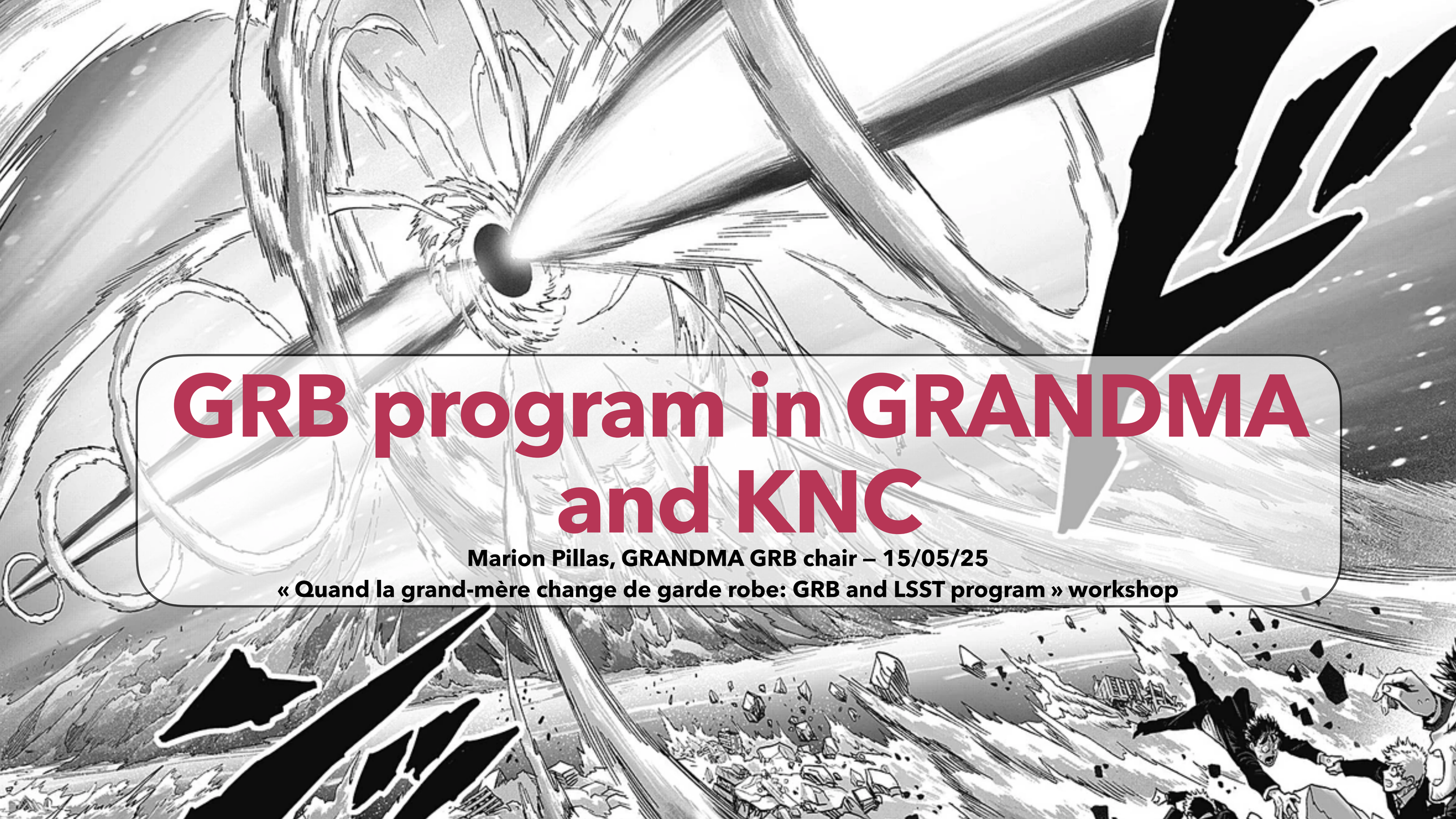


GRB program in GRANDMA and KNC

Marion Pillas, GRANDMA GRB chair – 15/05/25

« Quand la grand-mère change de garde robe: GRB and LSST program » workshop

GRANDMA GRB group — what is it? When is it?

- 1 chair: Marion Pillas
- 26 members : https://grandmagroupe.slack.com/archives/C084DGXN0PK
- 1 meeting every 2 weeks
- Discusion about:
  - Offline papers & coordination
  - Observation decision-making

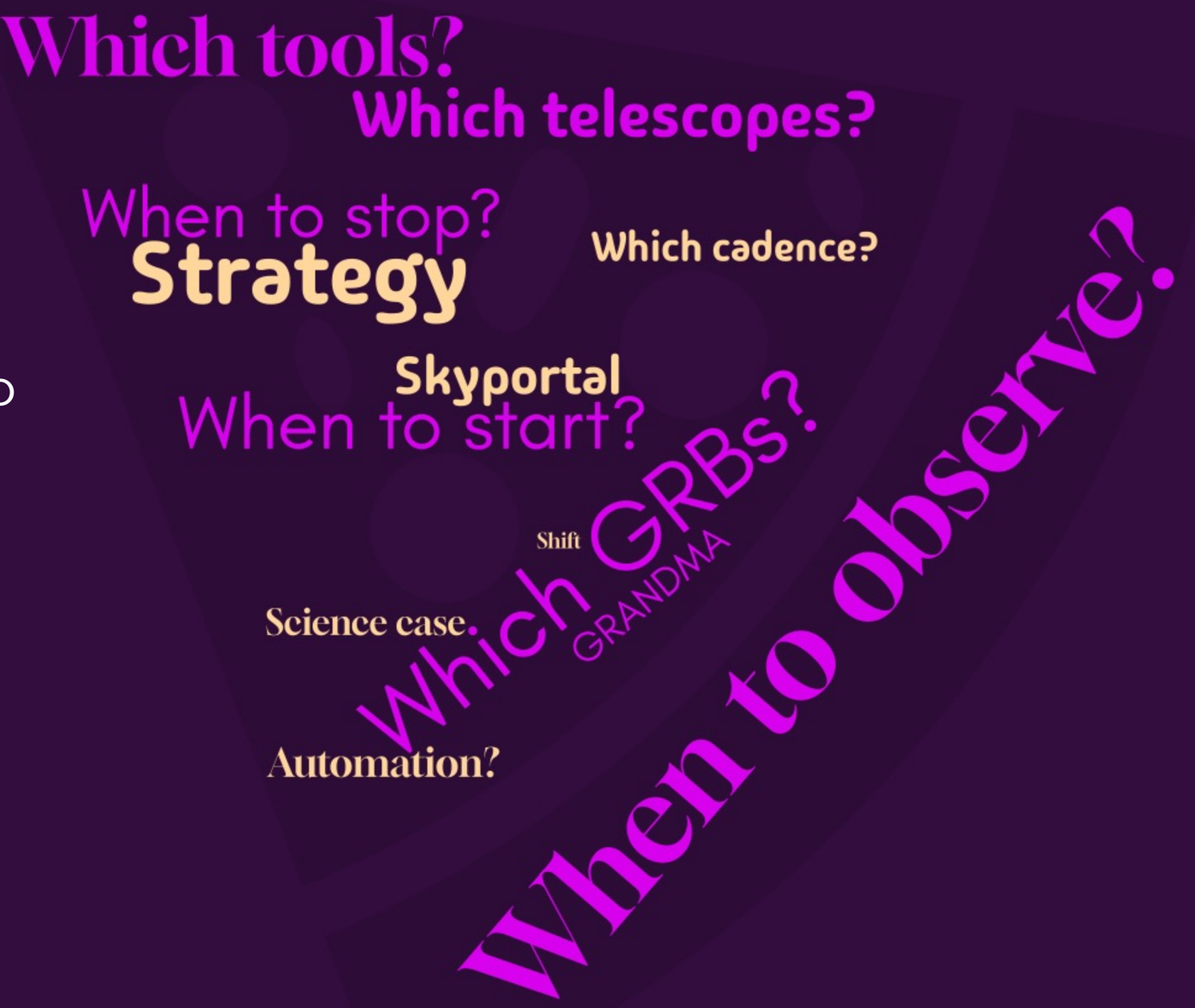
Ongoing offline work

- GRB 241025A: To be given to VLA? –> review needed
- GRB 241030A: modeling from both IAP and afterglowpy converging towards the same results: very high energy which is not consistent with the prompt – discussion ongoing about the next steps
  - How to validate the NMMA side? how to perform a review?
- GRB 250129A: Preliminary data given to UNAM - next meeting about modeling on May 21st
  - Common place for joint programs? What are the tools and services we share?
- GRB 250226A: Data analysis ongoing – to be given to EP lead by a EP – GRANDMA member: how do you handle these PhD projects around GRANDMA GRB paper?
- GRB 250424A: data acquisition done – discussion about what we do with it to be done
  - How to navigate on special events outside of shifters organisation?

To be discussed and decided!

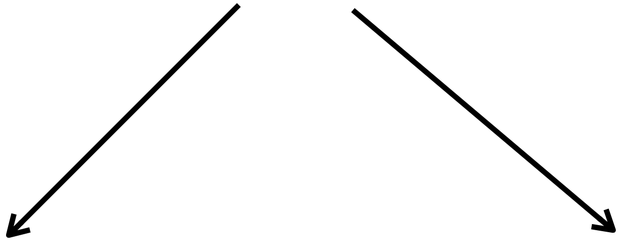
Low-latency work: GRB observation strategy

- Necessity to define the GRB science cases for GRANDMA
- Necessity to implement news tools to help the shifters



Low-latency work: GRB observation strategy

- Necessity to define GRB science cases for GRANDMA
  - What GRBs should be observed?



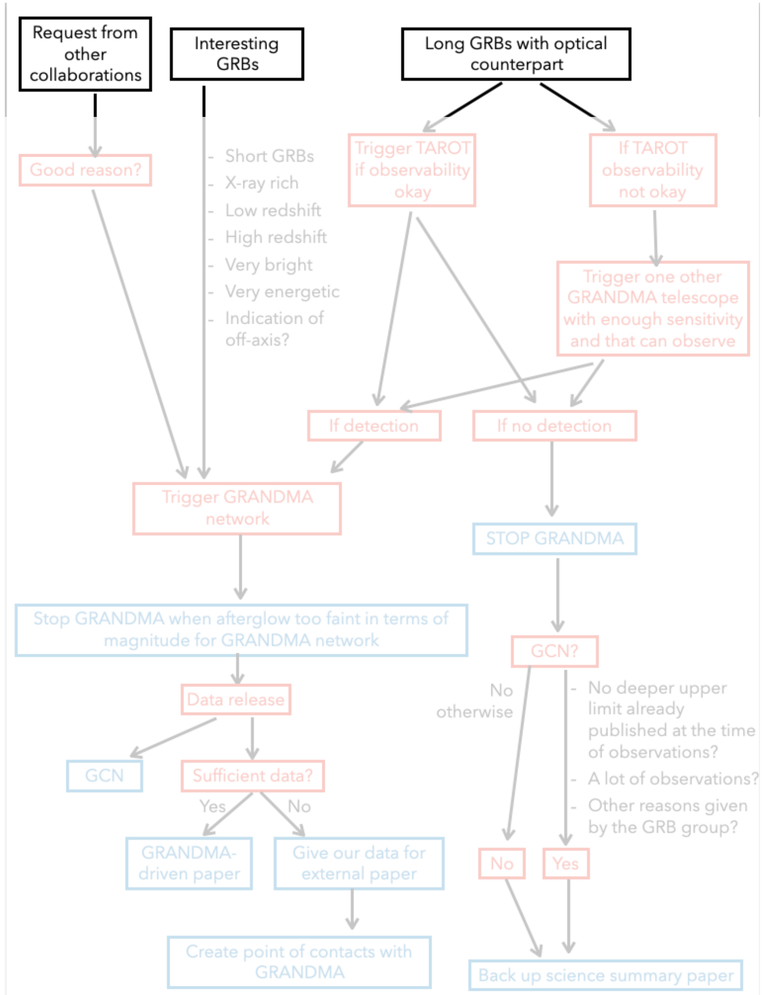
« Interesting GRBs »

« Regular » GRBs

Low-latency work: GRB observation strategy

« Interesting GRBs »

- Long GRB with X-ray counterpart (and optical?)
- Very energetic Prompt GRBs with LAT counterpart ~ $\mathcal{O}$(10–100 GeV) - Highest-energy photon above 10 Gev ~ 3/yr
- If the redshift is estimated within a day (or later if the GRB is very bright):
  - Low-redshift GRBs (z < 1) - Rate of ~ 7 over the last 3 months (4/7 released within a day) or z < 0.5?
  - High-redshift GRBs (z > 4) - Rate of ~ 3 over the last 3 months (2/3 released within a day)
- Short GRBs <2 s (Fermi, SVOM/GRM, MAXI, ARGILE) in at least one energy band and with upper band > 100 keV ; Short GRBs < 3 s (Swift) - if close to the threshold should be discussed
  - Should we apply a tiling strategy (with not well localized > 15arcmin)?
  - Selection on sky area?
- Other cases?
  - Off-axis jet scenario? –> how can we easily and rapidly get the information?

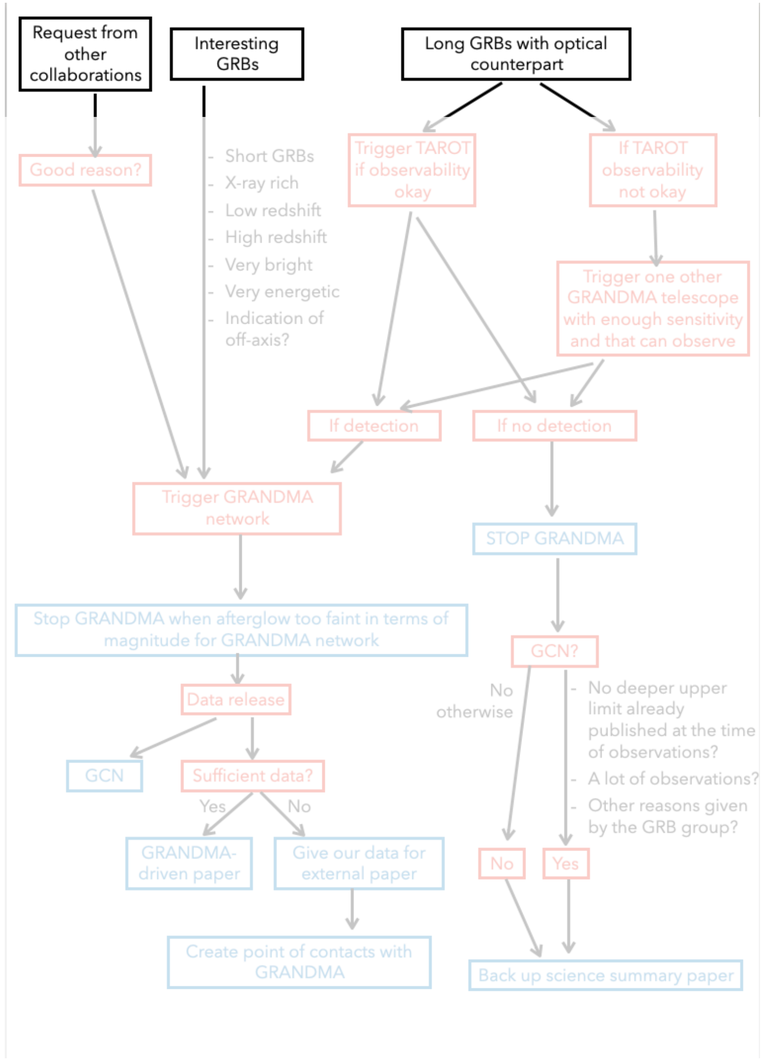


Low-latency work: GRB observation strategy

« Regular » GRBs

More regular follows-up of GRBs:

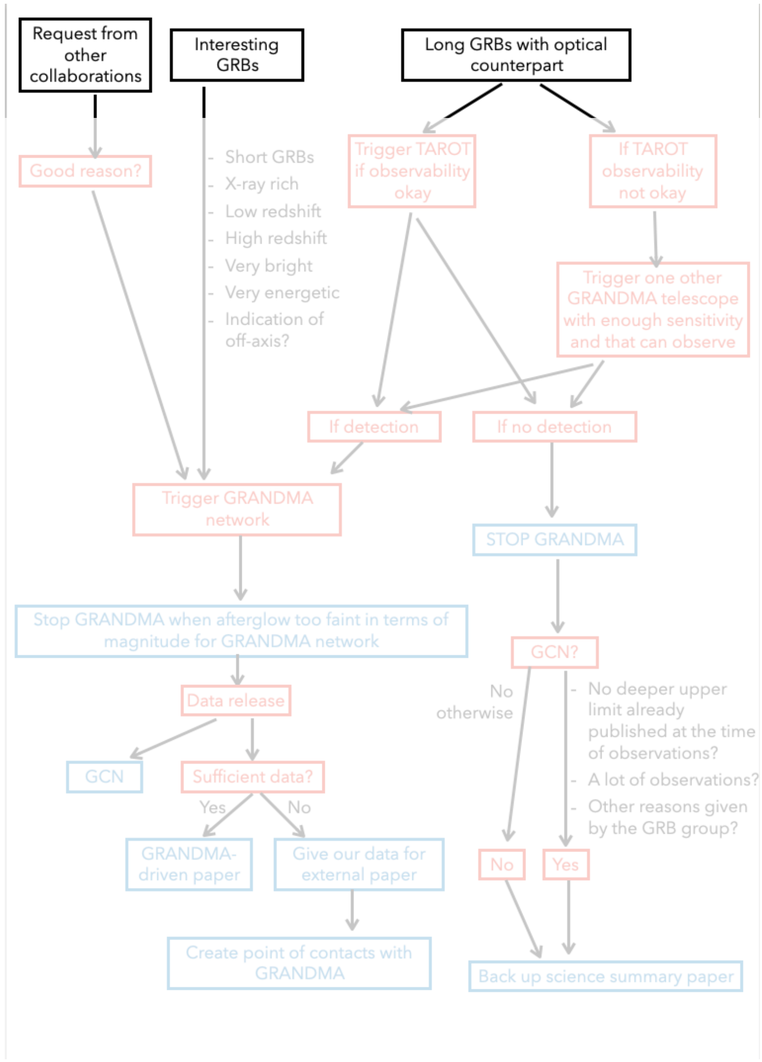
- **Long** (T90 > 2-3 s in one energy band)
- + **well-localized** (threshold? maybe < 4 arcmin radius uncertainty ~ TAROT/TCR FOV so it can be done in a single shot by the automated follow-up telescope?)
- + with an **optical** counterpart observed by another telescope



Low-latency work: GRB observation strategy

Special case: request

- If we have REQUESTS from other collaborations: under reasonable explanation the GRB chairs + Core Team agree to follow and the strategy is the above-mentioned strategy.
- Observations under MoU: to be determined after the MoU is signed by the two parties



Low-latency work: GRB observation strategy

Special case: request

- e.g. SVOM MoU:

According to the MoU we:
Will conduct optical and IR observations with its full network of well-localized (ECLAIRs) GRBs (¡ 12 arcmin radius) as requested by SVOM, at a rate between one source per week and one per month. These GRBs need to be carefully chosen. A minimum of 1 and a maximum of 4 GRBs per month should be observed. By order of priority:

- Short GRBs (but only if $<$ 12 arcmin radius, although pretty unlikely to have well-localized short GRBs)
- $<$ 12 arcmin radius SVOM GRBs detected with an optical counterpart
- $<$ 12 arcmin radius SVOM GRBs detected with an X-ray counterpart
- GRBs that are interesting for other reasons provided by SVOM. For that we advocate that two members of the GRB group should be associate researchers of SVOM (1 member from European Time Zone and one from US or Asia Time Zone) in order to discuss with SVOM folks and share relevant information to GRANDMA members and especially with the Weekly coordinator/shifters. In particular, as SVOM agreed with providing updated information on sources requested for GRANDMA observations (candidates refined localization, identification information, retraction, etc.), observations can be decided based on these informations. (Sounds like we need more SVOM people)

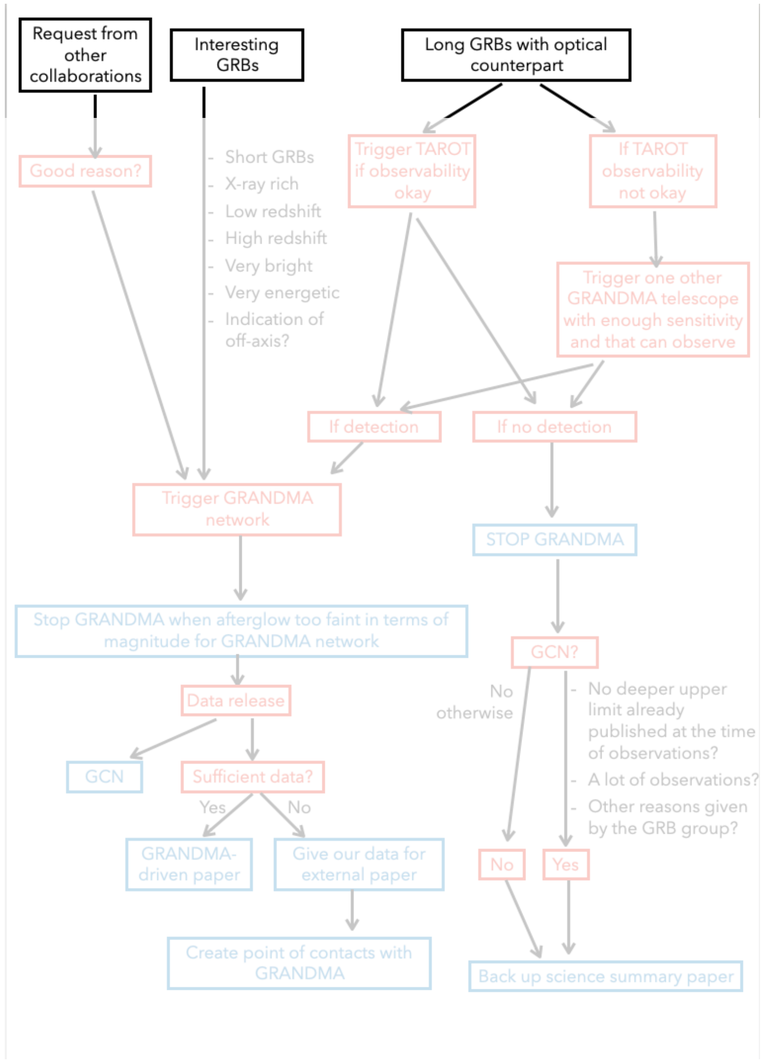
As we also agreed on:
providing preliminary results (unreviewed) as soon as possible (on best effort basis) prior to any public dissemination (e.g. GCN). providing images and corresponding (reviewed) magnitudes and spectra; including corrections for extinction and any known background (i.e. any products necessary for publication efforts). This will be on the associate research + weekly coordinator (cc PI of GRANDMA and GRB chair) to conduct the discussion and the data sharing. Finally, the publication and authorship rules will follow the rules decided in the MoU.

Low-latency work: GRB observation strategy

Implementation of Skyportal TAG

Ideally « real time » tags based on circulars would be implemented in skyportal

- Long vs short GRBs tag
- Well-localized tag
- X-ray counterpart tag
- Optical counterpart tag
- Low vs high Redshift tag
- Very energetic



Low-latency work: GRB observation strategy

Procedure to observe

Need to define categories for the shifters:

automatic telescopes,

regular telescopes,

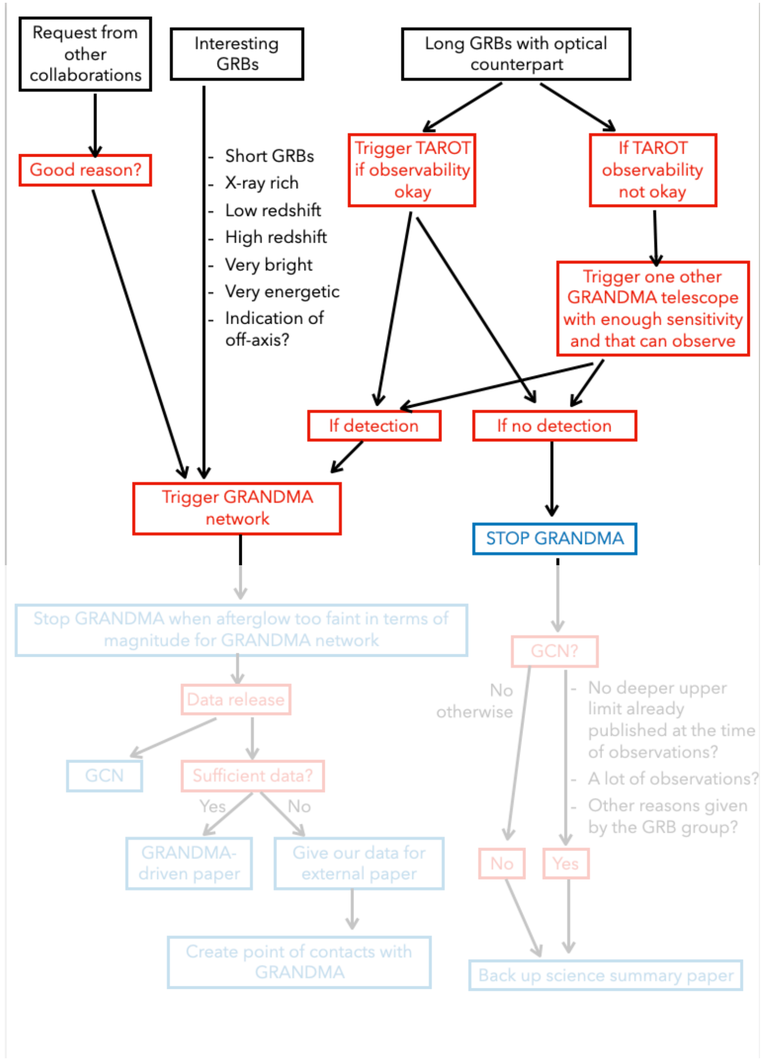
partner telescopes,

PI-contact telescope etc.

Low-latency work: GRB observation strategy

Procedure to observe

- If one of the interesting science case: trigger GRANDMA network by emailing + slack to the telescopes (automatic + regular telescopes?)
- If regular GRB:
  - Automatic observation with TAROT or TRT f the observability is okay (otherwise regular)
    - Image have to be analyzed as soon as possible (within the XXX hours)
  - Otherwise choose another telescope https://grandma.ijclab.in2p3.fr/research/grandma-project/

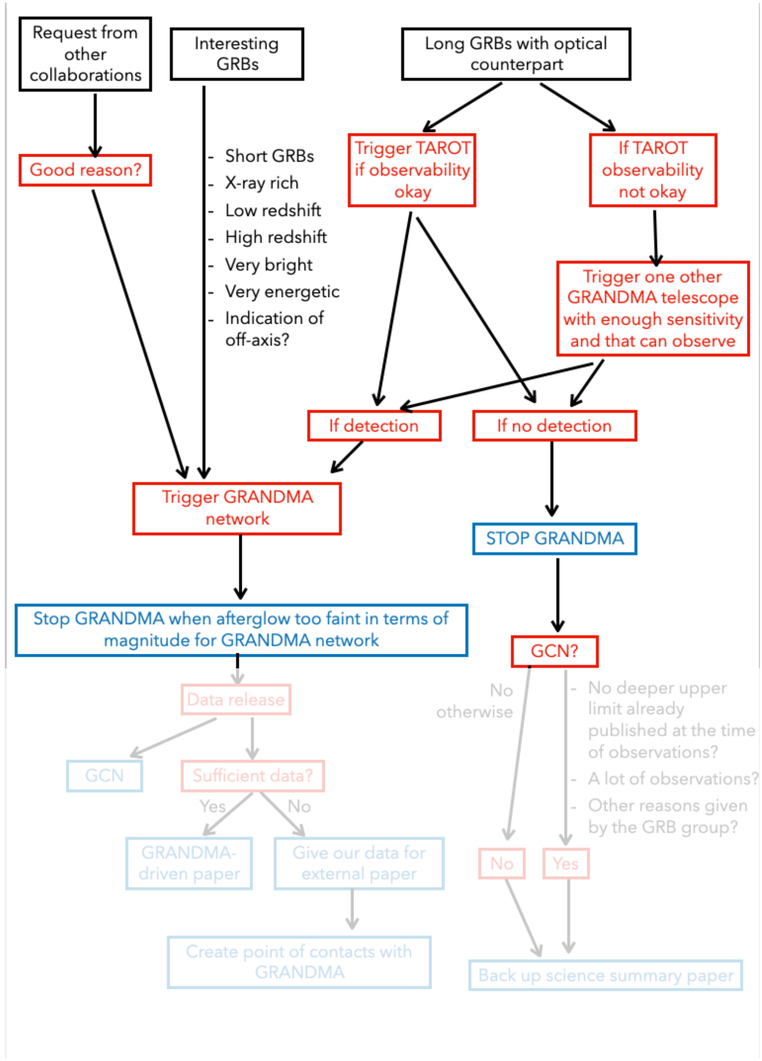


→ If nothing is visible in the first images we **STOP GRANDMA (except short because of possible KN)**

Low-latency work: GRB observation strategy

Procedure to observe

- If detection: we **CONTINUE GRANDMA**
- **DO NOT FORGET TO:** Update the sky localization ra,dec on SkyPortal
- We **STOP GRANDMA** when the afterglow is too faint for the network (in terms of magnitude) or after 2-3 days for all except hint of SN

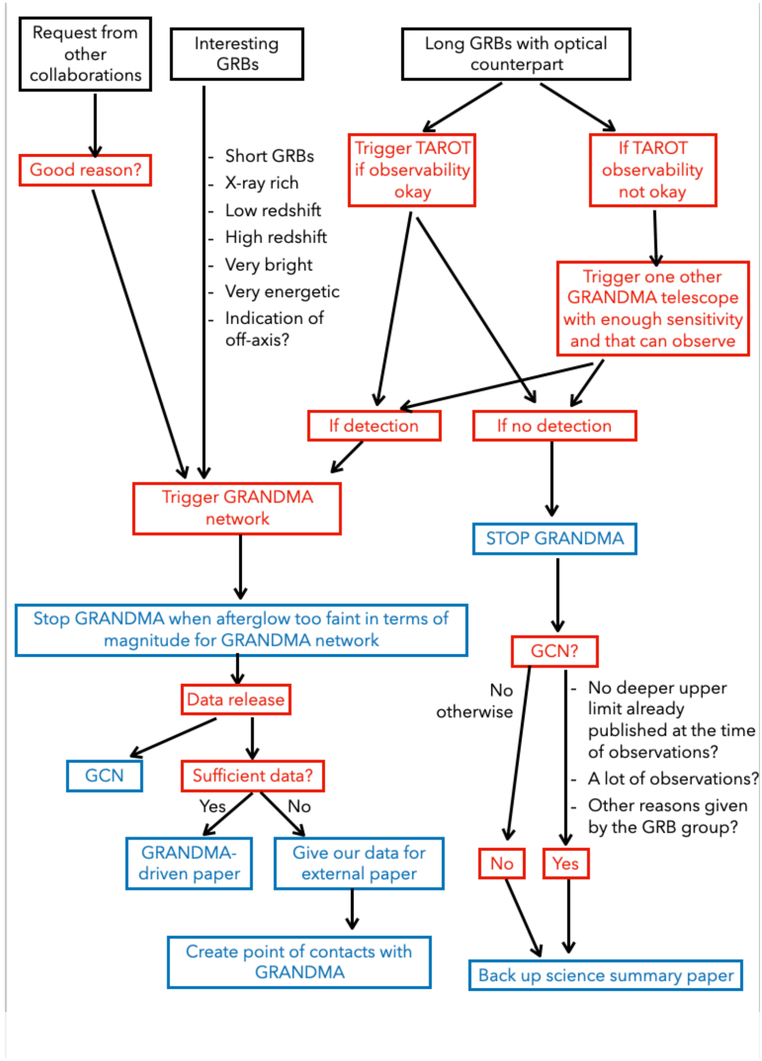


Connection to data analysis

- How of filter? Exposure? etc. Is it the role of shifters? Of WC? Of expertise from DAG?

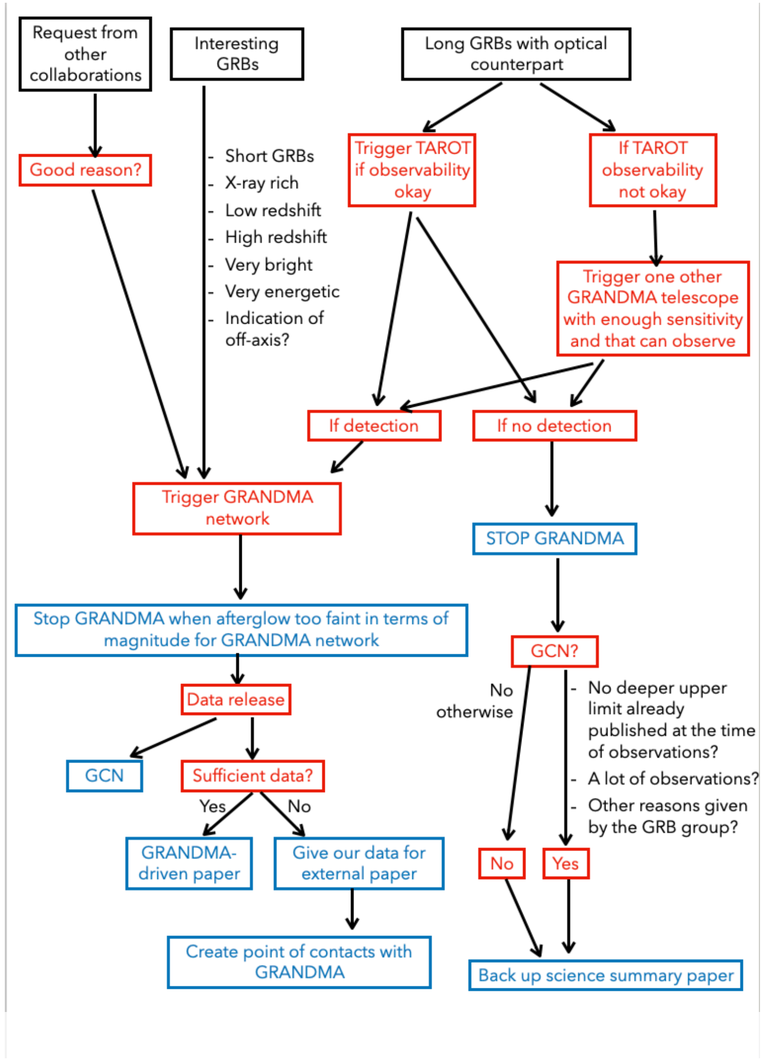
Publication of observations

- Detection → observations should be published
- Non-detection → Always published? Depending on the quantity and quality of data taken by GRANDMA?
- GCN versus public page?
- If detection:
  - If a lot of datapoints + enough manpower → GRANDMA-driven paper (but what is a lot? Do you cover an interesting or enough part of the LC? Are GRANDMA data sufficient by itself? –> to be discussed)
  - If not a lot of datapoints → we can give the data for an external paper
- Create point of contacts with other collaborations
- Define what I would call a "backup science" in case of non-detection → what constraints can be placed / population study to valorize upper limit in papers?

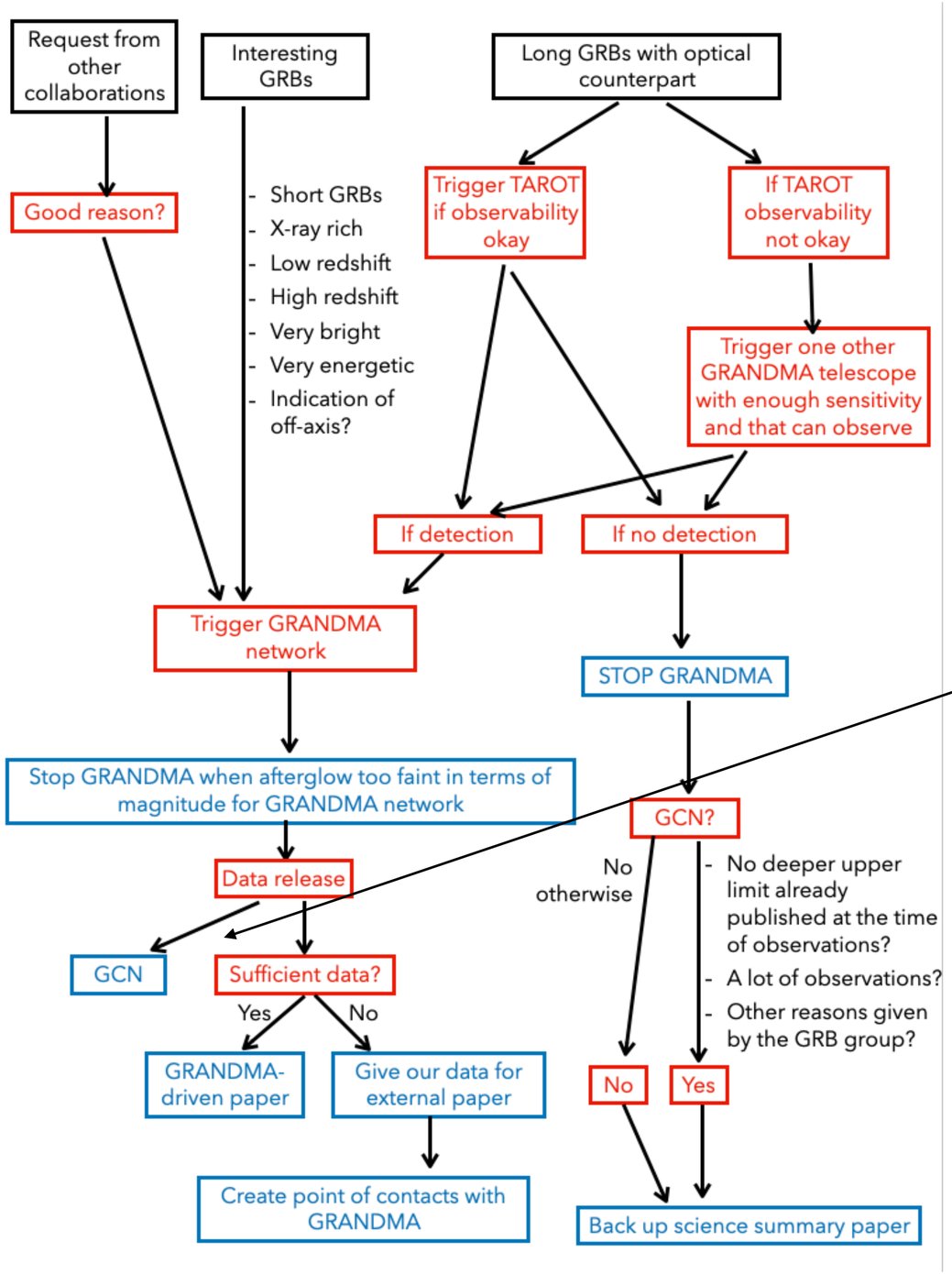


Publication of observations

- Connection to data analysis:
  - If case of publication of the results (GCN/paper/ public page…): data should be reviewed by data analysis experts
  - Reviewers to be found by DAG chair (/GRB group chair?/Task force?)
  - Need to follow the review procedure done by Sarah, Sergey, Dahlia
  - Wiki page summarizing the conclusion of the review? (Example ongoing with GRB250129A)



Global picture



Template of GCN for detection

NAMES OF THE SHIFTERS on behalf of the GRANDMA (IF KNC DATA: and Kilonova-Catcher collaborations):

The field of GRB XXX (CITE GCN OF GRB DETECTION) has been imaged with the NAME OF TELESCOPES located at NAME OF OBSERVATORY at TIME POST T0 with TYPE OF FILTER for a total exposure of PUT EXPOSURE TIME.

We detect an optical (OR NIR OR UVOT) transient at the enhanced TELESCOPE THAT DETECTED position (CITE GCN) down to (XXX FILTER) = XXX AB mag +/- XXX mag calibrated with nearby XXX stars and WITH/WITHOUT Galactic extinction correction. (IF SEVERAL OBSERVATIONS FROM DIFFERENT TELESCOPES: PUT A TABLE WITH T-T0, RA, DEC, TELESCOPE, FILTER, MAG, EXPOSURE)

All the data have been reduced by a single data processing pipeline, STDPipe (Karpov et al., 2025 Acta Polytechnica, 65(1), 50-64). Images obtained in XXX were calibrated using the XXX catalog. We use the SkyPortal application (skyportal.io) to monitor our observational campaign (Coughlin et al. 2023).

GRANDMA is a worldwide telescope network (grandma.ijclab.in2p3.fr) devoted to the observation of transients in the context of multi-messenger astrophysics (Antier et al. 2020 MNRAS 497, 5518). (IF KNC DATA: Kilonova-Catcher (KNC) is the citizen science program of GRANDMA (http://kilonovacatcher.in2p3.fr/).)

Should we move to **automatic** GCN/report?

Young scientists implication within the working group

Project ideas for students to improve the follow-up and make shifter's life easier:

- Tiling strategy implementation for short GRBs: For a Student? For Roman ? In M4OPT ?
- Fit of light curve decay automatically in sky portal which is done again each time a detection point is added to shifters can look at the plot and predict what would approximately be the magnitude in a few hours to decide 1) which telescope can observe 2) when to stop.
- Bigger project: study of the impact of the cadence of observations on the parameter estimation of the optical afterglow

The aforementioned projects together with other implementation could lead to a method paper "GRB observation strategy in GRANDMA and case study of GRB XXX »

+ Offline papers e.g. Dahlia's GRB, JG GRB etc.

+ Contribution to NMMA? GRB-NMMA subgroup?

Summary + Unanswered questions:

- Changes in science case? Is it too much?
- Skyportal tags?
  - Which tags are difficult to define with circulars?
- Changes in strategy?
  - Realistic timescale to analyze the first TAROT or TRT images?
- Publications?
  - GCN versus public page?
    - If GCN: I provides GCN templates in case of detection and non-detection
    - If public page: who set it up?
- Ideas of backup science?