

Experiences and results from the TAROT observation system

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CESR / OHP

TAROT experiment

Slew to target in less than 10 seconds

D=25 cm f=85 cm,

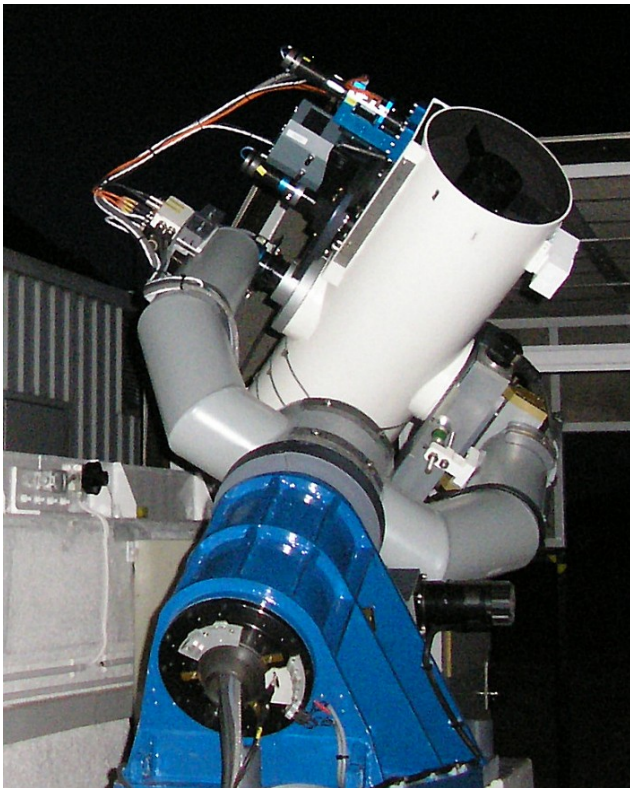
CCD Andor 2k x 2k, readout time in 5 sec. (noise 8 e)

Field of View = $1.9 \times 1.9^\circ$,

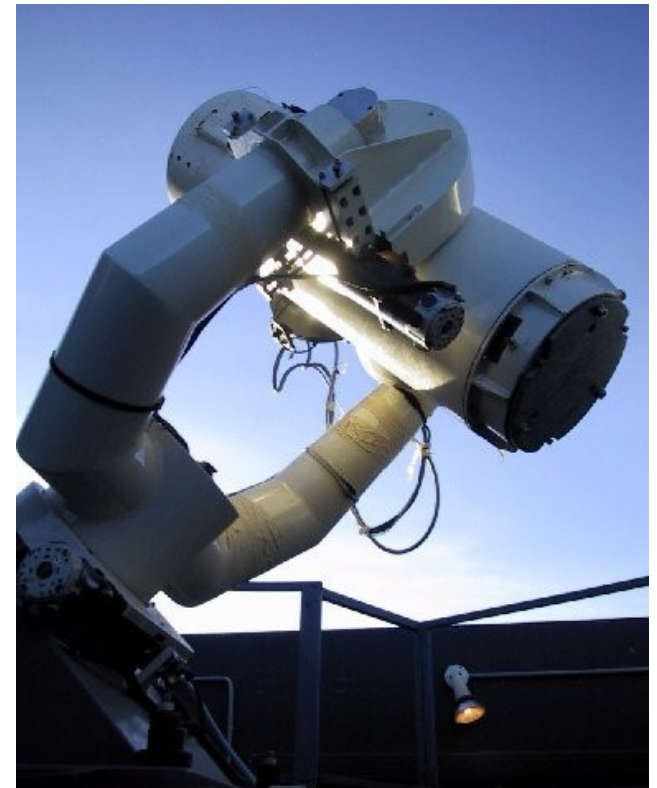
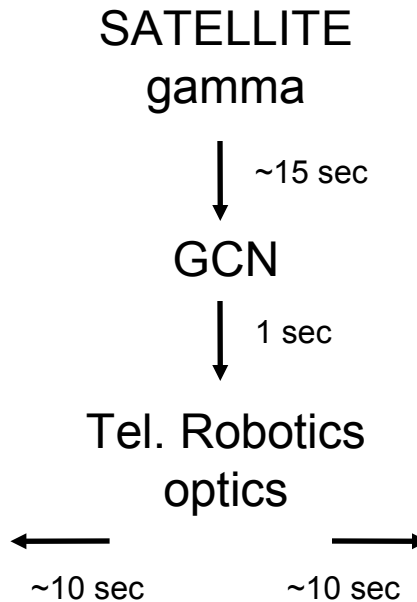
Spatial sampling = 3.3 arcsec/pix

Filters : B V R I C VN

Detectivity : V ~ 17 (1 min. exposure)



Chile 2006 (21 alerts)



France 1998 (81 alerts)²

TAROT : GRB publications

2 papers on GRB statistics from all observations:

2001A&A...378...76B

Limits on the early afterglow phase of gamma-ray burst sources from TAROT-1

2009AJ....137.4100K

Early optical observations of GRB sources by the TAROT telescopes: Period 2001-2008

10 papers on specific GRBs:

2003A&A...404..815K

Observational constraints on the afterglow of GRB 020531

2005A&A...439..L35K

Early re-brightening of the afterglow of GRB 050525a

2006ApJ...638L..71B

Detection of a Very Bright Optical Flare from the Gamma-Ray Burst GRB 050904 at Redshift 6.29

2006A&A...451L..39K

Continuous optical monitoring during the prompt emission of GRB 060111B

2007A&A...462..565G

The gamma-ray burst 050904: evidence for a termination shock?

2008A&A...483..847K

Early emission of rising optical afterglows: the case of GRB 060904B and GRB 070420

2008MNRAS.388..347C

The complex light curve of the afterglow of GRB071010A

2009ApJ...697L..18K

Observation of correlated optical and gamma emissions from GRB 081126

2009 A&A in press

Rise and fall of the X-ray flash 080330: an off-axis jet?

2009 A&A accepted

A multiwavelength study of Swift GRB 060111B constraining the origin of its prompt optical emission

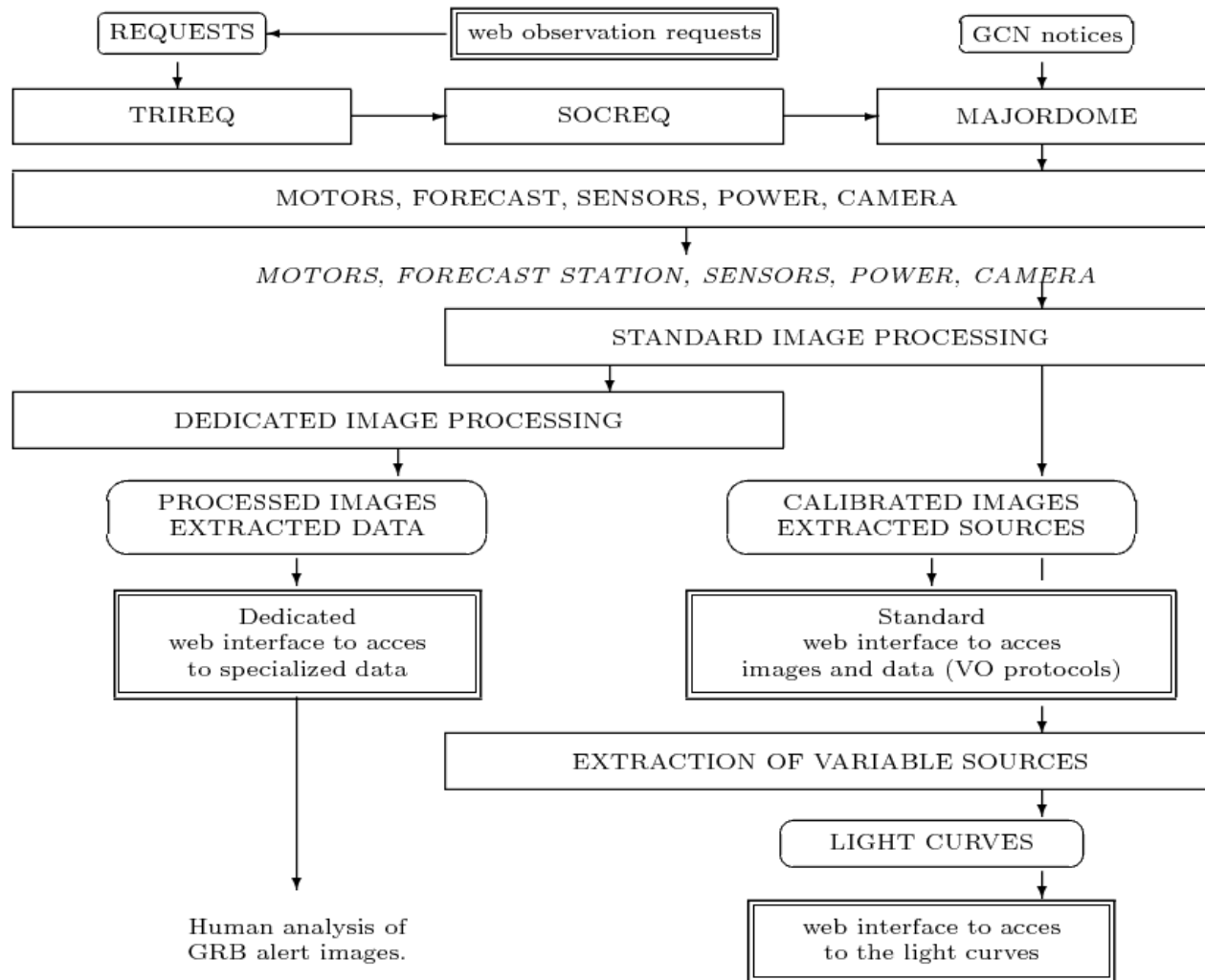
TAROT experiment - Robotic hardware

motors, sensors, telescope, camera, UPS, electricity, computers



building, roof, meteo station, internet and electric external connections

TAROT experiment - Robotic software



Legend:

FILES OR DATABASE

HARDWARE

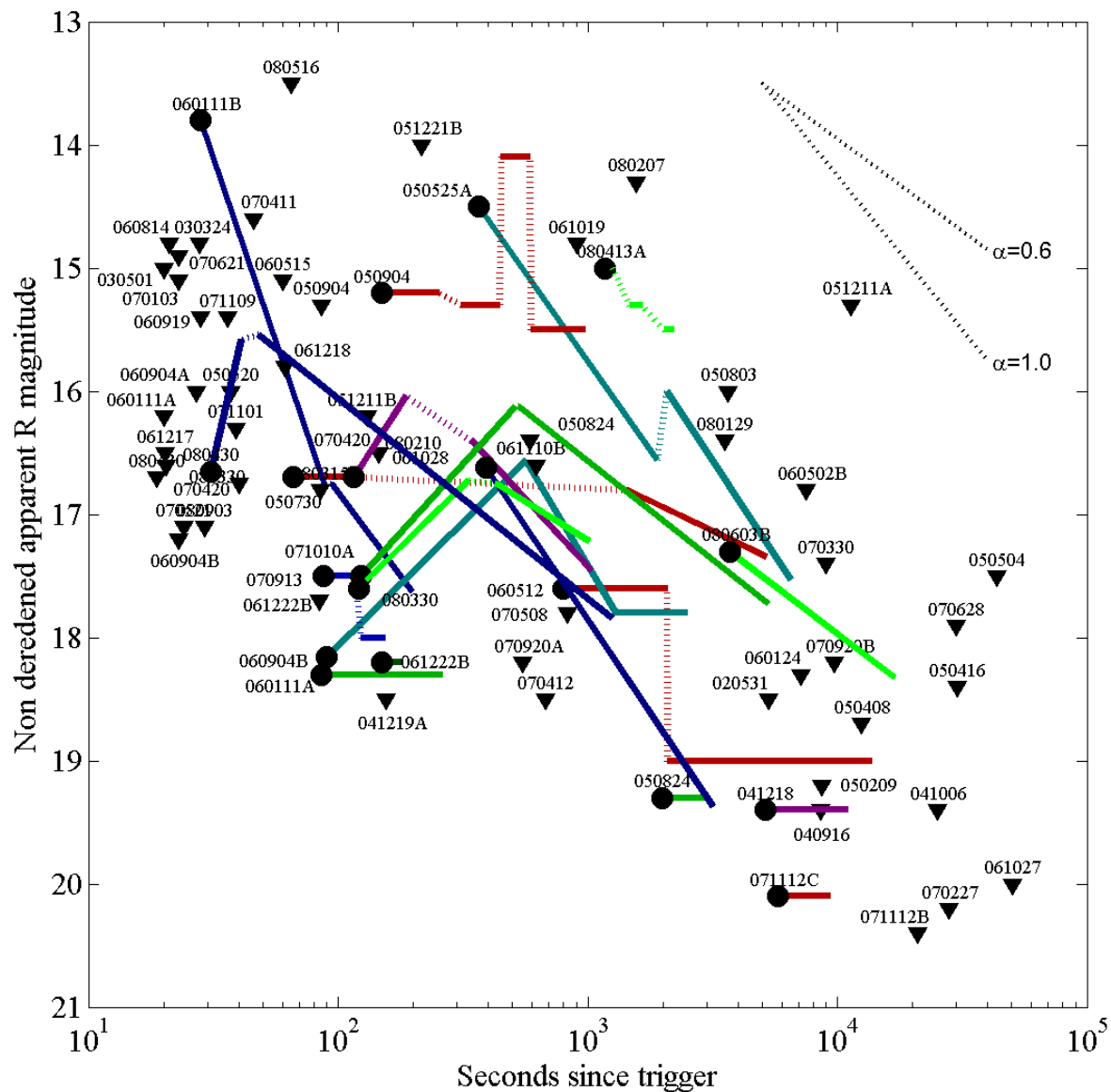
WEB pages

SOFTWARE

Fig. 2.— Flow diagram of TAROT components.

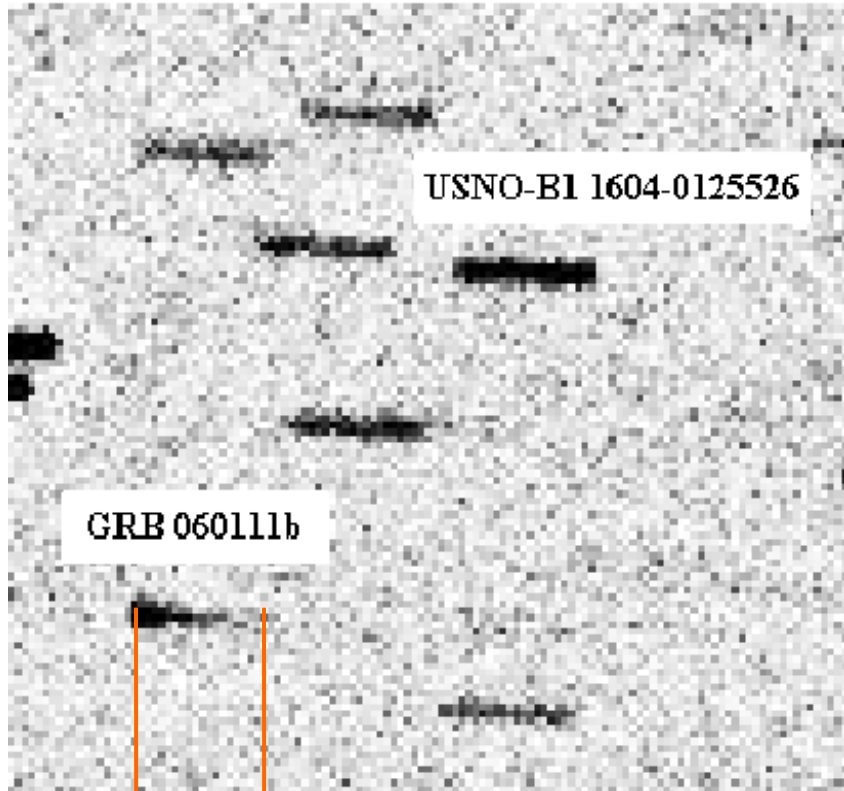
TAROT- GRB science

Period 2001-2008 : 52 upper limits, 20 positive detections (Klotz et al. 2009 AJ 137, 4100)



TAROT- GRB science

The trail technique to obtain a good time resolution at the beginning



(Klotz et al. 2006 A&A 451, L39)

Sequence :

1 x 60s C trailed

5 x 30s C diurnal motion

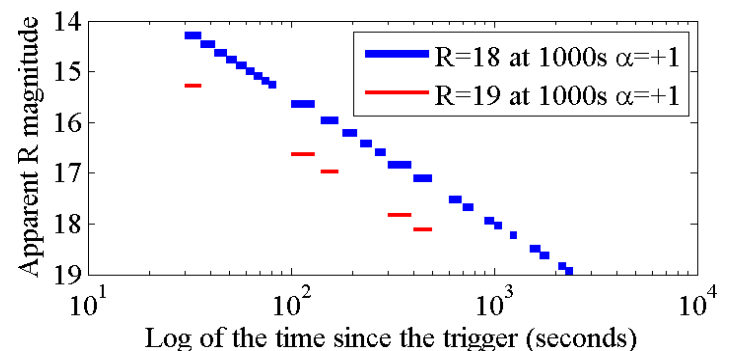
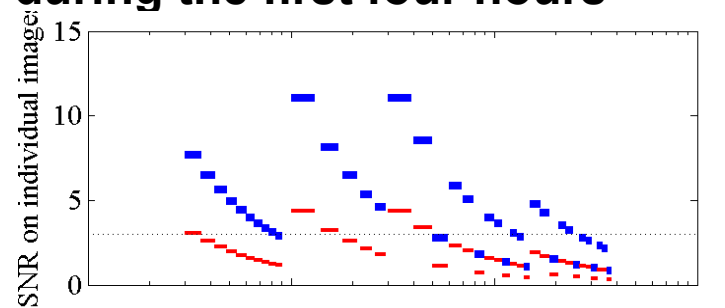
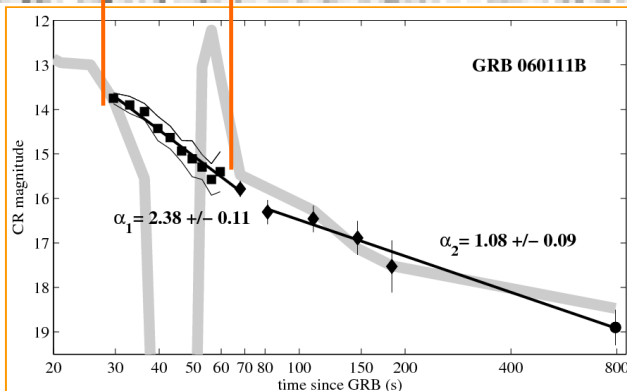
6 x 90s CCRCCR diurnal motion

6 x 90s CCRCCR diurnal motion

6 x 90s CCRCCR diurnal motion

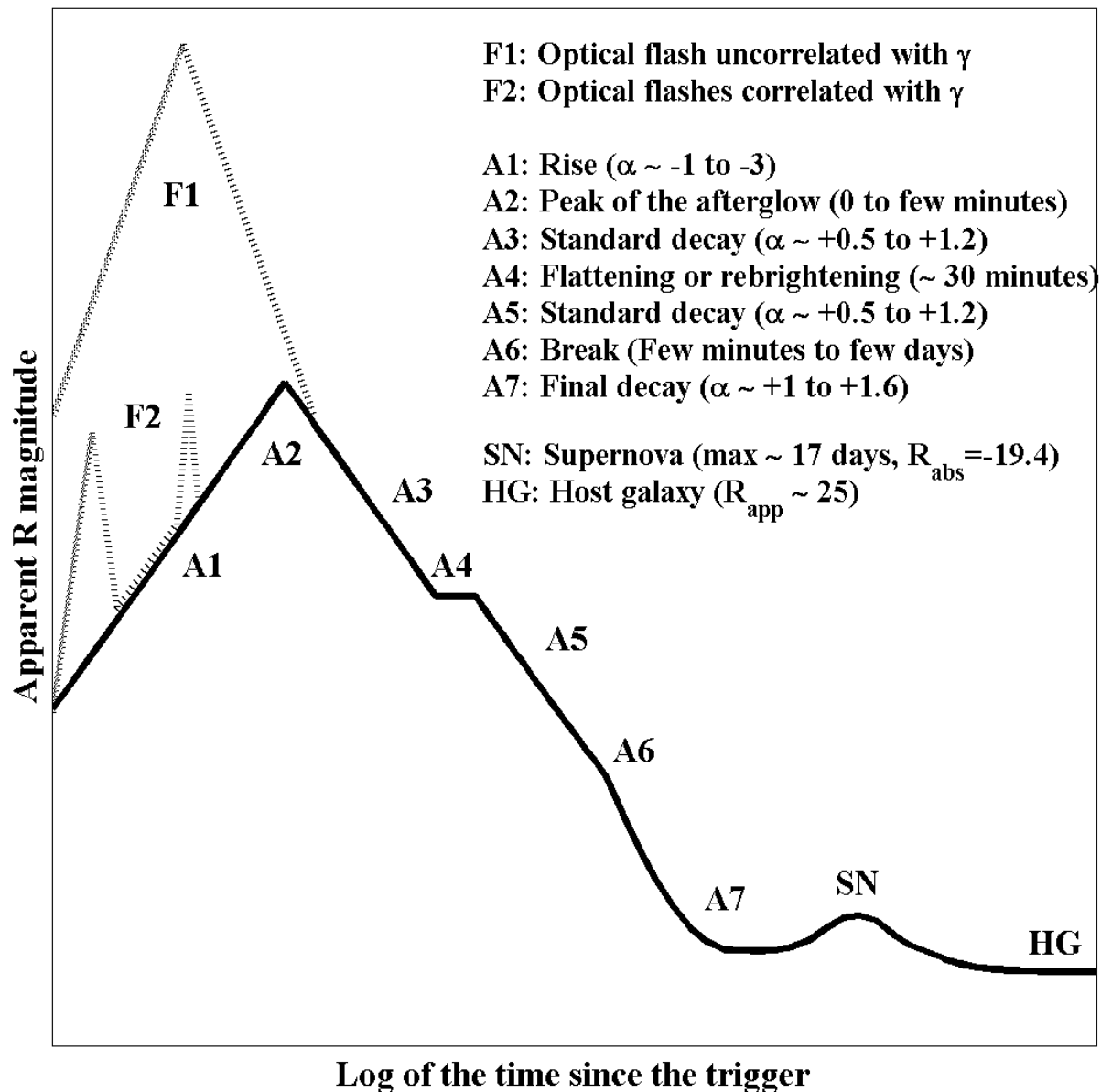
6 x 180s CCRCCR diurnal motion

during the first four hours

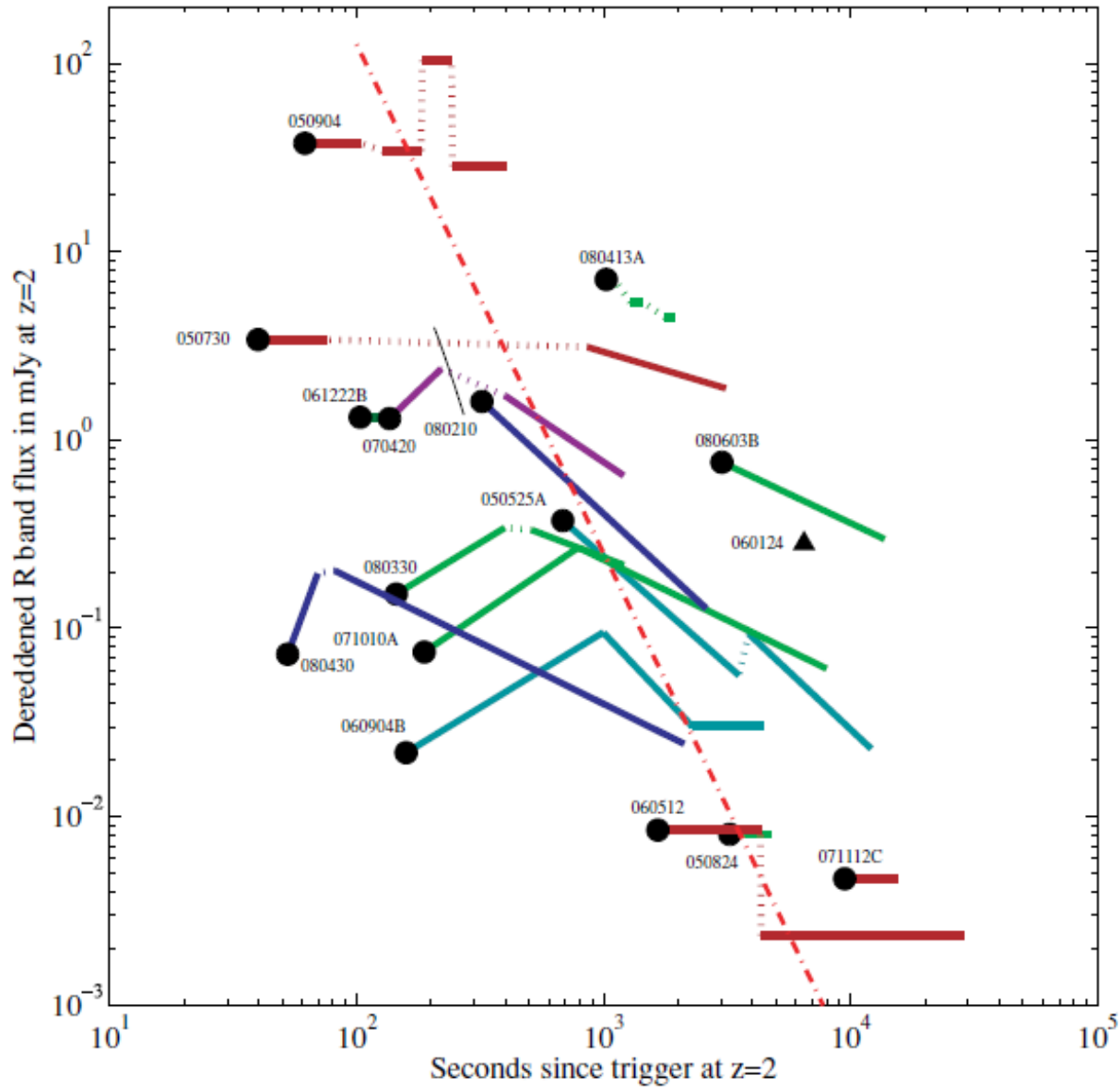


TAROT- GRB science

GRB canonical optical light curve



TAROT- "Absolute" light curves

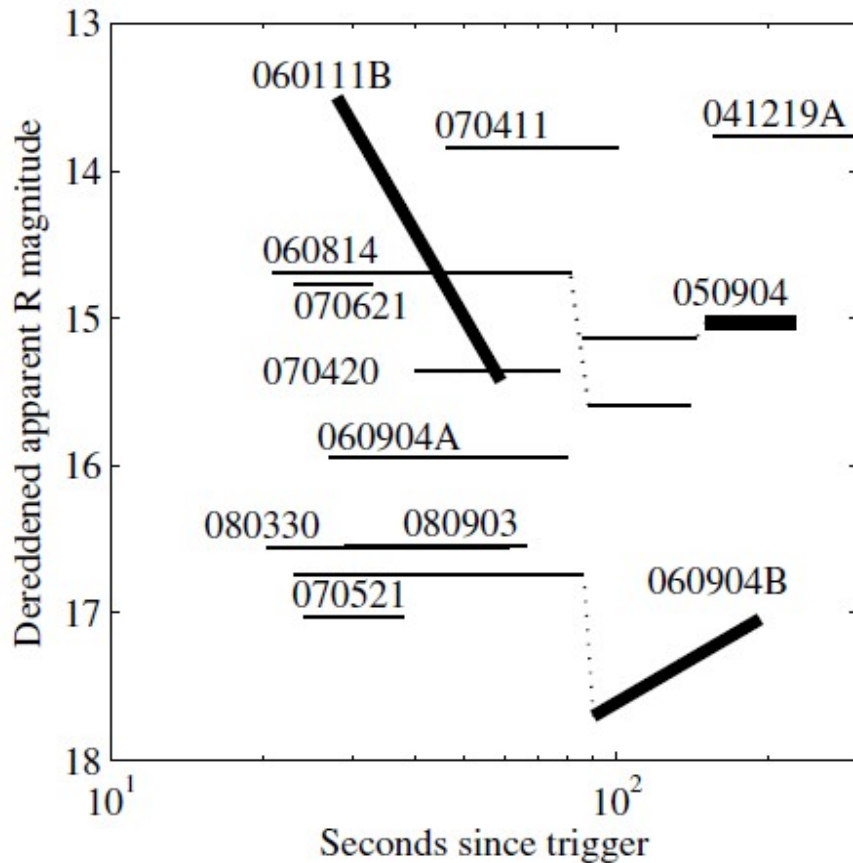


TAROT- observations during gamma emission

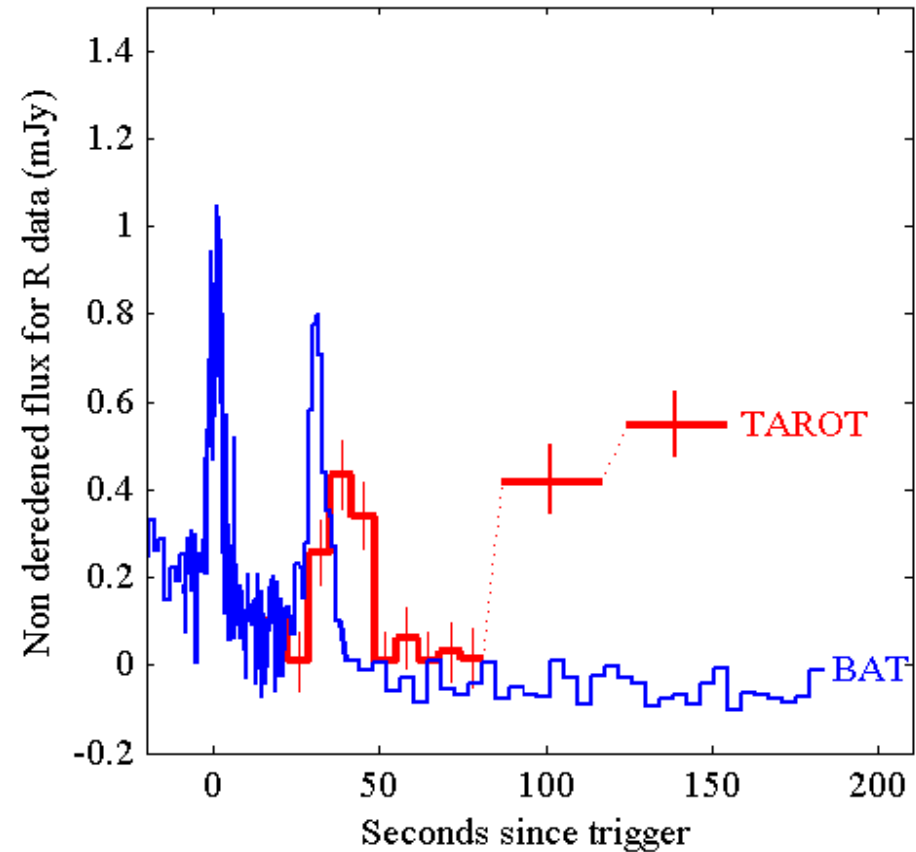


TAROT- observations during gamma emission

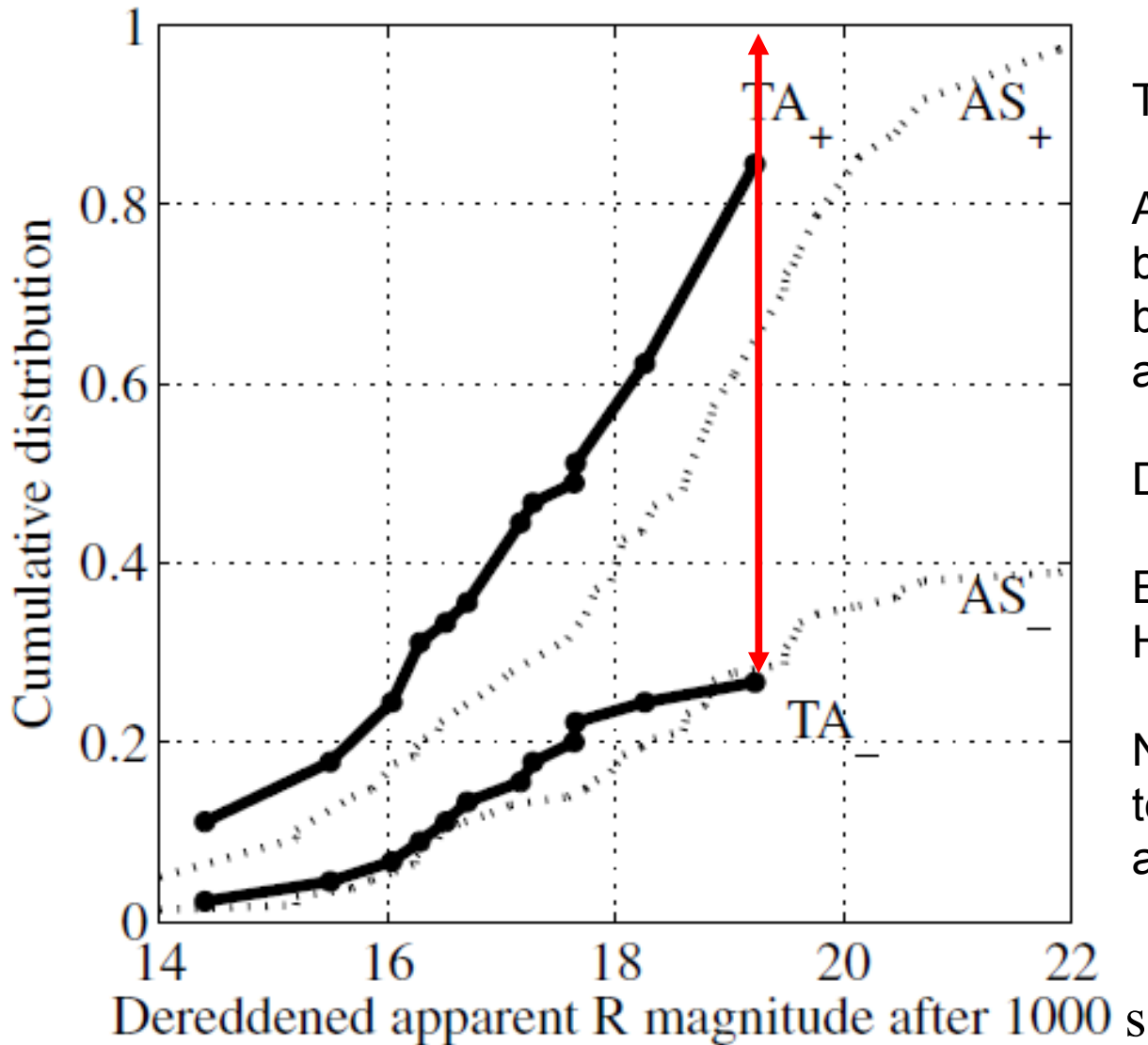
Period 2001-2008 :
11 upper limits, 3 positives



Special case of GRB 081126
Time lag optic/gamma



TAROT- Optical brightness distribution



The optical afterglow :

About 70% of the bursts are not seen brighter than $R=19$ after 1000 seconds.

Dark bursts :

Extinction by local dust
High redshifts ($z > 7$)

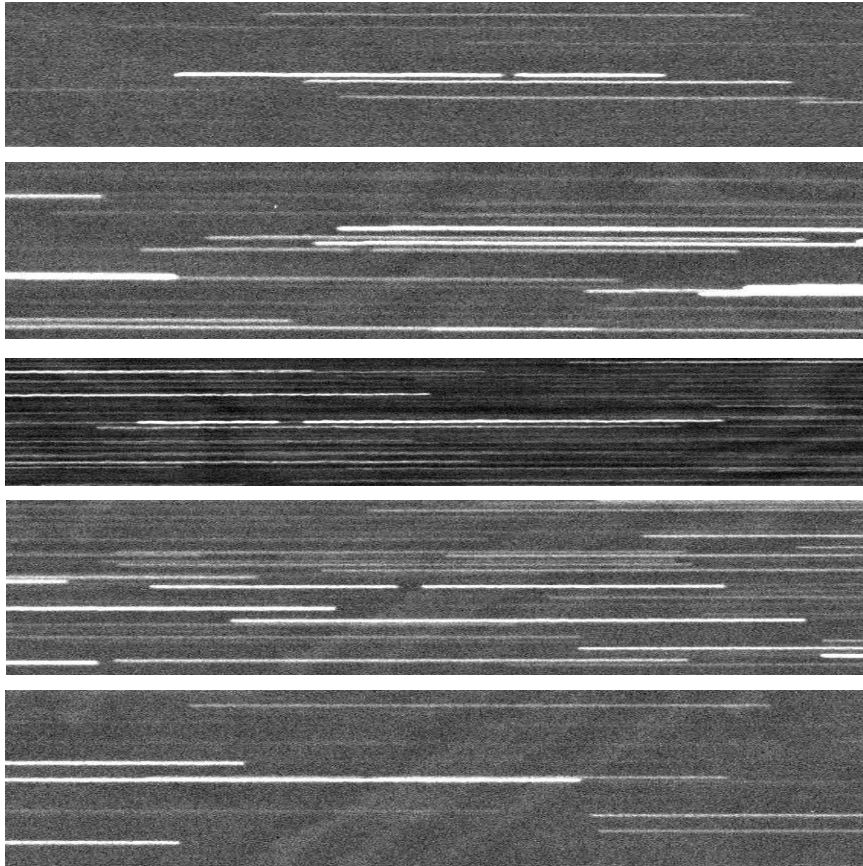
Need larger aperture telescopes (at less $R=22$ at 1000 sec.).

TAROT – occultations by asteroids

Science case; Predictions up to 1000 km from the observation site
Two trailed image of 90 seconds / predicted event.

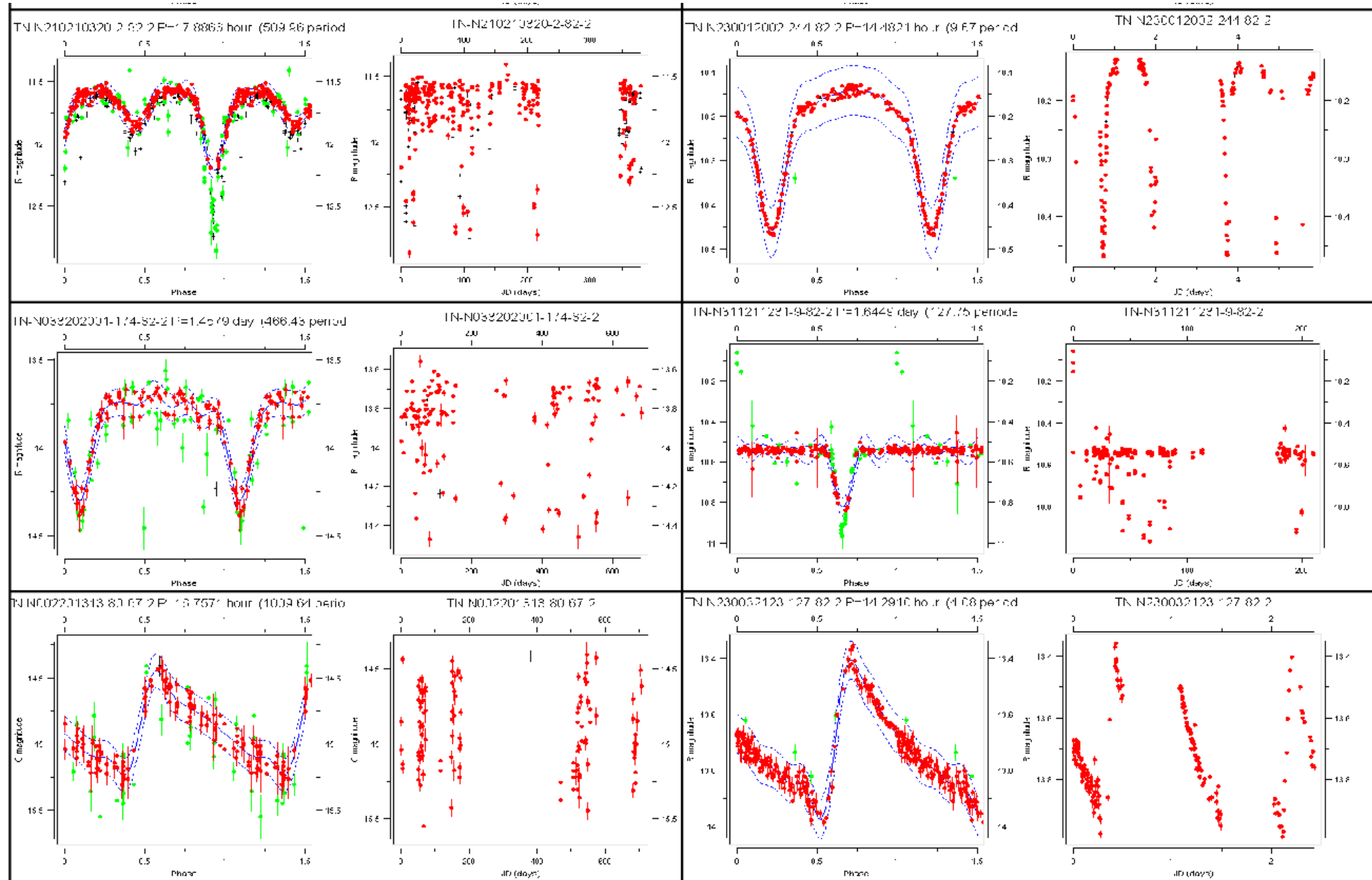
Calern dec-2004 to nov-2008 : 950 observations, 8 positives.

La Silla sept-2006 to nov-2008 : 500 observations, 5 positives.



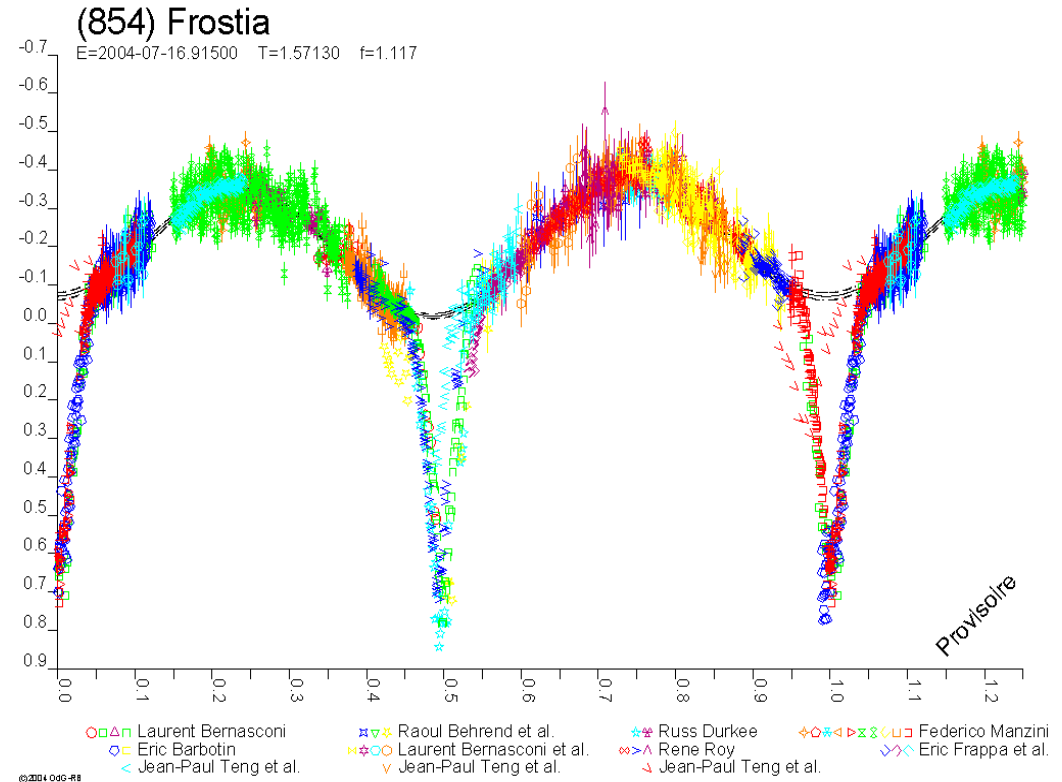
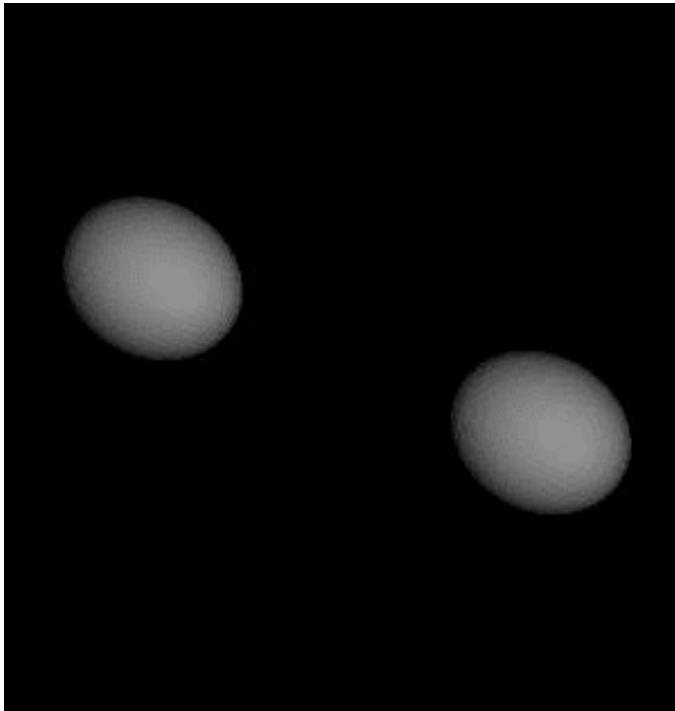
TAROT- New variable stars

1700 new variable stars (Damerджи et al. 2007 AJ 133, 1470)



TAROT- binary asteroids

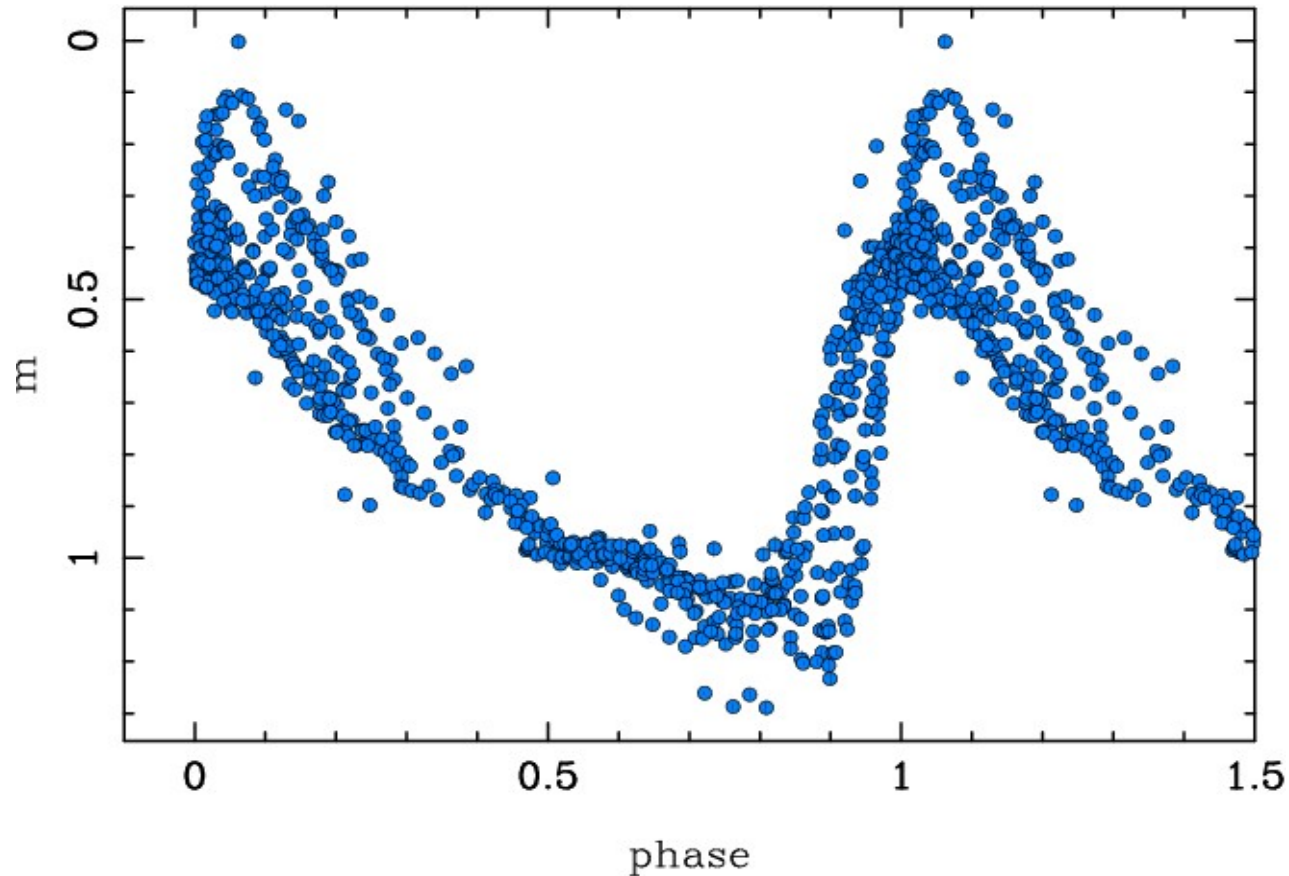
Science case: photometry (~ 0.1 mag) follow-up of interesting objects.



(Behrend et al. 2006 A&A 246, 1177)

TAROT- RR Lyrae stars

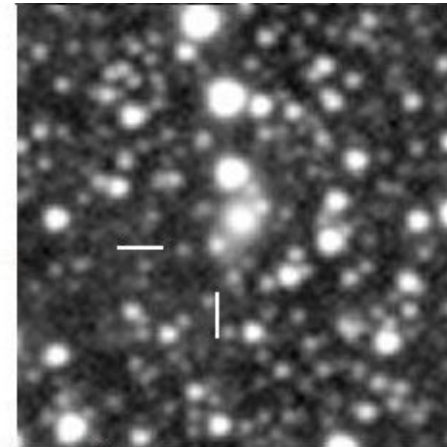
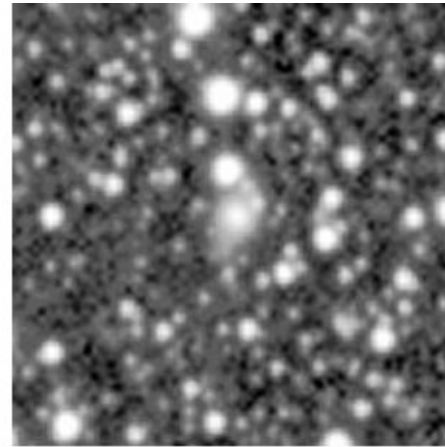
Science case: photometry (~ 0.1 mag) follow-up to check Blazhko effects



(Le Borgne et al. 2007 A&A 476, 307)

TAROT– Discovery of supernovae

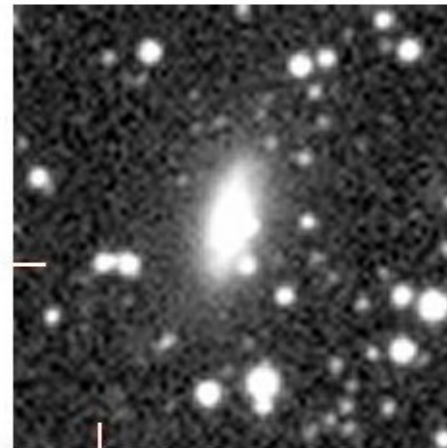
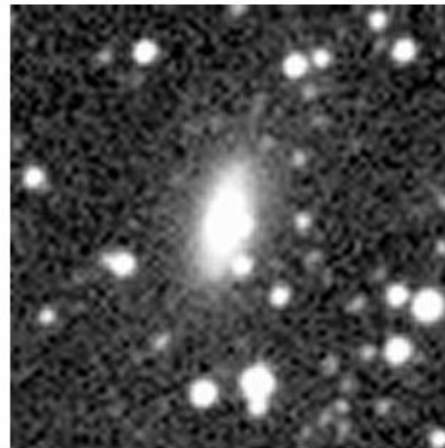
Supernovae discovered
at TAROT LA Silla



Supernova 2007cr in the galaxy ESO 137-19



Supernova 2007cv in the galaxy IC 2597



Supernova 2007ft in the galaxy NGC 4677

CADOR - a central point for a network

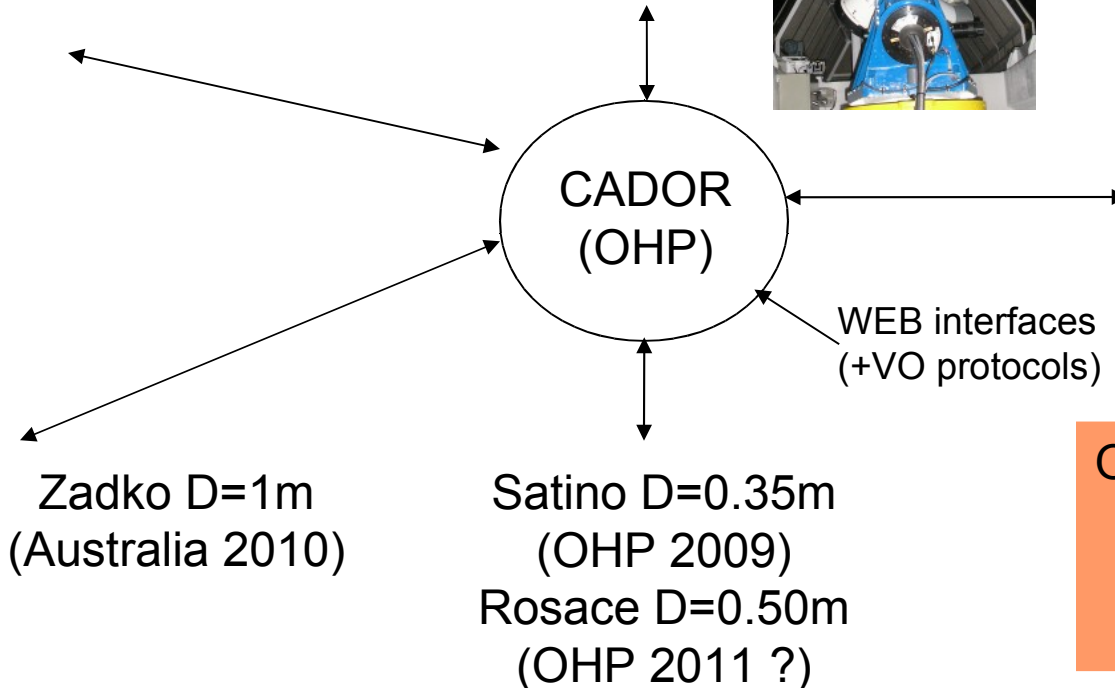
Science case; Managing the two TAROT and other robotic telescopes from a central point. CADOR is 9 computer server + 10 TByte of storage archive. In 2009, VO protocols (VOEvents), user friendly interface to access archives. In 2010, access to list of sources detected.



TAROT D=0.25m (Calern 1998) TAROT D=0.25m (La Silla 2006)



FARO D=0.20m (Banon 2009)



Other observatories possible if using the common software (ROS).