

The CAHA small telescopes responding automatically to Gamma-Ray Burst alerts.

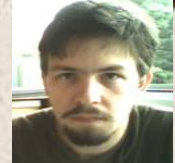
Javier Gorosabel + Martin Jelínek (IAA, Granada)

On behalf of, A.J. Castro-Tirado (IAA), P. Kubanek (IAA), A. de Ugarte Postigo (ESO),
J.M. Castro Cerón (DARK), M.D. Ramírez-Pérez (U. Leicester).

0.- The IAA GRB team: ¿Who are we?

✓ The core group:

- Alberto Castro-Tirado. IAA. Permanent staff.
- Petr Kubanek. IAA. PhD Student.
- Martin Jelínek. IAA. PhD Student.
- Javier Gorosabel. IAA. Permanent Staff.



✓ External close collaborators:

- Antonio de Ugarte Postigo. ESO. Postdoc.
- José María Castro Cerón. DARK. Ph D Student.
- María Dolores Pérez Ramírez. U. Leicester. Postdoc.



0.- The IAA GRB team: ¿Who are we?



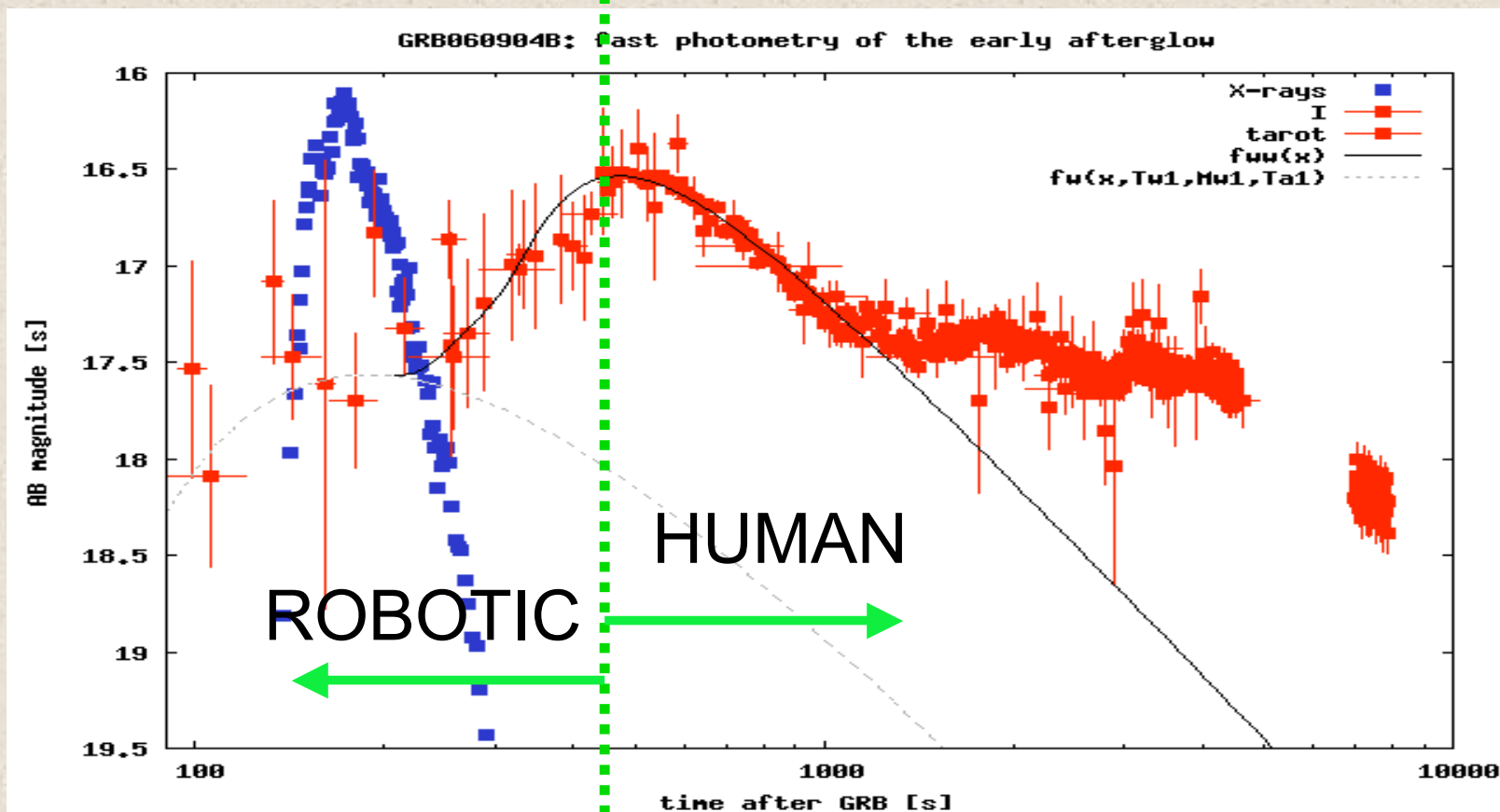
✓ Wide experience with robotic telescopes:

- BOOTES-IR: 60 cm infrared telescope, OSN, Granada, Spain.
- BOOTES-1: 30 cm in El Arenosillo, Huelva, Spain.
- BOOTES-2: 60 cm in La Mayora, Malaga, Spain.
- BOOTES-3: 60 cm in Mount John, New Zealand (in course).
- Collaborating with FRAM (Argentina), BART (Czech republic), WATCHER (South Africa), LSST (CCD testbed).

1.- The Science case: Responding robotically to GRB alerts

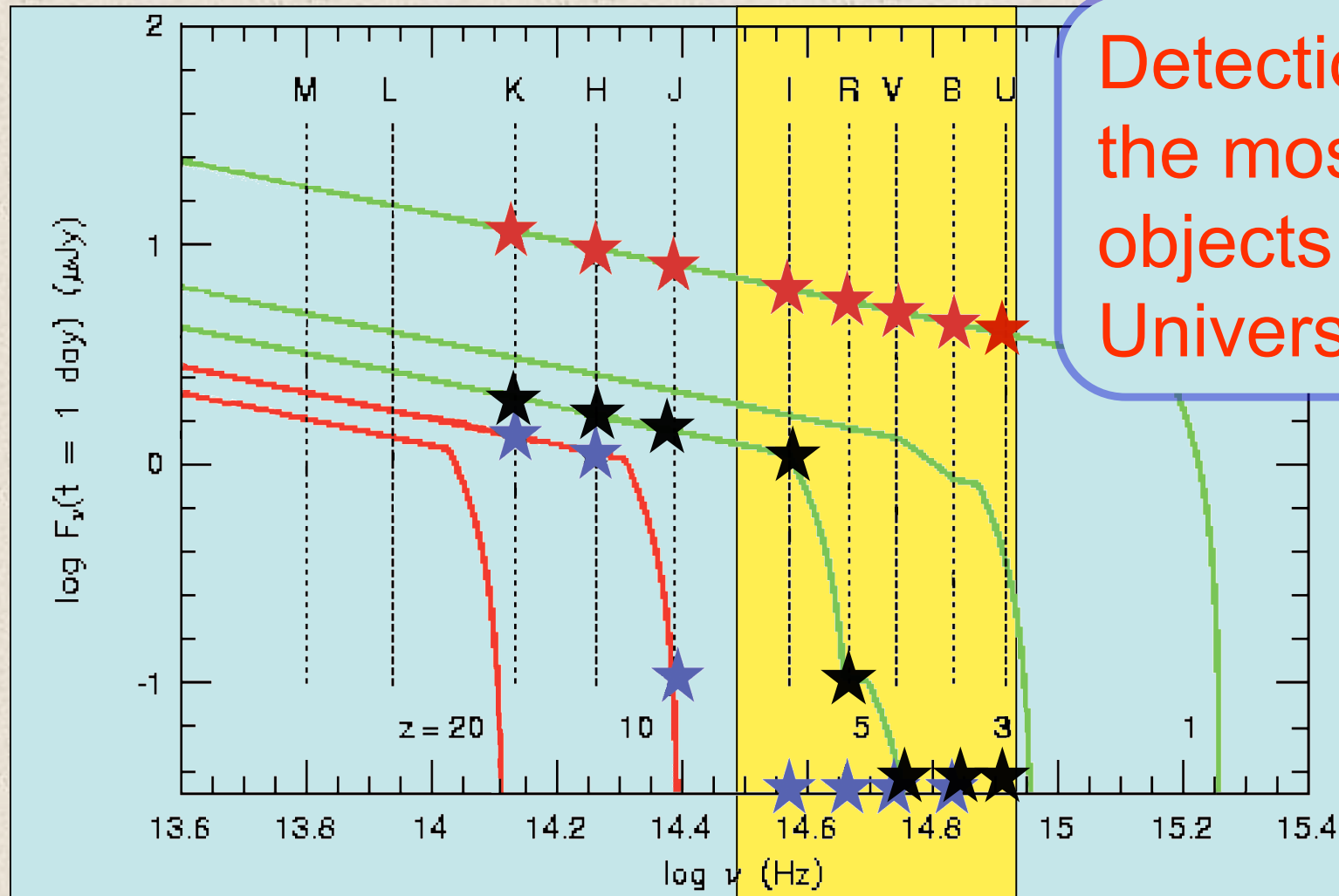
✓ Understanding the optical prompt emission of Swift GRBs.

- The afterglow model is only valid for times $>$ several minutes after the GRB.
- Swift does not cover the red optical part (besides it is only a 40cm telescope).
- Accurate photometric accuracy ($<3\%$) and wide spectral range is required.



✓ Detecting very high-redshift GRBs ($3 < z < 7$) with the 1.23m:

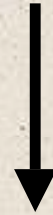
- The Ly α sharp break should appear in the SED constructed with BUSCA.



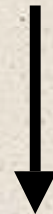
Detection of
the most distant
objects of the
Universe?

✓ The GLAST era and the role of the Schmidt telescope:

- GLAST launch is scheduled for May 2008.
- It will detect 200 GRBs/yr with error boxes of 5-15 deg in few seconds.
- Some of the error boxes (60 per yr) will be reduced to 10'.



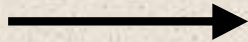
- A wide field of view telescope, like the Schmidt, can play an important role



How is the transparency of the Universe in the GeV-Tev range?

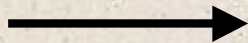
2.- Our needs: Requested telescope time

- Science case 1: Study of the prompt emission



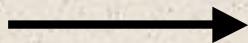
The 1.23m (+Astralux) is the best option. However still acceptable science could be done with the 2kx2k CCD, BUSCA and MAGIC

- Science case 2: Detection of high-redshift GRBs



The 1.23m (+BUSCA) is the best option. MAGIC can still be a good solution to search for ultra high-redshift GRBs.

- Science case 3: GRBs detected by GLAST



The Schmidt equipped with a wide field of view detector is the most efficient solution.

2.- Our needs: Requested telescope time

- Science cases 1+2 at the 1.23m telescope.

We estimate 16 Swift GRBs/year visible from CAHA in real time.

On average half a night per GRB.

In total 13 nights at the 1.23m and 11 nights at the Schmidt

with an accuracy of a few arcmin.

On average half a night per GRB

11 nights per year with the Schmidt

+

5 nights per year with the 1.23m

3.- Contribution to operations: **rts2 telescope operating system**

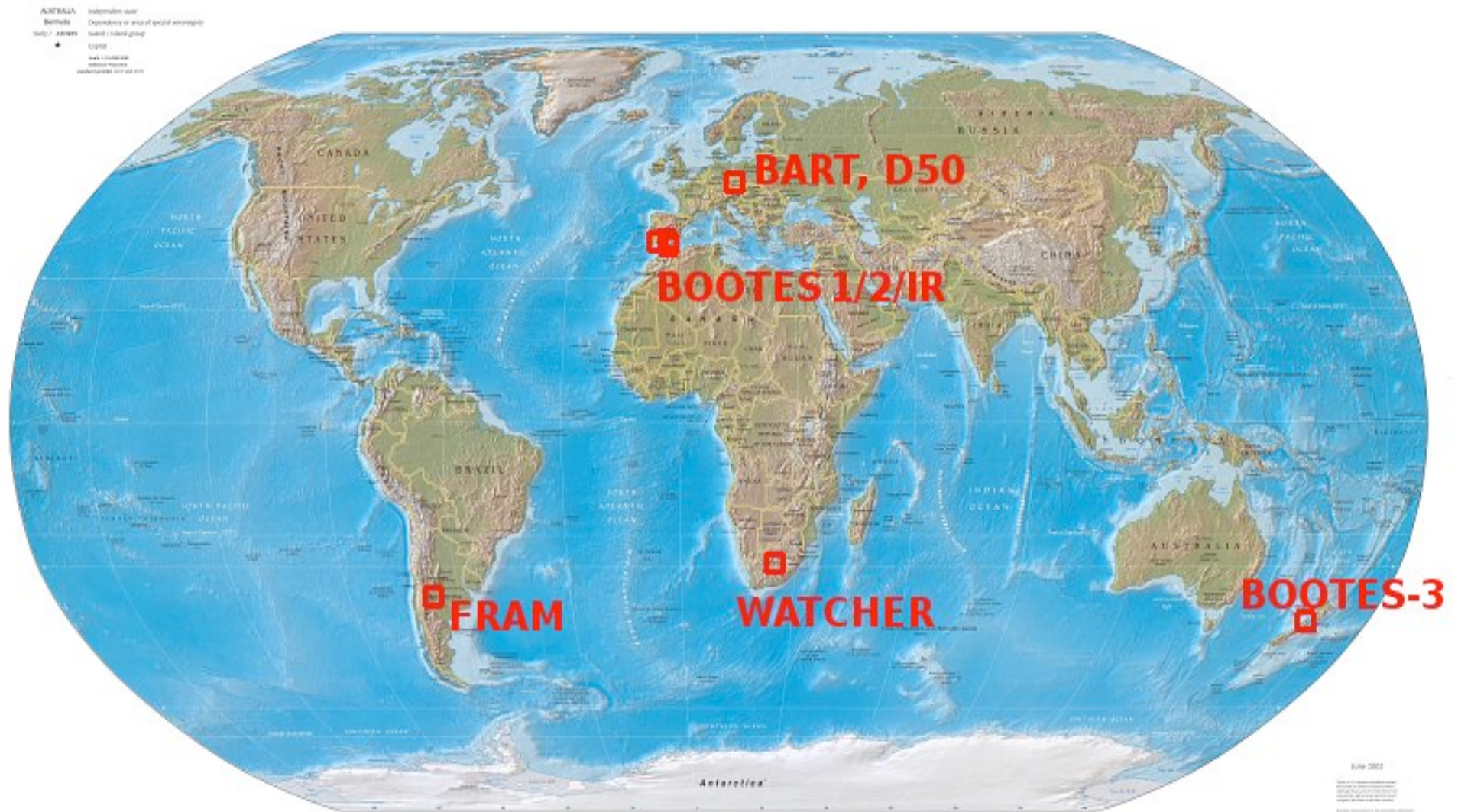
✓ What is rts2?

- It is a robust robotic telescope control system developed at IAA.
- Generic, modular, open package based on two basic ideas:
 - Autonomous (unmanned) operation
 - Rapid Response Mode is possible
- Can operate various kinds of instruments:
 - Extremely simple: (Allsky camera - only CCD + weather info)
 - Complete observatory: (i.e. Telescope w/ mount & camera(s), dome)
 - Exotic: (LSST CCD testbed)
- Optimized to minimize the overhead
 - Filter change while readout, slew.
 - Readout while slew, etc...

3.- Contribution to operations: **rts2** telescope operating system

✓ Where is rts2 used?

Physical Map of the World, June 2003



3.- Contribution to operations: **rts2 telescope operating system**

✓ **RTS2 Architecture**

- Independent, network modules (components):
 - Centralized (registration/priority server)
 - Device servers: (camera, telescope, dome, focuser, filter wheel etc.)
 - Frontends (executor, selector etc.)
- Fail safe (single failure does not endanger the system)
- "Plug-n-play" (module insertion/restarting possible)

3.- Contribution to operations: **rts2 telescope operating system**

✓ Observing

- Priority based scheduler with target repetition:
 - Monitoring (minor bodies, blazars, quasars, variable stars; comets)
 - Surveys (Galactic plane, satellite follow-up)
 - Rapid response mode
 - Photometric calibration (Landolt/Stetson fields)

Available also:

- Manual selection/override
- Predefined list [time,target]

3.- Contribution to operations: **rts2 telescope operating system**

✓ Real time image processing

- Real time astrometric solution:
 - Telescope control (pointing model in realtime)
 - Observing conditions checking (fwhm, extinction)
 - Pointing corrections (recentering)
 - **Image archival**
- Photometric calibration (work on course):
 - Regular imaging of standard fields.
 - Tens of pointings per night if requested.
- Image archiving:
 - Customizable directory structure.
 - Searchable SQL database (RA & DEC cone search)
 - VO compatible.

3.- Contribution to operations: **rts2 telescope operating system**

✓ **Targets:**

- Various types of coordinates for a target
 - RA & DEC celestial
 - Elliptical ephemerides (solar system bodies)
 - Rapid Response Mode (GRBs detected in realtime, SN, Nova, VO event)
 - Random grid for pointing model, standard fields, blank flat fields, etc..

✓ **Scripts:** Any target can have its own observing script

- Simple: “E 300”
- More complex: “set andor.subexp=2 hex 0.6 0.6 { E 20 }”
- Complicated, with exhaustive description of the config
 - Stored as file templates.
- Similar to ESO OBs
- Reusable for similar targets

4.- Conclusions: **rts2 telescope operating system**

- ✓ rts2 is designed to be used by any science case.
- ✓ rts2 is prepared to be plugged in any existing control system.
- ✓ rts2 is highly modular so it can be used partially if needed.
- ✓ rts2 is easily portable (POSIX C++)
- ✓ rts2 is normally in LINUX but also possible in Windows.

<http://rts-2.sf.net>