GW and neutrino sources- O/IR follow up

Sarah Antier (OCA)
William Lee (IA-UNAM)
Damien Dornic (CPPM)

CATCHING OPTICAL AND INFRARED BRIGHT TRANSIENTS
COLIBRI

Colibri team with multi-messenger connection

FRANCE:
S. Antier (OCA), S. Vergani (Obs Paris), N. Leroy (IJCLAB), D. Dornic (CPPM), A. de Ugarte Postigo (OCA), C. Lachaud (APC), A. Coleiro (APC), S. Basa (LAM) (only permanents is presented here)

MEXICO:
W. Lee, A. Watson, F. de Colle, D. López-Cámara, N. Fraija, R. Becerra, M. Pereyra, E. Moreno-Méndez

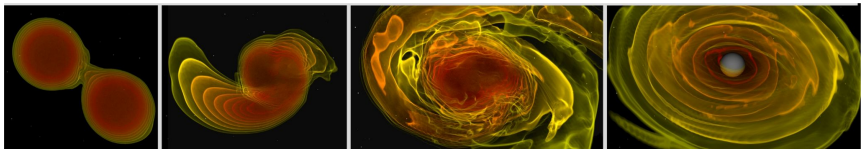
No other request since last February

CATCHING OPTICAL AND INFRARED BRIGHT TRANSIENTS
COLIBRÍ

WP1 - Define the scientific properties within multi-messenger science :

How we should focus on ? What observations do we need ? What collaboration do we need to complete our data set ? What scientific expertise do we require ?

- BNS and NS-BH mergers ejectae (BBH ?) :
  - different progenitor types vs the signatures emission : the HE emission, O/IR afterglow, and kn emission
  - geometry of the emission
  - physics of the relativistic jet : structure, collimation of the jet, infr. signature
- Stellar population models (including redshift)
- Nuclear Astrophysics: constraints of EoS



The O4 observing run

O4 - 24th of May 2023 → ~ Feb 2025

ER15 started at 1500 UTC on April 26, 2023

Virgo joined on Apr/26 at 1500 UTC, for a limited fraction of time over the duration of the ER, giving priority to commissioning activities aiming at improving the sensitivity

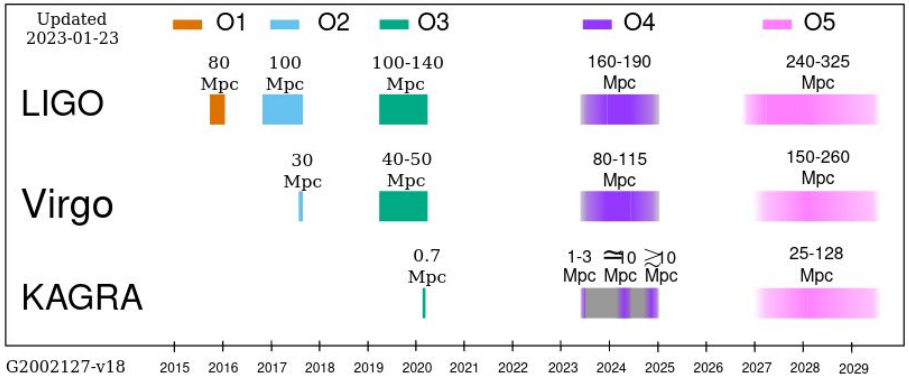
High prompt response from the LVK to **high profile events: BNS, NS-BH, Burst and event with loca. < 100 deg3**

ER15 : Actually 40 % duty cycle for single interferometer

H1, L1 > 120 Mpc and Virgo around 20 Mpc

Rate of public alerts: BNS: 36 (+49 - 22),

NSBH (6 +11 - 5) with a credible area very large.



Colibri science topic - BNS and NS-BH mergers as illustration

Which publications ?

A discovery from GRB associated to GW (quick publication within 6 months)

Case 1 : SVOM → Colibri team + SVOM team discovery paper (including GRB prompt and afterglow via ToO-Ex and ToO-MM)

Case 2 : Non SVOM prompt : Colibri team single paper ? in association with afterglow paper ? in association with afterglow +GW paper ?

A discovery from KNe associated to GW

Case 1: Colibri is The discovery or characterization discovery machine (paper in associations with LVK as NS properties, Cosmology, GW speed, etc)

Case 2: Colibri has data of KNe-GW counterpart: Colibri can/does not want associate data with bigger groups as SVOM-follow-up, GRANDMA, with DDOTI, ENGRAVE

No-detections : upper limit paper and summary. (?)

Confirmation of the science management plan
See case from GRB221009A

WP2 - Define the volume of observations for Colibri

Kilonova Challenge	Solution	COLIBRÍ
Short lived - Hours up to days	Quick reaction	20% prompt reaction
Faint - Peak at 20.5 mag at 200 Mpc	Deep Observations	YES, but < 1 arcmin, Useful for characterization KNe > 200 Mpc ?
Rapid Color Evolution	Observation in g and r (adding i if possible)	Multi-band at same time and large allocation time B, gri, zy, J, H
Large localisation uncertainties + Many alerts to follow + Need well sampled lightcurves	No duplication Coordination of Observations Careful alerts selection	Colibri be associated with others partners … + Who is specialist on GW signal analysis ?

Discussion :

Depth → to be calculated vs distance of the GW event

Color sequence → g, i, r, H, g ?

Cadence → immediate response, +1d (AG), +few days (kn), + 1-3 weeks

AlertS (GW plan or individual alerts) reception → I propose a test with gwemopt

Should we go after BBH events? Probably yes?

WP3 - Define the interfaces, and tools for scientific return

Some of these tools/people are available within this collaboration and others are not.

Some data will be publicly available in restricted fashion (e.g. GCNs) and some will not.

Data Analysis

detection, photometric characterization ex: stdpipe

spectroscopic characterization

Physics

stellar population synthesis models; nucleosynthesis codes for r-process (mostly); HD/MHD/RMHD codes for jet propagation, binary merger modeling, EoS of dense matter.

Proposal within Colibri consortium

- Follow-up of DDOTI GW optical candidates
- Follow-up of GRANDMA GW optical candidates (Antier et al.,)
- Follow-up of SVOM GW candidates from the space and on the ground (Turpin et al.,)
- Follow-up of massive black hole candidates (Vergani et al., Watson et al.,)
- Follow-up of Tidal disruption events (Lachaud et al.,)
- Characterization of candidates counterparts to neutrino detected by IceCube and KM3NeT (Foisseau et al., Pradier et al.,)
- Regular monitoring of a selection of bright radio core AGNs
- ….

SN	Blondin, Lee	B1
GW follow-up, neutrino follow-up	Antier/Dornic/Watson	A1
off-axis GRB, hostless GRB	Atteia/Watson	B2
AGN, TDE, massive BH, magnetars	Basa/Lee	A2
FOT, FRB, XRB	Turpin/ Watson	A3
GRB General	Vergani/Watson	
GRB SVOM	Basa/Cordier/Lee	

Colibri proposals

A	B
Typical duration of one block	*Typical duration of an observation block in minutes. Each block is independant.*
Number of blocks per object	*How many blocks per object observed. These blocks could be split over several night or on the same night (please specify here the case).*
Number of objects per semester	*An observation program is composed of several blocks: the sum of all the blocks corresponds therefore to the quota allocated to the program.*
Instrumental configuration	*Filters: combination of grizyJH. + wide-band filters (optional: exposure time duration per filter)*

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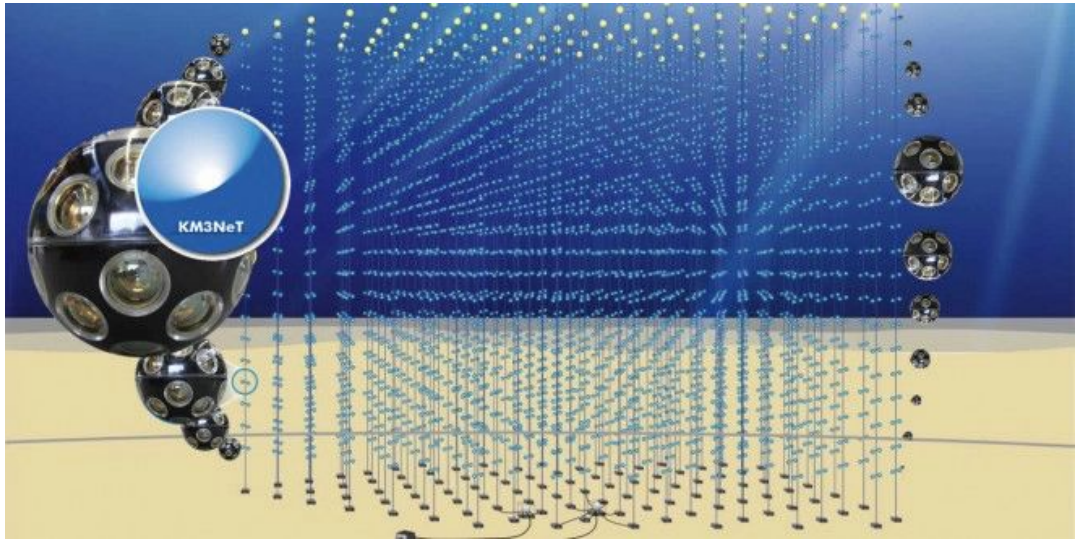
Proposal detail

	A	B	C
5			
7	**Observationnal context**	*As the visibility of the GRB afterglow is very short, the reception of the VO alert will interrupt the observing sequence. The first 30-60min block is not interruptible. Depending on the burst, multiple sequences will be planned in the same night and in the following night.*	
8			
9	**Dependency**	SVOM	
10			
11	**Typical duration of one block**	20 min	
12			
13	**Number of blocks per object**	6	
14			
15	**Number of objects per semester**	30 (total of 60 hours requested for the program)	
16			
17	**Instrumental configuration**	wide-band filters for the first 5 min then all filters, grizyJH	
18			
19			

Last news of KM3Net



2 detectors in construction in South of Italy (ARCA - HE), in South of France (ORCA - LE):
=> 21/18 operational lines (+~15 lines this year) - start alert program end of 2023 with 1-2 alerts per month

=> Send neutrino alerts with the best angular resolution possible (gain 3-10 compare to IceCube for track/cascade channels)

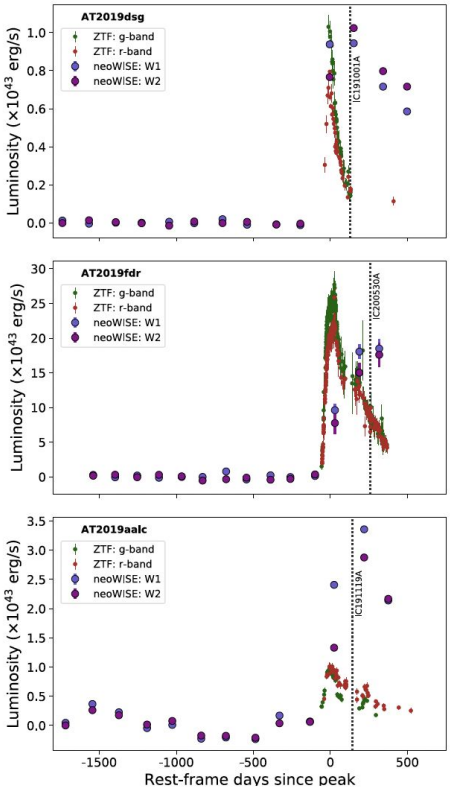
WP4 - Neutrinos and the KM3NET Program with Colibri

COLIBRI:

- Vis observation: light-curve monitoring, changing state of potential neutrino emitters such as bright radio core AGNs
- IR is important for the CCSN, obscured GRB, dust echo in TDE….
- Multi-band allows to constrain the redshift

Alert reception: VO Event via GCN

Obs. strategies: fast multi-band follow-up (~10-15min), long term monitoring (~3min each week or two) for AGNs/TDEs
CCSN: tiling on the error region…
To be quantified the amount of times



(Van Velzen et al, 2021)

Final

Define the people involved in the scientific group - People to be consider in the group should allocate time for

WP1 - Define the scientific properties within multi-messenger science :

How we should focus on ? What observations do we need ? What collaboration do we need to complete our data set ? What scientific expertise do we require ?

WP2 - Define the volume of observations for Colibri

For prompt observations vs early revisits (within months) vs long term monitoring

Adjust in regards to politics of data sharing vs others colibri programs ?

WP3 - Define the interfaces, and tools to set up for the program

Orchestration of the telescope (in connection with Colibri operation group) vs Data analysis vs Modeling

WP4 - KM3NET contribution ?