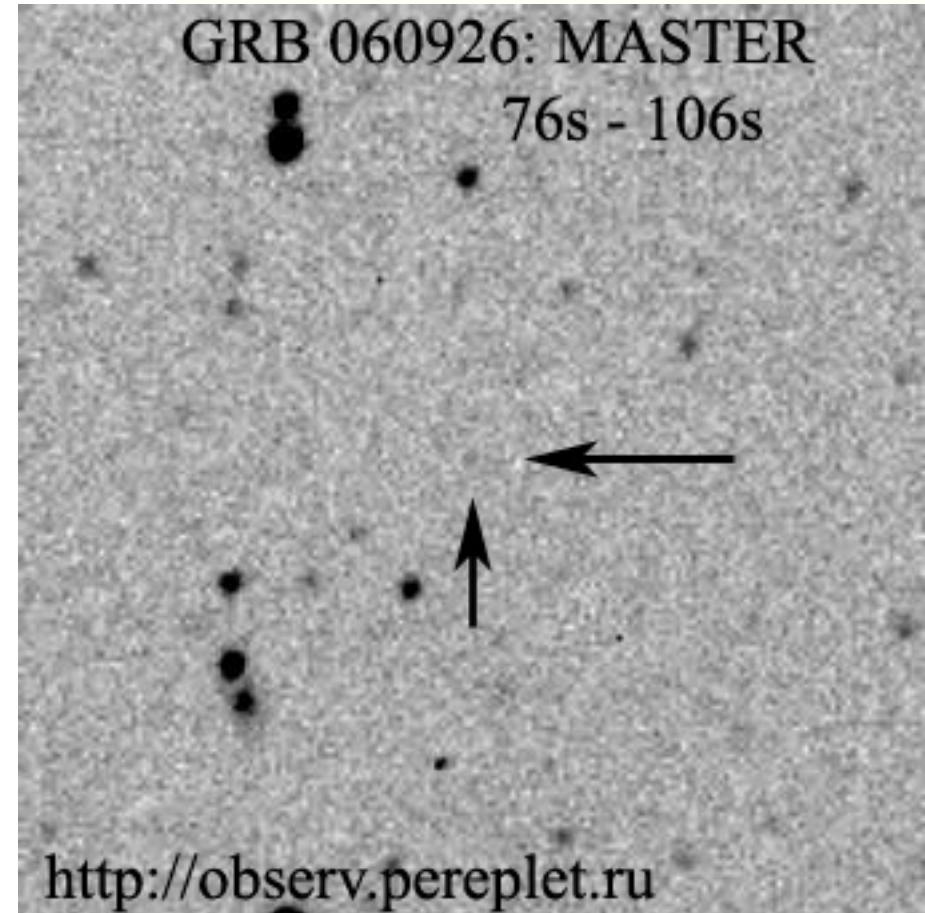
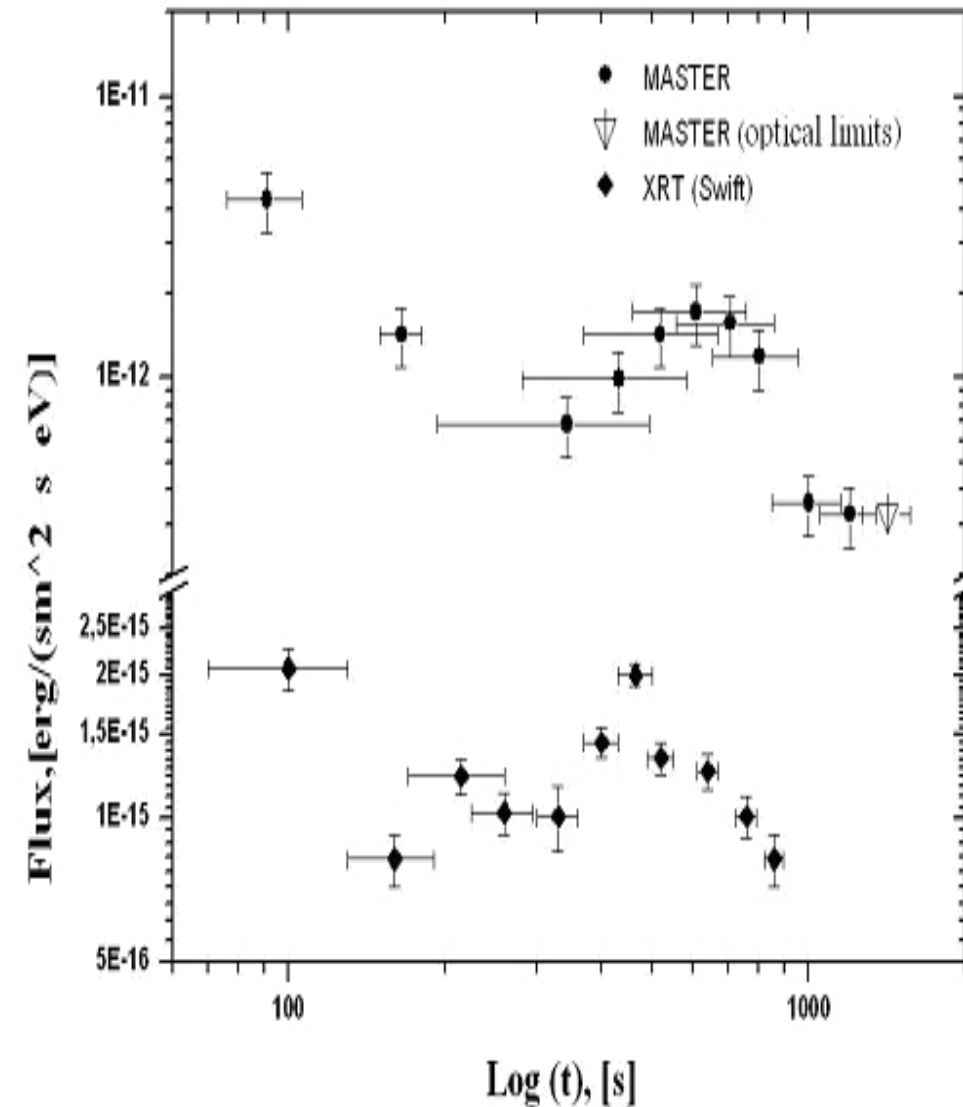
Optical flare discovery

Lipunov et al., 2007ARep., Vol. 51, p.1004

- MASTER robotic system (<http://observ.pereplet.ru>) responded to GRB060926 (Holland et al., GCN Circ 5612) under the good conditions (V. Lipunov et al., GCN Circ 5632). The first image was started at 2006-09-26 16:49:57 UT, **76 s after the GRB time** (355 mm telescope, 6 square degrees FOV, 2.1" per pix, CCD Alta U16).
- Observations were synchronously with SWIFT XRT, that let us
- The unfiltered image is calibrated relative to USNO A2.0 (0.8 R + 0.2 B). We find (Lipunov et al., GCN5632) faint OT on the first and on the coadded images at position: $\alpha = 17\ 35\ 43.66$ $\text{dec} = 13\ 02\ 18.3$ $\text{err} = \pm 0.7''$ which coincided with the Holland et al.(GCN Circ 5612) OT position.



GRB060926 – discovery of the optical flare



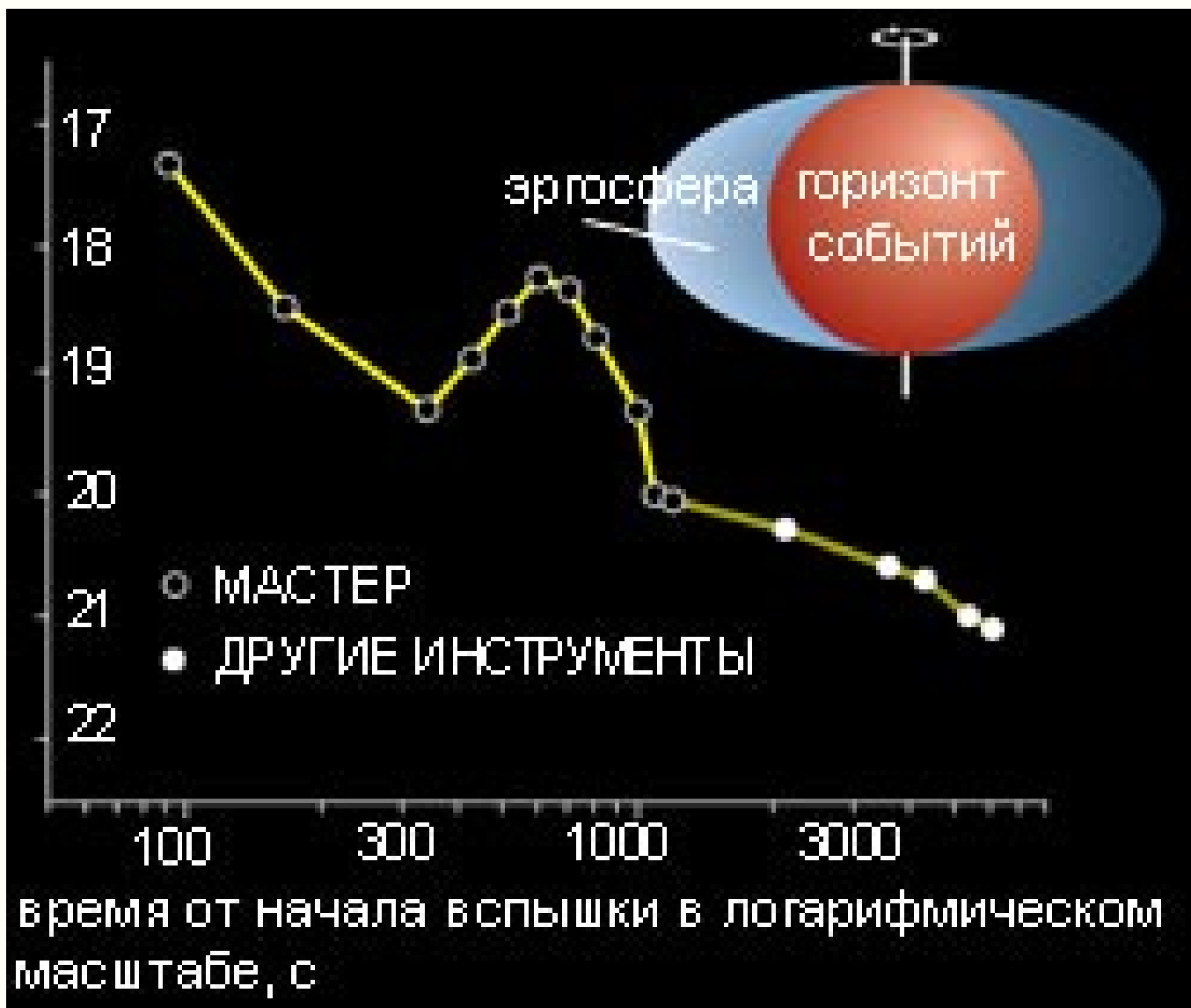
GRB 060926

Optical-X-ray spectra power law determination

The X-ray spectrum covering the time period from T+67s to T+878s is well fit by an absorbed power-law with a photon index of $2.1(+/-0.3)$ and column density of $(2.2+/-0.9)e21 \text{ cm}^{*-2}$ (Swift, M. Perri et al., GCN 5622). They note the Galactic column density in the direction of the source is $7.3e20 \text{ cm}^{*-2}$. This means that absorption is about 1 magnitude in our band.

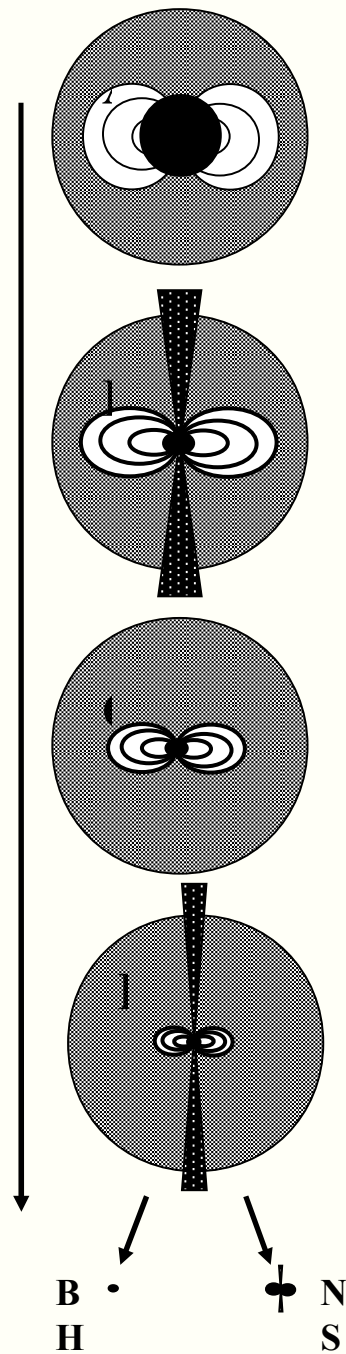
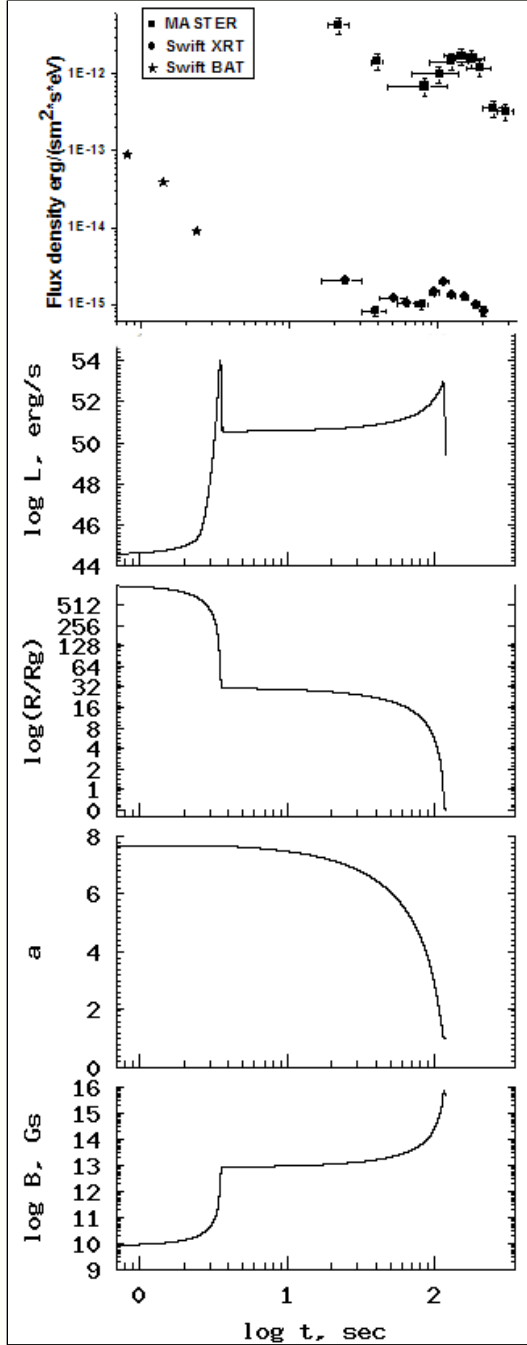
The optical-xray data is well fit by power-law with a photon index of $1.7+/-0.2$ during all our time observation.

GRB 060926



Discovery of an optical flare from GRB 060926 by the MASTER robotic telescope: Possible formation of a marginally rotating black hole 2008AstL...34..145L

The MASTER robotic telescope has obtained the first optical images of GRB 060926. We have discovered an optical flare from GRB 060926, a recurrent brightening that closely follows its behavior in the X-ray range. We have determined the spectral slope for GRB 060926 from the X-ray to optical range in the first minutes. Based on the spinar model, we show that the parameters of the optical and X-ray flares suggest that the gamma-ray burst resulted from the core collapse of a $7 M_{\odot}$ star with an initial effective Kerr parameter of 7.6 and an initial magnetic-to-gravitational energy ratio of 10^{-4} .



Theoretical interpretation:
 Spinar Model for GRB
 (Lipunov & Gorbovskoy,
 2007, ApJ.,665L.,97L)

2 stage collapse

The model parameters:

1) Specific Kerr parameter

$$a := \frac{J \Omega c}{G M^2}$$

2) Magnetic Gravitational energy ratio

$$a_m = \frac{m^2}{R^2 G M^2}$$

$$M = 7M_{sun}, a_0 = 7.6 \text{ и } \alpha_m = 10^{-4}$$

THE SHORT BURST GRB 051103— A SOFT GAMMA-RAY REPEATER IN THE GALAXY M81?

MASTER robotic system (<http://observ.pereplet.ru>) responded to GRB051103.4 (GRB_TIME is 2005-11-03 09:25:43.785, S. Golenetskii et al., GCN4197) at several minutes after GCN Circ4197 time (GCN4198). The first image (6 square degrees) was at 2005-11-05 19:55:47 UT, 2 days 10:30:03.215 after the GRB time. We have 36 images with total exposition 1080 s between 19:55:47 - 21:45:17 on 6 square degrees area. The robot not find OT-candidate in IPN error box.

“Triangulation”

Short burst GRB 051103



• *December 2008 - Dream in iron*

