Proposed **(Prompt)** GRB Network with Large Active Missions

Eric Burns

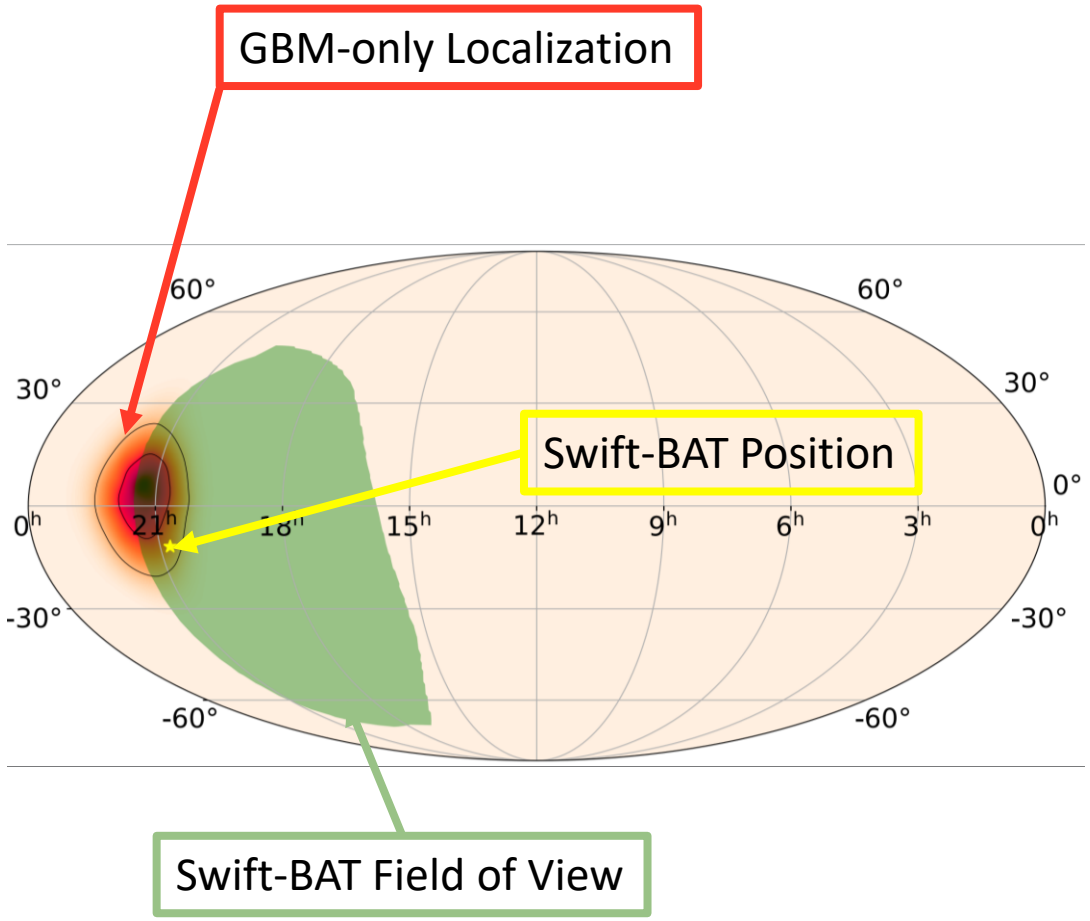
NASA GSFC/USRA

Status of Active Missions

- Several Large Active Missions/Instruments **for the detection of prompt emission**
  - E.g. Fermi-GBM, Swift-BAT, KONUS-Wind, INTEGRAL SPI-ACS, Insight-HXMT, AstroSAT-CZTI, etc
- Shared work:
  - The Interplanetary Network
    - Localizations manually refined through timing annuli
  - The LIGO/Virgo, Fermi-GBM, and Swift-BAT Joint Working Group
    - Automated Joint GW-GRB Localizations
    - Working towards automated Joint GBM-BAT Localizations
- Related work:
  - This GRB NanoSat Initiative
  - Time-domain Astrophysics Coordination Hub (TACH)
  - Statistical formalism for associating events - e.g. https://arxiv.org/abs/1712.05392

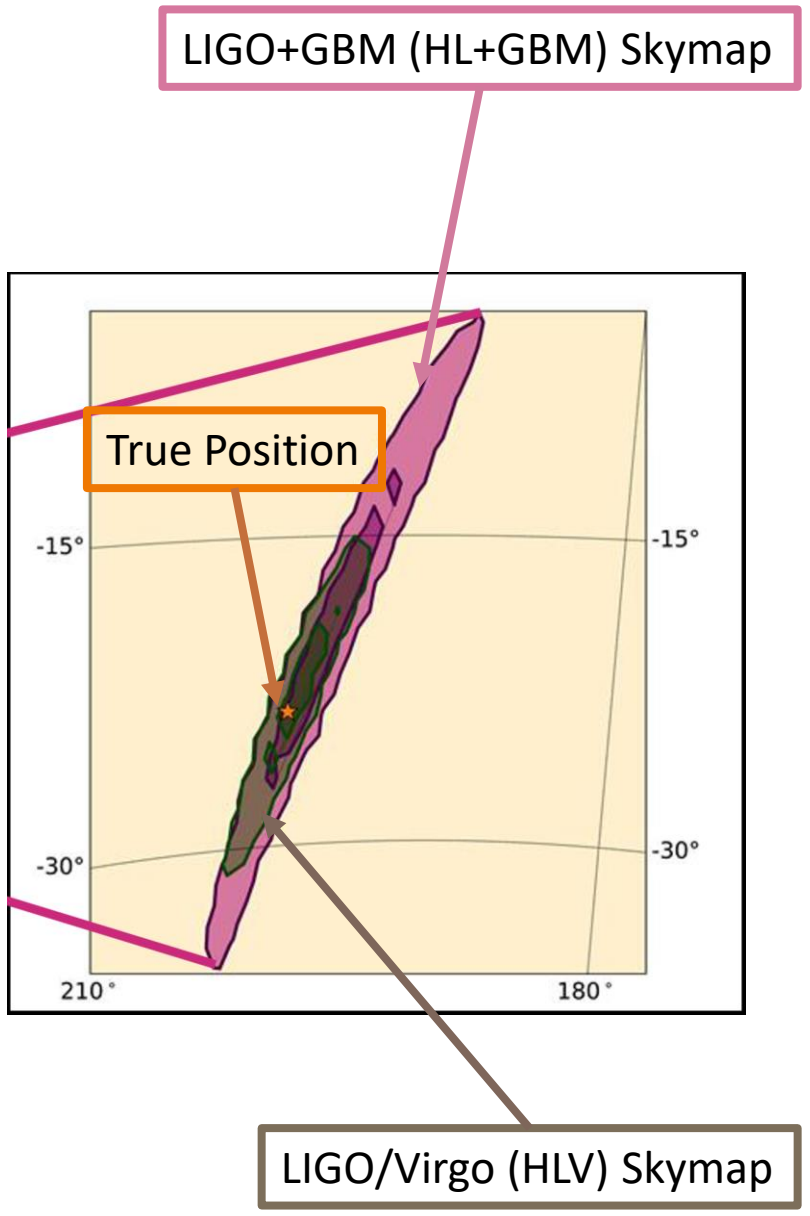
Examples – GRB 200216A

- GBM Triggered on-board in response to GRB 200216A
- Swift did not trigger on-board as it occurred in a sub-optimal geometry.
- The Swift team commanded the spacecraft to save the full event data.
- This data enabled them to identify the position to ~3 arcminute accuracy (expect ~>15/yr)
- Using external trigger information can enable prioritization of data downlink (see Jeremy's future talk)



Examples – GRB 170817A

- The LIGO (HL) skymap was available in one hour. The HL+GBM skymap was ~60 sq. deg.
- The LIGO/Virgo (HLV) skymap was available in ~5 hours and was ~30 sq. deg.
- Combined GW-GRB localizations can aide the multimessenger follow-up effort
- LIGO/Virgo and GBM will soon automatically report joint localizations



Potential Benefits of an Active Mission GRB Network

- Combined Alert Streams through GCN/TACH
- Combined Localizations (e.g. reporting through HEALPix)
  - Automate IPN work
  - Combined Independent Localizations
  - Include/Exclude Earth occulted regions; rule out regions with sensitive non-detections
- Unifying Software
  - E.g. the GBM team has developed the new spectral analysis software GSPEC
  - The developers are generalizing the software to work for future missions
  - BurstCube are working to make their files compatible

Potential Benefits of an Active Mission GRB Network

- Single GW+GRB working group with LIGO/Virgo/KAGRA and the GRB Missions
  - GW-GRB Joint Localization Stream
  - Joint Reporting for key events (e.g. GW170817, GRB 170817A)
    - Individual teams publish their own results. Combined science results are published together
    - Speed of Gravity improvements
  - Shared interface

- More unified access with other groups
  - E.g. SNEWS, Treasure Map, Optical facilities, etc

Current Status

- **Meeting with Mission/Instrument PIs to gauge interest and understand their needs (e.g. this meeting)**
- TACH is developing a GRB naming service
- The Fermi-GBM and Swift-BAT teams are working closer than ever to combine localizations in a non-trivial manner

Does it make sense to combine these efforts?

- Previously listed benefits
- Potentially shared trigger algorithms, atmospheric response, localization, classifiers, association algorithms, etc
  - Prevent unnecessary duplication of existing software
- Shared or joint sub-threshold searches

- For NanoSat Teams – access to institutional knowledge
- For active missions – potential reason for funding software development; improvements to our own analysis

Potential Steps Forward

- Next few months:
  - Write a Code of Conduct
  - More formally reach out to existing teams (e.g. like this call)
  - Establish how we will work together

- ~December 2020
  - Use the NanoSat organizational meetings as a place to work out these details

- By O4 (~Fall 2021):
  - Have some level of combined analysis/software implemented