Astro COLIBRI in practice

2022-11-15

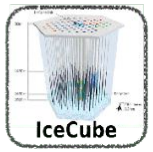
Patrick Reichherzer for the Astro-COLIBRI team

Idea of Astro-COLIBRI

events

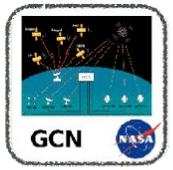
photons, GWs, ν

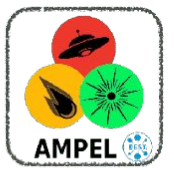
monitoring observatories



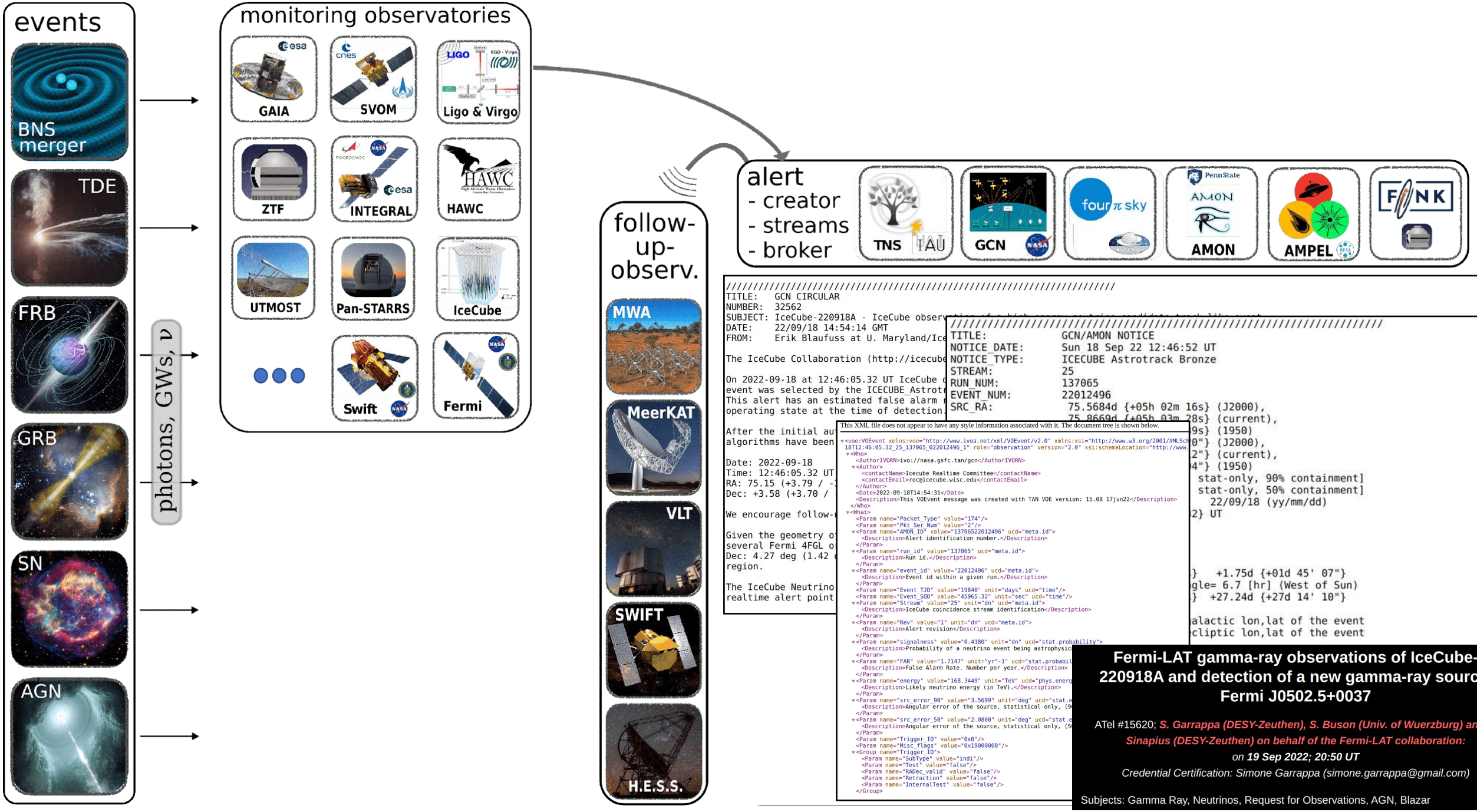
follow-up-observ.

alert
- creator
- streams
- broker





Idea of Astro-COLIBRI




```
//////////////////////////////////////////////////////////////////////
TITLE:   GCN CIRCULAR
NUMBER:  32562
SUBJECT: IceCube-220918A - IceCube observ
DATE:    22/09/18 14:54:14 GMT
FROM:    Erik Blaufuss at U. Maryland/Ice

The IceCube Collaboration (http://icecube

On 2022-09-18 at 12:46:05.32 UT IceCube
event was selected by the ICECUBE_Astrot
This alert has an estimated false alarm
operating state at the time of detection.

After the initial au
algorithms have been

Date: 2022-09-18
Time: 12:46:05.32 UT
RA: 75.15 (+3.79 /
Dec: +3.58 (+3.70 /

We encourage follow-

Given the geometry o
several Fermi 4FGL o
Dec: 4.27 deg (1.42
region.

The IceCube Neutrino
realtime alert point
```

```
//////////////////////////////////////////////////////////////////////
TITLE:           GCN/AMON NOTICE
NOTICE_DATE:     Sun 18 Sep 22 12:46:52 UT
NOTICE_TYPE:     ICECUBE Astrotrack Bronze
STREAM:          25
RUN_NUM:         137065
EVENT_NUM:       22012496
SRC_RA:           75.5684d {+05h 02m 16s} (J2000),
                  75.8669d {+05h 03m 28s} (current),
                                          9s} (1950)
                                          0"} (J2000),
                                          2"} (current),
                                          4"} (1950)
                                           stat-only, 90% containment]
                                           stat-only, 50% containment]
                                             22/09/18 (yy/mm/dd)
                                          2} UT
                                          }   +1.75d {+01d 45' 07"}
                                          gle= 6.7 [hr] (West of Sun)
                                          }  +27.24d {+27d 14' 10"}
                                          alactic lon,lat of the event
                                          cliptic lon,lat of the event
```

This XML file does not appear to have any style information associated with it. The document tree is shown below.


```
<voe:VOEvent xmlns:voe="http://www.ivoa.net/xml/VOEvent/v2.0" xmlns:xsi="http://www.w3.org/2001/XMLSch
18T12:46:05.32_25_137065_022012496_1" role="observation" version="2.0" xsi:schemaLocation="http://www
  <Who>
    <AuthorIVORN>ivo://nasa.gsfc.tan/gcn</AuthorIVORN>
    <Author>
      <contactName>Icecube Realtime Committee</contactName>
      <contactEmail>roc@icecube.wisc.edu</contactEmail>
    </Author>
    <Date>2022-09-18T14:54:31</Date>
    <Description>This VOEvent message was created with TAN VOE version: 15.08 17jun22</Description>
  </Who>
  <What>
    <Param name="Packet_Type" value="174"/>
    <Param name="Pkt_Ser_Num" value="2"/>
    <Param name="AMON_ID" value="13706522012496" ucd="meta.id">
      <Description>Alert identification number.</Description>
    </Param>
    <Param name="run_id" value="137065" ucd="meta.id">
      <Description>Run id.</Description>
    </Param>
    <Param name="event_id" value="22012496" ucd="meta.id">
      <Description>Event id within a given run.</Description>
    </Param>
    <Param name="Event_TJD" value="19840" unit="days" ucd="time"/>
    <Param name="Event_SOD" value="45965.32" unit="sec" ucd="time"/>
    <Param name="Stream" value="25" unit="dn" ucd="meta.id">
      <Description>IceCube coincidence stream identification</Description>
    </Param>
    <Param name="Rev" value="1" unit="dn" ucd="meta.id">
      <Description>Alert revision</Description>
    </Param>
    <Param name="signalness" value="0.4180" unit="dn" ucd="stat.probability">
      <Description>Probability of a neutrino event being astrophysic
    </Param>
    <Param name="FAR" value="1.7147" unit="yr^-1" ucd="stat.probabil
      <Description>False Alarm Rate. Number per year.</Description>
    </Param>
    <Param name="energy" value="168.3449" unit="TeV" ucd="phys.energ
      <Description>Likely neutrino energy (in TeV).</Description>
    </Param>
    <Param name="src_error_90" value="3.5699" unit="deg" ucd="stat.e
      <Description>Angular error of the source, statistical only, (9
    </Param>
    <Param name="src_error_50" value="2.0800" unit="deg" ucd="stat.e
      <Description>Angular error of the source, statistical only, (5
    </Param>
    <Param name="Trigger_ID" value="0x0"/>
    <Param name="Misc_flags" value="0x19000000"/>
    <Group name="Trigger_ID">
      <Param name="SubType" value="indi"/>
      <Param name="Test" value="false"/>
      <Param name="RADec_valid" value="false"/>
      <Param name="Retraction" value="false"/>
      <Param name="InternalTest" value="false"/>
    </Group>
```


Fermi-LAT gamma-ray observations of IceCube-220918A and detection of a new gamma-ray source, Fermi J0502.5+0037

ATel #15620; *S. Garrappa (DESY-Zeuthen), S. Buson (Univ. of Wuerzburg) and J. Sinapius (DESY-Zeuthen) on behalf of the Fermi-LAT collaboration:*

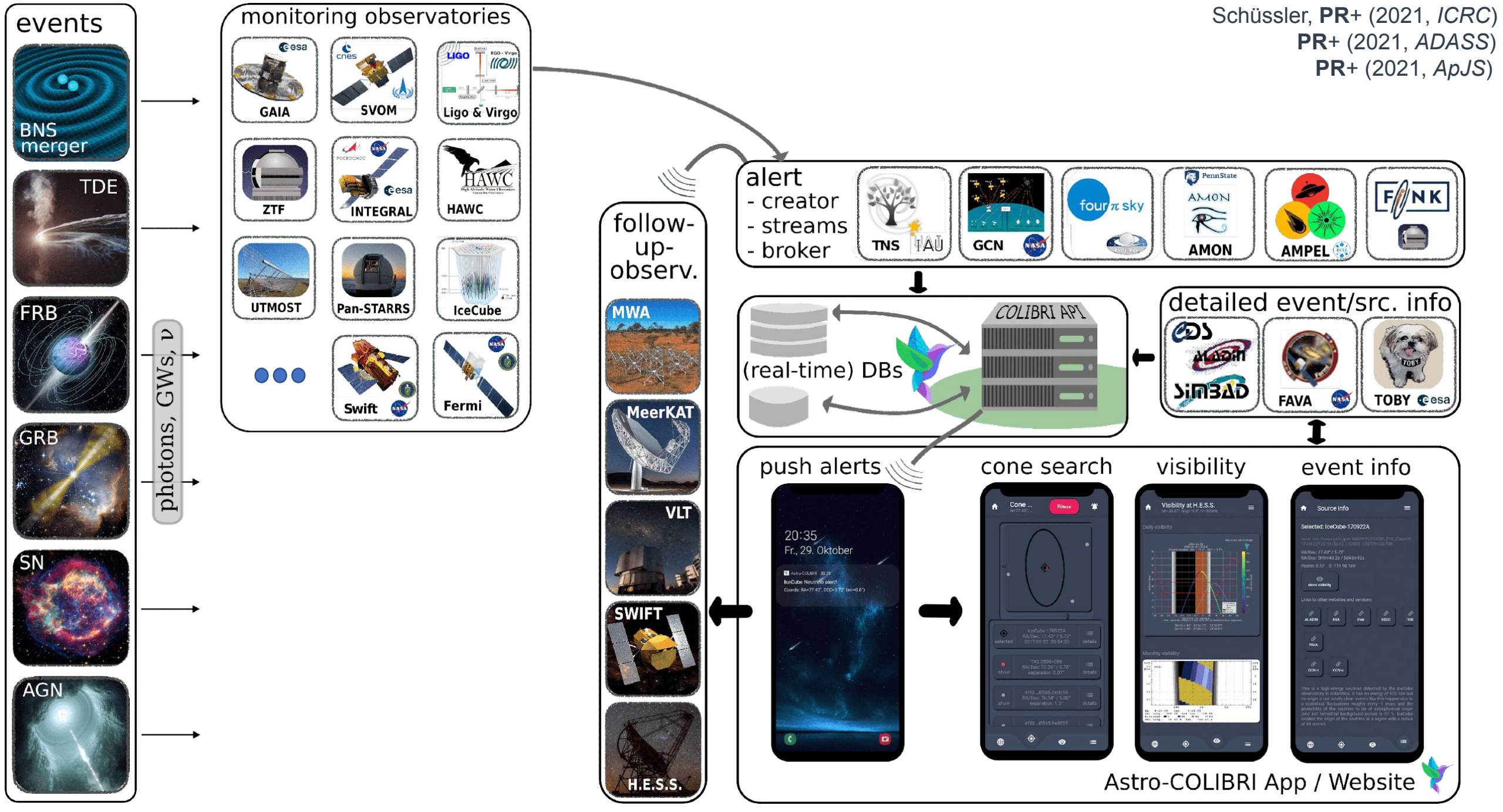
*on **19 Sep 2022; 20:50 UT***

Credential Certification: Simone Garrappa (simone.garrappa@gmail.com)

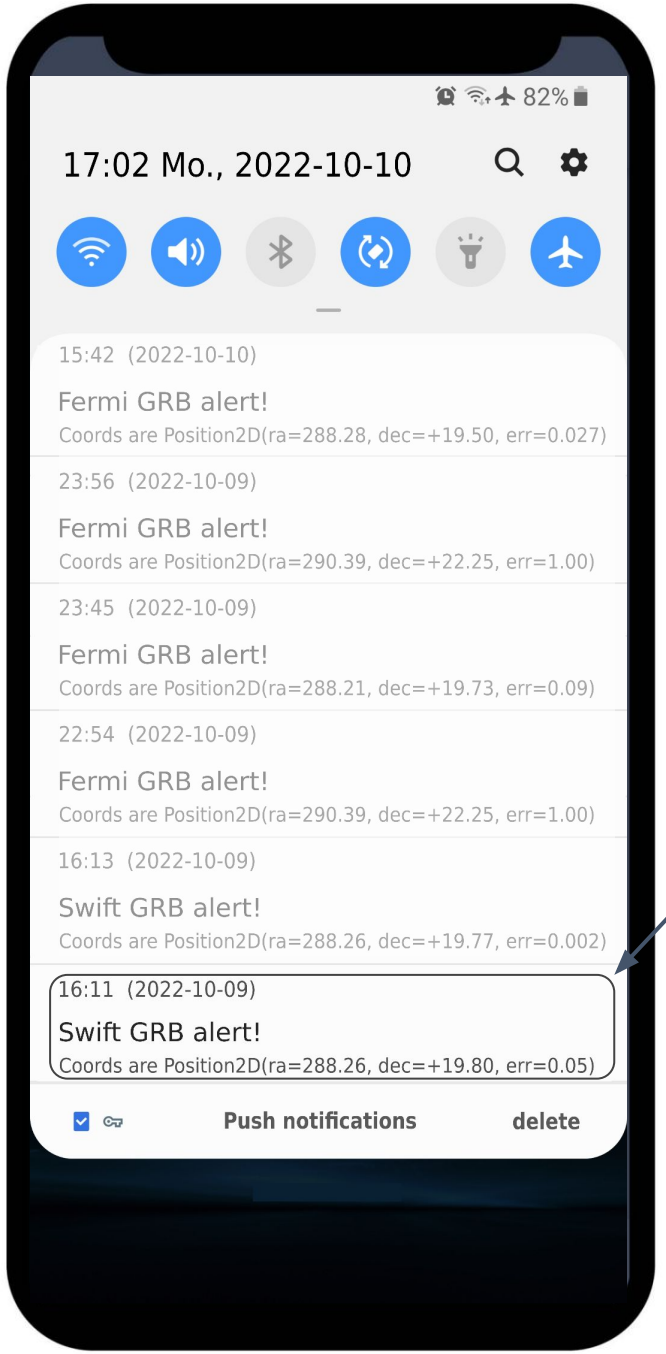
Subjects: Gamma Ray, Neutrinos, Request for Observations, AGN, Blazar

Idea of Astro-COLIBRI

Schüssler, **PR+** (2021, *ICRC*)
PR+ (2021, *ADASS*)
PR+ (2021, *ApJS*)



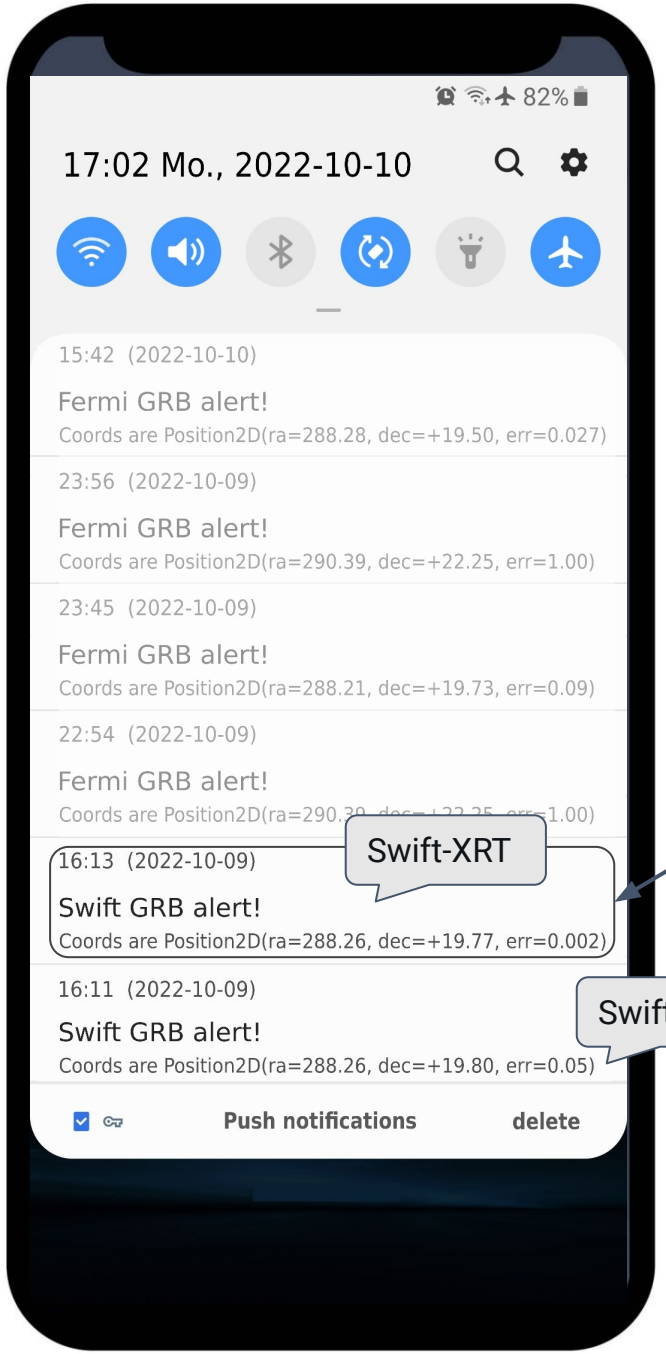
GRB 221009A in Astro-COLIBRI



Notice 2022-10-09 GCN/SWIFT NOTICE (Swift-BAT GRB Position)

```
TITLE:           GCN/SWIFT NOTICE
NOTICE_DATE:     Sun 09 Oct 22 14:11:33 UT
NOTICE_TYPE:     Swift-BAT GRB Position
TRIGGER_NUM:     1126853,   Seg_Num: 0
GRB_RA:          288.263d {+19h 13m 03s} (J2000),
                 288.512d {+19h 14m 03s} (current),
                 287.718d {+19h 10m 52s} (1950)
GRB_DEC:         +19.803d {+19d 48' 09"} (J2000),
                 +19.843d {+19d 50' 33"} (current),
                 +19.717d {+19d 42' 60"} (1950)
GRB_ERROR:       3.00 [arcmin radius, statistical only]
GRB_INTEN:       0 [cnts]    Image_Peak=903 [image_cnts]
TRIGGER_DUR:     64.000 [sec]
TRIGGER_INDEX:   20000     E_range: 15-50 keV
BKG_INTEN:       0 [cnts]
BKG_TIME:        0.00 SOD {00:00:00.00} UT
BKG_DUR:         0 [sec]
GRB_DATE:        19861 TJD;   282 DOY;   22/10/09
GRB_TIME:        51017.99 SOD {14:10:17.99} UT
GRB_PHI:          44.81 [deg]
GRB_THETA:        44.40 [deg]
SOLN_STATUS:     0x13
RATE_SIGNIF:     0.00 [sigma]
IMAGE_SIGNIF:    8.02 [sigma]
MERIT_PARAMS:     +1  +0  +0  +6  +1  -2  +0  +1  +9  +0
SUN_POSTN:       194.99d {+12h 59m 58s}   -6.40d {-06d 23' 47"}
SUN_DIST:         95.46 [deg]   Sun_angle= -6.2 [hr] (East of Sun)
MOON_POSTN:       12.65d {+00h 50m 36s}   +2.60d {+02d 35' 55"}
MOON_DIST:        83.61 [deg]
MOON_ILLUM:      100 [%]
GAL_COORDS:       52.99,  4.34 [deg] galactic lon,lat of the burst (or transient)
ECL_COORDS:      293.29, 41.78 [deg] ecliptic lon,lat of the burst (or transient)
COMMENTS:        SWIFT-BAT GRB Coordinates.
COMMENTS:        This is an image trigger.  (The RATE_SIGNIF & BKG_{INTEN, TIME, DUR} are undefined.)
COMMENTS:        A point_source was found.
COMMENTS:        This does not match any source in the on-board catalog.
COMMENTS:        This does not match any source in the ground catalog.
COMMENTS:        This is a GRB.
COMMENTS:        This trigger occurred at longitude,latitude = 31.83,11.92 [deg].
```

GRB 221009A in Astro-COLIBRI

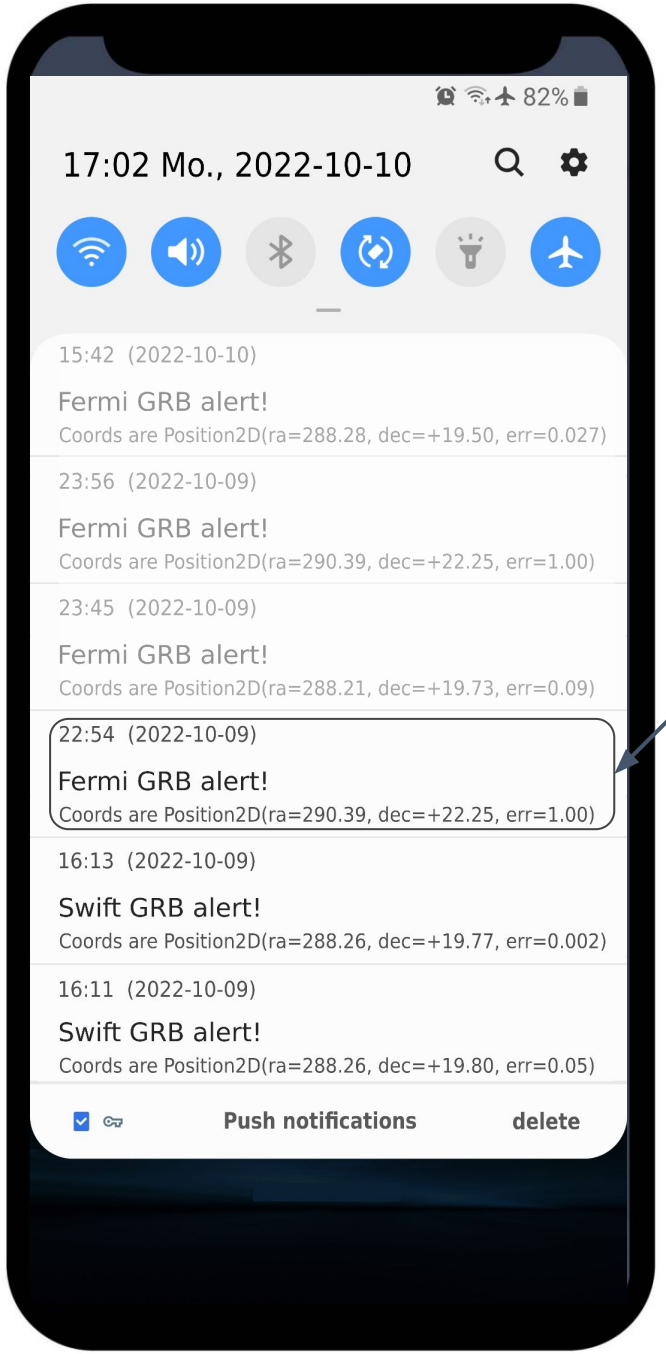


Notice 2022-10-09 GCN/SWIFT NOTICE (Swift-BAT GRB Position)

Notice 2022-10-09 GCN/SWIFT NOTICE (Swift-XRT Position)

```
TITLE:            GCN/SWIFT NOTICE
NOTICE_DATE:      Sun 09 Oct 22 14:13:30 UT
NOTICE_TYPE:      Swift-XRT Position
TRIGGER_NUM:      1126853,   Seg_Num: 0
GRB_RA:           288.2643d {+19h 13m 03.43s} (J2000),
                  288.5128d {+19h 14m 03.06s} (current),
                  287.7187d {+19h 10m 52.49s} (1950)
GRB_DEC:          +19.7712d {+19d 46' 16.3"} (J2000),
                  +19.8112d {+19d 48' 40.2"} (current),
                  +19.6852d {+19d 41' 06.7"} (1950)
GRB_ERROR:        5.6 [arcsec radius, statistical plus systematic, 90% containment]
GRB_INTEN:        2.51e-08 [erg/cm2/sec]
GRB_SIGNIF:       6.78 [sigma]
IMG_START_DATE:   19861 TJD;   282 DOY;   22/10/09
IMG_START_TIME:   51188.59 SOD {14:13:08.59} UT,   170.6 [sec] since BAT Trigger Time
TAM[0-3]:         327.64 237.18 261.73 243.44
AMPLIFIER:        2
WAVEFORM:         134
SUN_POSTN:        194.99d {+12h 59m 58s}   -6.40d {-06d 23' 49"}
SUN_DIST:          95.46 [deg]   Sun_angle= -6.2 [hr] (East of Sun)
MOON_POSTN:        12.66d {+00h 50m 40s}   +2.61d {+02d 36' 26"}
MOON_DIST:         83.62 [deg]
MOON_ILLUM:       100 [%]
GAL_COORDS:        52.96,  4.32 [deg] galactic lon,lat of the burst
ECL_COORDS:       293.28, 41.75 [deg] ecliptic lon,lat of the burst
COMMENTS:         SWIFT-XRT Coordinates.
COMMENTS:         The XRT position is 1.88 arcmin from the BAT position.
```

GRB 221009A in Astro-COLIBRI



Circular 32636 GRB 221009A: Fermi GBM detection of an extraordinarily bright GRB

TITLE: GCN CIRCULAR
NUMBER: 32636
SUBJECT: GRB 221009A: Fermi GBM detection of an extraordinarily bright GRB
DATE: 22/10/09 20:54:36 GMT
FROM: Peter Veres at UAH <veresp@gmail.com>

P. Veres (UAH), E. Burns (LSU), E. Bissaldi (Politecnico and INFN Bari), S. Lesage (UAH), O. Roberts (USRA)
report on behalf of the Fermi GBM Team:

"At 2022-10-09 13:16:59.000 UT on 9 October 2022, the Fermi Gamma-Ray Burst Monitor (GBM) triggered and located GRB 221009A (trigger 687014224 / 221009553).

This event, if it is a GRB, it is the brightest among the GBM detected GRBs. If it is not a GRB then it is a rare transient event. Follow-up across all wavelengths is encouraged.

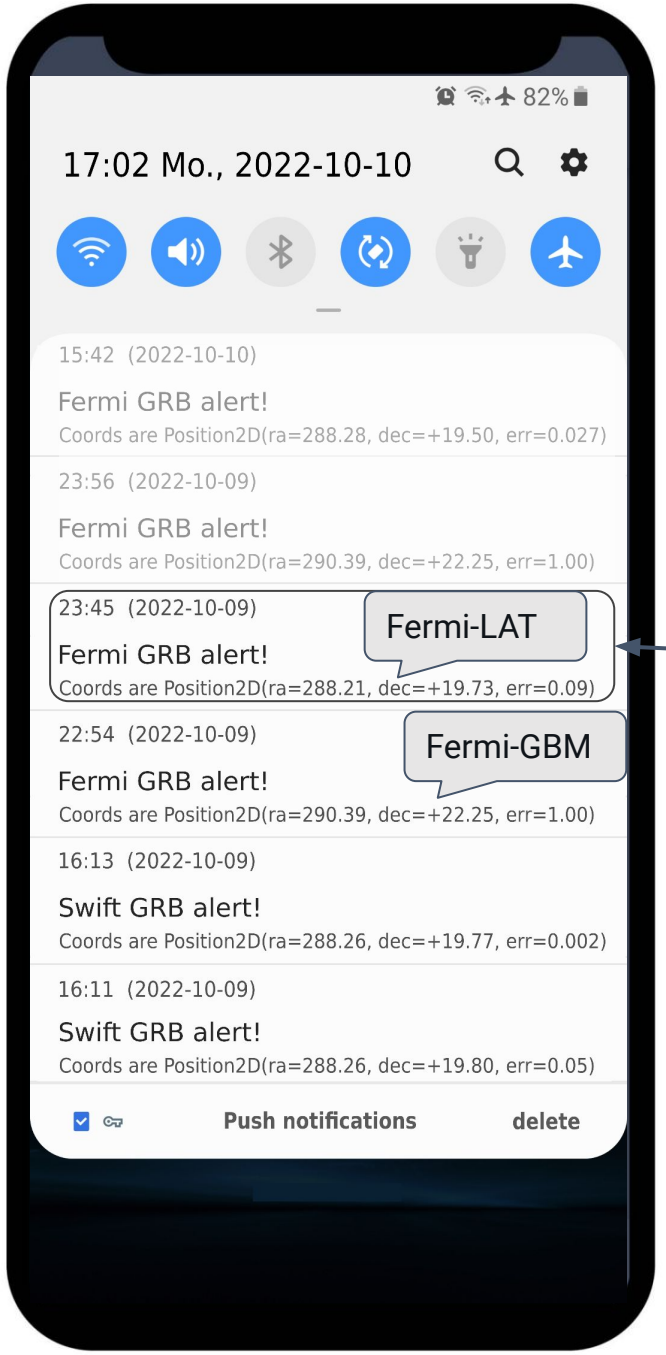
The on-ground calculated location, using the GBM trigger data, is RA = 290.4, DEC = 22.3 (J2000 degrees, equivalent to 19 h 22 m, 22 d 15 '), with a statistical uncertainty of 1 degrees (radius, 1-sigma containment, statistical only; there is additionally a systematic error which we have characterized as a core-plus-tail model, with 90% of GRBs having a 3.7 deg error and a small tail suffering a larger than 10 deg systematic error. [Connaughton et al. 2015, ApJS, 216, 32]).

This location is consistent with the Swift J1913.1+1946 localization (Dichiara et al. GCN 32632) though it precedes the Swift trigger by an hour.

The angle from the Fermi LAT boresight at the GBM trigger time is 76 degrees.

The GBM light curve consists of an initial ~10 s long pulse, followed by an extraordinarily bright episode at ~180 s after the trigger time, lasting at least 100 seconds.

GRB 221009A in Astro-COLIBRI



Circular 32636

TITLE: GC
NUMBER: 32
SUBJECT: GR
DATE: 22/
FROM: Pe

P. Veres (U
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Circular 32637 GRB 221009A or Swift J1913.1+1946: Fermi-LAT detection

TITLE: GCN CIRCULAR
NUMBER: 32637
SUBJECT: GRB 221009A or Swift J1913.1+1946: Fermi-LAT detection
DATE: 22/10/09 21:45:05 GMT
FROM: Elisabetta Bissaldi at INFN,Bari <elisabetta.bissaldi@ba.infn.it>

E Bissaldi (Politecnico and INFN Bari), N. Omodei (Stanford Univ.),
M. Kerr (NRL), report on behalf of the Fermi-LAT team:

At 14:17:05.99 on October, 09, 2022 Fermi-LAT detected high-energy emission
from Swift J1913.1+1946 or GRB 221009A, which was reported by
Swift (Dichiara et al. GCN #32632) and by GBM (Veres et al. GCN #32636).
The best LAT on-ground location is found to be

RA, Dec = 288.21, 19.73 (J2000)

with an error radius of 0.09 deg (90 % containment, statistical error only).
This was 94 deg from the LAT boresight at the time of the trigger.

The data from the Fermi-LAT show a significant increase in the event rate
that is spatially and temporally correlated with the trigger with high significance.

The 100 MeV - 1 GeV photon flux in the time interval 500-3500 s after
the Swift trigger is (1.27 +/- 0.16)E-05 ph/cm2/s.
The estimated photon index above 100 MeV is -2.12 +/- 0.11.
The highest-energy photon is a 7.8 GeV
which is observed 766 seconds after the Swift trigger.

The Fermi-LAT point of contact for this burst is
Elisabetta Bissaldi (elisabetta.bissaldi@ba.infn.it).

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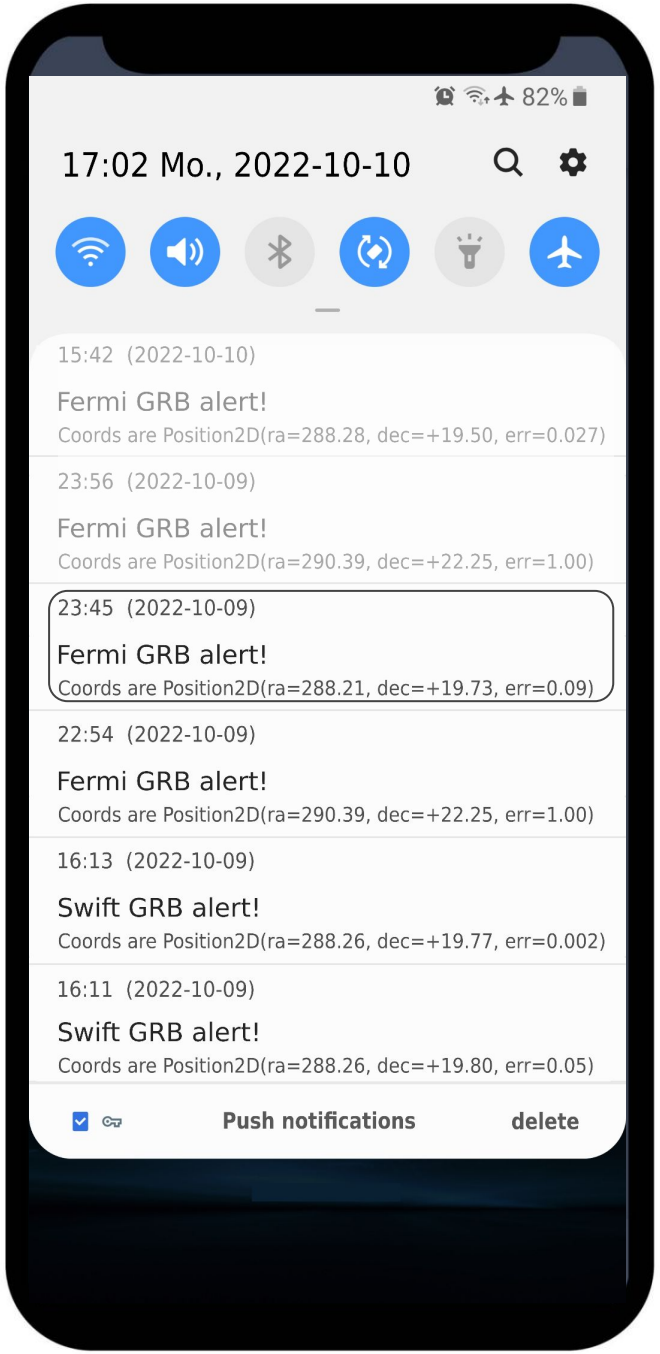
GRB 221009A in Astro-COLIBRI



Circular 32636

Circular 32637 GRB 221009A or Swift J1913.1+1946: Fermi-LAT detection

TITLE:
NUMBER:
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FROM:

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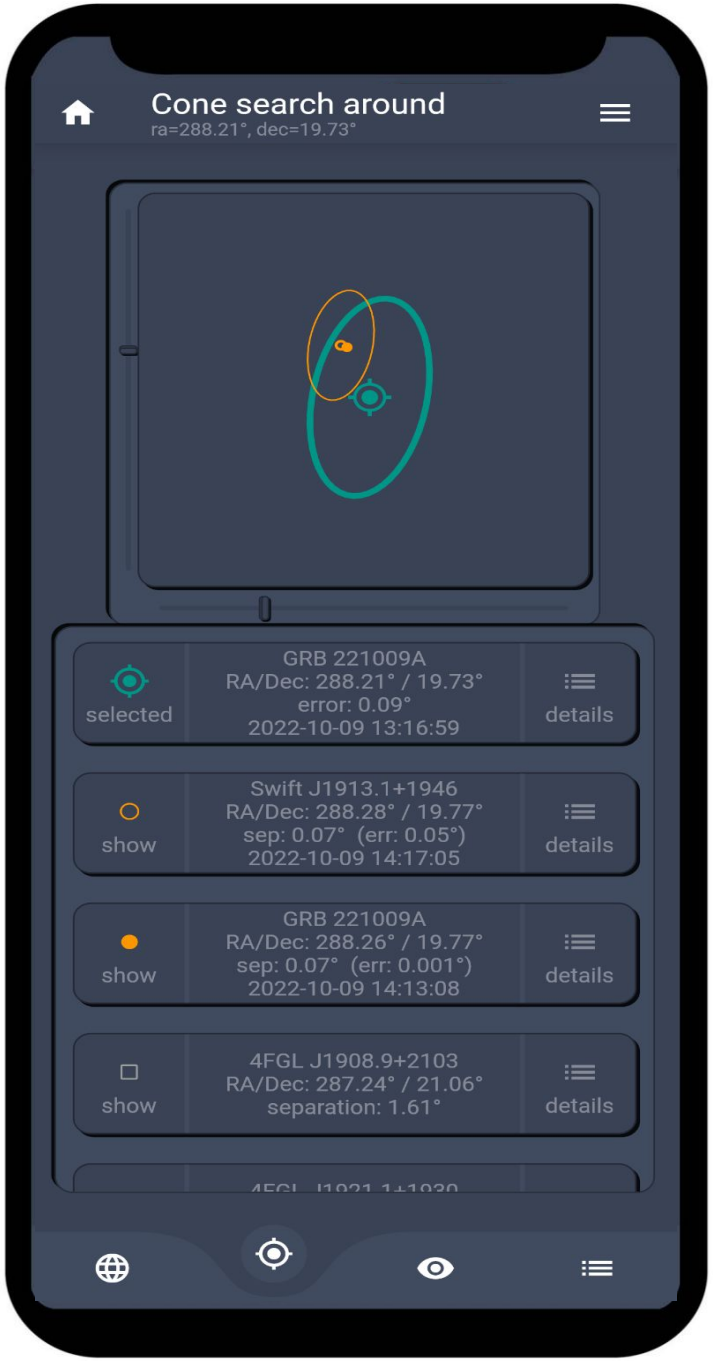

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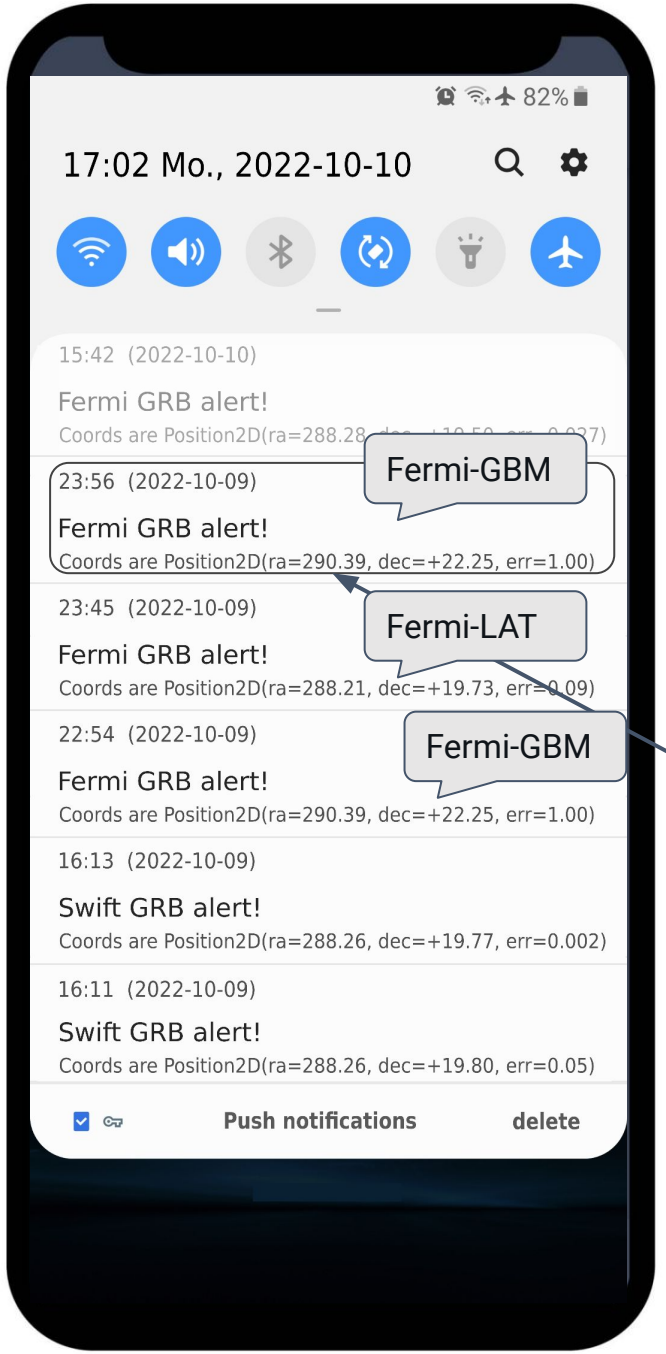
GRB 221009A in Astro-COLIBRI



Circular 32636

TITLE: GC
NUMBER: 32
SUBJECT: GR
DATE: 22

Circular 32637 GRB 221009A or Swift J1913.1+1946: Fermi-LAT detection

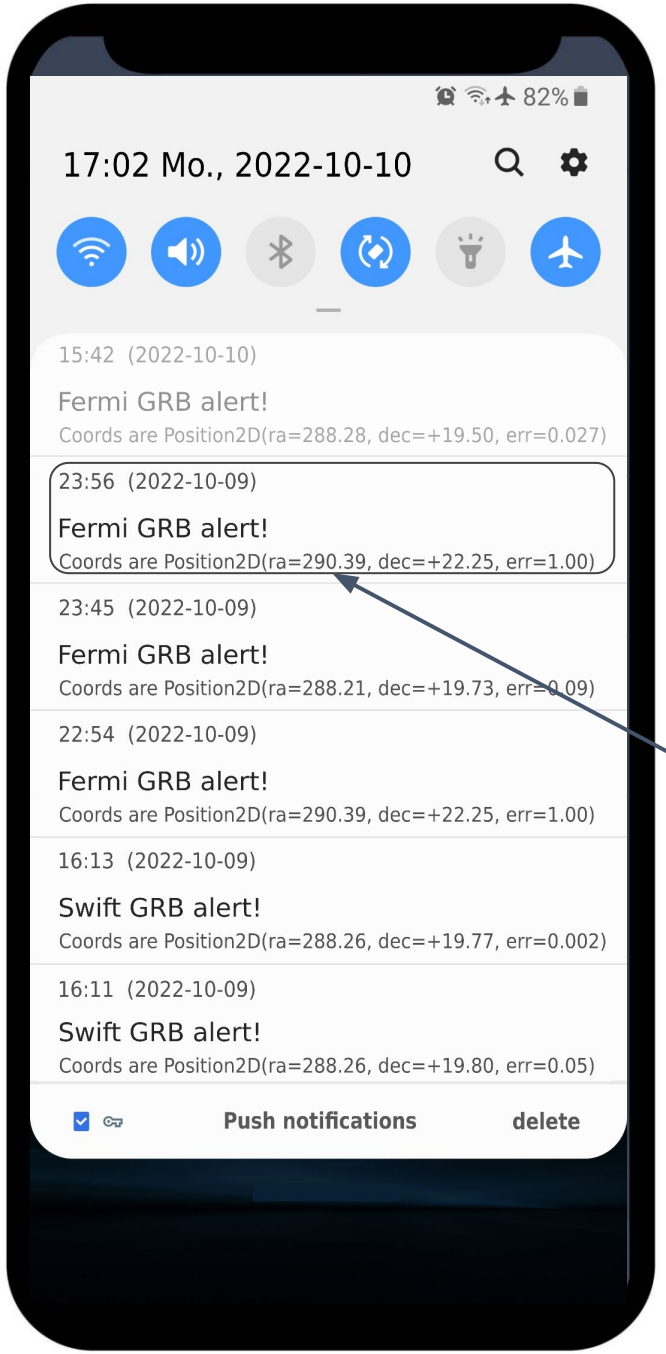
TITLE: GCN CIRCULAR
NUMBER: 32637
SUBJECT: GRB 221009A or Swift J1913.1+1946: Fermi-LAT detection

Notice 2022-10-09 GCN/FERMI NOTICE (Fermi-GBM Final Position)

```
TITLE:           GCN/FERMI NOTICE
NOTICE_DATE:     Sun 09 Oct 22 21:56:40 UT
NOTICE_TYPE:     Fermi-GBM Final Position
RECORD_NUM:      0
TRIGGER_NUM:     687014224
GRB_RA:          290.390d {+19h 21m 34s} (J2000),
                 290.633d {+19h 22m 32s} (current),
                 289.856d {+19h 19m 25s} (1950)
GRB_DEC:         +22.250d {+22d 15' 00"} (J2000),
                 +22.294d {+22d 17' 40"} (current),
                 +22.154d {+22d 09' 15"} (1950)
GRB_ERROR:       1.00 [deg radius, statistical only]
GRB_DATE:        19861 TJD;   282 DOY;   22/10/09
GRB_TIME:        47819.99 SOD {13:16:59.99} UT
GRB_PHI:         256.53 [deg]
GRB_THETA:        64.91 [deg]
E_RANGE:         50.000 - 300.000 [keV]
LOC_ALGORITHM:   415 (Gnd S/W Version number)
SUN_POSTN:       195.29d {+13h 01m 09s}   -6.52d {-06d 31' 08"}
SUN_DIST:         97.40 [deg]   Sun_angle= -6.4 [hr] (East of Sun)
MOON_POSTN:       16.56d {+01h 06m 14s}   +4.61d {+04d 36' 39"}
MOON_DIST:        84.49 [deg]
MOON_ILLUM:      100 [%]
GAL_COORDS:       56.08,  3.71 [deg] galactic lon,lat of the burst (or transient)
ECL_COORDS:      296.55, 43.83 [deg] ecliptic lon,lat of the burst (or transient)
LC_URL:          http://heasarc.gsfc.nasa.gov/FTP/fermi/data/gbm/triggers/2022/bn221009553/quicklook/glg_lc_medres34_bn221009553.gif
LOC_URL:         http://heasarc.gsfc.nasa.gov/FTP/fermi/data/gbm/triggers/2022/bn221009553/quicklook/glg_locplot_all_bn221009553.png
COMMENTS:        Fermi-GBM Final Position.
COMMENTS:        This Notice was ground-generated -- not flight-generated.
COMMENTS:        The LC_URL file should be available by the time this FINAL notice is produced.
COMMENTS:        This notice has human-in-the-loop processing.
```

lasting at

GRB 221009A in Astro-COLIBRI



Circular 32636

TITLE: GC
NUMBER: 32
SUBJECT: GR
DATE: 22

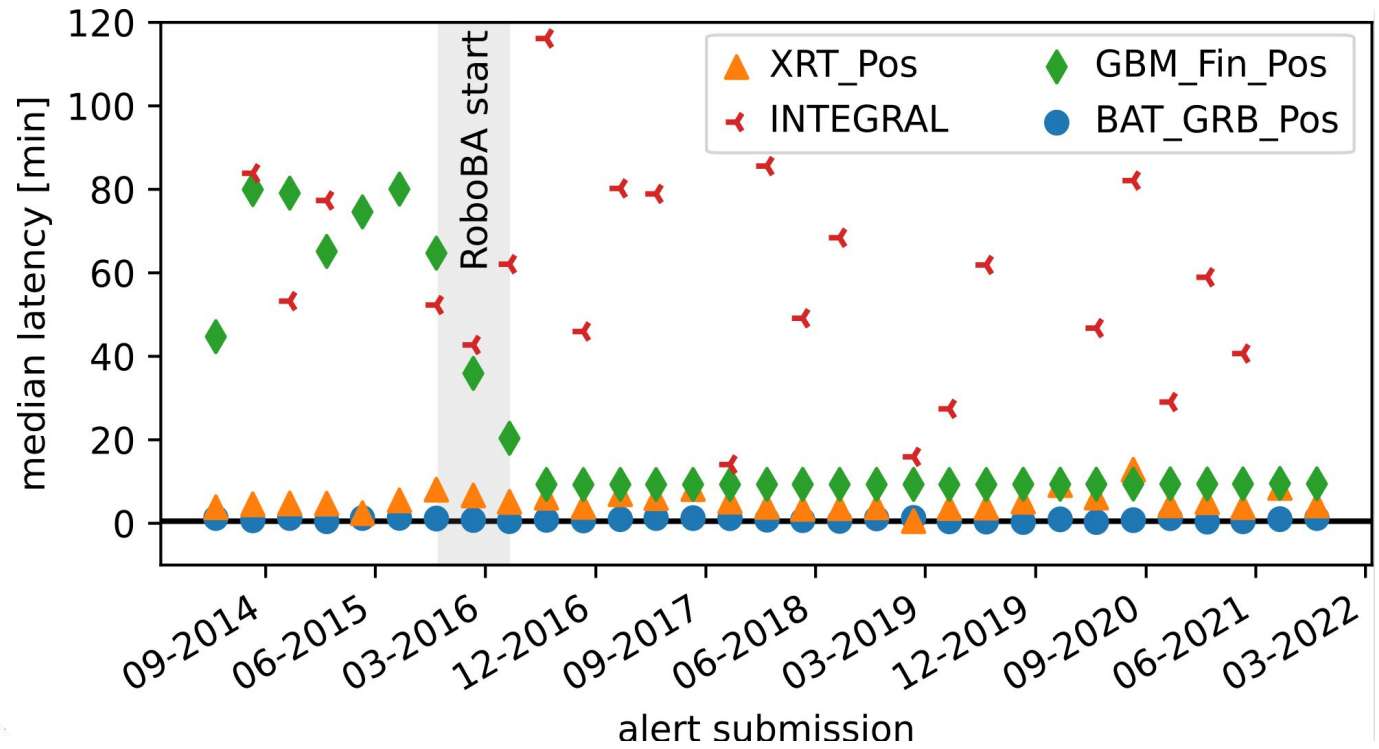
Circular 32637 GRB 221009A or Swift J1913.1+1946: Fermi-LAT detection

TITLE: GCN CIRCULAR
NUMBER: 32637
SUBJECT: GRB 221009A or Swift J1913.1+1946: Fermi-LAT detection

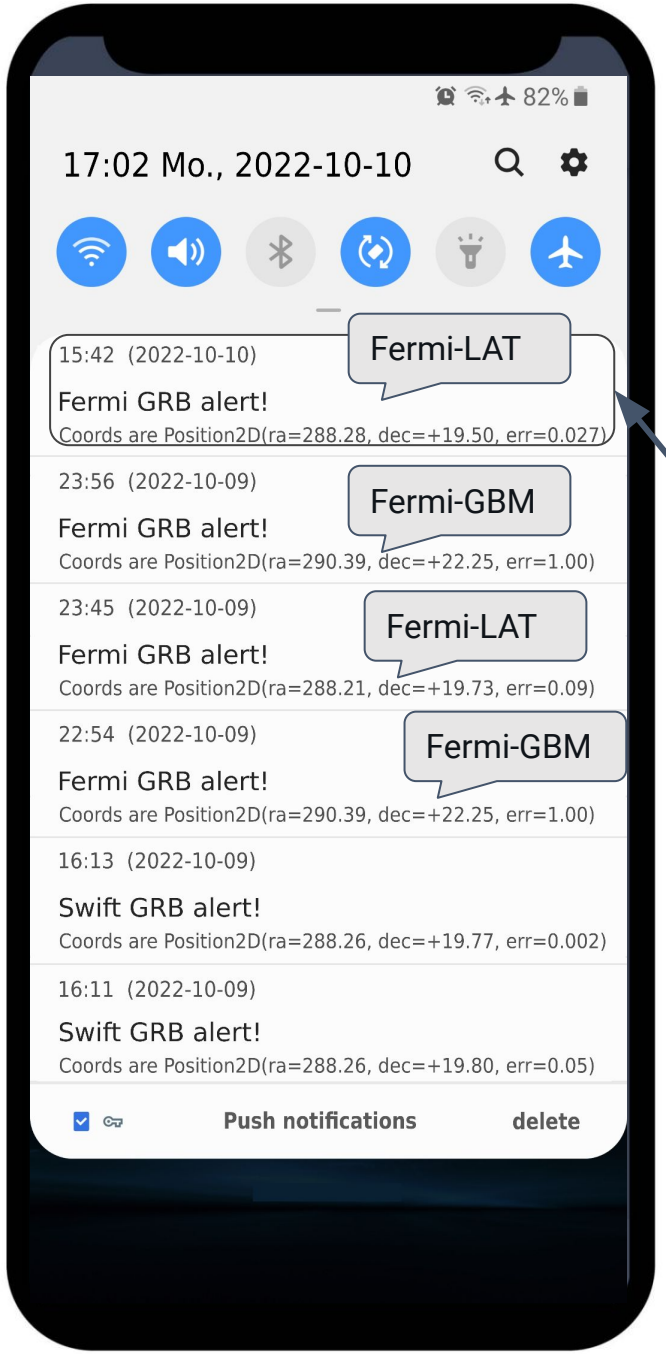
Notice 2022-10-09 GCN/FERMI NOTICE (Fermi-GBM Final Position)

TITLE: GCN/FERMI NOTICE
NOTICE_DATE: Sun 09 Oct 22 21:56:40 UT
NOTICE_TYP
RECORD
TRIGGE
GRB_R
GRB_D
GRB_E
GRB_D
GRB_T
GRB_P
GRB_T
E_RAN
LOC_A
SUN_P
SUN_D
MOON_
MOON_
MOON_
GAL_CO
ECL_COO
LC_URL: s34_bn221009553.gif
LOC_URL: http://heasarc.gsfc.nasa.gov/FTP/fermi/data/gbm/triggers/2022/bn221009553/quicklook/glg_locplot_all_bn221009553.png
COMMENTS: Fermi-GBM Final Position.
COMMENTS: This Notice was ground-generated -- not flight-generated.
COMMENTS: The LC_URL file should be available by the time this FINAL notice is produced.
COMMENTS: This notice has human-in-the-loop processing.

lasting at



GRB 221009A in Astro-COLIBRI



Circular 32658 GRB 221009A: Fermi-LAT refined analysis

TITLE: GCN CIRCULAR
NUMBER: 32658
SUBJECT: GRB 221009A: Fermi-LAT refined analysis
DATE: 22/10/10 13:42:46 GMT
FROM: Roberta Pillera at Politecnico and INFN Bari <roberta.pillera@ba.infn.it>

GRB 221009A: Fermi-LAT refined analysis

R. Pillera (Politecnico and INFN Bari), E Bissaldi (Politecnico and INFN Bari),
N. Omodei (Stanford Univ.), G. La Mura (LIP, Portugal),
F. Longo (University and INFN Trieste) report on behalf of the Fermi-LAT team:

We report updated observations of GRB 221009A which was detected by Swift (Kennea et al. GCN #32635), Fermi-GBM (Veres et al. GCN #32636, Lesage et al. GCN #32642), Fermi-LAT (Bissaldi et al. GCN #32637), and the IPN (Svinkin et al. GCN #32641).

GRB 221009A triggered Fermi-GBM on October 10, 2022, at 13:16:59.99 UT (trigger 687014224/221009553), about 1 hour earlier with respect to the Swift trigger, which was reported as a new bright hard X-ray and optical transient and tentatively classified as Swift J1913.1+1946 (Dichiara et al., GCN 32632). Prompt GCN notices from Fermi-GBM were not distributed due to problems with the real-time downlink from TDRS, therefore no automatic Fermi-LAT GRB pipelines were triggered by the GBM event.

Using LAT events with E>100 MeV between T0+200 s and T0+800 s, we find a LAT localization of

RA = 288.282, Dec = 19.495,

with a 90% containment radius of 0.027 degrees (statistical only).

with a 90% containment radius of 0.027 degrees (statistical only).

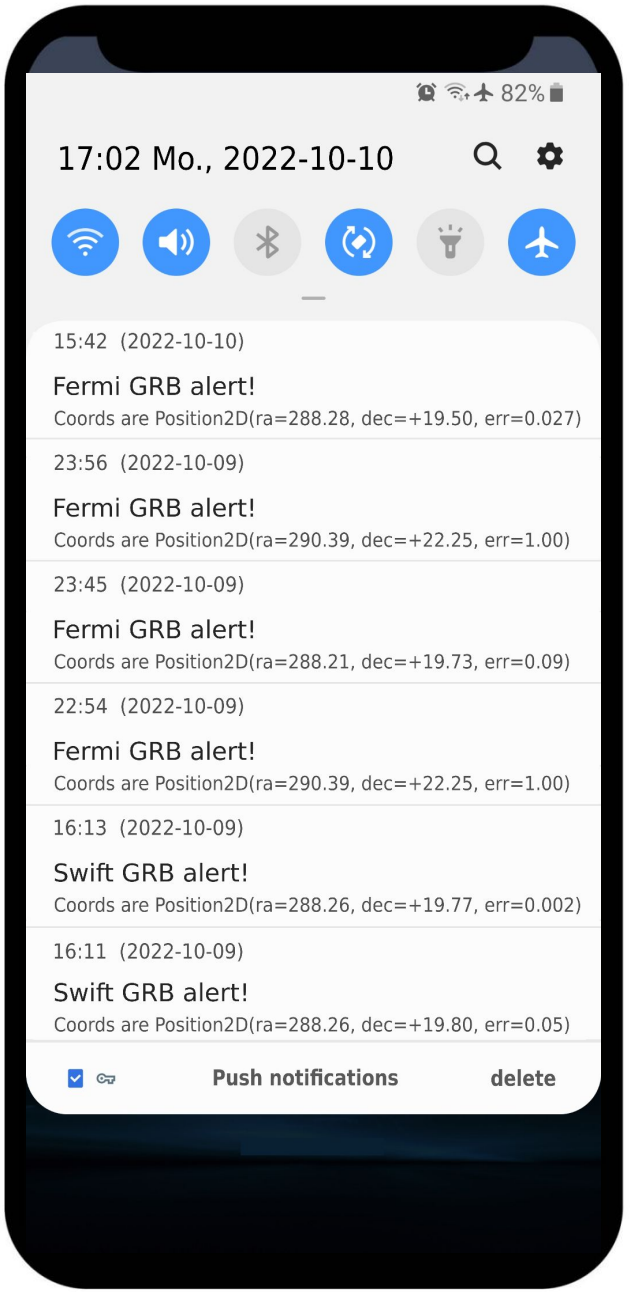
The LAT lightcurve shows a bright structured emission episode which is temporally coincident with the GBM main emission episode starting at T0+200s.
The 100 MeV - 1 GeV photon flux in the time interval 200-800 s after the GBM trigger is (6.2 +/- 0.4)E-03 ph/cm2/s.
The estimated photon index above 100 MeV is -1.87 +/- 0.04.

From a preliminary analysis, the LAT emission is extending for about 25ks post GBM trigger.
The highest-energy photon is 99.3 GeV (with a probability of 99.2%) which is observed 240 seconds after the GBM trigger.
This represents the highest GRB photon energy ever detected by Fermi-LAT (the previous record holder being a 95 GeV event from GRB 130427A).

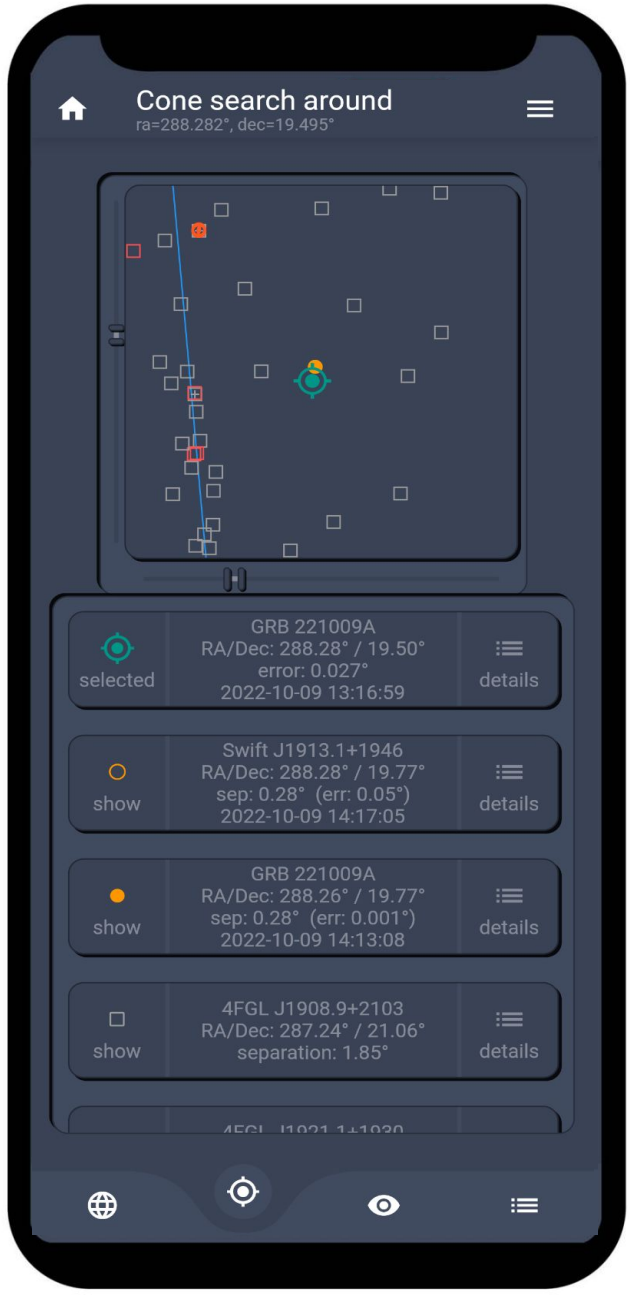
The Fermi-LAT point of contact for this burst is Elisabetta Bissaldi (elisabetta.bissaldi@ba.infn.it).

The Fermi-LAT is a pair conversion telescope designed to cover the energy band from 20 MeV to greater than 300 GeV. It is the product of an international collaboration between NASA and DOE in the U.S. and many scientific institutions across France, Italy, Japan and Sweden.

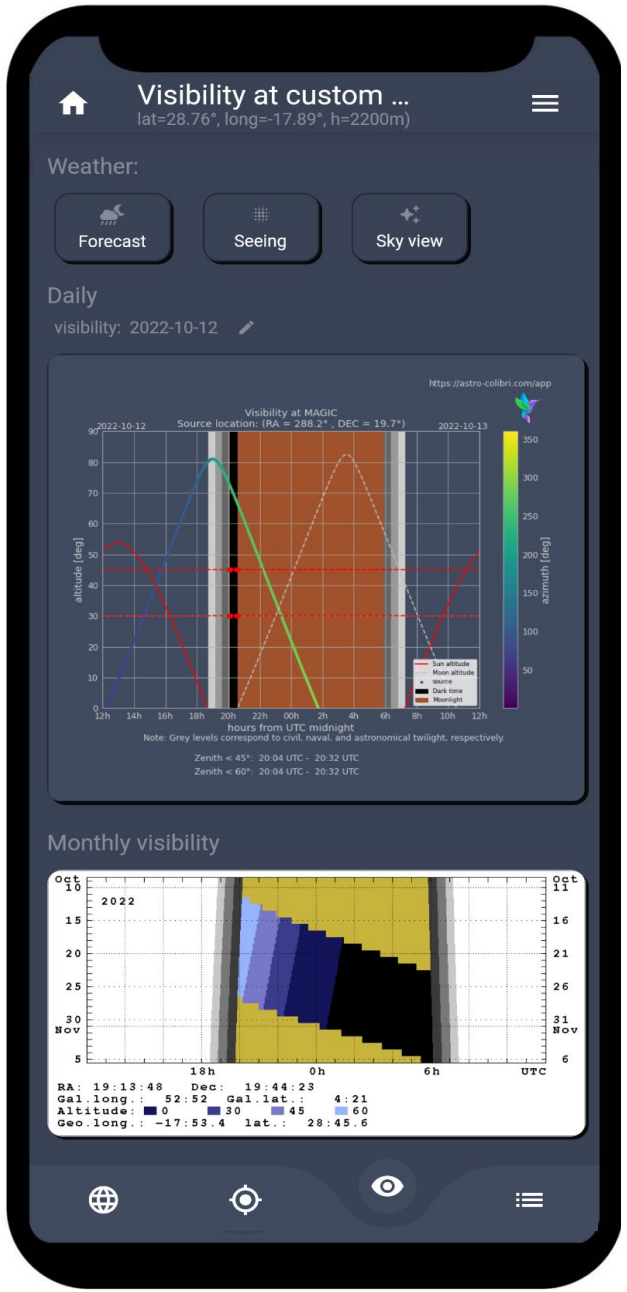
GRB 221009A within Astro-COLIBRI App



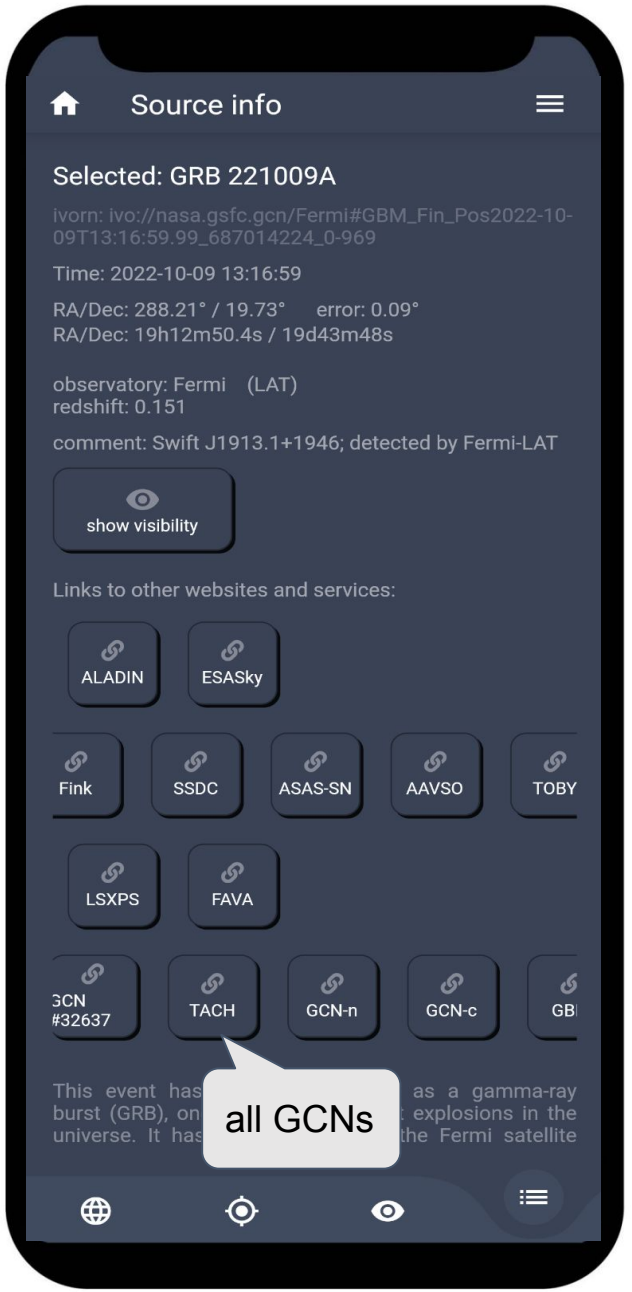
GRB 221009A



Cone search: Fermi & Swift

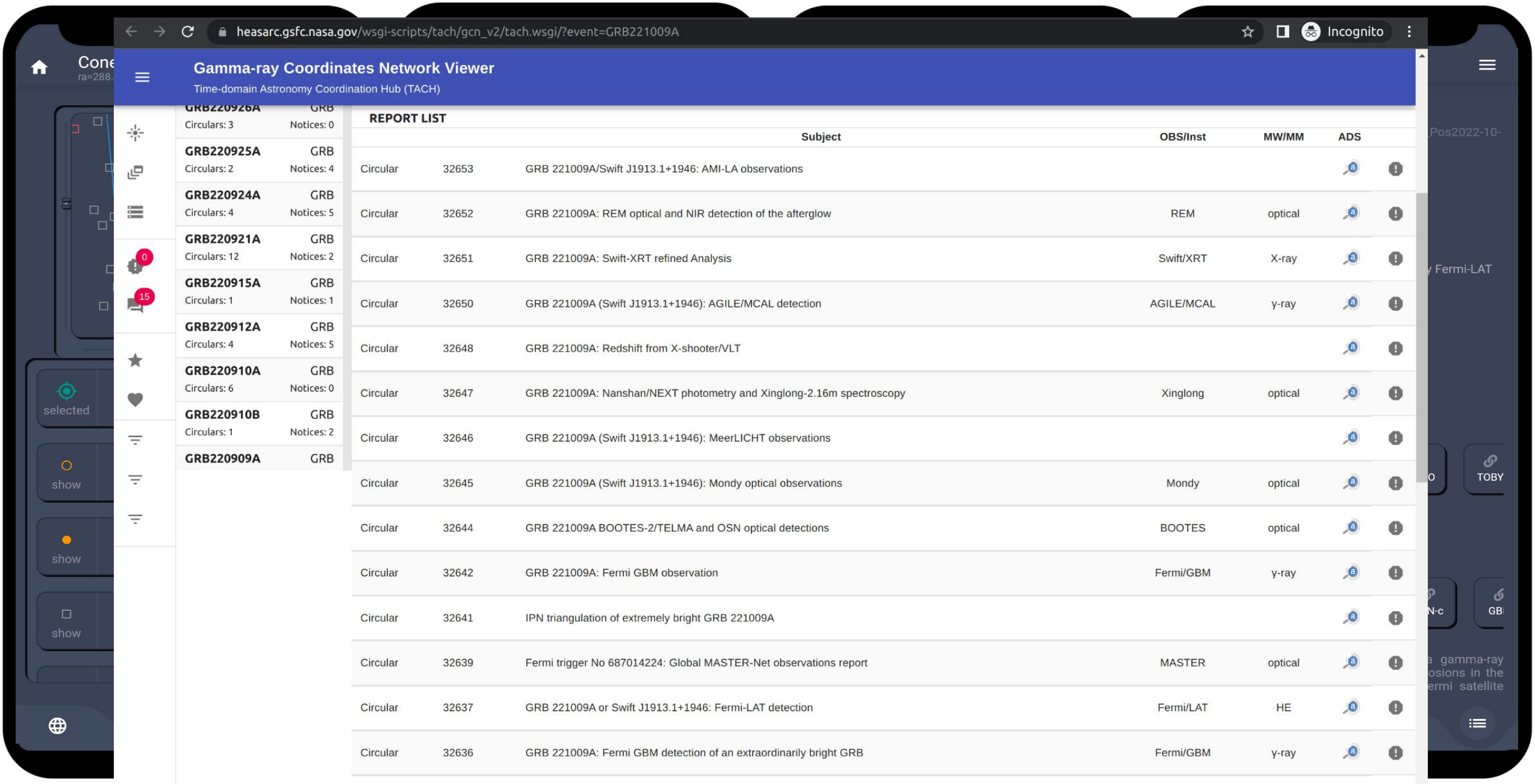


Visibility for MAGIC (etc.)



Many customized links

GRB 221009A within Astro-COLIBRI App

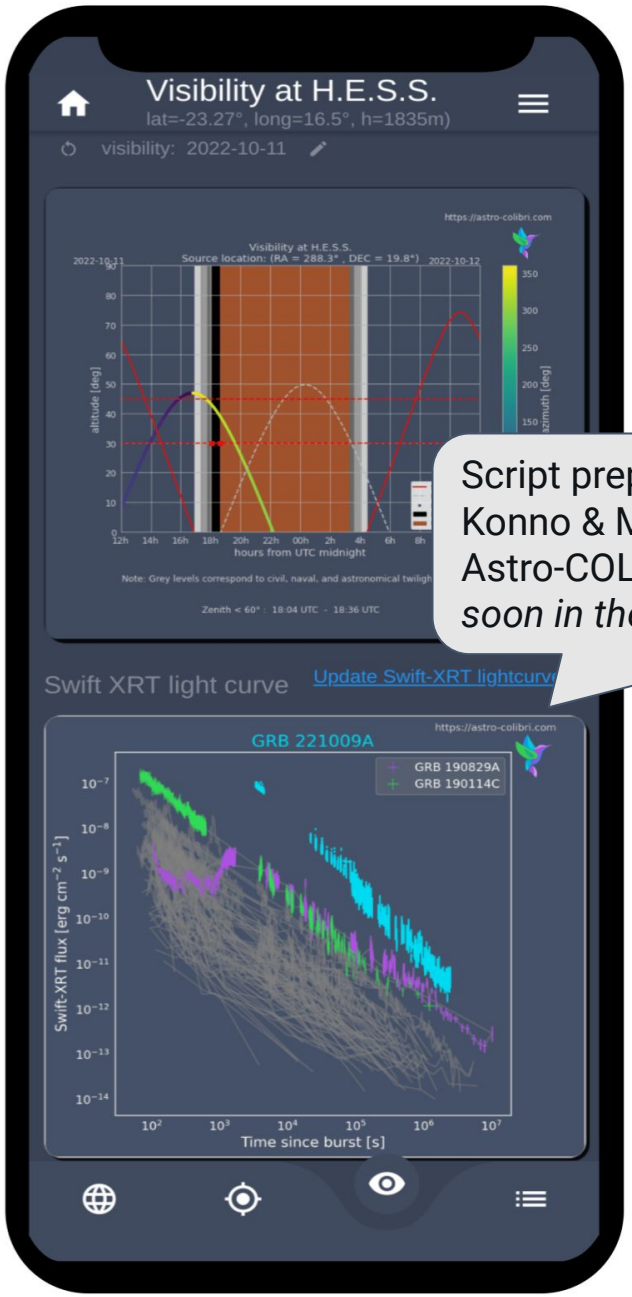


Real-t on

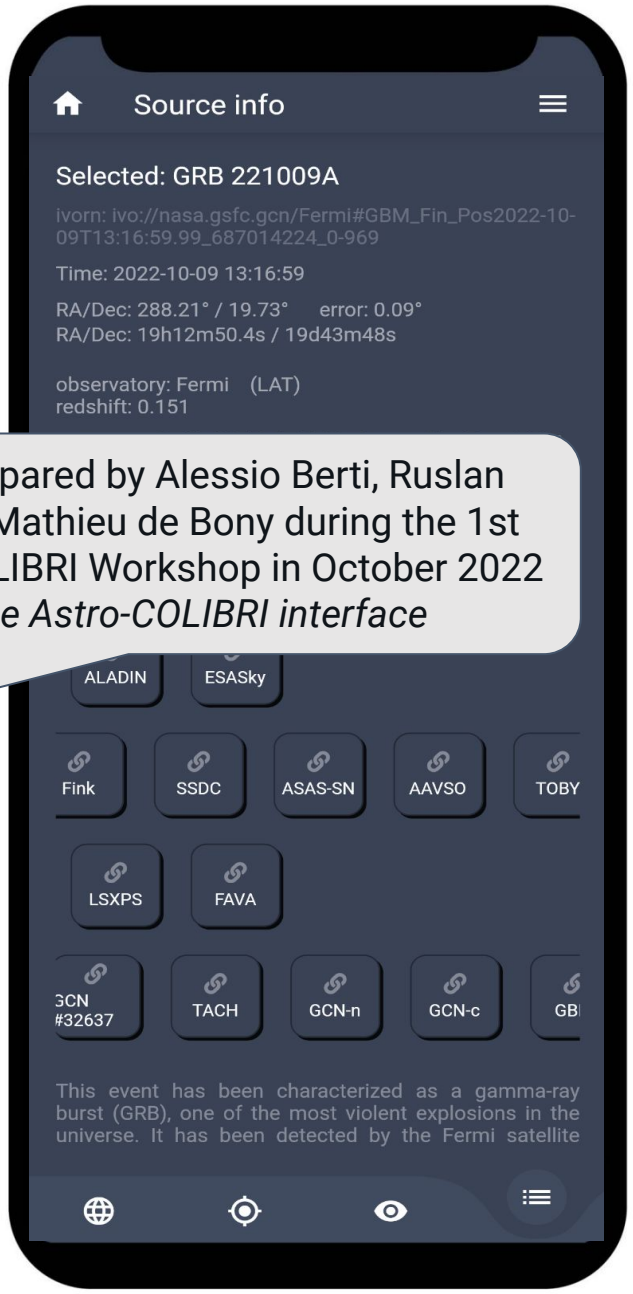
GRB 221009A within Astro-COLIBRI App

Real-time notifications

Cone search



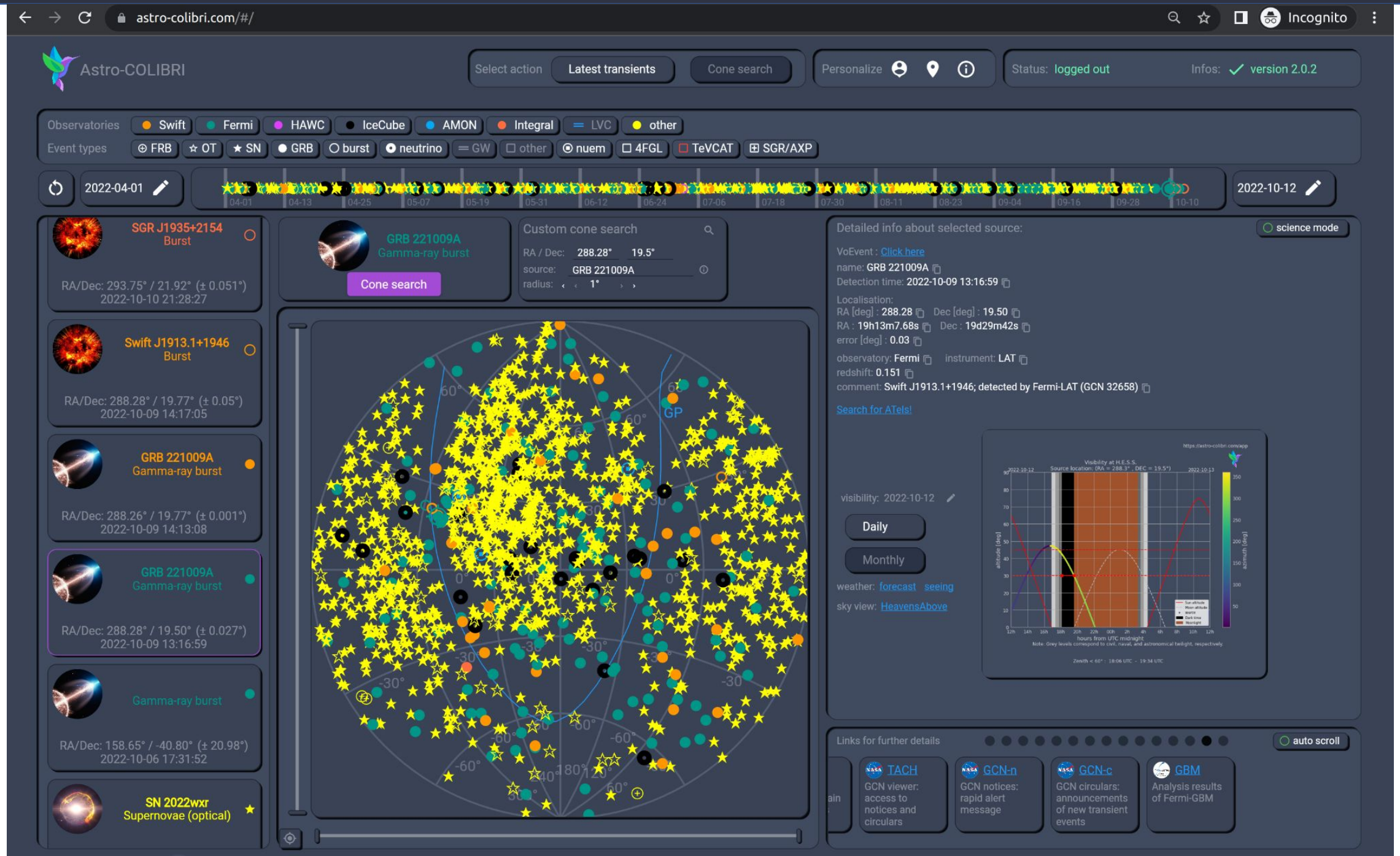
Transient visibility

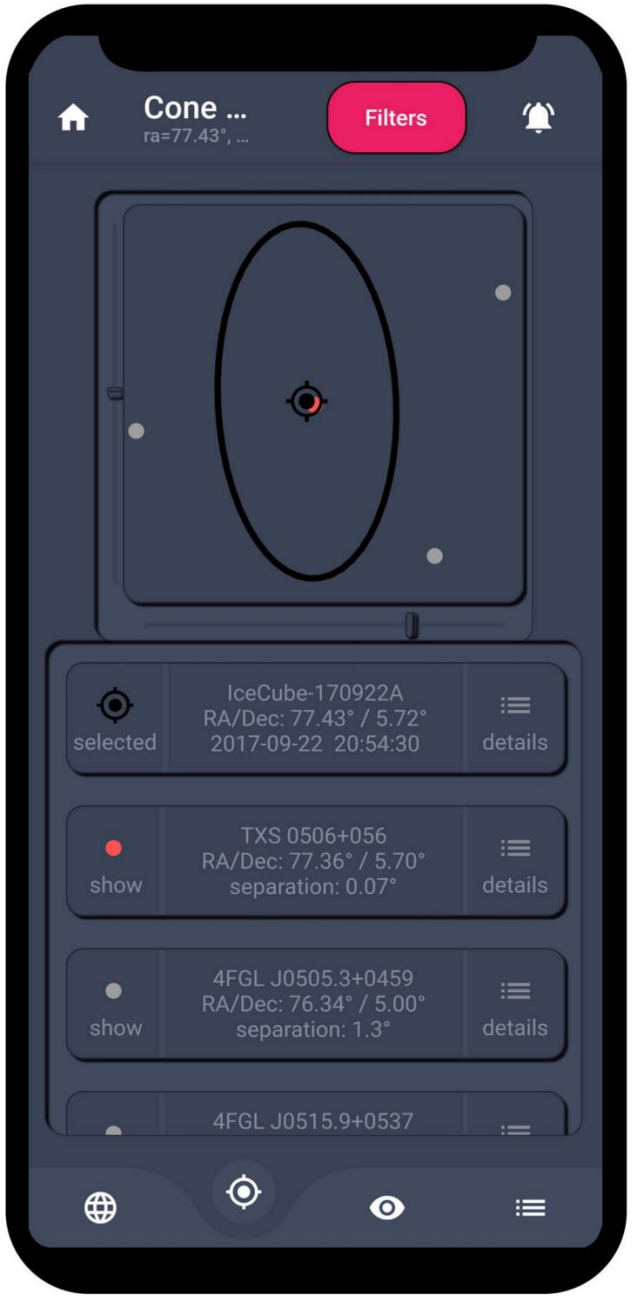


Further information

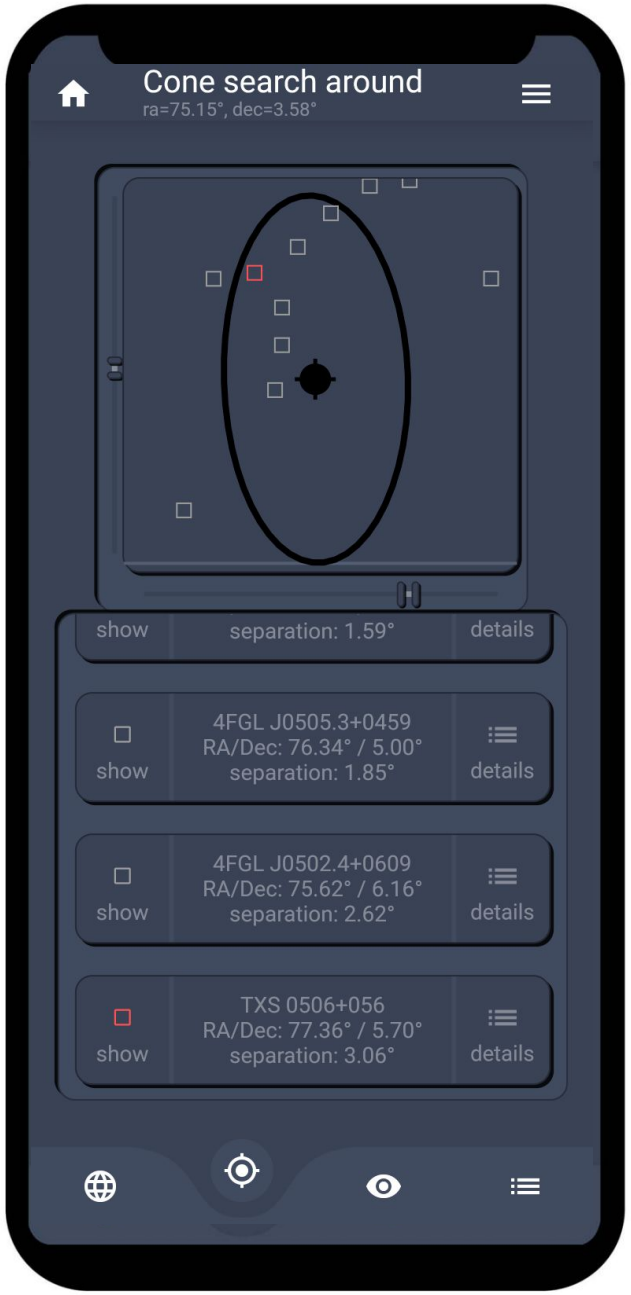
Script prepared by Alessio Berti, Ruslan Konno & Mathieu de Bony during the 1st Astro-COLIBRI Workshop in October 2022 *soon in the Astro-COLIBRI interface*

Transients since 2022-04-01

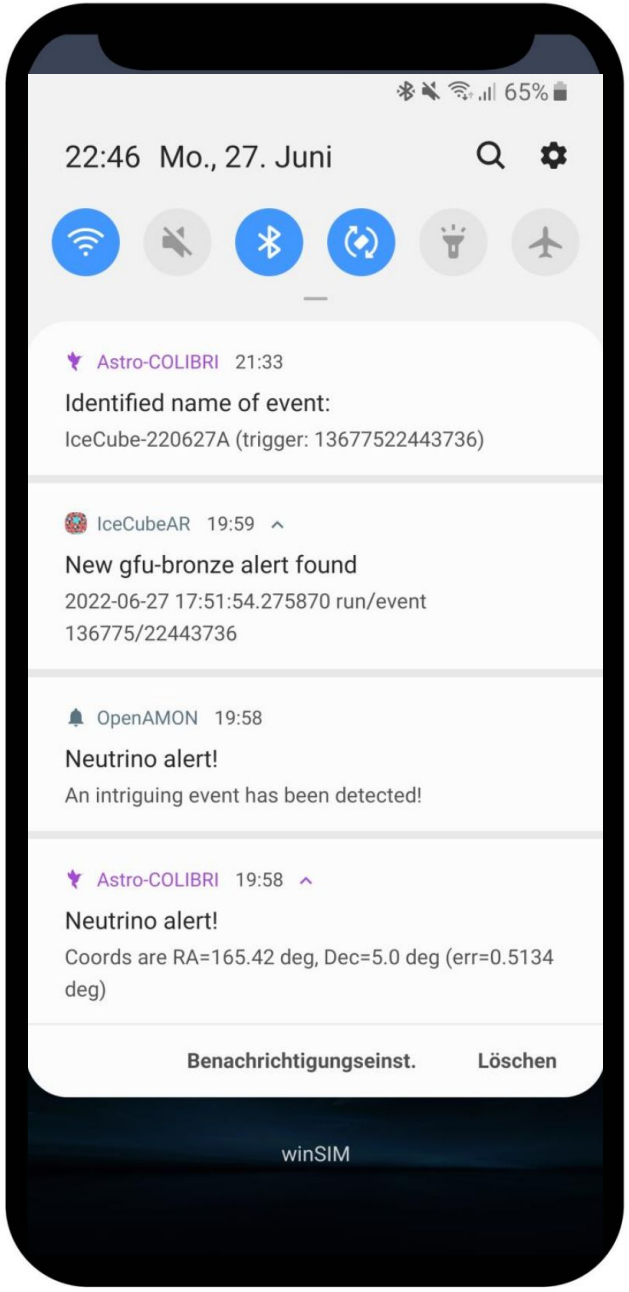




IceCube-170922A (2017-09-22)

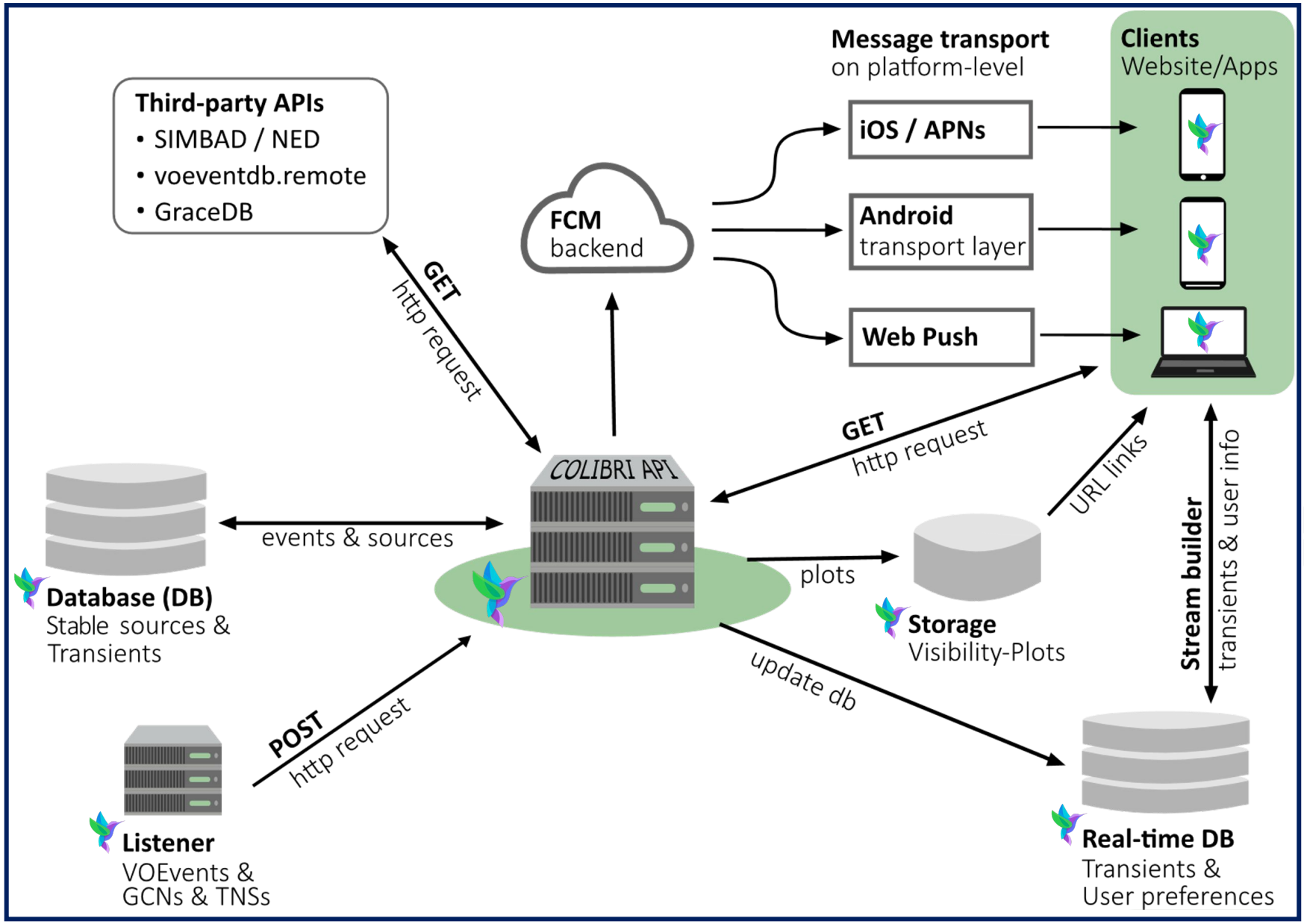


IceCube-220918A (2022-09-18)



IceCube-220627A (2022-06-27)

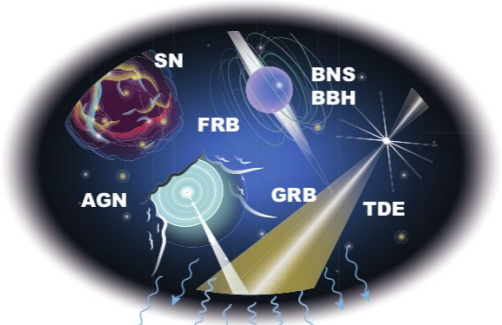
Summary



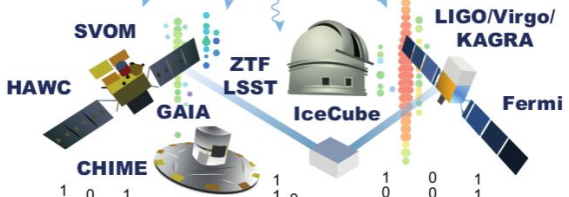
Reichherzer et al. (2021)

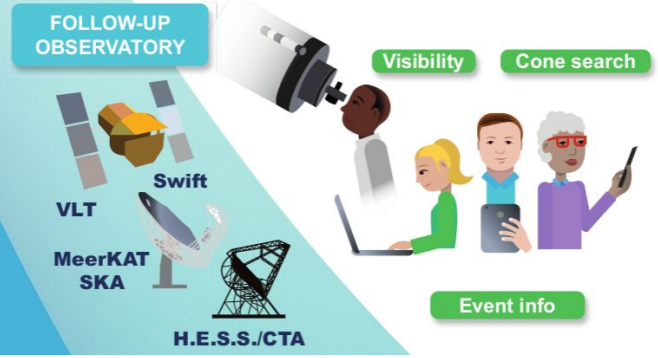
feedback & feature requests: **astro.colibri@gmail.com**

Summary

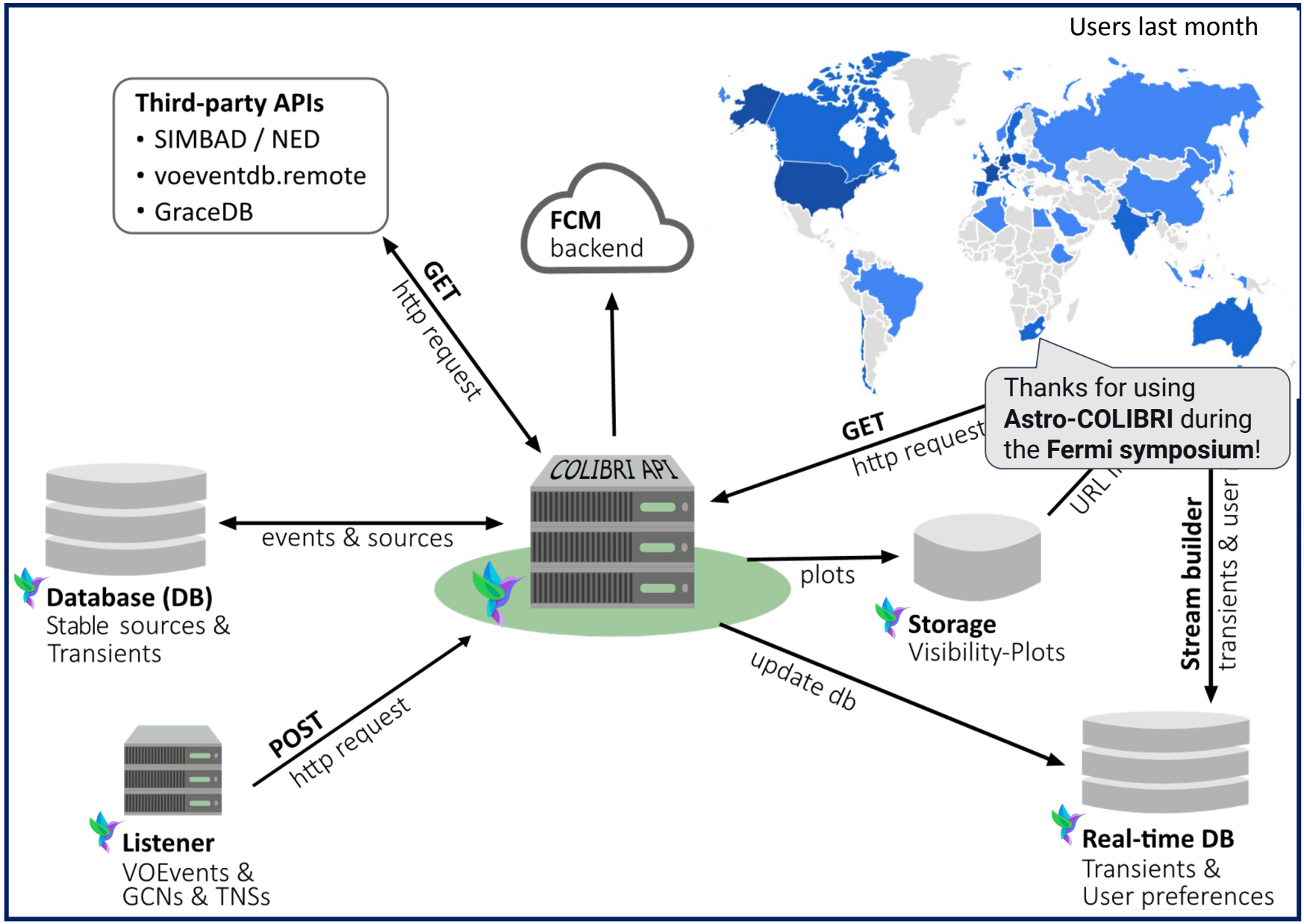


Photons, GWs, υ





Reichherzer et al. (2021)



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