



# Astro-COLIBRI

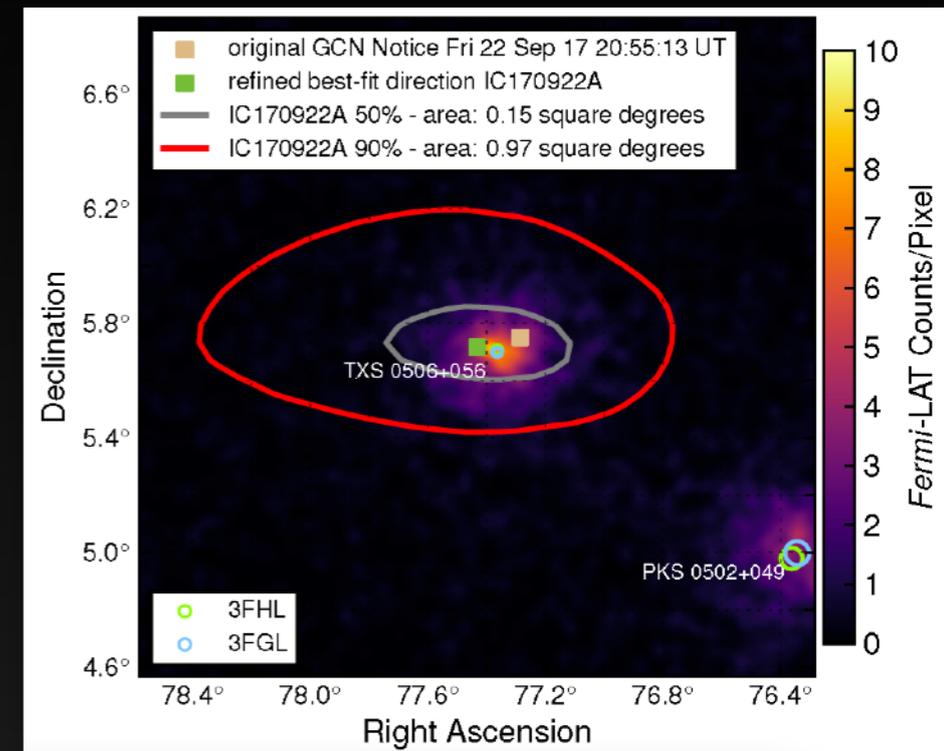
**CO**incidence **LIB**rary for **R**real-time **I**nquiry for multi-messenger astrophysics

Fabian Schüssler (IRFU, CEA Paris-Saclay)  
on behalf of the Astro-COLIBRI team



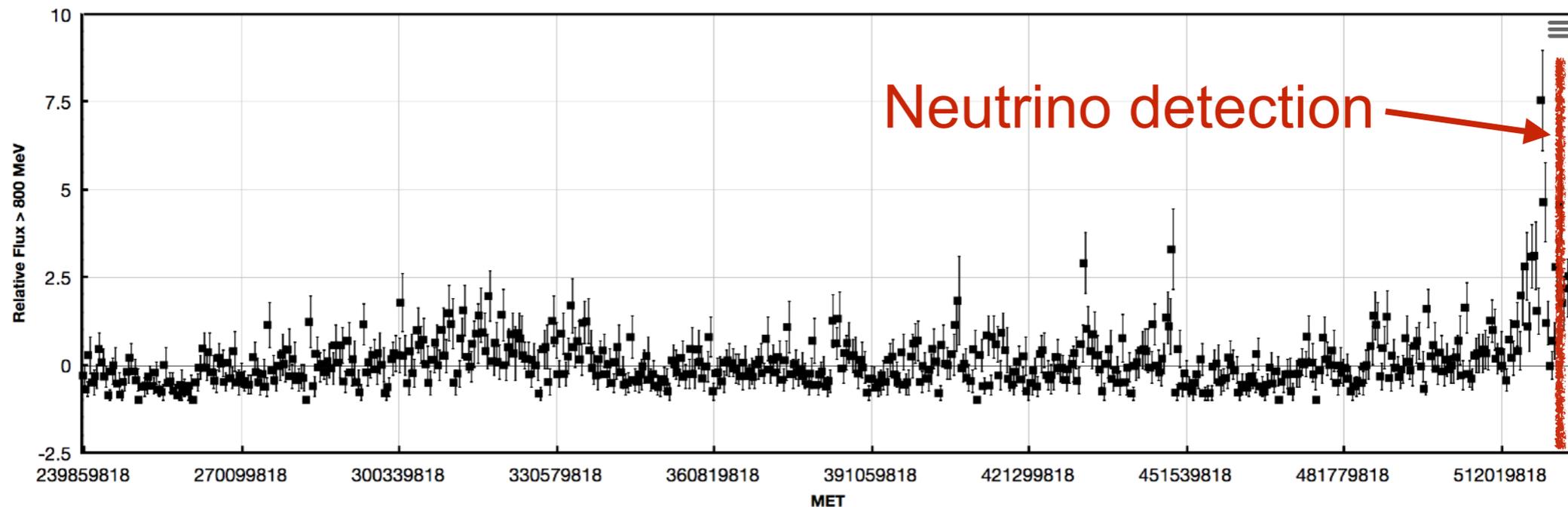
# IceCube-170922A and TXS 0506+056

- 22/09/2017: Detection of another high-energy neutrino of about 300 TeV by IceCube: automatic and public alert distribution to follow-up observatories at all wavelengths
- 28/09/2017 Fermi-LAT: Detection of an active blazar within the neutrino uncertainty region [ATEL #10791](#)



High Energy Light Curve (800 MeV - 300 GeV)

High-energy gamma rays (Fermi-LAT)



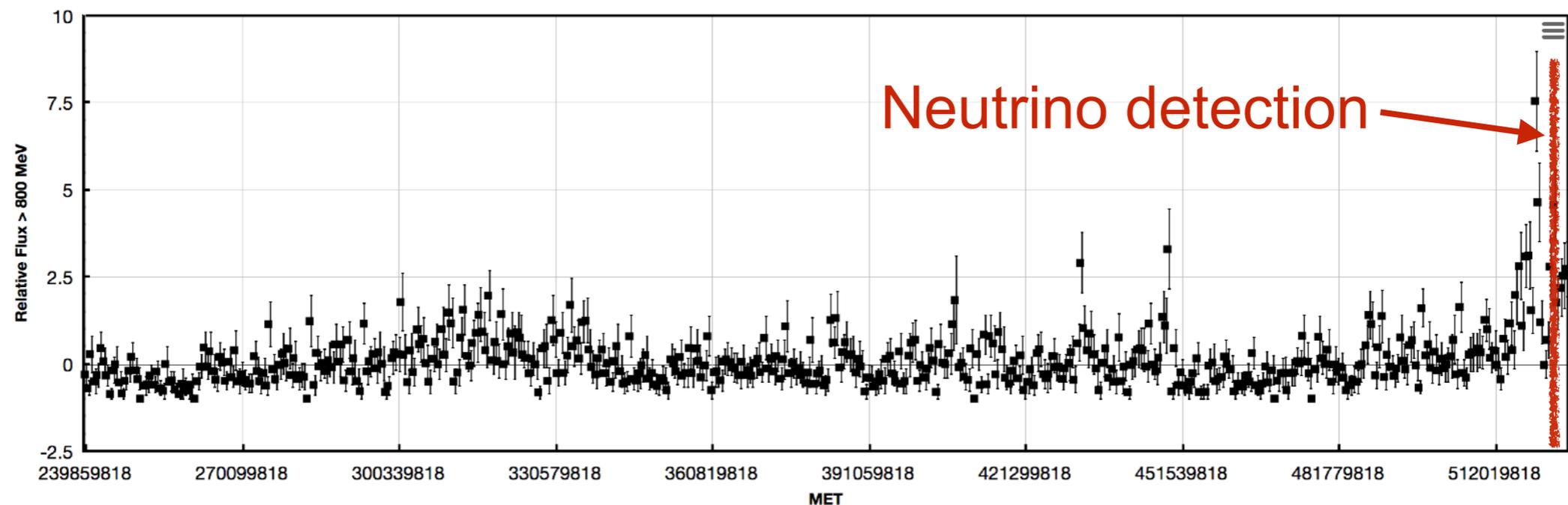
# Behind the curtain

- It took 6 days between the neutrino detection and the realization that there is a flaring blazar within the localisation uncertainty!



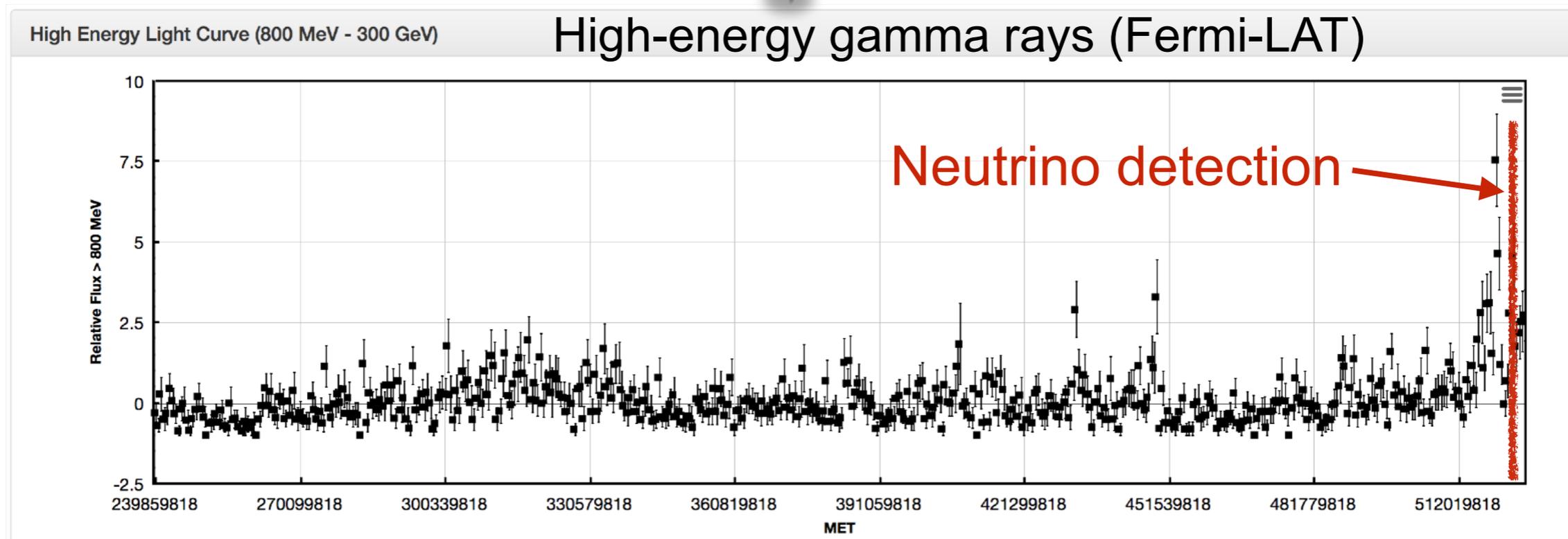
High Energy Light Curve (800 MeV - 300 GeV)

High-energy gamma rays (Fermi-LAT)

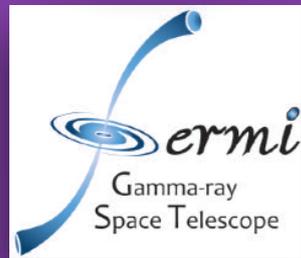
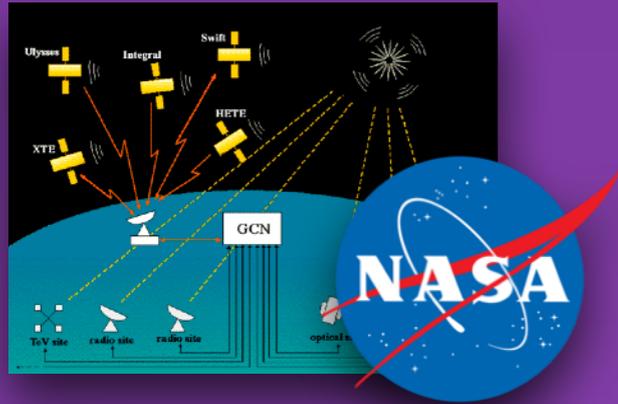


# Behind the curtain

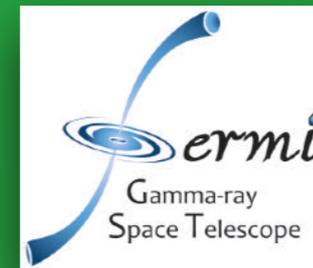
- It took 6 days between the neutrino detection and the realization that there is a flaring blazar within the localisation uncertainty!
- Cone search within the neutrino uncertainty => TXS 0506+056
- Check state of the source(s) in FAVA
- => Many tools are available but need for automatisisation + interfaces



# Main idea



...



...



# Astro-COLIBRI

- Astro-COLIBRI: automatic pipeline providing easy access to
  - transient detections (GRBs, FRBs, TDEs, SNe, OTs, high-energy neutrinos, GWs, etc.)
  - interfaces: <https://astro-colibri.com> + Android + iOS
  - a central API with publicly available endpoints for cone searches, etc.
- Version 1.0 released in August (>500 users at the moment)
  - v1.3 release earlier this week
- Paper published: P. Reichherzer et al., 2021 ApJS 256 5 ([link](#))



# monitoring satellites and observatories

Fermi | Swift | INTEGRAL | Svom | IceCube | Ligo & Virgo | HAWC

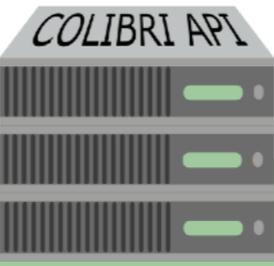
## alert

TNS | GCN | fourπ sky | AMON

- creator
- streams
- broker

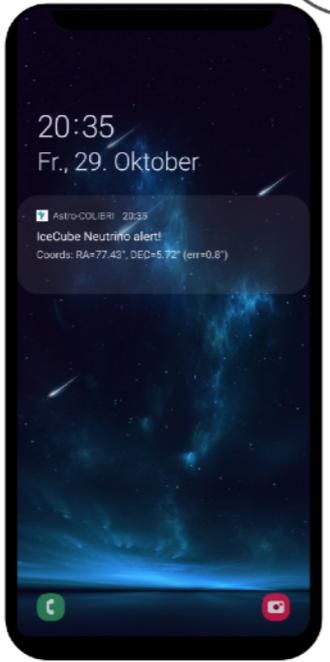


Astro-COLIBRI pipeline



real-time db & APIs

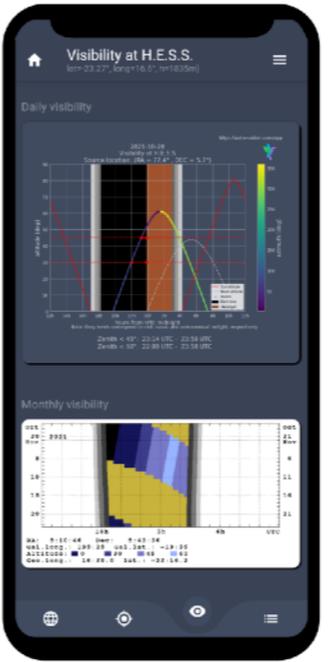
## push alerts



## cone search



## visibility



## event info

Selected: IceCube-170922A

RA/Dec: 77.43° / 5.72°

Pastor: 0.57 E: 119.98 TeV

Links to other websites and services: ALADIN, ESA, Fink, SSCD, TOB, FAVA, GCNe, GCNc

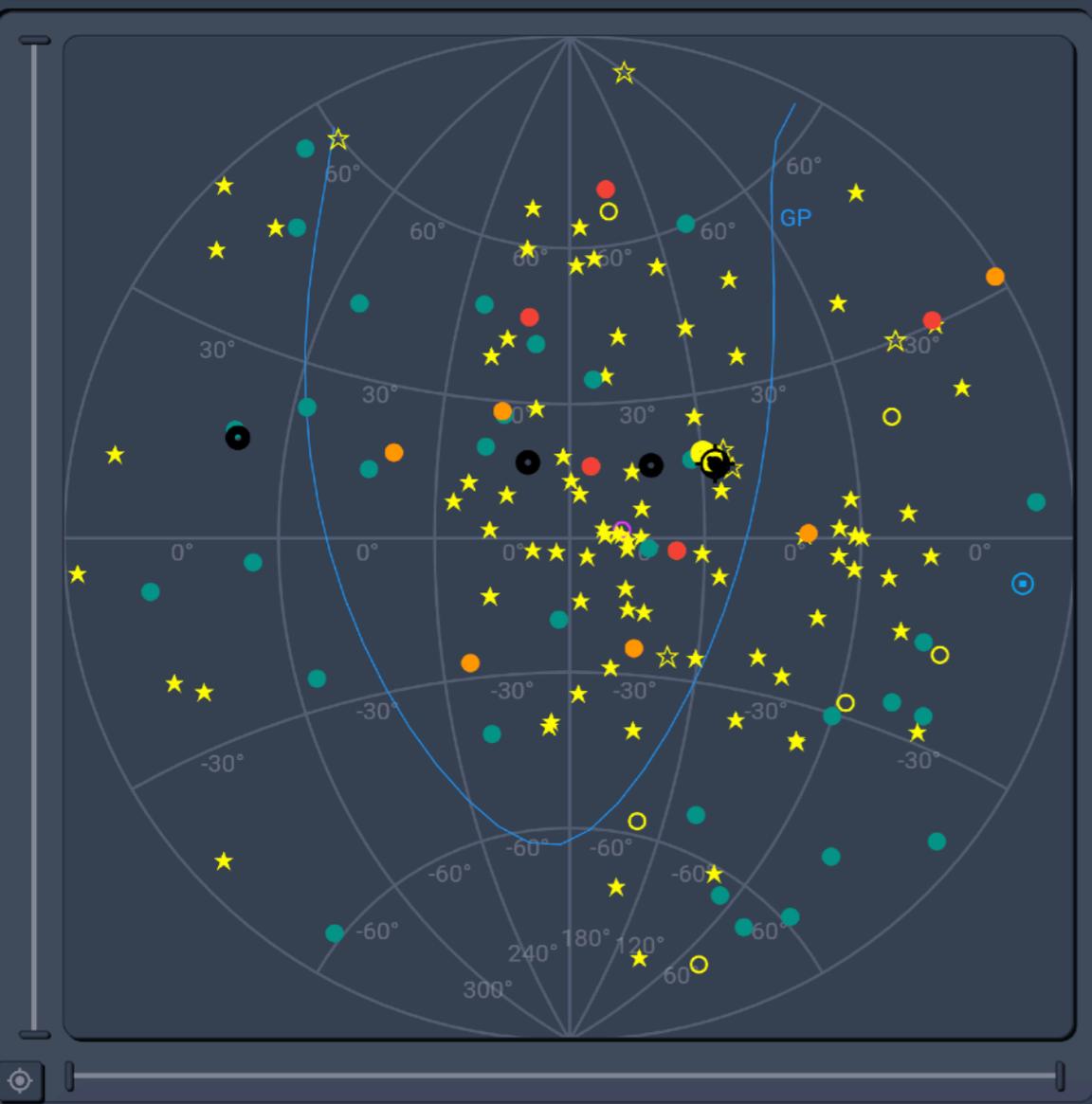
multimessenger alert pipeline



# Web interface

Astro-COLIBRI select action Latest transients Cone search personalize 📍 🔍 🔔 Status: logged in as fabian.schu Infos: ✔ v release: v1.3.0

Filters From 2021-12-01 to 2022-01-11 ● Swift ● Fermi ● HAWC ● IceCube ● AMON ● Integral ● SVOM = LVC ● other Type of events : 👁 FRB ☆ OT ★ SN ● GRB ○ burst ● neutrino = GW 👁 nuem



|  |  |  |
|--|--|--|
|  | <b>IceCube-211208A</b><br>RA/Dec: 114.52° / 15.56°<br>error: 2.129°<br>2021-12-08 20:02:51 |  |
|  | RA/Dec: 326.33° / 47.68°<br>error: 12.93°<br>2022-01-10 04:31:43                           |  |
|  | PKS0903-57<br>RA/Dec: 136.23° / -57.58°<br>2022-01-10 02:48:21                             |  |
|  | SN 2022is<br>RA/Dec: 154.08° / 43.07°<br>2022-01-09 12:28:48                               |  |
|  | SN 2022fw<br>RA/Dec: 185.98° / -3.44°<br>2022-01-09 11:45:36                               |  |
|  | SN 2022io<br>RA/Dec: 126.16° / 54.67°<br>2022-01-09 11:29:45                               |  |
|  | SN 2022im<br>RA/Dec: 118.75° / 42.77°<br>2022-01-09 11:28:19                               |  |

Detailed info about selected source:

VoEvent : [Click here](#)  
name: IceCube-211208A   
RA / Dec: 7h38m4.78s / 15d33m36s   
observatory: IceCube   
FAR: 1.20/yr P\_astro: 0.50 E: 171.08 TeV

Links : [ALADIN](#) [ESA](#) [Pan-STARRS](#) [Fink](#) [SSDC](#) [TOBY](#) [FAVA](#) [ASAS-SN](#) [GCN-n](#) [GCN-c](#)

This is a high-energy neutrino detected by the IceCube observatory in Antarctica. It has an energy of 171 TeV but its origin is not totally clear: events like this happen due to statistical fluctuations roughly every 0.8 years and the probability of the neutrino to be of astrophysical origin (and not terrestrial background noise) is 50 %. IceCube located the origin of the neutrino to a region with a radius of 128 arcmin within the Gemini constellation.

Learn more about IceCube: [link](#)

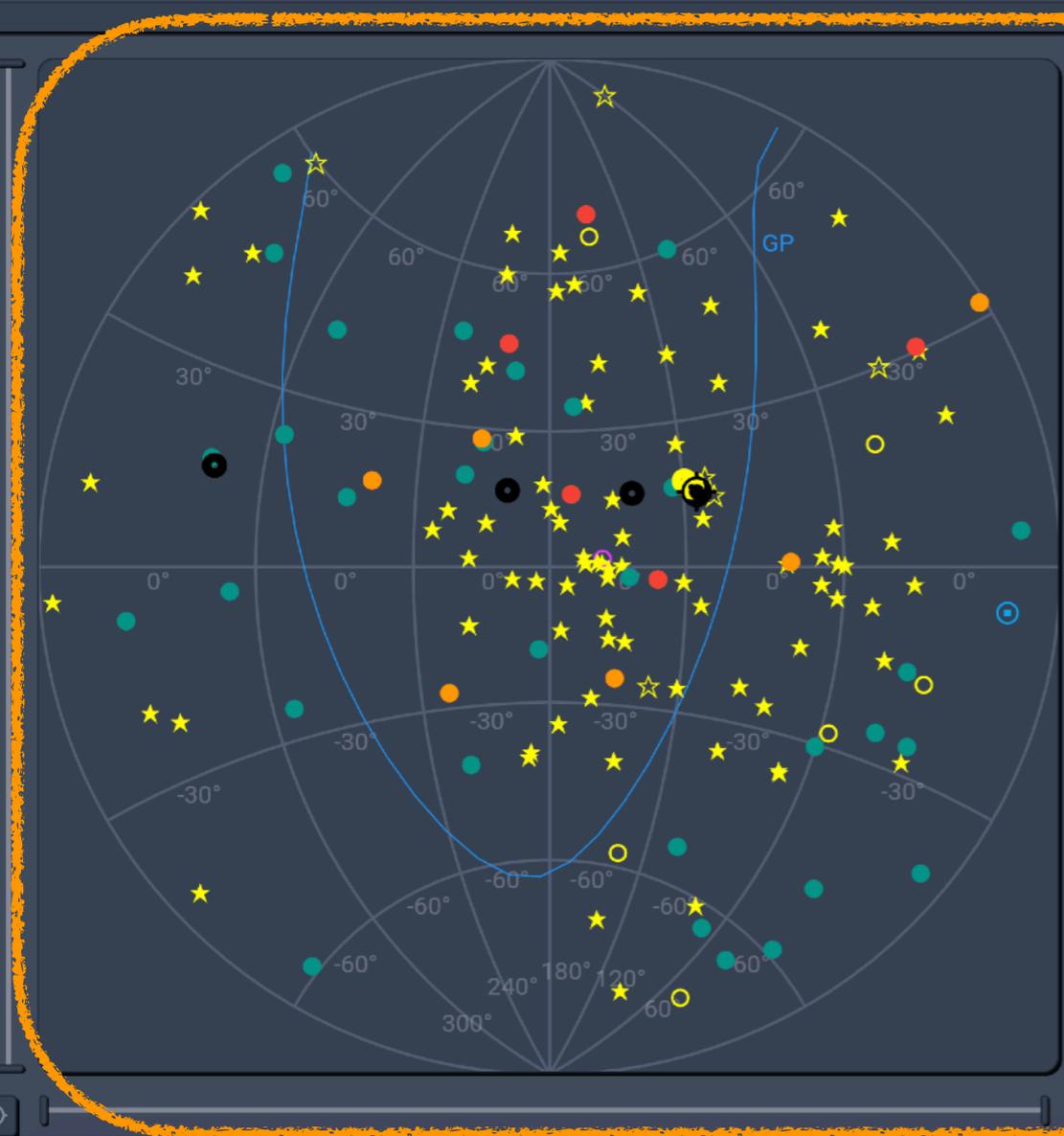
Discuss this event on Twitter: [@AstroColibri](#)

Daily Monthly

Weather: [Forecast](#) [Seeing](#) Sky view: [HeavensAbove](#)



# Latest transients



|  |  |  |
|--|--|--|
|  | <b>IceCube-211208A</b><br>RA/Dec: 114.52° / 15.56°<br>error: 2.129°<br>2021-12-08 20:02:51 |  |
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### Detailed info about selected source:

VoEvent : [Click here](#)  
name: [IceCube-211208A](#)  
RA / Dec: [7h38m4.78s / 15d33m36s](#)  
observatory: [IceCube](#)  
FAR: [1.20/yr](#) P\_astro: [0.50](#) E: [171.08 TeV](#)

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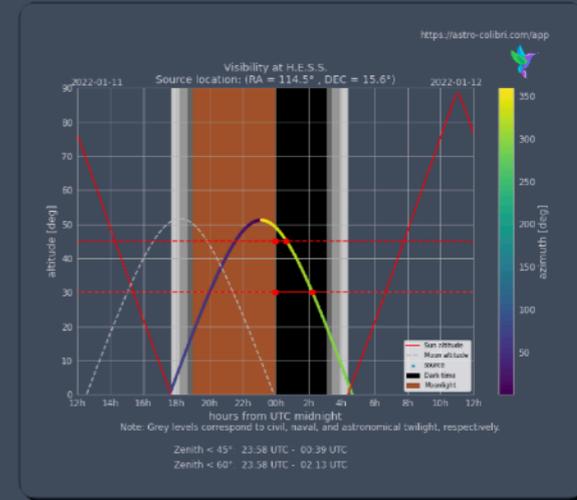
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Learn more about IceCube: [link](#)

Discuss this event on Twitter: [@AstroColibri](#)

[Daily](#) [Monthly](#)

Weather: [Forecast](#) [Seeing](#) Sky view: [HeavensAbove](#)





# Additional information

Astro-COLIBRI interface showing a star map, filters, and event details for IceCube-211208A.

**Filters:** From 2021-12-01 to 2022-01-11. Instruments: Swift, Fermi, HAWC, IceCube, AMON, Integral, SVOM, LVC, other. Type of events: FRB, OT, SN, GRB, burst, neutrino, GW, nuem.

**Star Map:** A celestial map showing various astronomical events. A blue circle highlights the location of IceCube-211208A in the Gemini constellation.

**Event Details:**

- IceCube-211208A**  
RA/Dec: 114.52° / 15.56°  
error: 2.129°  
2021-12-08 20:02:51
- PKS0903-57**  
RA/Dec: 136.23° / -57.58°  
2022-01-10 02:48:21
- SN 2022is**  
RA/Dec: 154.08° / 43.07°  
2022-01-09 12:28:48
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- SN 2022im**  
RA/Dec: 118.75° / 42.77°  
2022-01-09 11:28:19

**Detailed info about selected source:**

VoEvent: [Click here](#)  
name: IceCube-211208A  
RA / Dec: 7h38m4.78s / 15d33m36s  
observatory: IceCube  
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Links: [ALADIN](#) [ESA](#) [Pan-STARRS](#) [Fink](#) [SSDC](#) [TOBY](#) [FAVA](#) [ASAS-SN](#) [GCN-n](#) [GCN-c](#)

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Learn more about IceCube: [link](#)  
Discuss this event on Twitter: [@AstroColibri](#)

**Weather:** [Forecast](#) [Seeing](#) **Sky view:** [HeavensAbove](#)

**Visibility at H.E.S.S.:** Source location: (RA = 114.5°, DEC = 15.6°)



# Additional information

The screenshot shows the Astro-COLIBRI website interface. At the top, there are navigation buttons for 'select action', 'Latest transients', and 'Cone search', along with a 'personalize' section and a status bar indicating 'logged in as fabian.schu' and 'v release: v1.3.0'. The main content area features a grid of logos for various astronomical observatories and data sources, including SIMBAD, NED, TNS, GCN, Swift, GraceDB, LSC, VIRGO, ALADIN, ESA, Fermi, SSDC, and TOBY. A central star map is overlaid with green arrows pointing to these logos. On the right side, a detailed information panel for a selected source is displayed, containing the following text:

Detailed info about selected source:  
VoEvent : [Click here](#)  
name: IceCube-211208A  
RA / Dec: 7h38m4.78s / 15d33m36s  
observatory: IceCube  
FAR: 1.20/yr P\_astro: 0.50 E: 171.08 TeV  
Links : [ALADIN](#) [ESA](#) [Pan-STARRS](#) [Fink](#) [SSDC](#) [TOBY](#) [FAVA](#) [ASAS-SN](#) [GCN-n](#) [GCN-c](#)

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Learn more about IceCube: [link](#)  
Discuss this event on Twitter: [@AstroColibri](#)

Below the text are buttons for 'Daily' and 'Monthly' views, and links for 'Weather: Forecast Seeing' and 'Sky view: HeavensAbove'. At the bottom right, there is a graph titled 'Visibility at H.E.S.S.' showing astronomical visibility over time.



# Cone searches

Astro-COLIBRI

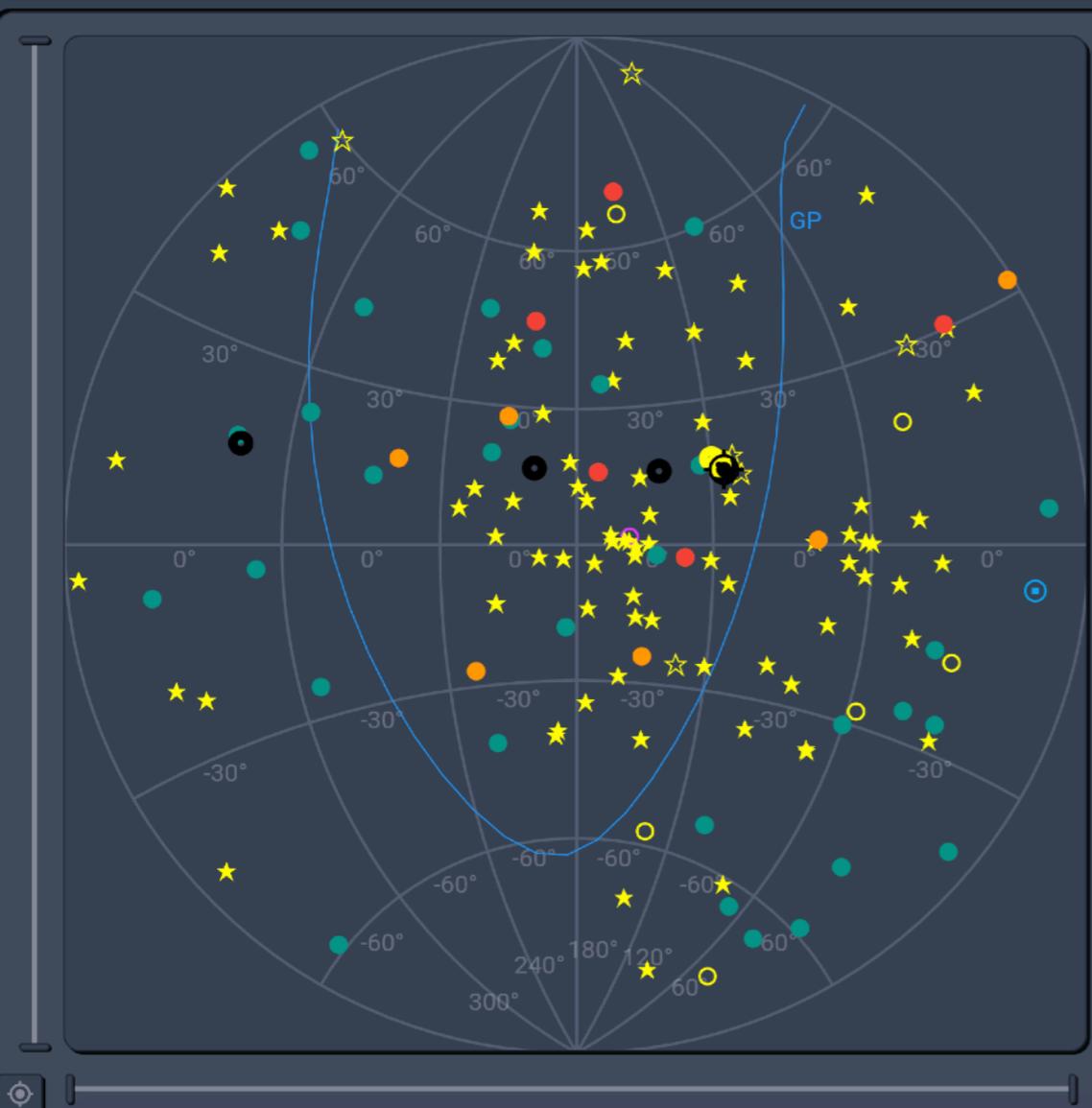
select action **Latest transients** Cone search

personalize

Status: **logged in as fabian.schu** Infos: v release: v1.3.0

Filters From 2021-12-01 to 2022-01-11 Swift Fermi HAWC IceCube AMON Integral SVOM LVC other

Type of events: FRB OT SN GRB burst neutrino GW nuem



|  |  |  |
|--|--|--|
|  | <b>IceCube-211208A</b><br>RA/Dec: 114.52° / 15.56°<br>error: 2.129°<br>2021-12-08 20:02:51 |  |
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|  | SN 2022io<br>RA/Dec: 126.16° / 54.67°<br>2022-01-09 11:29:45                               |  |
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Detailed info about selected source:

VoEvent: [Click here](#)

name: IceCube-211208A

RA / Dec: 7h38m4.78s / 15d33m36s

observatory: IceCube

FAR: 1.20/yr P\_astro: 0.50 E: 171.08 TeV

Links: [ALADIN](#) [ESA](#) [Pan-STARRS](#) [Fink](#) [SSDC](#) [TOBY](#) [FAVA](#) [ASAS-SN](#) [GCN-n](#) [GCN-c](#)

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Learn more about IceCube: [link](#)

Discuss this event on Twitter: [@AstroColibri](#)

**Daily** **Monthly**

Weather: [Forecast](#) [Seeing](#) Sky view: [HeavensAbove](#)



# Cone searches

Astro-COLIBRI

select action Latest transients **Cone search**

personalize

Status: [logged in as fabian.schu](#) Infos: ie: v1.3.0

Filters From 2021-12-01 to 2021-12-13 Swift Fermi HAWC IceCube AMON Integral SVOM LVC other

Type of events: FRB GRB burst neutrino GW nuem 4FGL TeV CAT SGR/AXP

Cone search

RA / Dec: **114.52° 15.56°**

source: **IceCube-211208A**

radius: **<< 2.13° >>**

|  |   |  |
|--|---|--|
|  | IceCube-211208A<br>RA/Dec: 114.52° / 15.56°<br>error: 2.129°<br>2021-12-08 20:02:51       |  |
|  | 4FGL J0738.4+1539<br>RA/Dec: 114.61° / 15.66°<br>separation: 0.13°                        |  |
|  | 4FGL J0743.1+1713<br>RA/Dec: 115.78° / 17.22°<br>separation: 2.05°                        |  |
|  | 4FGL J0738.1+1742<br>RA/Dec: 114.54° / 17.71°<br>separation: 2.15°                        |  |
|  | BUST-211204A<br>RA/Dec: 116.50° / 16.60°<br>sep: 2.17° (err: 2.5°)<br>2021-12-04 14:52:47 |  |
|  | 4FGL J0739.7+1743<br>RA/Dec: 114.95° / 17.72°<br>separation: 2.2°                         |  |
|  | 4FGL J0738.6+1311<br>RA/Dec: 114.66° / 13.19°<br>separation: 2.38°                        |  |

Detailed info about selected source:

name: **4FGL J0738.1+1742**

name FGL: **3FGLJ0738.1+1741**

RA / Dec: **7h38m9.36s / 17d42m25.2s**

assoc: **PKS 0735+17**

Links: [SIMBAD](#) [NED](#) [ALADIN](#) [ESA](#) [Pan-STARRS](#) [Fink](#) [SSDC](#) [TOBY](#) [FAVA](#) [LAT-LCR](#) [ASAS-SN](#)

FLaapLUC: [longterm](#) [shortterm](#)

This is a source know to emit high-energy gamma rays in the GeV domain. It has been detected by the LAT instrument onboard the Fermi satellite and is part of the 4FGL catalog.

You can find details about the Fermi spacecraft here: [link](#)

Discuss this event on Twitter: [@AstroCollibri](#)

**Daily** **Monthly**

Weather: [Forecast](#) [Seeing](#) Sky view: [HeavensAbove](#)



# Visibility

## Observatory selection

The screenshot shows the Astro-COLIBRI website interface. At the top, there are navigation buttons: "select action", "Latest transients", "Cone search", "personalize", a location pin icon (circled in orange), and a notification bell. The user is logged in as "fabian.schulz".

Below the navigation, there are filter options for "From 2021-12-01 to 2021-12-13" and "Type of events". A "Filters" button is visible on the left.

The main content area is divided into three sections:

- Left Panel:** A sky map showing a search cone for "IceCube-211208A" with a radius of 2.13°. The search parameters are RA/Dec: 114.52° / 15.56°.
- Middle Panel:** A list of search results for "IceCube-211208A" and other sources. Each entry includes a "show" button and a "cone search" button. The selected source is "IceCube-211208A" with RA/Dec: 114.52° / 15.56° and a date of 2021-12-08 20:02:51.
- Right Panel:** Detailed information about the selected source, including its name (4FGL J0738.1+1742), RA/Dec (7h38m9.36s / 17d42m25.2s), and associated sources (PKS 0735+17). It also includes links to various observatories and a "Daily" button (circled in orange).

At the bottom right, there is a "Visibility at H.E.S.S." graph showing altitude (deg) vs. hours from UTC midnight. The graph includes curves for Sun altitude, Moon altitude, and Dark time. The source location is (RA = 114.5°, DEC = 17.7°). The graph shows a significant visibility window during the night.



# Android + iOS

**Astro-COLIBRI**

selected **IceCube-211216A** RA/Dec: 316.05° / 15.79° error: 1.86° 2021-12-16 07:07:38 cone search

show **SN 2022bf** RA/Dec: 20.86° / 49.97° 2022-01-03 21:07:12 cone search

show **GRB 220103A** RA/Dec: 36.86° / -15.70° error: 8.4° 2022-01-03 21:03:12 cone search

show **HAWC-220103A** RA/Dec: 156.33° / 1.83° error: 0.599° 2022-01-03 08:01:56 cone search

**Visibility at H.E.S.S.**  
lat=-23.27°, long=16.5°, h=1835.0m

Weather: Forecast Seeing Sky view

Daily visibility

Monthly visibility

**Source info**

Selected: GRB 220107A

ivorn:  
ivo://nasa.gsfc.gcn/Fermi#GBM\_Fin\_Pos2022-01-07T14:45:31.93\_663259536\_0-516

RA/Dec: 168.17° / 34.98°  
RA/Dec: 11h12m40.8s / 34d58m48.0s

observatory: Fermi  
significance: 68.3  $\sigma$   
comment: long GRB

show visibility

Links to other websites and services:

- ALADIN
- ESA
- Fink
- ASAS-SN
- SSDC
- TOBY
- FAVA
- GCN-n
- GCN-c
- GBM

Alert notifications in real-time



# Astro-COLIBRI

Contact/feedback: [astro.colibri@gmail.com](mailto:astro.colibri@gmail.com)

- Web interface: <https://astro-colibri.com>
- API (incl. documentation): <https://astro-colibri.herokuapp.com>

Android Play Store



Apple iOS App Store



Introductions/tutorials on YouTube



Twitter: [@AstroColibri](https://twitter.com/AstroColibri)





# Architecture

