GRBs Orphan Afterglows (OAs)

- Short presentation of the topic:
  - What are GRB OAs?
  - Why observing them?
  - Why observing them with Colibrí?

- Discussion:
  - Science goals justifying their observation with Colibrí
  - Trigger sources?
  - Criteria for the observation of GRB OAs with Colibrí?
  - Observing strategy
  - …

- A word of caution: these slides have *not* been prepared, they are raw material to introduce the discussion.
  - Incomplete: important points/issues may be missing

- Outcome: Fill the excel file!

What are they?

- GRB « orphan » afterglows designate GRB afterglows where the GRB is absent.
  - Really absent, not undetected!
- The most common explanation is a GRB seen off-axis, typically beyond 2 times the beaming angle of the jet (see plot).
- GRB OAs exist: they have been detected by ZTF.
  - Andreoni et al. (2021): *Fast-transient Searches in Real Time with ZTFReST: Identification of Three Optically Discovered Gamma-Ray Burst Afterglows and New Constraints on the Kilonova Rate*

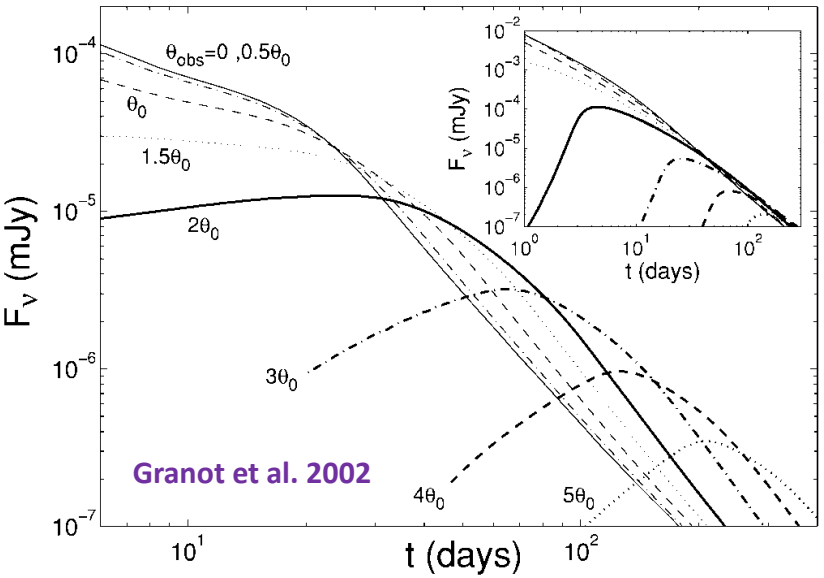

FIG. 2.—Light curves of model 3 for $\theta_0 = 0.2$, $E_{52} = n_0 = z = 1$, $p = 2.5$, $\epsilon_e = 0.1$, $\epsilon_B = 0.01$, and $\nu = 5 \times 10^{14}$ Hz. The inset shows the same light curves for model 2, where the same traces correspond to the same viewing angles θ_{obs}.

Why observing GRB OAs?

- The rate and spectro-temporal evolution of GRB OAs may provide crucial information on the jet:
  - Geometry: uniform or structured jet
  - Cocoon
  - Beaming angle…
- Space density of GRBs (after correction for the beaming)

Identifying GRB OAs

- Identifying GRB OAs is complex:
  1. Be sure it is a GRB afterglow
  2. Be sure it is orphan

1. GRB OAs have characteristic colors & temporal evolution.
   - Confirming a candidate requires repeated observations for multiband photometry & temporal evolution of the candidate afterglow.
   - Flare stars are significant contaminants.

2. Requires GRB monitors (not discussed here).
   - All optically selected afterglows are not OAs.

Why observing GRB OAs with Colibrí?

- With multiband capability, good sensitivity and great availability, Colibrí is perfectly suited to characterize & confirm the nature of GRB OA candidates.
- Confirming the candidates quickly may require using templates of GRB OAs.

Time for discussion

- Suggested topics:
  - Science goals justifying the observation of GRB OAs with Colibrí
    - GRB jets geometry, …
  - Trigger sources & expected number
    - VRO, …
    - At Colibrí sensitivity, we do not expect more OAs than GRB afterglows
  - Criteria for the observation of GRB OAs with Colibrí
    - Which criteria beyond the brokers selection?
    - Limiting magnitude, …
  - Observing strategy
    - Perform various series of images with all the filters (in a sequence TBD).
    - Establish the best sequence of filters a durations, this requires simulations with known afterglows and orphan afterglows.
    - Decide quickly if this a good candidate. If not stop observations (unless it's a kilonova ☺).
    - …

Conclusions & Actions

- Some conclusions of the discussion:
  - GRB OAs are interesting targets
    - They add up to other transients, like FBOTs
    - **ACTIONS:**
      - Find a way to introduce long-lived transients (hours to days) in the programming of Colibrí, e.g. a web page, in complement with alerts and general program.
      - Discuss with Fink, the selection of GRB OA candidates.
  - At Colibrí sensitivity (r ≈ 21 – TBC), the candidate GRB OAs should not be so frequent
    - **ACTIONS:**
      - Evaluate the number of candidates.
      - Define a few typical scenarios for OA candidate observation.
- Additional points:
  - Role of HE monitors of SVOM (GRM & ECLAIRs) to distinguish OAs from normal afterglows.
  - Role of EP to constrain the X-ray afterglow.