



AHEAD 2020

Integrated activities for the High Energy Astrophysics Domain



Funded by the Horizon 2020
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The AFIS platform to correlate and visualize prompt HE results from space missions

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WP 12.2 objectives:

WP 12.2 aims to develop a platform to perform joint analyses of prompt data acquired by several space missions: AGILE, Fermi, INTEGRAL, and SWIFT (AFIS).

The analyses shall be performed on two data types:

1. **Standard event;**
2. **Sub-threshold events;**

The standard events can be **science alerts on transient events** detected by one of the space mission members of the AFIS project or from external observatories in the Multi-Messenger (MM) / Multi-Wavelength (MW) context (e.g. Gravitational Waves, neutrinos, and GRBs) and shared through the GCN network.

The sub-threshold events are transient events detected by the AFIS facilities, but that does not exceed the significance to be classified as science alerts (e.g., 5 sigmas).



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WP 12.2 planning for period June 2021 - June 2022

1. Implement the new science alerts manager using the COMET framework. **Done**
2. Receive standard and sub-threshold events automatically by AFIS facilities (AGILE and INTEGRAL). **In progress (End of May)**
3. Visualize the sub-threshold event list in the AFIS web portal. **Done**
4. Implement an SFTP connecton to allow AFIS facilities to automatically upload the analysis results; **Done**
5. Containerize the AFIS platform to allow an easy deployment. **Done**
6. Prepare the Software Design Document of the AFIS project **In progress (End of May)**
7. Prepare the User Manual In progress **(End of June)**



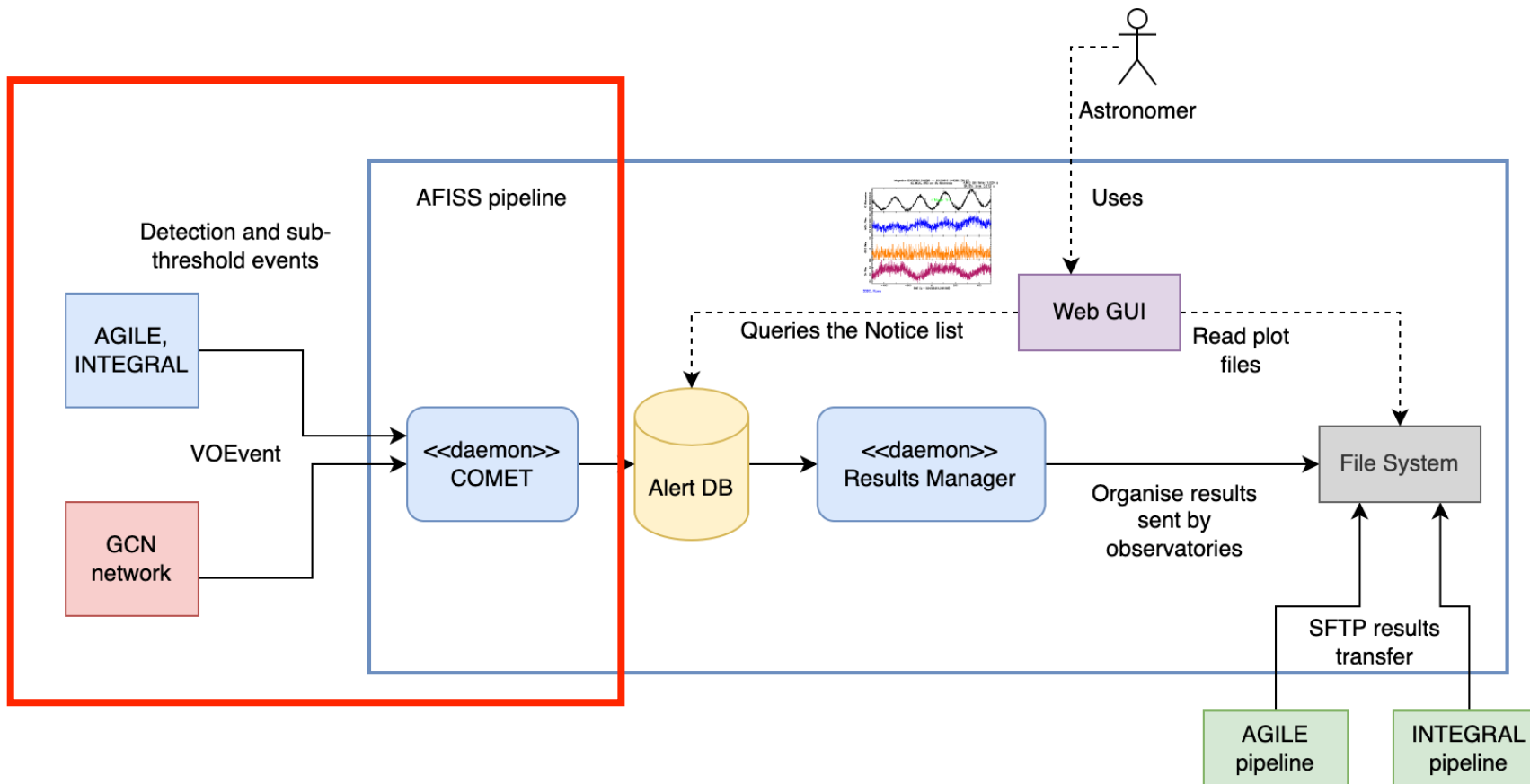
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AFIS platform architecture (Updated 2022)





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The COMET framework

- COMET is an implementation of the VOEvent Transport Protocol. It provides automated mechanisms to develop a platform for fast and reliable distribution of VOEvents.
- The VOEvent is a standard data format to share transient celestial events.
- The COMET framework can subscribe to other services such as the GCN network or publish events to the global VOEvent community.
- In addition, we can send direct events from the facilities pipelines to the COMET platform that we implemented for COSI.

Ack: J. Swinbank, Comet: A VOEvent broker, Astronomy and Computing, 2014. [DOI](#)



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Science Alerts received from the GCN network

1. LVC (LIGO and Virgo collaboration)
2. LVC tests several times a day
3. FERMI GBM
4. FERMI LAT
5. SWIFT BAT
6. ICECUBE ASTROTRACK GOLD
7. ICECUBE ASTROTRACK BRONZE

Work in progress

- MAXI
- KONUS
- Super Kamiokande



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Internal Science Alerts from AGILE and INTEGRAL

- The real-time analysis of AGILE and INTEGRAL can send internal science alerts related to standard or sub-threshold events to the COMET receiver of the AFIS platform.
- The events must be sent in VOEvent format, a standard data format in XML to exchange transient events.
- When the AFIS platform receives internal events, it sends a notification to the AFIS team. It checks if there are other science alerts, standard events, or sub-threshold events in a configured time window near the received event.
- The email notification sent to the AFIS team about standard and sub-threshold events also contains information about other transients events that can be temporally correlated



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Results of AFIS facilities related to a science alert

- The AFIS platform collects the results of real-time analysis pipelines developed for AGILE and INTEGRAL.
- The pipelines automatically send the results through an SFTP connection. It is also possible to upload the results manually from the web interface.
- An automated software (Results Manager) organizes the results received through the SFTP connection, and the web interface shows all the results related to the same science alert.



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External Science Alerts

Notices

Show entries

Search:

Instrument name	Trigger id	seqnum	Event id	trigger time (UTC)	notice time (UTC)	Trigger time (TT)	Event Type	link
SWIFT	1104343	0		2022-04-27T21:00:35.040	2022-04-27T21:01:58	578178035.04	BNS: BBH: NSBH: Terrestrial:	Results Upload Data
SWIFT	1032350	0		2021-02-13T00:10:13.820	2021-02-13T00:10:27	540259813.82	BNS: BBH: NSBH: Terrestrial:	Results Upload Data
SWIFT	1032183	0		2021-02-12T04:25:18.020	2021-02-12T04:26:26	540188718.02	BNS: BBH: NSBH: Terrestrial:	Results Upload Data
SWIFT	1031728	0		2021-02-10T02:00:27.920	2021-02-10T02:00:39	540007227.92	BNS: BBH: NSBH: Terrestrial:	Results Upload Data
SWIFT	1031636	0		2021-02-09T21:39:44.540	2021-02-09T21:40:42	539991584.54	BNS: BBH: NSBH: Terrestrial:	Results Upload Data
LIGO	1907060109	0	S190706ai	2019-07-06T22:26:41.345	2019-07-06T22:45:06	489536801.34471	BNS: 0 BBH: 0.989784794892 NSBH: 0 Terrestrial: 0.0102152051078	Results Upload Data



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Conclusion

1. We are developing the second version of the AFIS platform with new features to automatically manages standard and sub-threshold events.
2. The AFIS system is able to receive MW-MM science alerts from the GCN network using the COMET framework.
3. AGILE and INTEGRAL can send sub-threshold events (automatically or manually) to the AFIS platform using the same COMET framework of the standard events.
4. The users receive an email notification for new transient events and can visualize the results obtained from all AFISS observatories using a web graphical user interface.
5. The user can Visualise the sub-threshold event sent from AGILE and INTEGRAL with a list of possible time coincident events.