



KILONOVA CATCHER

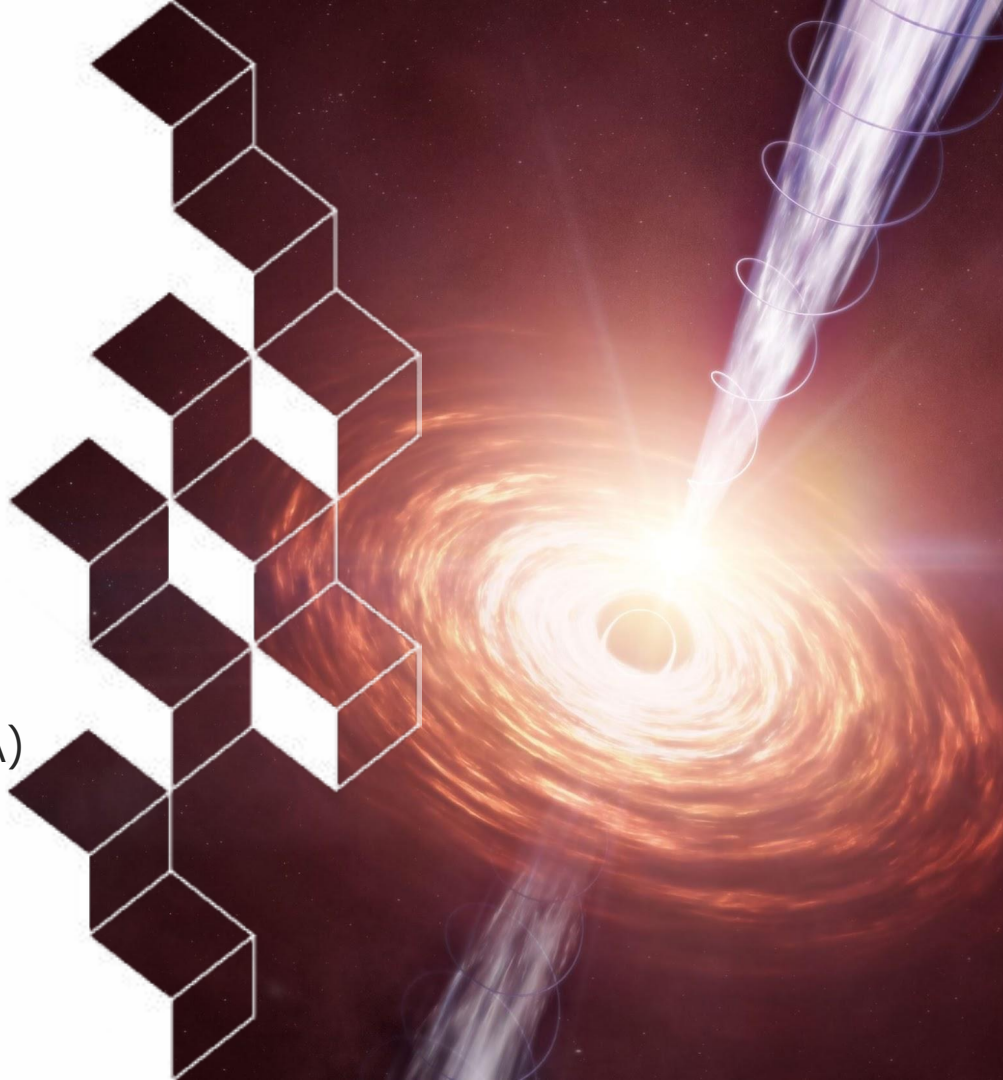
RAPAS

Réseau Amateurs Professionnels pour les Alertes Scientifiques



Citizen Sciences in High-energy Astrophysics

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(with the contribution of F. Schussler CEA)
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Why citizen sciences in high-energy astrophysics?

The modern astronomy and more specifically the Time domain astronomy is highly demanding in technical and human resources

Citizens can help to obtain better data and scientific diagnostics

- ✓ Citizens are numerous and more flexible than pro telescope systems.
- ✓ They can largely complement the pro observations and cover the gaps (at least at optical wavelengths)
- ✓ They are highly motivated and provide scientific ready data (training may be required)
- ✓ They can contribute to the labelling of large amount of data sets ([Zooniverse](#) platform)

Why citizen sciences in high-energy astrophysics?



A direct way to bridge the gap between Science and the civil society

- ✓ One of our goal as scientists is to bring the scientific knowledge everywhere outside our labs to the general public
- ✓ We must fight against obscurantism at any level, especially in our epoch where fake news are largely spread all over the world.
- ✓ It gives more visibility to our scientific domain for funding agencies

Some citizen science projects related to ATPEM activities

<https://gemini.obspm.fr/> (API ProAm OBSPM-PSL)



Astro-COLIBRI

PI: F. Schussler (CEA/Irfu)



KILONOVACATCHER

Kilonova-Catcher

PI: D. Turpin (CEA/Irfu)

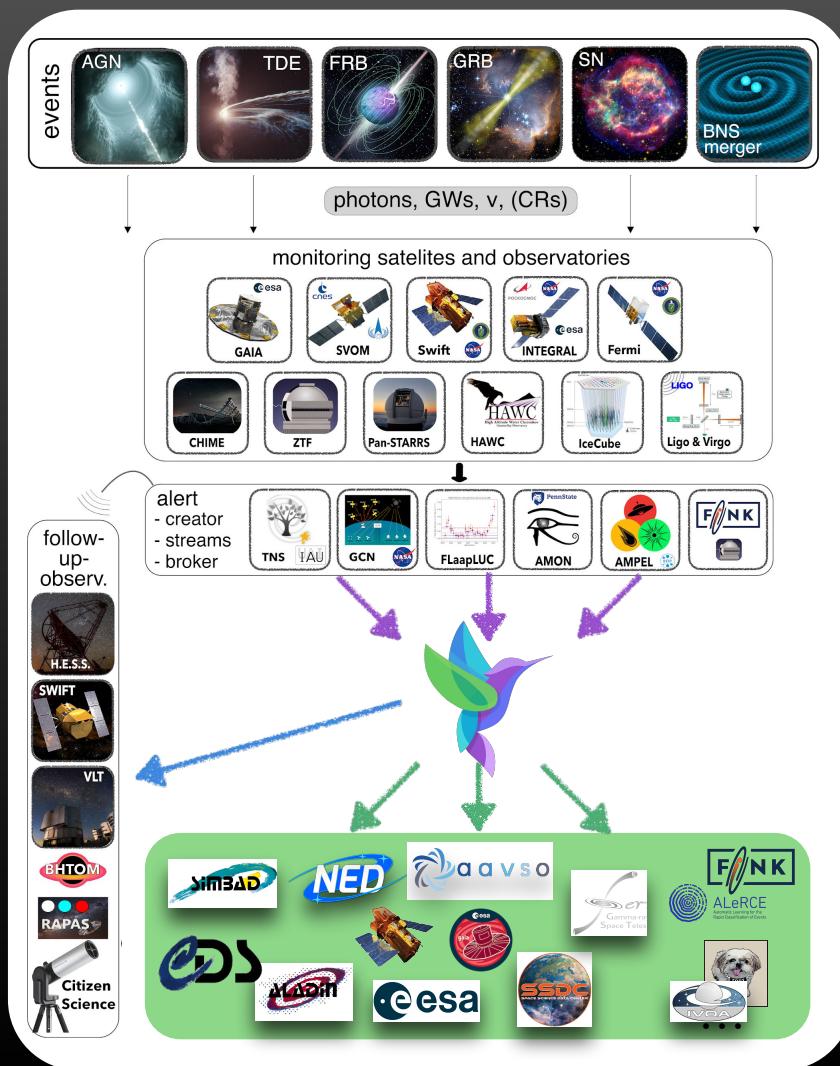
Today's talk



RAPAS

PI: W. Thuillot (IMCCE) & M. Dennefeld (IAP)

See the talk of W. Thuillot



Astro-COLIBR

Summary of all publicly available alert channels

Modern platforms:
API + web + smartphones

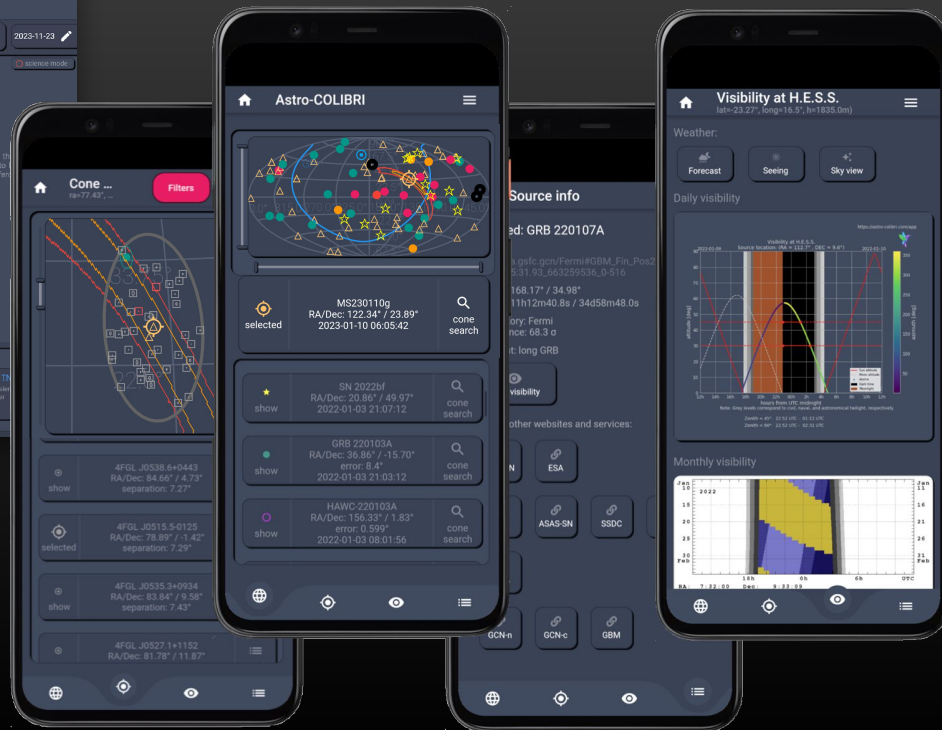
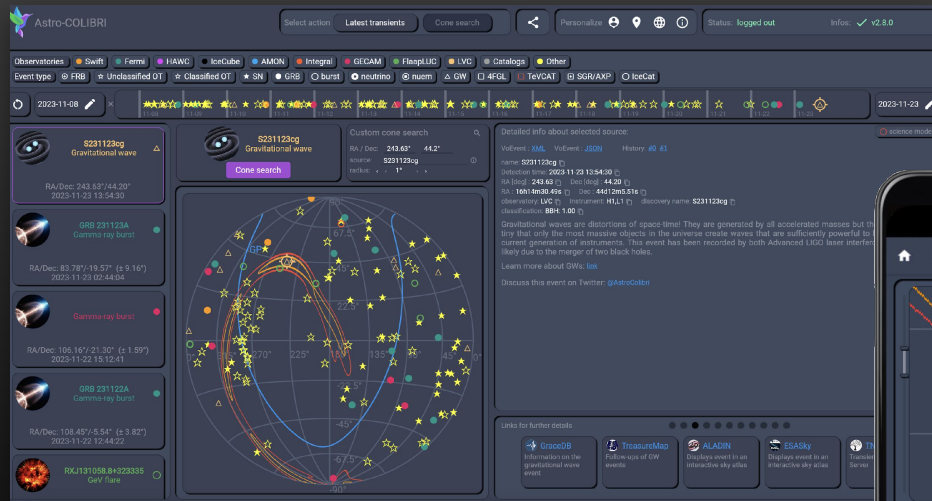
professional +
amateur astronomers

Complement existing
platforms



User interfaces

<https://astro-colibri.com>





Citizen science

The full Astro-COLIBRI platform is openly accessible to citizen scientists

Graphical interfaces + smartphone apps lower the access boundaries to information about transient phenomena => amateur astronomers can now easily contribute to time domain observations

Wealth of information can be overwhelming: dedicated tutorials and training workshops by the Astro-COLIBRI team

Open discussion forum: <https://forum.astro-colibri.science>

- Exchanges between professional and amateur astronomers
- Discussion of observations (Pro and Am)
- Exchanges with the Astro-COLIBRI development team



Example: RAPAS network

For details see the following presentation by William Thuillot

Weekly selection of the most interesting targets: published in the Astro-COLIBRI forum

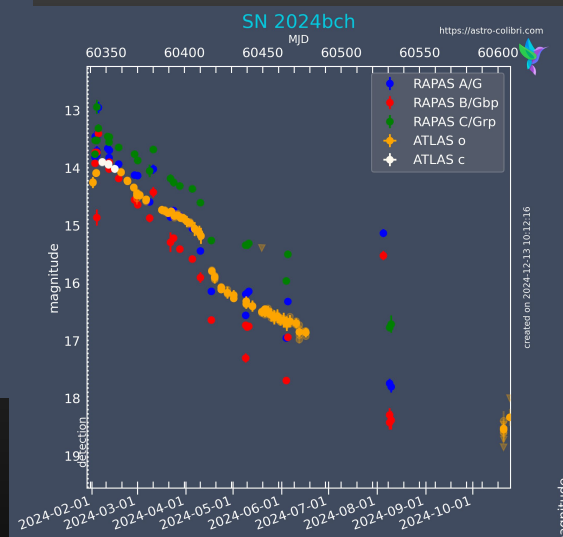
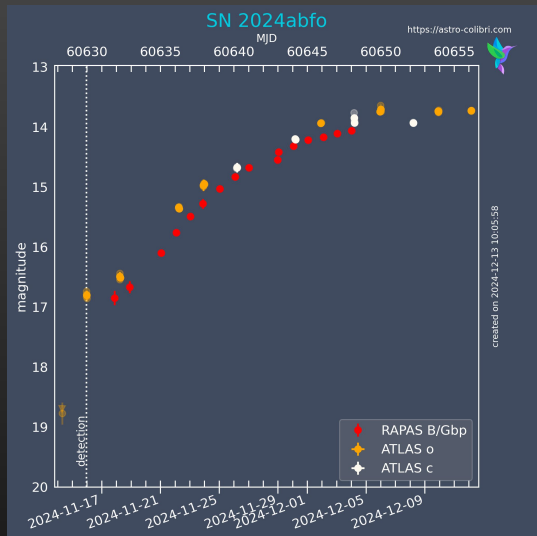
- Automatic filtering of recent detections
- Manual submissions by RAPAS members via a dedicated button in the Astro-COLIBRI app
- Voting on events by RAPAS members for continued multi-week/month coverage

Collected photometric data accessible via Astro-COLIBRI

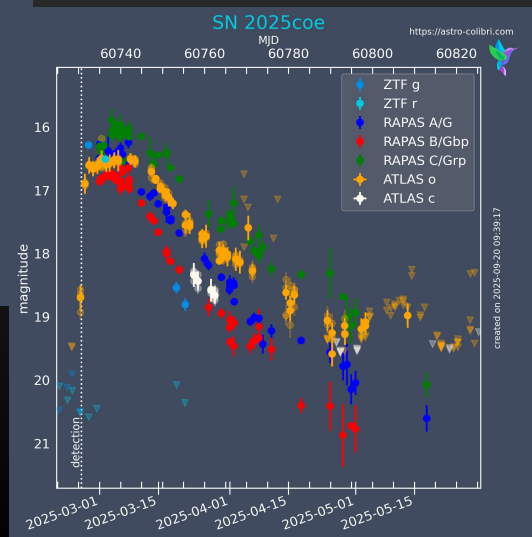


First results

Publication of several
GCN circulars and TNS
AstroNotes



Photometric observations by members of the
RAPAS network complement the large optical
surveys (e.g. ZTF, ATLAS, ASAS-SN, etc.)





Global reach

Close contacts with amateur astronomer organisations across Europe (e.g. Germany, Spain, UK, Poland)

Collaboration with the Unistellar/SETI citizen science program

Main partner of the Open Universe initiative of the United Nations Office for Outer Space Affairs: astronomy capacity building in the global South

Participation in the IAU working group on Amateur-Professional relations

More details: <https://astro-colibri.science/engagement>

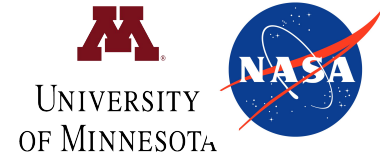


KILONOVA CATCHER

2025 Pro-AM Collab., GEMINI Award at SF2A



<https://gemini.obspm.fr/20250602-prix-2025/>





KILONOVACATCHER

Kilonova-Catcher: the scientific team

**KNC
PI**



Damien TURPIN

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**GRANDMA
PI**



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**pro-am project expert in
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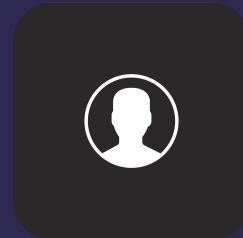
**Communication
& Outreach**



Cristina ANDRADE

**University of Minnesota
USA**

Technical support



Gérard MARCHAL-DUVAL

IT dept. at IJCLab
(Paris, France)

Without forgetting the past contributions of:

Antoine Cailleau
Pierre-Alexandre Duverne
Quentin André
Michael Coughlin
Jean-Grégoire Ducoin



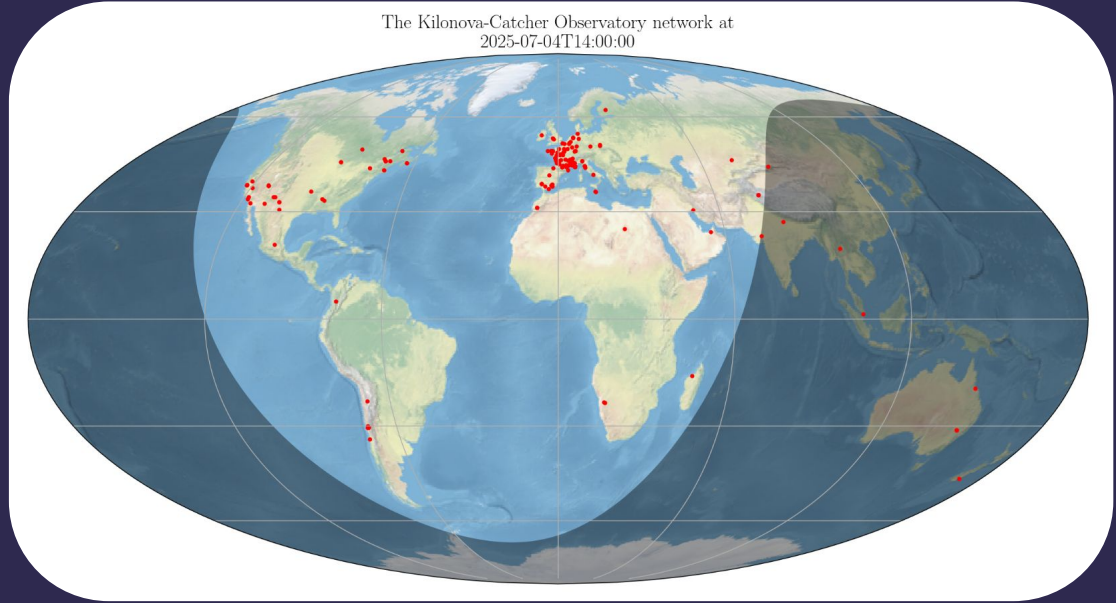
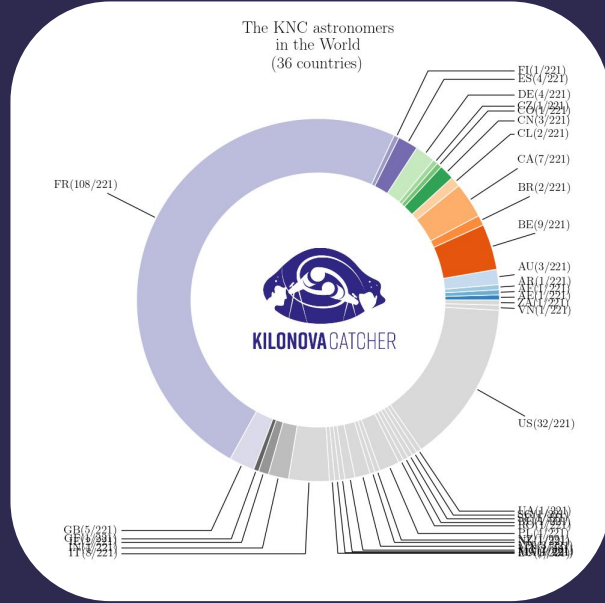
Sébastien GREGOIRE

IT dept. at IJCLab
(Paris, France)



KILONOVA CATCHER

The Kilonova-Catcher network in a nutshell

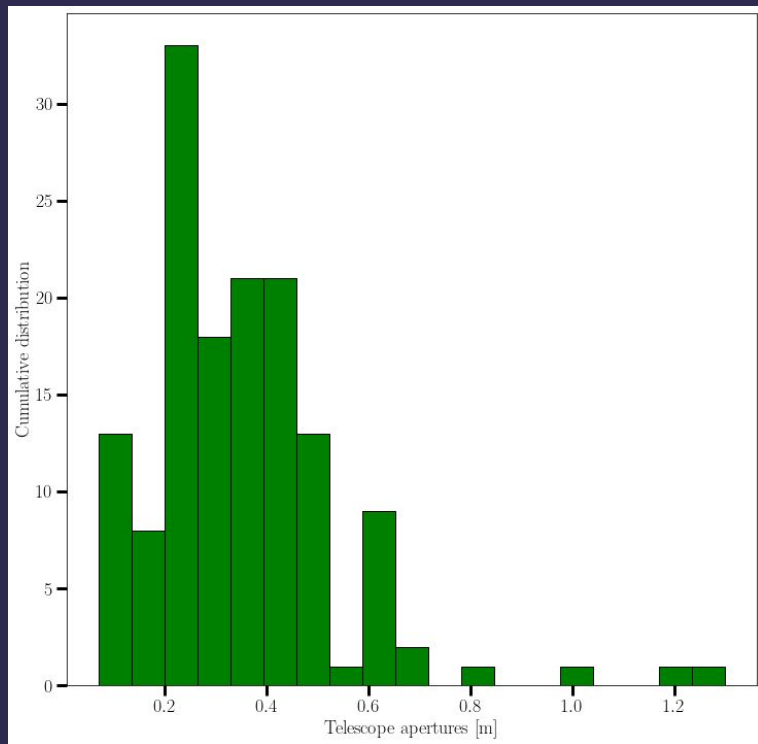


221 citizen astronomers, 36 countries, 160 individual telescopes (+14 in remote access) all over the world
~50% of French astronomers!



The Kilonova-Catcher network in a nutshell

KILONOVA CATCHER



Median diameter of the KNC telescopes = 0.32 m

Available filters

- Johnson BVRI
- Luminance / unfilter
- Gaia filter (**RAPAS**) -> See W. Thuillot presentation
- sdss gri (**We have delivered 7 filter sets to 7 KNC astronomers**)

Image depth (typical values)

g~[18 - 21.5] (exp~30' - 2h)

r~[18 - 21] (exp~30' - 2h)

i~[17 - 19] (exp~30' - 2h)



The science cases of Kilonova-Catcher

Main Program (Since 2018)



Optical counterparts of
Compact Binary mergers
BNS/NSBH
(LIGO, Virgo, Kagra)

ToO programs (Since 2020)



- Optical counterparts of Gamma-ray Bursts (Swift, SVOM)
- Fast optical transients (ZTF, Rubin LSST)
- SNe (ZTF, Rubin LSST, etc.)
- Fast X-ray transients?



KILONOVACATCHER

The GRANDMA/Kilonova-Catcher system in a nutshell

Organise the follow-up campaigns
(obs. plans) and directly send the alerts
to KNC members (GW, GRB, SNe, etc.)

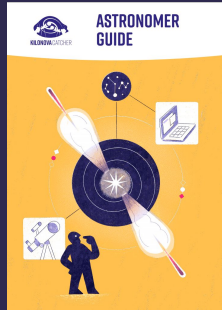
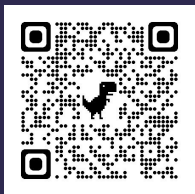


alerts

images

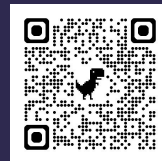
Communication, Training sessions
Data analysis and scientific exploitation

Our interfaces



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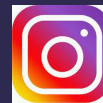
Outreach



GRANDMA Youtube

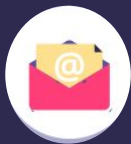


KNCX



KNC instagram

<http://kilonovacatcher.in2p3.fr>



mailing list



Slack KNC

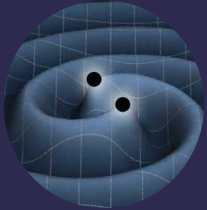
Connections with projects & external agencies





Scientific outputs since 2020

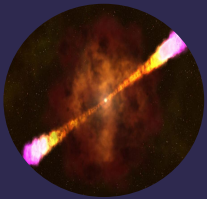
- **8 publications in refereed journals (+5 on-going projects)**
- **~50 GCN Circulars (Observation reports)**
- **1 KNC reference publication (to be written...)**



GRANDMA observations of advanced LIGO's and advanced Virgo's third observational campaign

The first six months of the Advanced LIGO's and Advanced Virgo's third observing run with GRANDMA

Limits on the Ejecta Mass During the Search for Kilonovae Associated with Neutron Star-Black Hole Mergers: A case study of S230518h, GW230529, S230627c and the Low-Significance Candidate S240422ed



GRANDMA and HXMT Observations of GRB 221009A: The Standard Luminosity Afterglow of a Hyperluminous Gamma-Ray Burst

Multiband analyses of the bright GRB 230812B and the associated SN2023pel

Ready for O4 II: GRANDMA observations of Swift GRBs over eight weeks in spring 2022



GRANDMA observations of ZTF/Fink transients during summer 2021

Early-time Observations of SN 2023wrk: A Luminous Type Ia Supernova with Significant Unburned Carbon in the Outer Ejecta



KILONOVA CATCHER

Merci à tous les contributeurs!

Credits: M. Freeberg

— SN 2023wrk

Credits: E. Broens

GRB 231115A / M82

GRB 230328B

Credits: F. Kugel

— GRB 230812B

Credits: M. Serrau

Take-home messages

- ❑ ATPEM is well represented in the citizen science field proposing various projects about the Multi-Messenger transient sky (Astro-COLIBRI, KNC, RAPAS)
- ❑ Various ways to involve citizens in science
 - ❑ Direct contributions (science-ready data production and delivery)
 - ❑ Indirect contributions (data review, labelling, veto, alert watchers, Forum, etc.)
 - ❑ Seminars/Webinars/conferences and Pro-Am meetings
 - ❑ Training/teaching sessions on various subjects (data processing, coding, observational methods, feedback about technology, etc.)



It requires to develop tools, a working environment to share informations, a web site or App, educative contents, fundings, etc.

Citizen Science initiatives have to be taken as a real scientific project to live long