

## **Short notes about break-out sessions on NS physics/EM broadband modeling and interpretation and SN/FRB/neutrinos**

### **NS physics/ EM broadband modeling and interpretation**

- So far, no clear projects for MoUs linked to NS physics/kilonova modelling
- Consensus on having more statistic to identify if and what joint analyses are useful
- At the present stage of detections, more useful to use published results from the EM and GW analysis to interpret sources

General consensus on the power of joint studies, but necessity of further discussions about:

- folding EM information into the PE;
- what is the information that can constrain kilonova modeling
- constraining post-merger GW search using EM info about remnant (e.g X-ray plateau, kilonova)

Astronomers asked about LVC capabilities to detect remnant emission from BH/unstable-stable NS remnant and merger/ringdown for NSBH. Described sensitivity limitation of LIGO and Virgo at high frequency.

Discussion about posterior release. Highlighted posterior release is an ongoing activity and will come, but not on a short timescale. Also discussed the catalog and if EM partners could then publish follow-ups on things that turned out not to be true. Indicated that catalog and EM follow-up paper and GCN release will happen not before June. Request to read the EM paper in advance (there are triggers not retracted) as done for detections.

### **SN**

- Supernovae → GW side: on source window from optical observation is rather large (~days). Makes a low significance GW event very difficult to dig out of the noise. Low energy neutrinos fundamental to get the  $t_0$  of the trigger. Useful for extracting a GW signal out of the noise.

Are the neutrino detectors able to cover all the sky and 24\*7 days for galactic SN?

In the optical, the survey cadency permits at best a 12 hrs window. The UV/X-ray SBO would allow us to restrict the window. However, to increase the possibility to observe a SBO we need to wait for instruments such as Theseus (if approved 2029).

Info about progenitor could be for GW search. There is progenitor info only for a fraction of SN. On the other side, astronomers expect info from GW to better constrain explosion progenitor.

Survey of local galaxies?

### **Joint sub-threshold analysis**

- interest mainly from radio and high-energy observatories
- LVC has subthreshold for high-energy candidate (Fermi)/neutrino

- Radio → sharing of radio FRB (even if dispersion measure indicates distant objects wrt to LIGO and Virgo sensitivity)
- Taking into account the effort for sub-threshold studies, is gain guaranteed? Depends on each experiment's detection range and FAR. Going from 1/year --> 1/day FAR change means < 25% astrophysical source gain (see fig. 3 of <https://arxiv.org/abs/1304.0670>)

## Tools and database

General consensus on the importance of sharing information about observations and transients detected in the sky map to coordinate the best EM follow-up

- There are many pieces of software already developed for different purposes: collect info, visualize observations, build light curve, interact with catalogs.
- Necessity of common tools and standard format to share info about observations.
- Development of database and tools should be a transient astronomy community effort (including GW transients)
- So far, there is a lack of compatibility across GCNs → how much the community is interested to share information and use a standard format?
- the Swift notices, which produce counterpart rankings, are a good example to follow in other bands

The above points are goals of “Asterics”, which is supposed to be a MMA infrastructure. Already, the Virgo community is involved in common GW tools implementation and development.

Assignment:

constitute a working group among different communities interested on GW and multi-messenger astronomy to identify the different pieces of code already existing, evaluate the interest to share info and use standard format, and to define how to proceed to have a platform of tools ready for O3.

- **MoU procedure** – open call? → necessity to identify scientific topics, not a generic call. At the present stage, it seems not feasible to open a call as long as specific scientific joint goals of LVC and astronomical community are not clear.

-(off-line) suggestion of an open call for expressions of interest from the community for science that would be enabled by sharing information beyond that planned to be included in OPAs.