

# TAROT, GRANDMA

Feedback for SVOM on GRB follow-up  
S. Antier (Artémis) & A. Klötz (IRAP)

# TAROT updates



Michel BOER (PI)  
Alain KLOTZ (co-PI)

205 GRBs observed  
5% observés pendant l'émission gamma + détection visible  
10% observés après l'émission gamma + détection visible

**TAROT Calern (France)**

D = 25 cm FoV =  $2^\circ \times 2^\circ$   
Slewing < 10 s Since  
1998



**TAROT La Silla (Chile)**

D = 25 cm FoV =  $2^\circ \times 2^\circ$   
Pointing < 10 s Since 2006



**TAROT Reunion (France)**

D = 18 cm FoV =  $4^\circ \times 4^\circ$   
Pointing < 5 s  
Since 2016

new members : A. deUgarte Postigo, S. Antier ARTEMIS/OCA

# TAROT - training for SVOM

- 01.04.2022 - TAROT is able to receive SVOM alerts and can automatically observe the sources
- 07.2022 – TAROT will provide cutouts around the ECLAIRs (Swift-BAT) source. We will provide calibrated images with flats and darks (and WCS if success). We have some limitations to transfer raw data for TAROT-Chile (limit of data volume per day) and TAROT-Réunion (band pass limited to 2 Mbits/s).
- Spring 2023 – Pyros (telescope controller and data base for the images) will replace CADOR (PI. IRAP)
- ARTEMIS is asking for a system engineer to conduct operations for TAROT and for future instrumental projects at Calern.

# TAROT – Latency of SVOM alerts

Alert Swift 19 march 2022 - trigger Swift 1098132

BAT localization, RA=218.2072, Dec=61.2888

Trigger time : 2022-03-19T21:40:33.33

NASA Alert for position + 7s 2022-03-19T17:40:51

Received at TAROT-CADOR < 1s later

Chanel = VOEvent SVOM

RA=218.1569, Dec=61.265 (ECLAIRs coordinates)

Received at TAROT-CADOR + 26s delay from NASA alert (+ 43s after T0) on 2022-03-19T17:41:06

Alerte Swift 4 April 2022 - trigger Swift 1098132

RA=50.4479, Dec=10.0045

Trigger time = 2022-04-04T11:54:30.42

NASA Alert for position +55s after T0 on 2022-04-04T11:55:23

Received at TAROT-CADOR < 1s later

Chanel VOEvent SVOM

RA=50.4478976, Dec=10.004496 (ECLAIRs coordinates)

Received at TAROT-CADOR + 38s delay from NASA alert (+ 1min33s after T0) on 2022-04-04T11:56:03

Check latency with IRIS



# GRANDMA - Updates



PI. S.Antier (Artémis), Co-PI. A. Klotz (IRAP)

New groups: KAO, MNCA, XAO, EPFL, UL, CAMK, OCA/Lagrange

Observing time applied to for 2022B GTC (Kann), Opticon (deUgarte Postigo, NOT, LT, LCO, REM), NOEMA (deUgarte Postigo), CFHT (Ducoin), ESO (Antier, VLT)

## Scientific program

- Kilonovae
- Binary compact coalescences & neutron stars
- GW counterparts
- Neutrino counterparts

Collaboration (80 members)  
Including GW and neutrino Physicists, Nuclear astrophysicists Astrophysicists, Observers, ...

# GRANDMA - ZTF/Fink alerts

GRANDMA Observations of ZTF/Fink Transients during Summer 2021, link

<https://arxiv.org/abs/2202.09766>

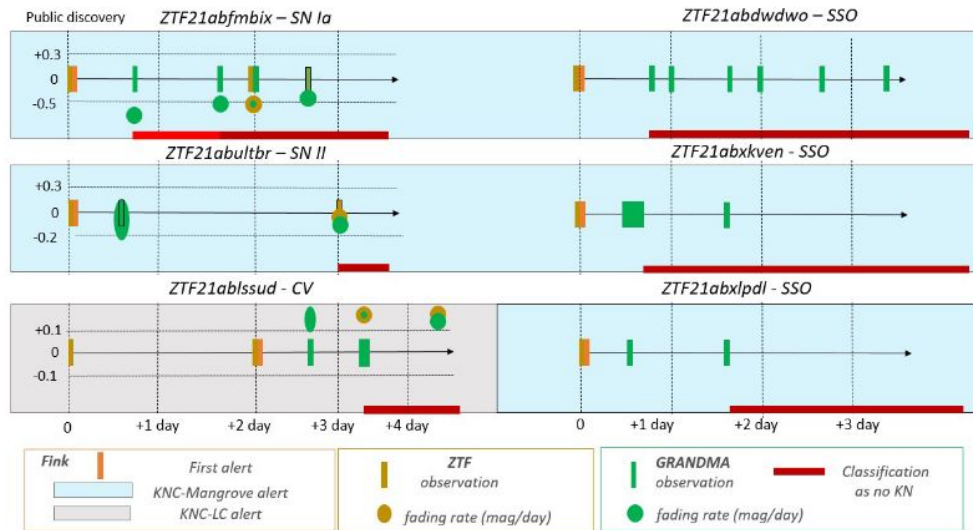
4 months of observations from June to September 2021

37 telescopes involved with 26 amateur astronomers

35 million new sources detected by the Zwicky transient facility from april to september 2021

107 passed our criteria based on the light curve evolution from kilonovae

68 passed our criteria based on their location on nearby galaxy



**Figure 8.** Overview of the GRANDMA observations of the six ZTF-Finkalerts followed up by professional and amateurs astronomers. The ZTF-Finkalerts came from two selection filters of the initial ZTF flux measurements named “KN-LC” and “KN-Mangrove” (see section 3). Displayed in orange are the time-stamps for the first alert provided by FINK Gold vertical bars represent the time-stamps of the release of ZTF public data, and green vertical bars represent the GRANDMA data analyzed by STDpipe and MUPhoten. The circles present our fading slope estimation using  $r'/R$  filters (see section 4.3); in gold using only ZTF public data, and in green using ZTF+GRANDMA data. Horizontal red bars show the period when the alert is considered as of no further interest for KN searches. SSO corresponds to Solar System Object, CV to cataclysmic variable, and SN to supernova given by our post-observation analysis months after (see figure 4.4.4). We see the potential of the amateur community to distinguish astrophysical events into three categories: moving objects, fast transients (KNe, GRBs) and slow transients (supernovae, CVs).

# GRANDMA – GRB campaign – 20.03.2022 to 15.05.2022

20 telescopes involved to follow-up GRBs from SWIFT-BAT

- Goal : find optical transients and perform follow-up
- Preparing the O4 campaign (shifts rota, online analysis)
- For co-I of SVOM, provide feedback for SVOM

## GRB 220319A: GRANDMA observations

<https://gcn.gsfc.nasa.gov/gcn3/31785.gcn3> - Upper limit of amateur astronomers up to 20. from 14 min post BAT alert

Ali-50 observed the source 5.6h post alert with 20.1 upper limit in clear

No credible UVOIR found by GRANDMA and other colleagues

## GRB 220325A: GRANDMA observations

<https://gcn.gsfc.nasa.gov/gcn3/31804.gcn3> - Upper limit from SNOVA-NOWT-KAO-C2PU with 21 in r-band after 4h

No optical detection found by GRANDMA and other colleagues

## GRB 220403B: GRANDMA observations

No rapid observations from GRANDMA since the trigger was around 20h42 UTC (end of Chinese night) – Alert was detectable in the north at 19 mag < 2h post BAT alert. UBAI should have detected but didn't trigger its telescope

## GRB 220404A: GRANDMA observations

Alert too close to the Sun for a majority of observers – Ali-50 triggered observations 7 min post alert, data are processed.

# GRANDMA – Take away messages for the GRB follow-up campaign

## Telescope teams

- Some teams in GRANDMA are observing GRBs since a (long) while. They accept to join the GRB GRANDMA campaign to practice for O4 and but not to particularly create a general GRB group in GRANDMA
- Some teams do not have any experience in GRBs. Since one month, we are training them
  - how to receive a GRANDMA alert
  - to provide a list of observers/operator to contact (to provide feedback « Are you observing ? » « how is the weather »)
  - to provide a list of data reduction experts

## Suggestions

- organization of training campaigns, that lasts at minimal a month
- provide a guide that contains
  - « how to receive alerts », decoding SVOM Voevents alerts (must be a long way to go ...)
  - how to calibrate the data
  - some training with exercises



# GRANDMA – Take away messages for the GRB follow-up campaign

## Burst advocates

- 6h rota-shifts with two shifters and 1 week coordinator
- BAs were requested
- to contact telescope teams when there is an alert
- to assist telescope teams during a follow-up. For example, let's them know what is the expected brightness of the afterglow
- to report observations outside of GRANDMA

## Suggestions

- training, training, training (also the “experienced” weekly coordinators)
- practice cases, a general logbook and an event logbook are mandatory (or a wiki)
- use the same “name” all the time (e.g not weather is good at OHP, weather is good for Basa’s telescope, weather is good for IRIS ...)
- Allow some “break” with light shifts once every two months
- Automatization will take about 6 months
- Provide observability map (no need to ask TCH feedback when dec is +90°)
- in the beginning, recycling the weekly FAs more rapidly and pairing them with less experienced folks
- do not copy paste a GCN, proceed as report like (J.-G. Ducoin, 2022-04-04T11:25) GRB 220403B: LBT observations, 31826, AFTG:1 , AB magnitude  $r = 20.9 \pm 0.1$  , 2022-04-04, 0.3 days after the burst trigger.
- pop up a message on iFSC when a telescope is out of observation for several days
- give an “all clear” flag to stop observations

# GRANDMA - Follow-up of SVOM GRBs

GRANDMA has its own scientific program : GW counterparts, neutrino counterparts and ejecta related to explosive stars.

It is too preliminary to engage an MoU between GRANDMA and SVOM

GRANDMA is interested in following-up SVOM alerts during testing runs, especially for short GRBs. Collaborations can be made on a case by case basis when SVOM flies.

The model of GRANDMA is to write its own article based on its scientific program, and to include several experts from the particular trigger.

A GRANDMA campaign is triggered to answer specific scientific questions, with its observation and astrophysical implications valued in a GRANDMA article. Members within GRANDMA bring their expertise and their instruments based on individual motivations.

# Kilonova-catcher - joint interest in a citizen science program

SVOM can, for example, enlarge the program of Kilonova-catcher to “GRB-catcher”.

Fondateurs: A. Klotz, A. Cailleau, PI: Damien Turpin co-PI: Sarah Antier, project supersided by GRANDMA

The project is funded for 25 keuros for 2022 - 2023 by MITI CNRS

We have included a group of 100 members, with 30 active observers

The question of the data analysis of amateur astronomer images continues to be very critical