AGILE QUICKLOOK, APP, AND THE GW EFFORT

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and

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INTRODUCTION

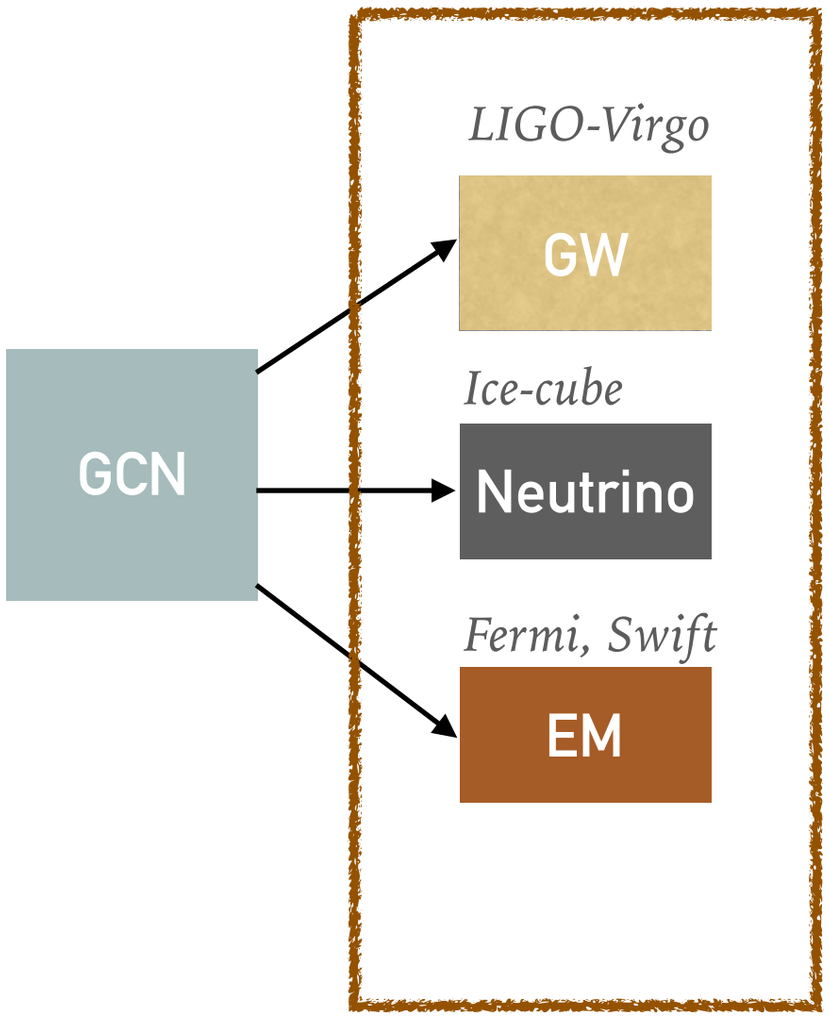
- The AGILE innovative approach to
  - fast γ-ray transient detection and reaction,
  - and GCN EM, neutrino and GW follow-up
  - which are challenging tasks and a crucial part of the AGILE scientific program
- Science alerts
- Keyword: data, people, procedures, software pipelines

SCIENCE ALERTS

- Something in the sky need our attention for an immediate follow-up
- Automated systems generate and receive science alerts
- Science alerts:
  - **internal** (generated by AGILE)
  - **external** (from other instruments)

EXTERNAL SCIENCE ALERT

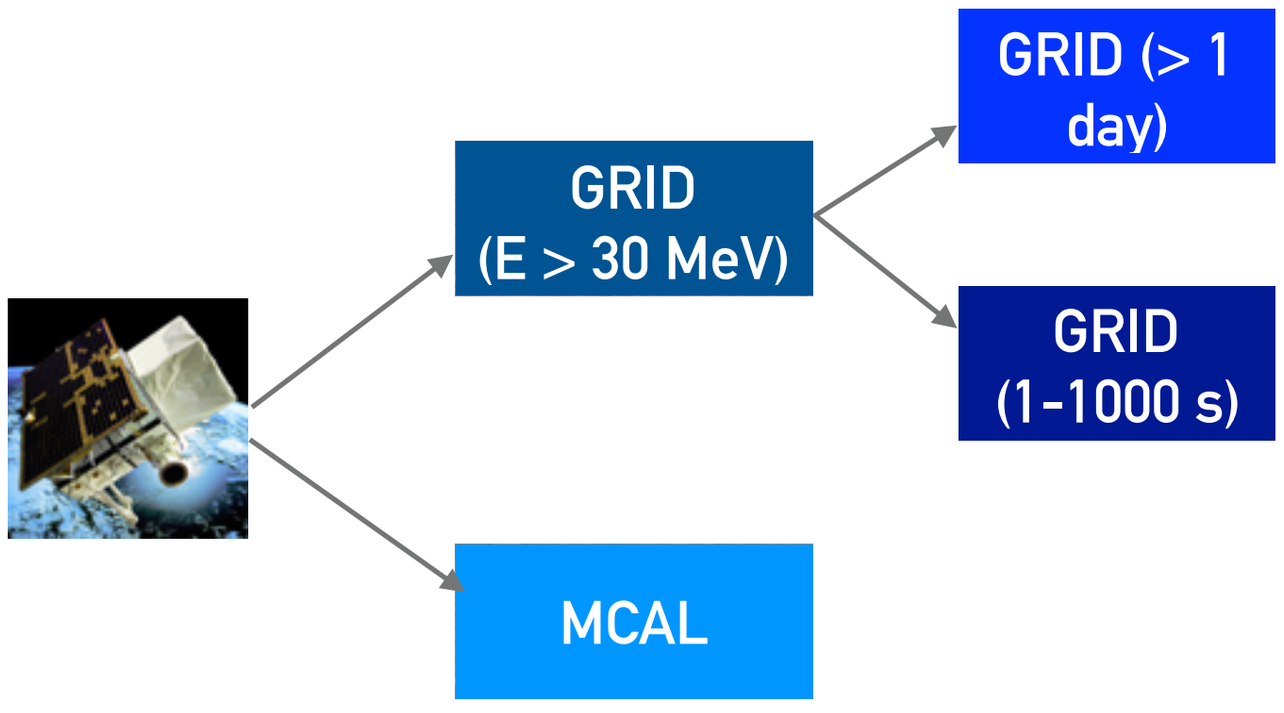
- Automated reaction and follow-up of external science alerts



Alerts are received

INTERNAL SCIENCE ALERTS

➤ Generation of alerts from AGILE data for external communication

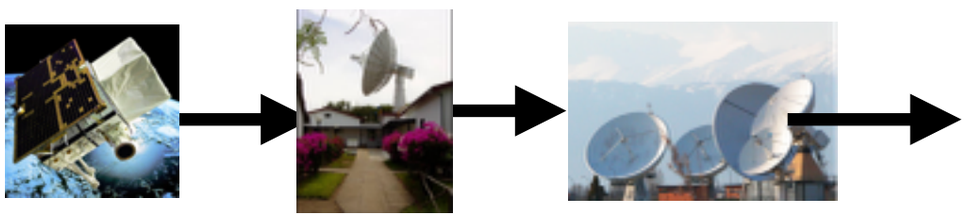


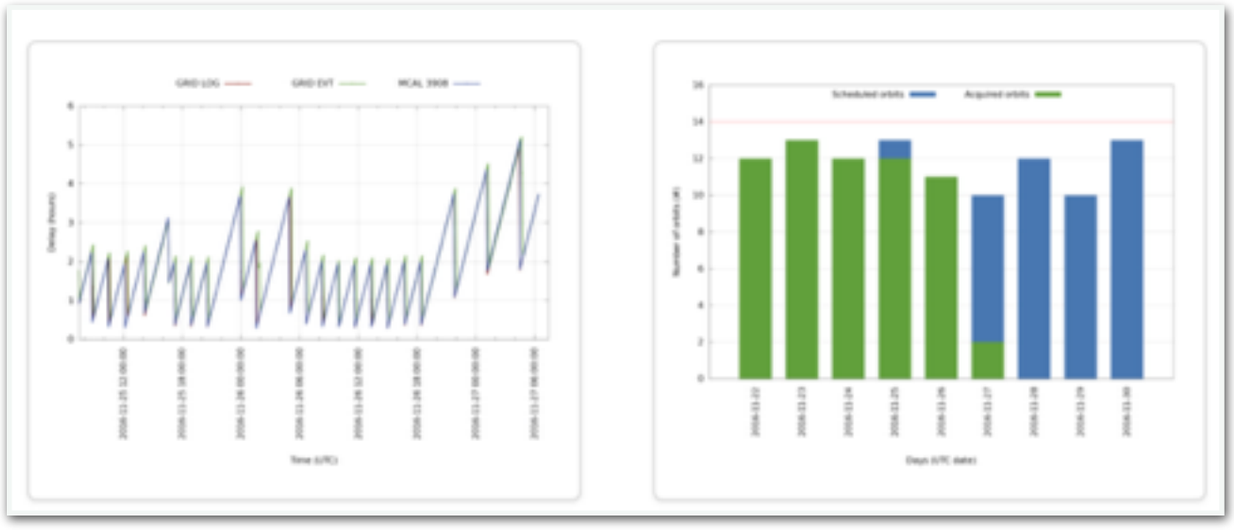
Alerts are generated

REACTION TO SCIENCE ALERTS

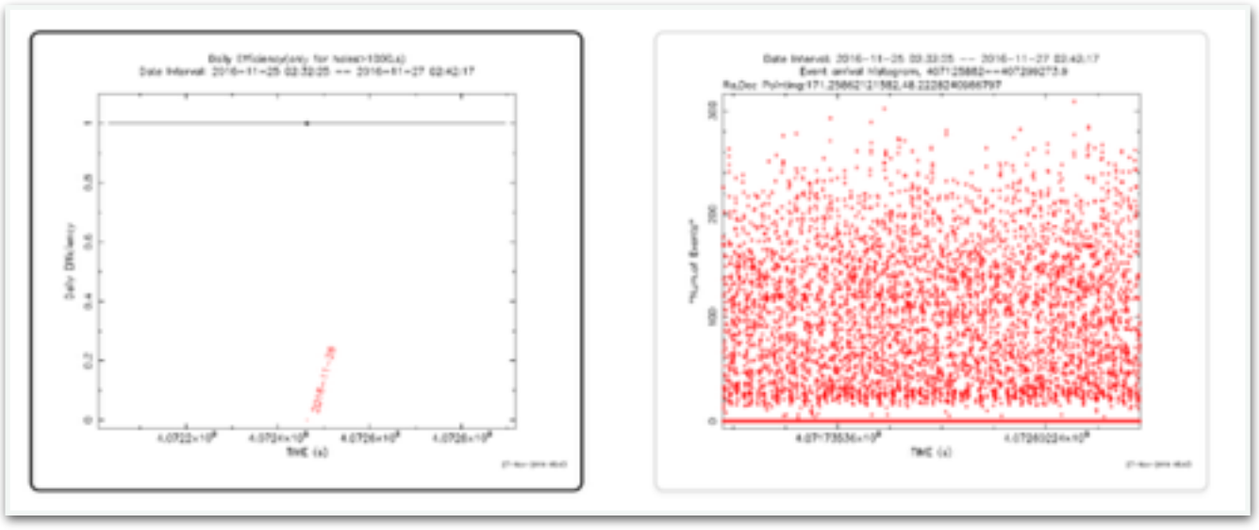
- What we need for an effective reaction to science alerts?
  - **Data**, in the shortest time and with the best data quality
  - **People**, on-duty and and on-call
  - **Procedures**, to understand what we have to do
  - **Software**, a.k.a. **AGILE on-line analysis** pipelines

DATA: DATA FLOW AND DATA QUALITY





data flow status

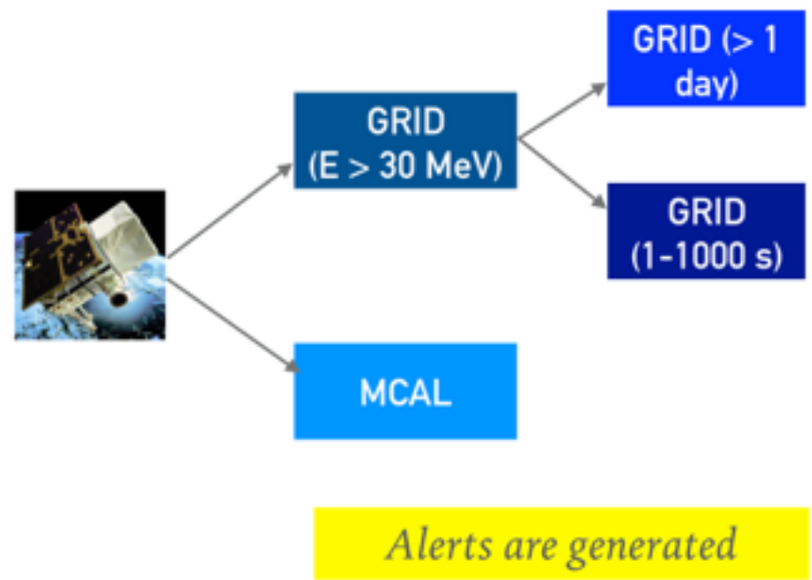


data quality status

PEOPLE (AND PROCEDURES)

Fast reaction to GW alerts: publication of GCN circulars within 2-3 hours

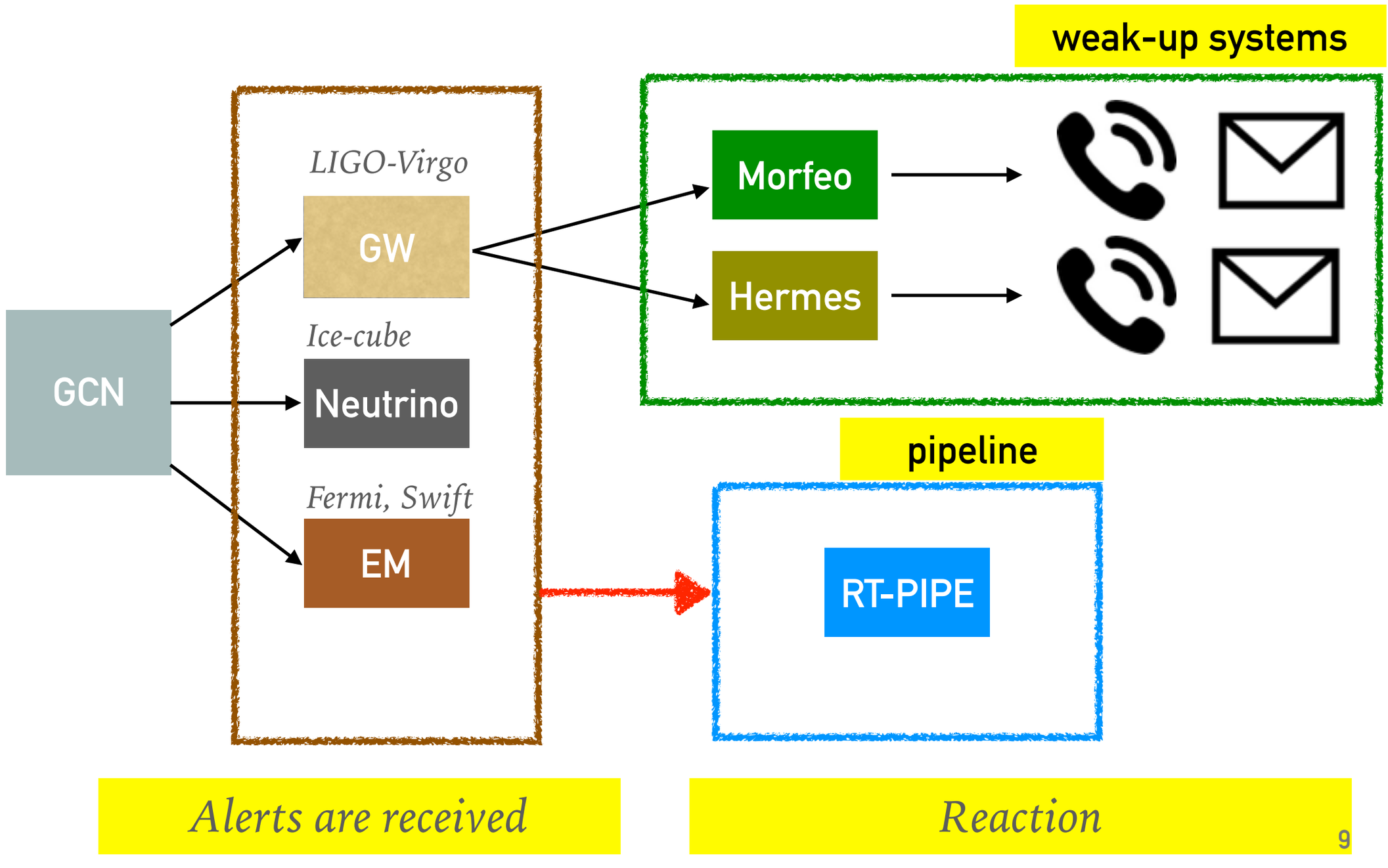
- **Two workgroups**
  - AGILE GW Team (agilegw@iasfbo.inaf.it and WhatsApp group)
    - external science alerts follow-up
    - 10 people 7/24 on-duty and on-call
    - fast reaction to GW alerts
    - check neutrino and EM alerts during working hours
  - Flare Advocate Team (agilefateam@iasfbo.inaf.it)
    - internal science alerts manual check
    - 7 people on-duty and on-call during working hours
    - manual check of external science alerts from e.g. Astronomer Telegrams
- **Well defined procedures and responsibilities**



Fast reaction and Bruno Rossi prize

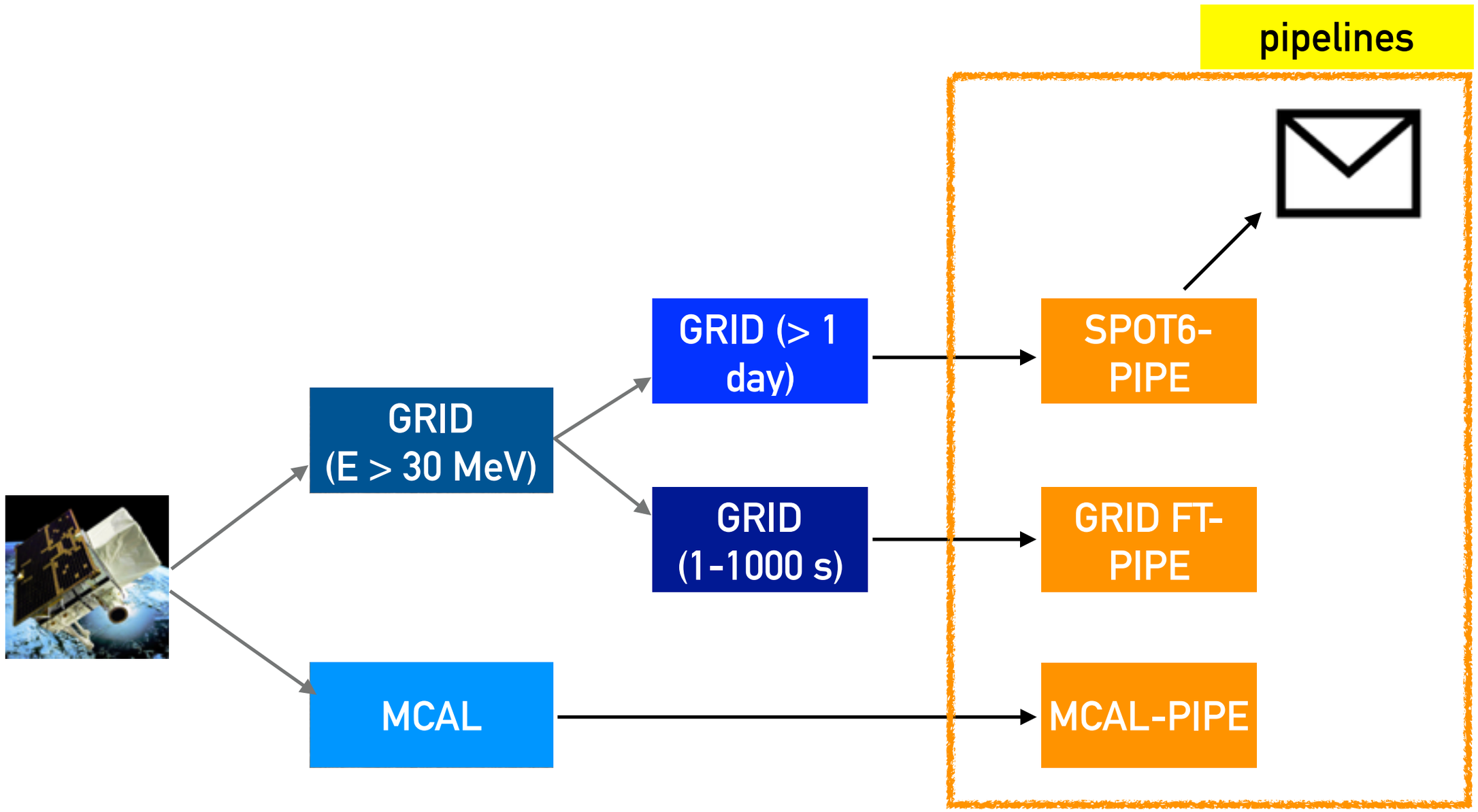
SOFTWARE: EXTERNAL SCIENCE ALERT

- Automated reaction and follow-up to external science alerts



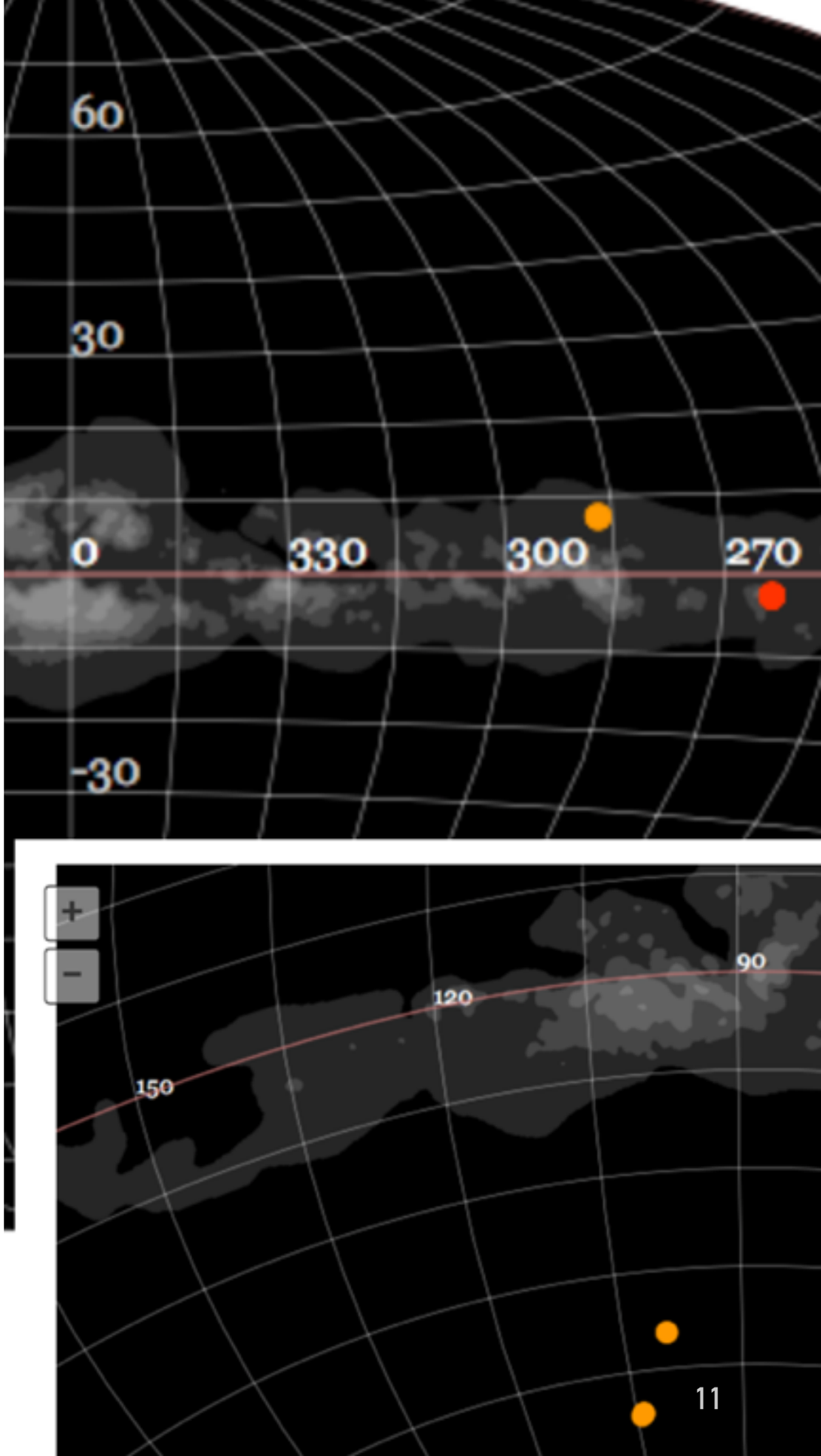
SOFTWARE: INTERNAL SCIENCE ALERTS

- Generation of alerts from AGILE data for external communication



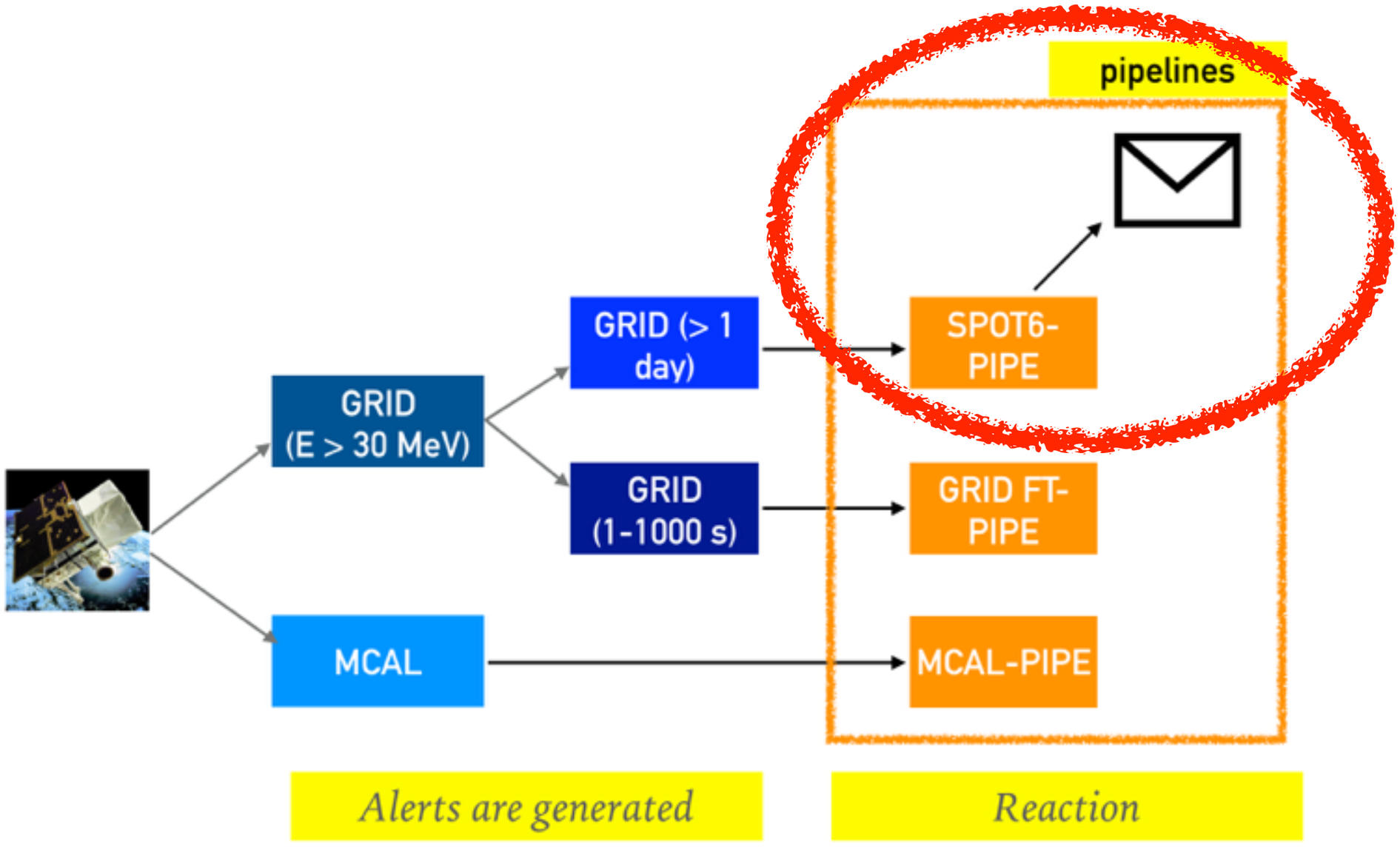
SPOT6-PIPE

Generation of science alerts (AGILE-GRID) > 1 day timescale

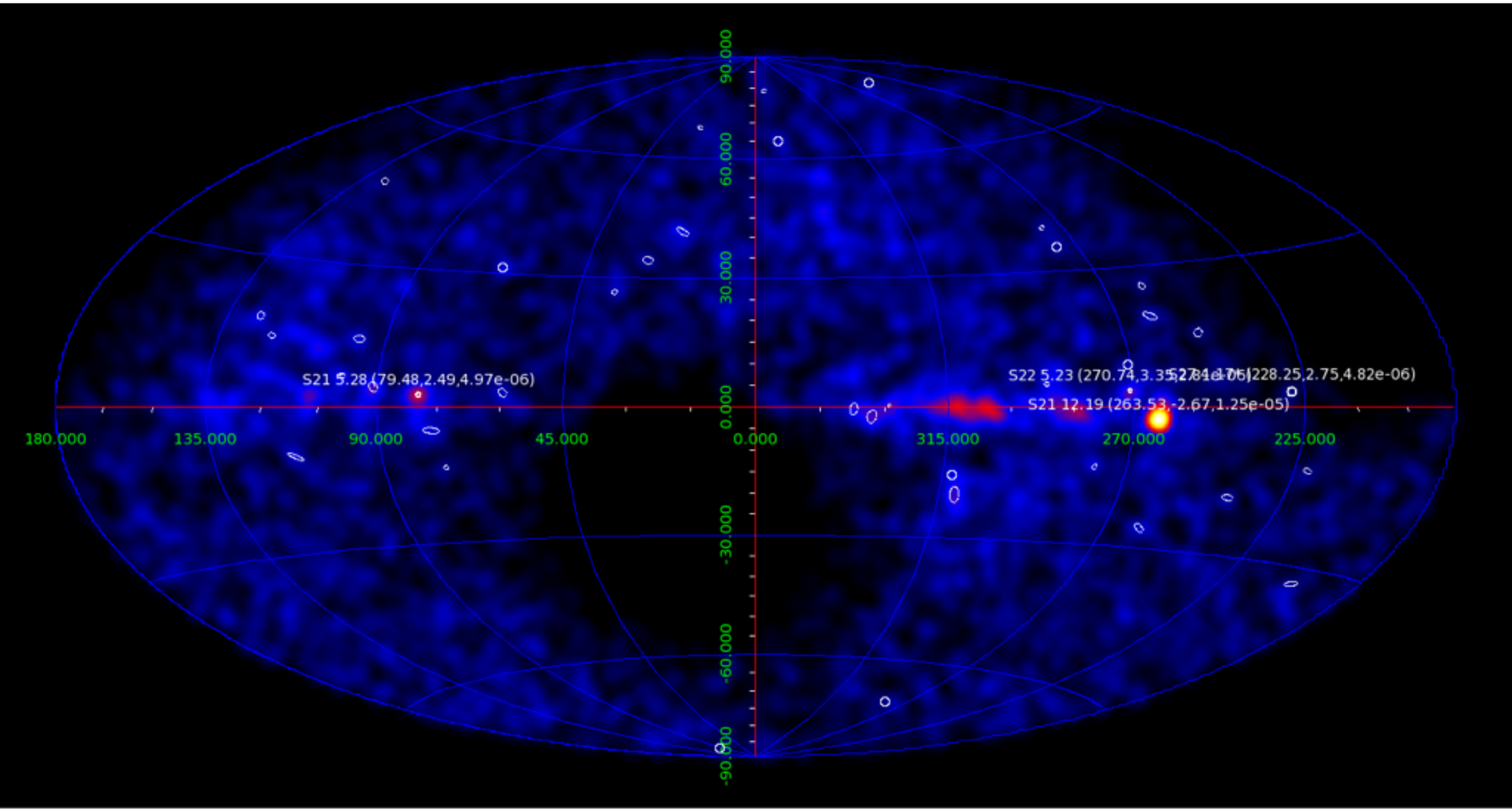


SPOT6-PIPE

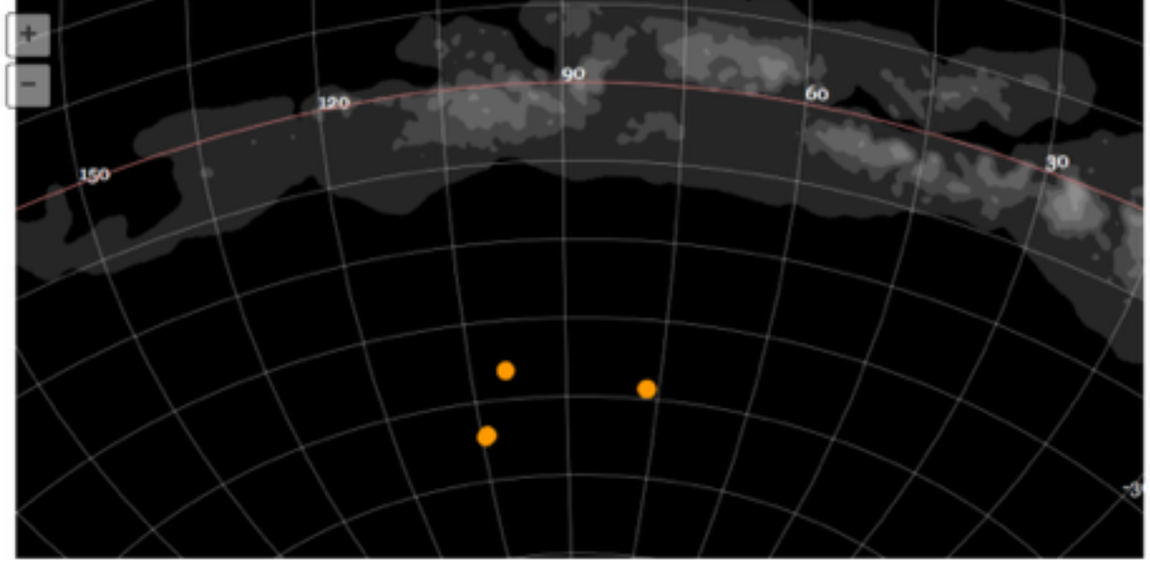
- Automated analysis of GRID data every contact
- Generation of AGILE-GRID internal alerts to FA team (via e-mail and push notifications)



SPOT6: FULL SKY VIEW

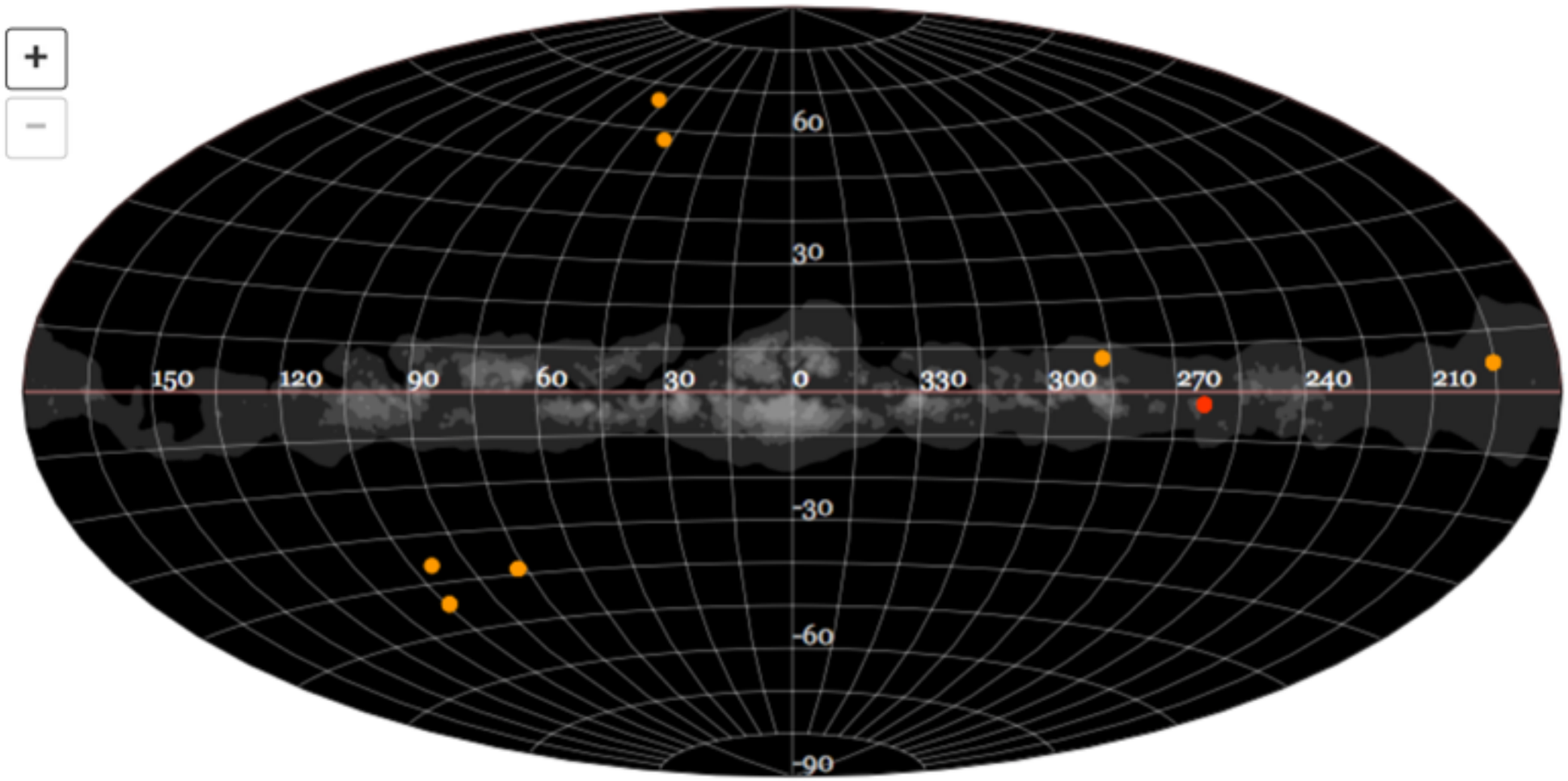


THE AGILE GRID "DASHBOARD"



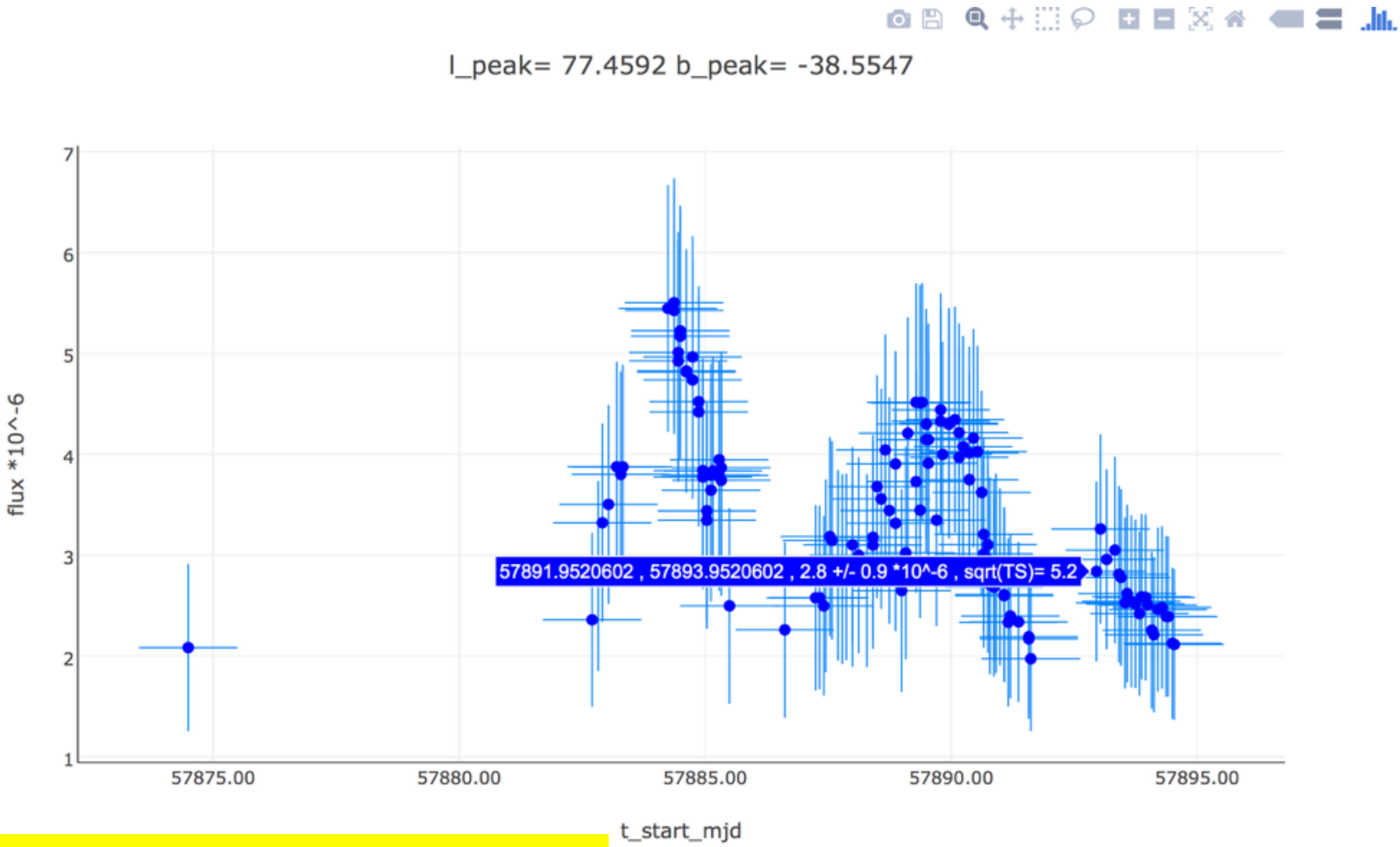
AGILE DASHBOARD Demo | Home | Last 2-Day Report | Light

analysis= spot6_2, t_start= 57893, t_stop= 57896, light curve



Science Tools → Transient Search → Science Alert DB → Data Warehouse → AGILE Dashboard

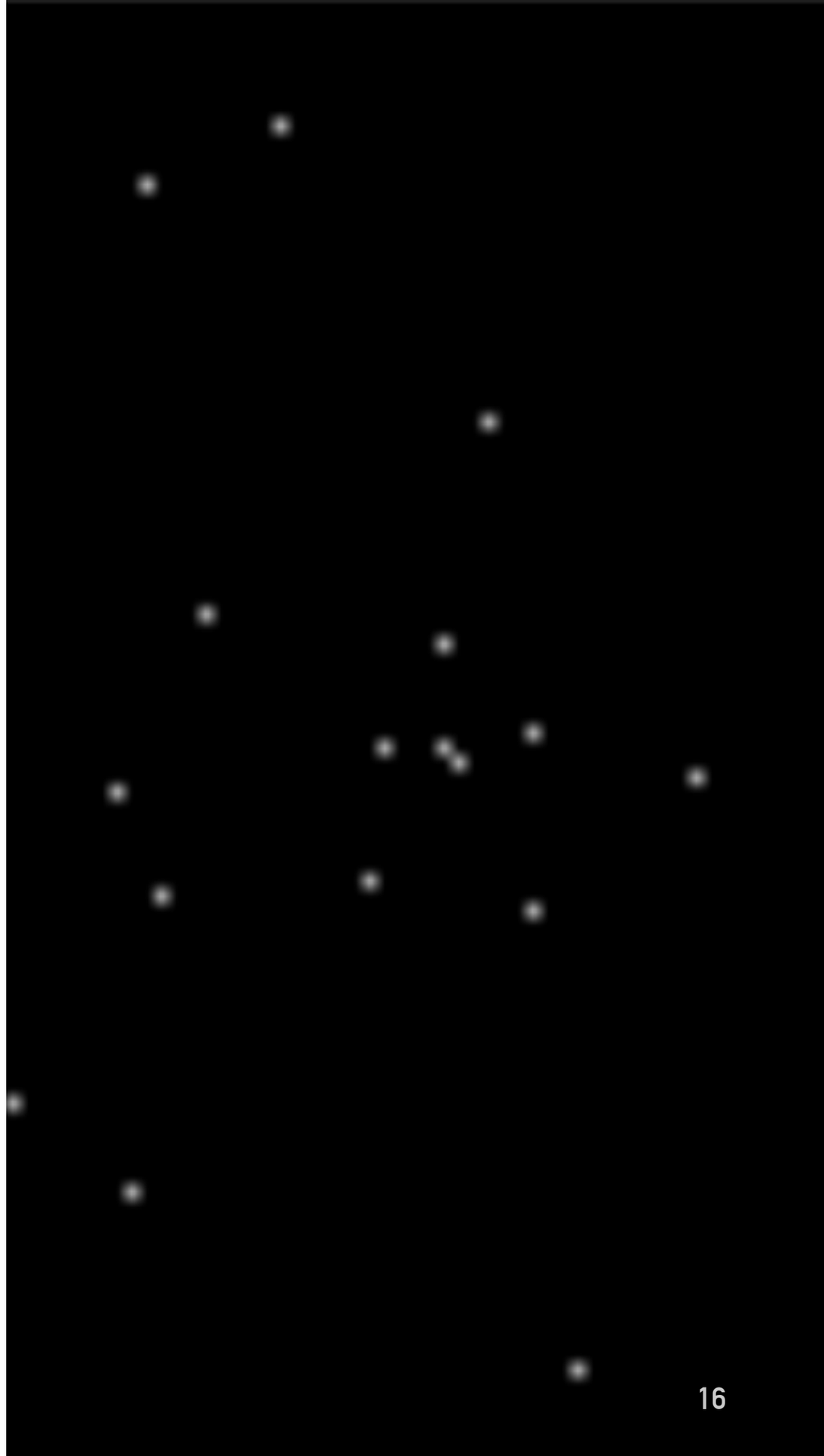
THE AGILE GRID "DASHBOARD"/2



Check poster session: N. Parmiggiani

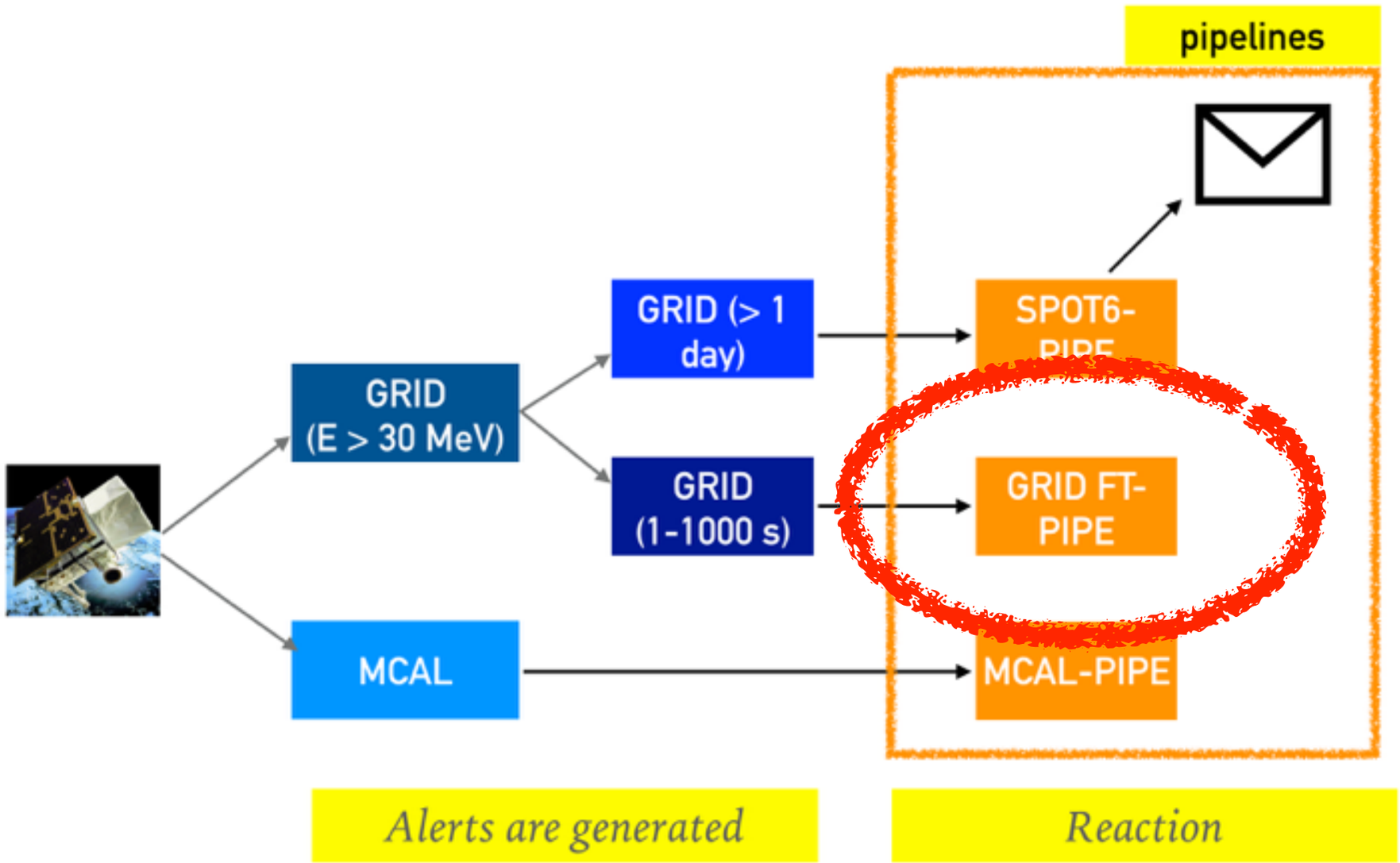
SEARCH FOR SHORT-TERM GAMMA-RAY TRANSIENTS

Generation of science alerts (AGILE-GRID): 1-1000 secs timescale



GRID FT-PIPE (UNDER DEVELOPMENT)

- Automated analysis of GRID data every contact
- Generation of AGILE-GRID internal alerts



SEARCH FOR SHORT-TERM GAMMA-RAY TRANSIENTS

- 1-1000 seconds, E>30 MeV
- Li&Ma analysis
- Different proposals. Between them:
  - to avoid trial we are developing a new “spotfinder” algorithm using Bayesian classifier

Image after a non linear stretching

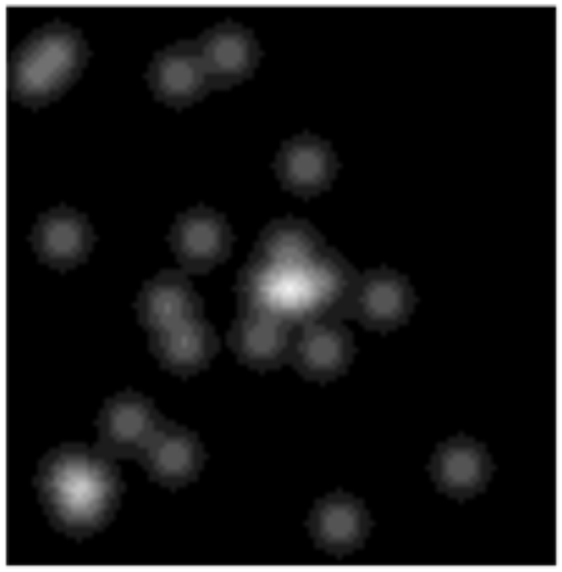


Image after Gaussian Smoothing (and after a linear stretching for a better view)

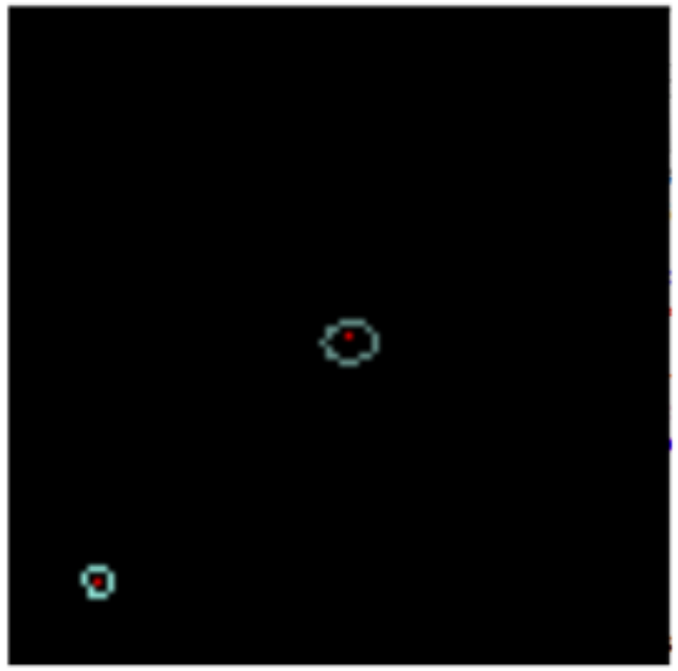
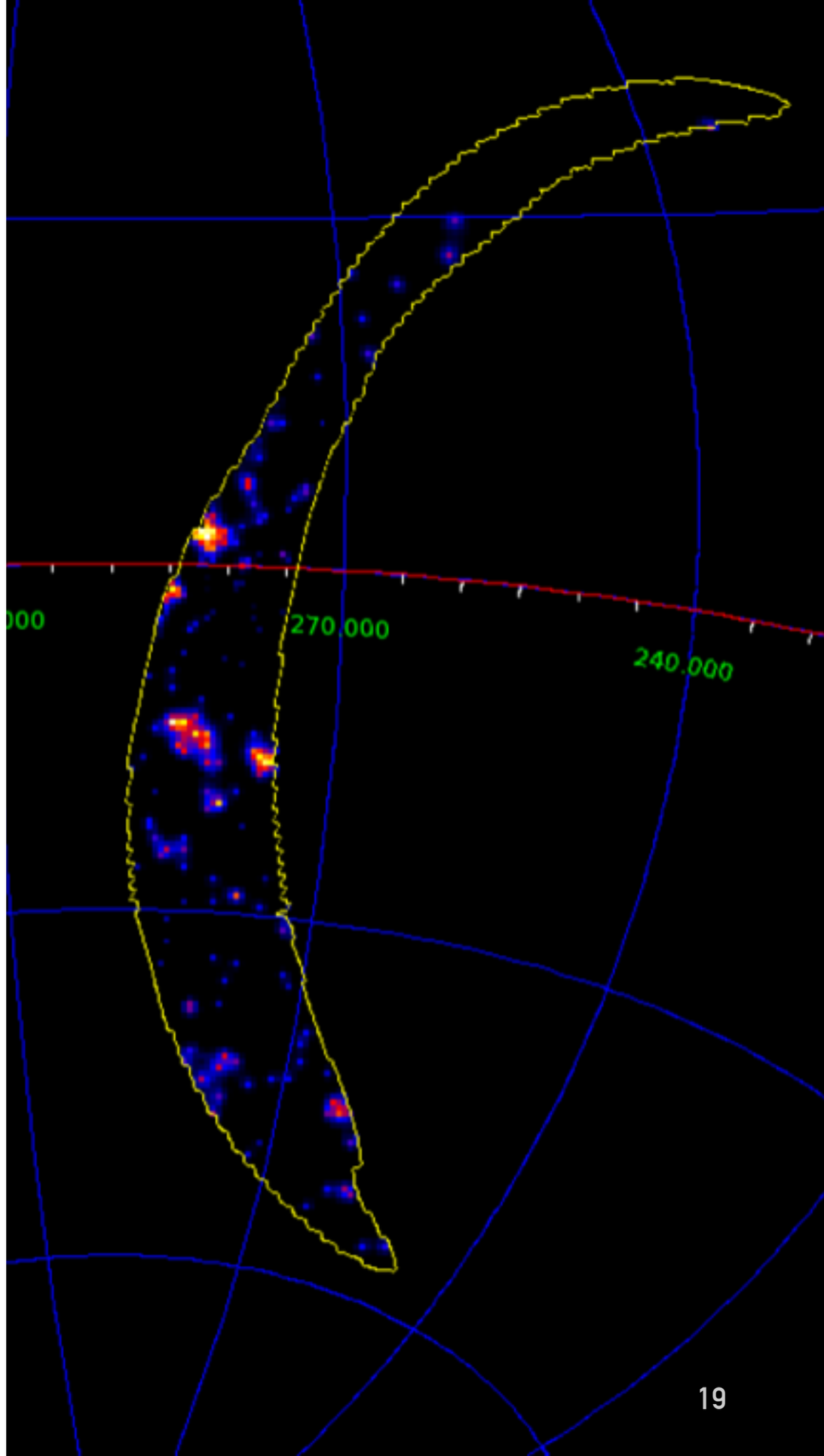


Image after the opencv “find contours” function

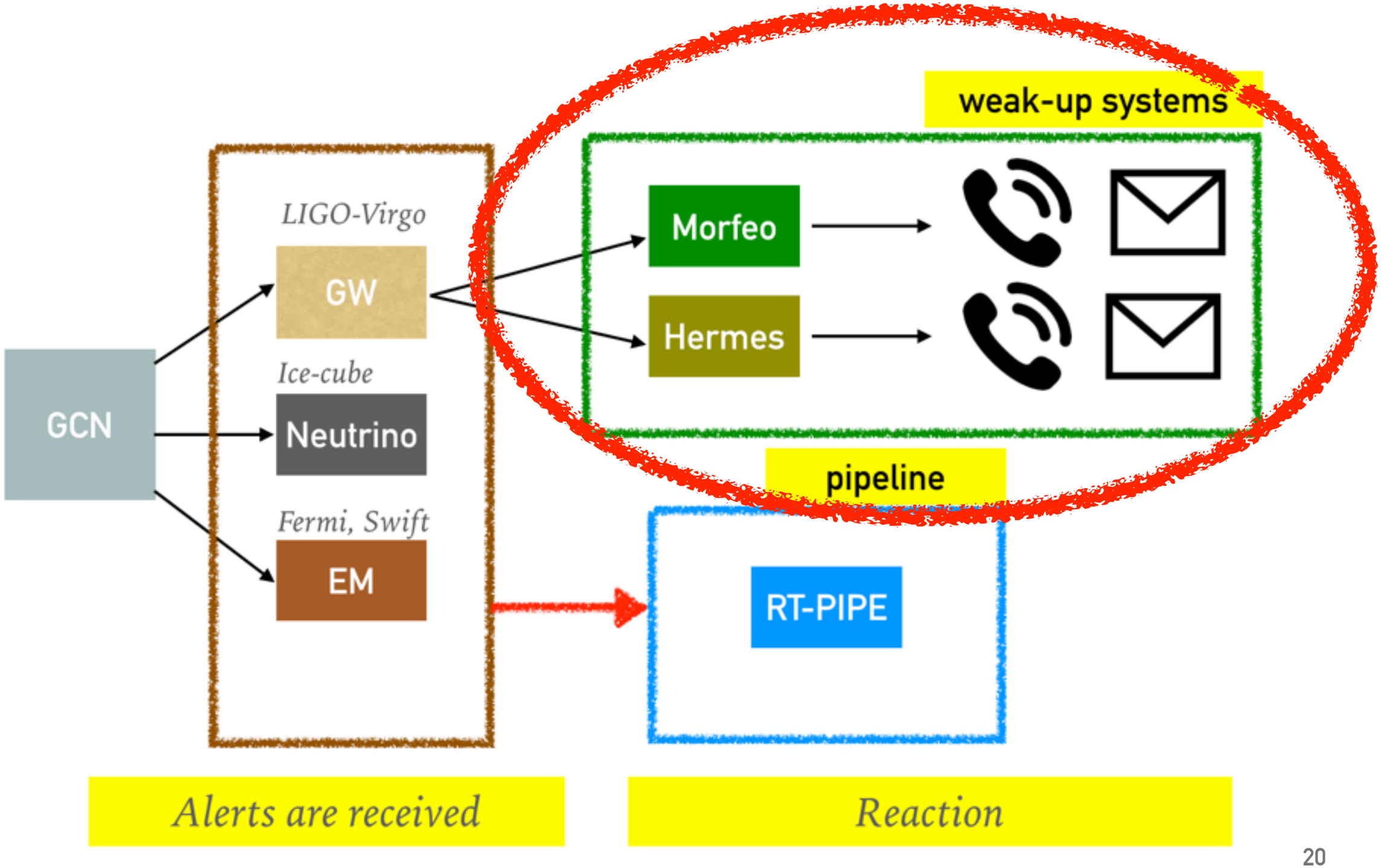
	Area del blob / Numero di fotoni	Media dei livelli di grigio	Media livelli di grigio / Numero fotoni / Vicinanza fotoni
Correctly Classified Instances	470 (94%)	470 (94%)	470 (94%)
Incorrectly Classified Instances	30 (6%)	30 (6%)	30 (6%)
Kappa statistic $\in [-1,1]$	0.88	0.88	0.88
Confusion Matrix	GRB: 222 / 28; BG: 2 / 248	GRB: 227 / 23; BG: 7 / 243	GRB: 224 / 26; BG: 4 / 246
Accuracy	94.54%	94.20%	94.38%
F-Measure	93.67%	93.80%	93.72%
False Negatives Rate (fn/tp+fn)	11.20%	9.2%	10.4%
False Alarm Rate (fp/fp+tn)	0.8%	2.8%	1.6%

RT-PIPE

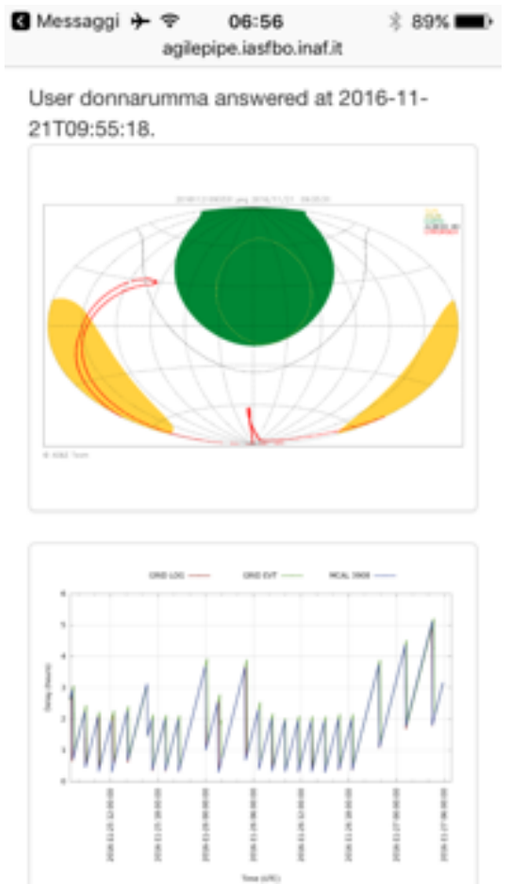
Automated reaction to GCN alerts



SOFTWARE: EXTERNAL SCIENCE ALERT

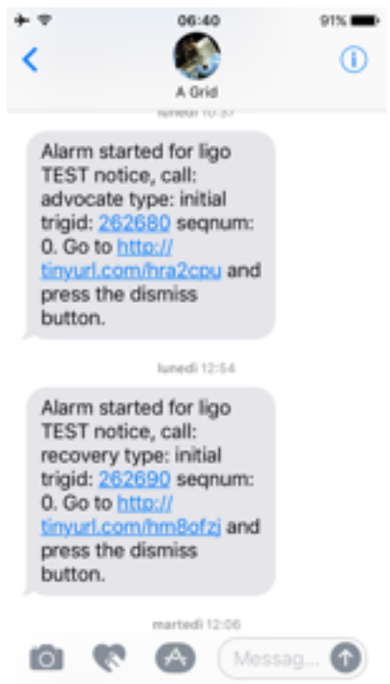


CALL LEVELS



nominal: 60”

Prevision report



nominal: 30”

SMS

PI

SMS
Call

Recovery (AB, ID)

SMS
Call

BA BA backup

SMS
Call

Morfeo

BA BA backup

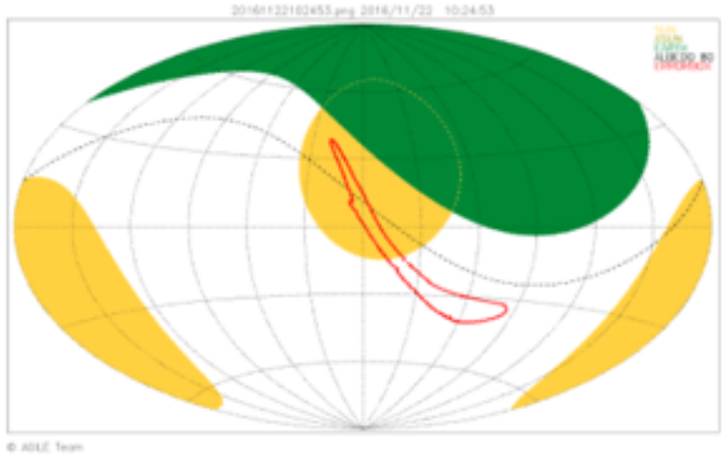
SMS
Call

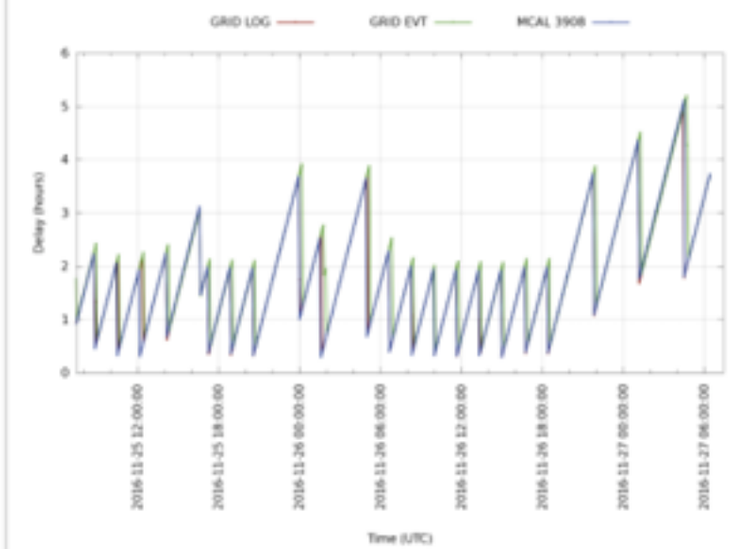
Hermes

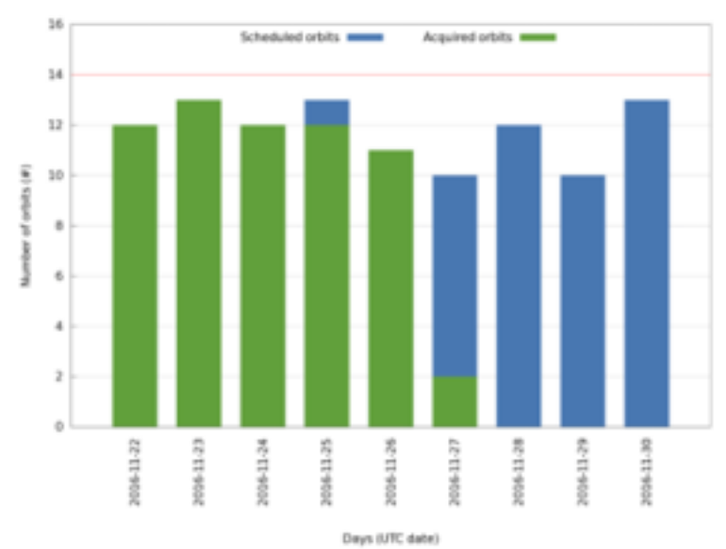
nominal: 30”

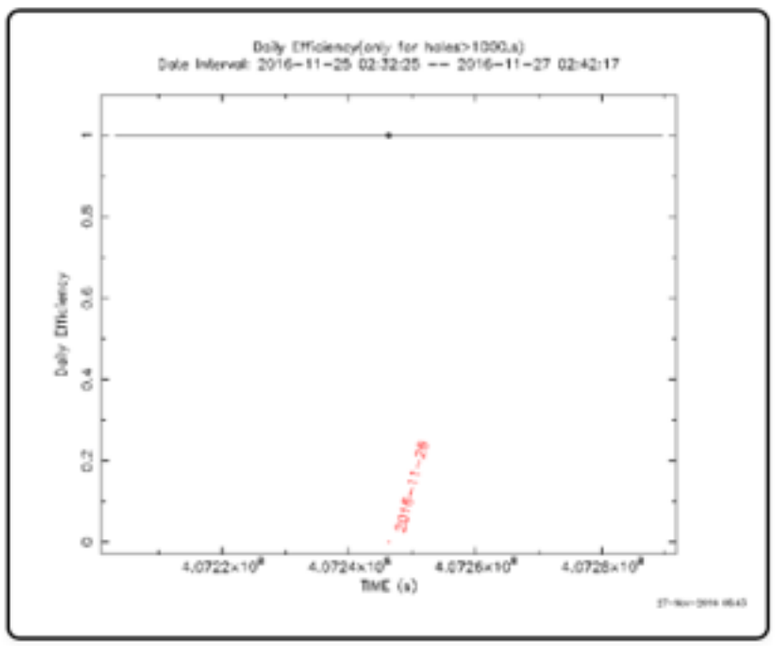
LVC_INITIAL

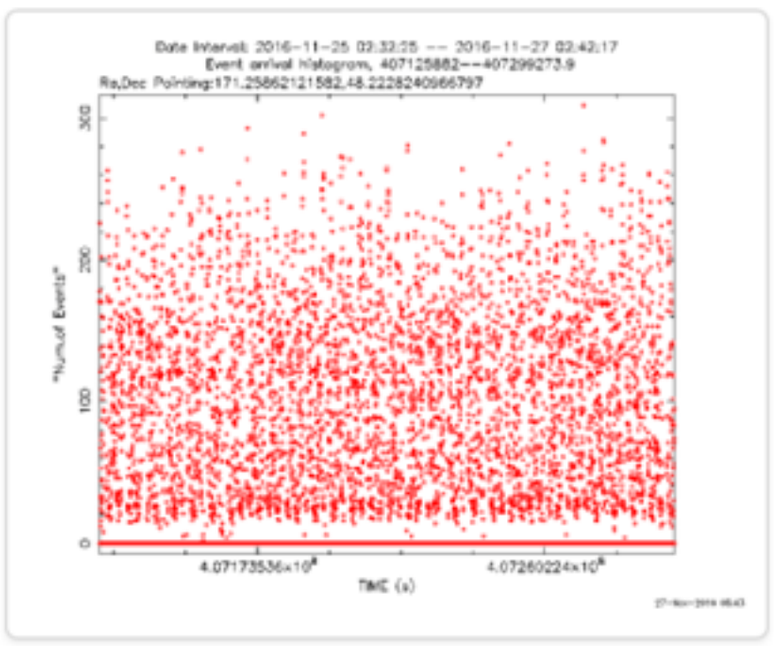
PREVISION REPORT





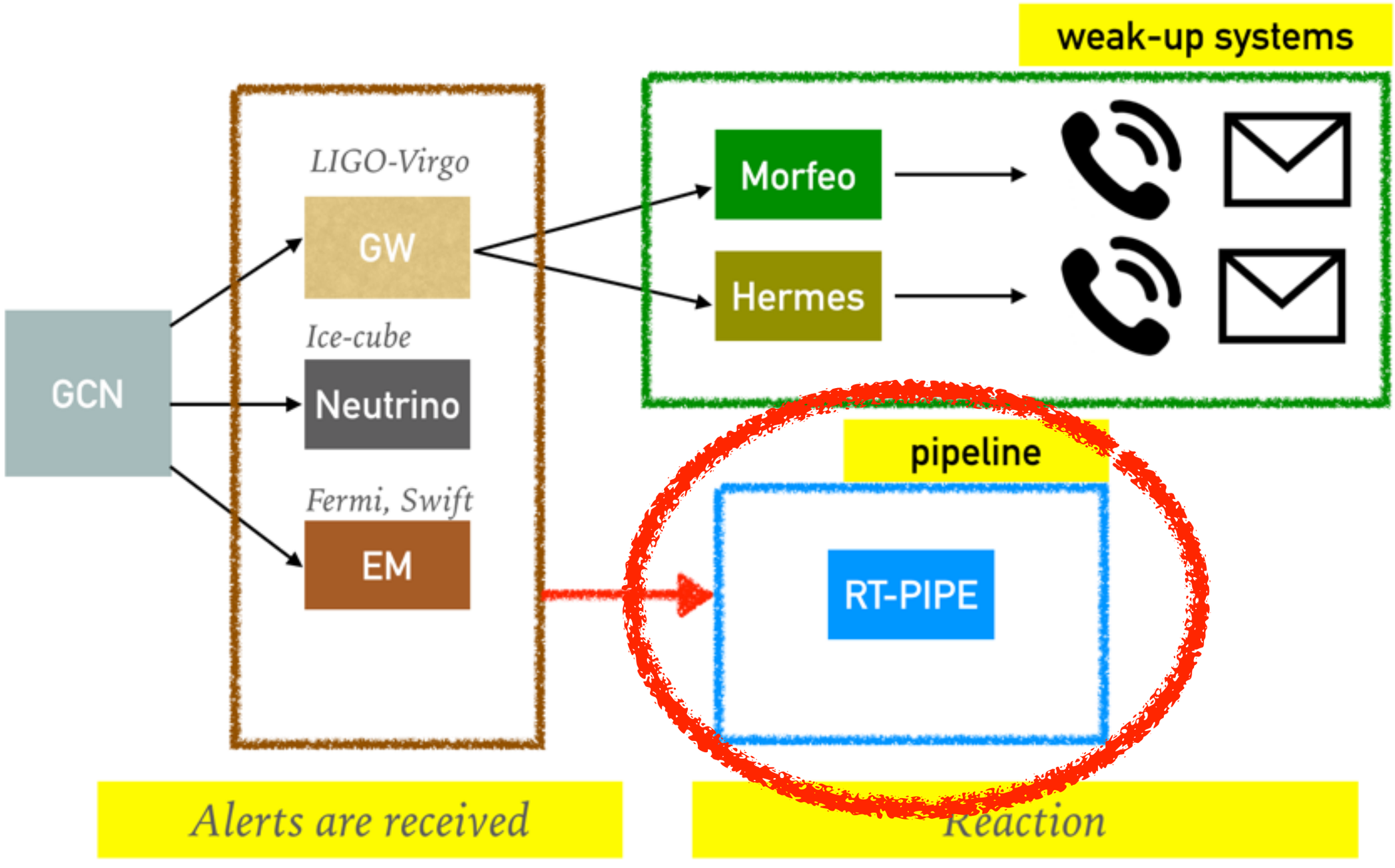






What will happen next two hours?

SOFTWARE: EXTERNAL SCIENCE ALERT



EXTERNAL GW ALERTS REACTION

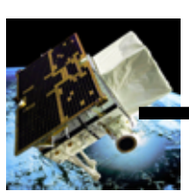
GCN notice @ ASDC

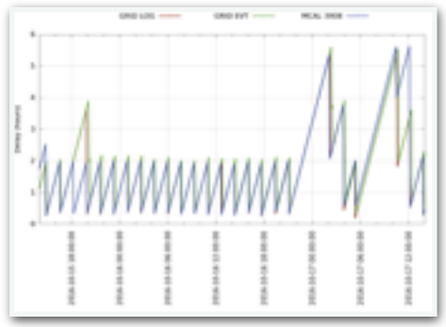
GCN notice @ IASFBO

RT-PIPE

short-term analysis

data quality and data flow



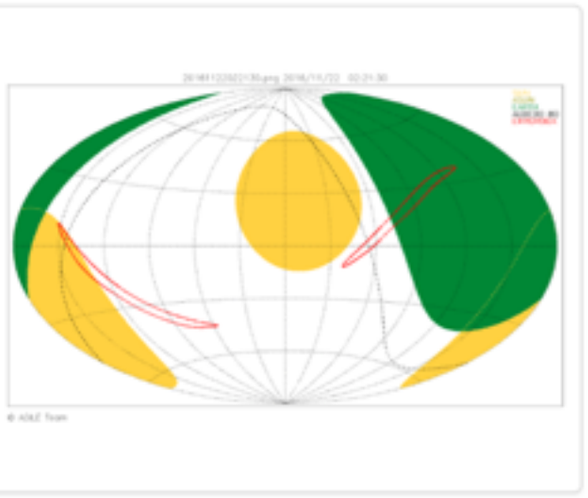


>= 25’

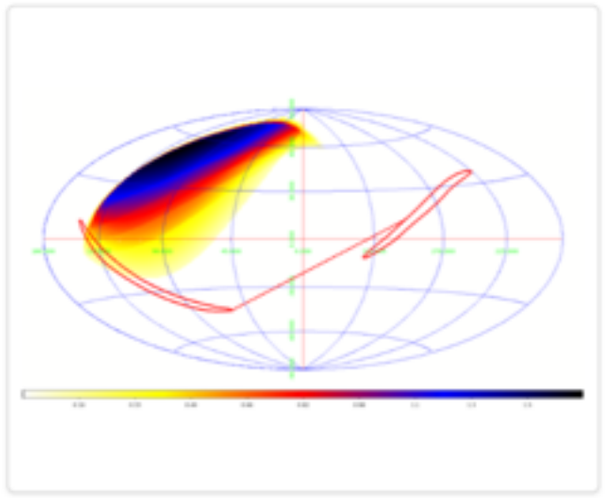
PROMPT ANALYSIS RESULTS

nominal: 25'-120'

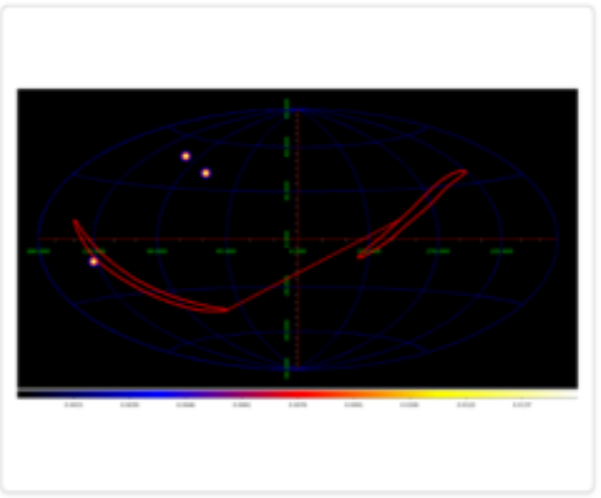
Visibility



GRID Exposure

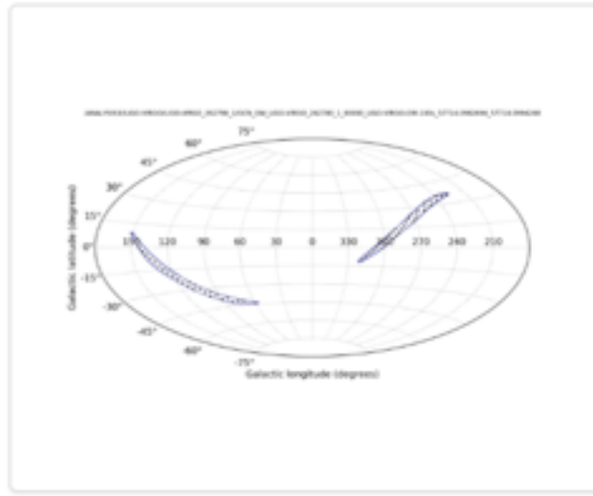


GRID Counts

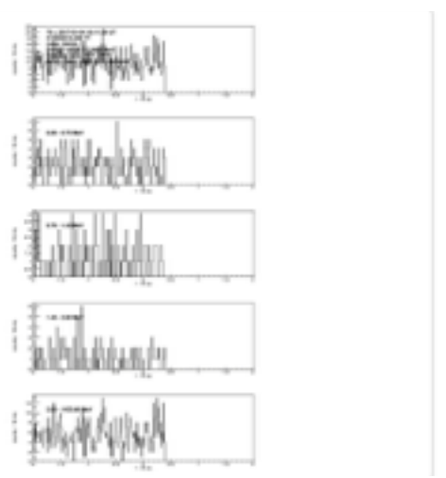


GW Analysis

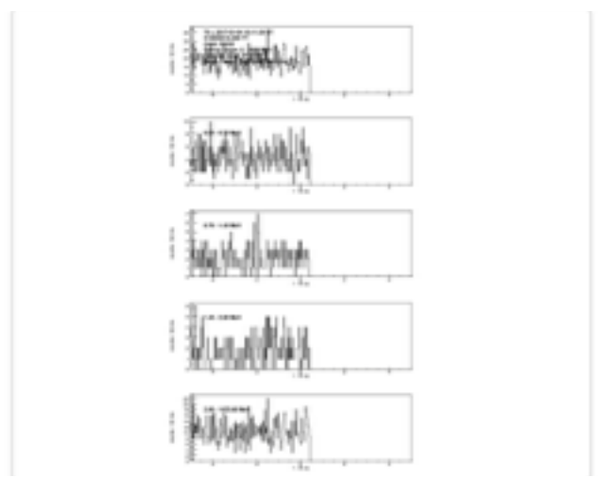
[T0, T0+100s], bkg [T0-500, T0+600]



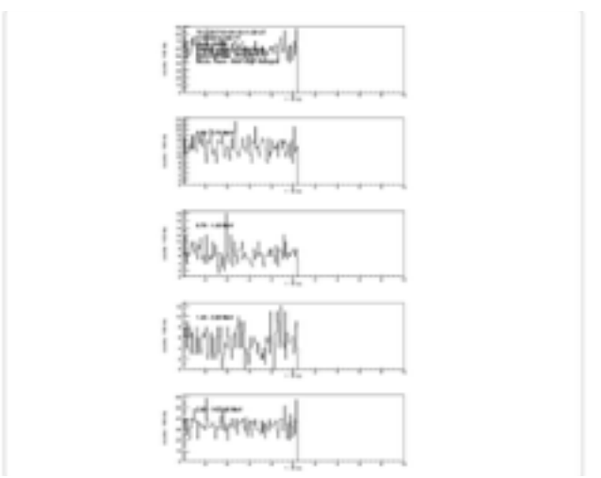
No GW analysis results above 3 sigma



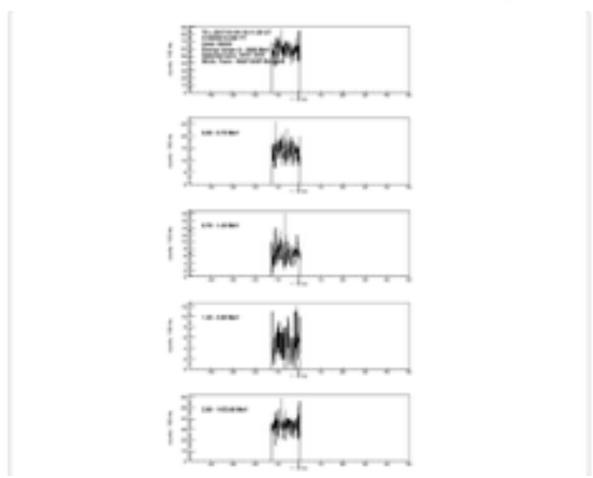
Ratemeters AC 1



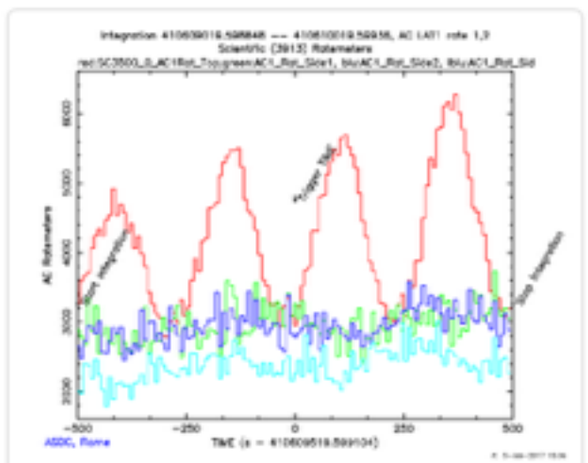
Ratemeters AC LAT1 HK

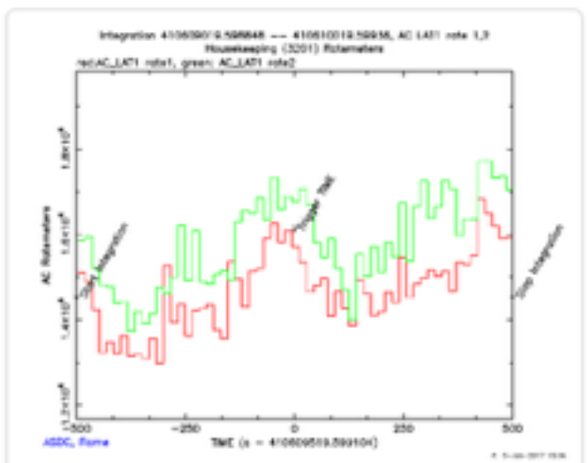


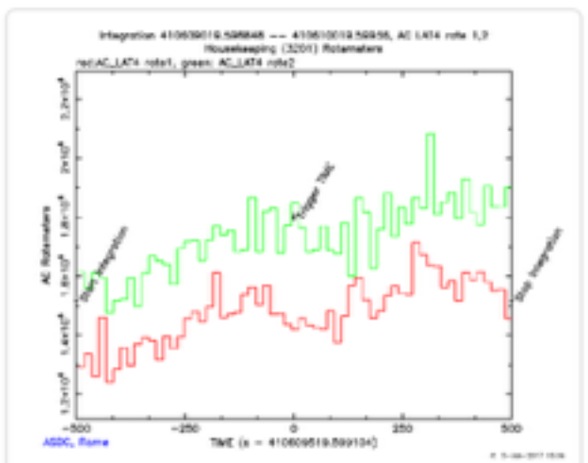
Ratemeters AC LAT4 HK

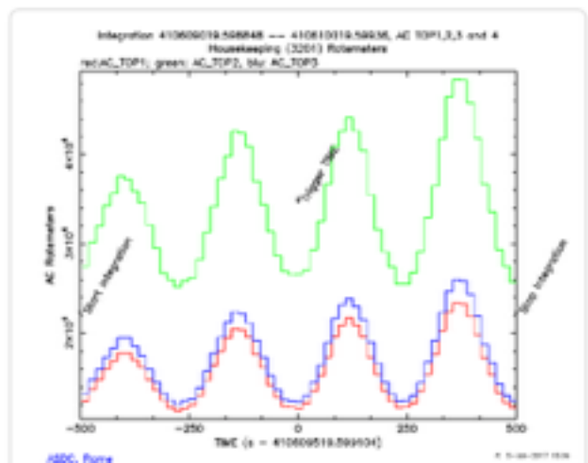


Ratemeters AC TOP HK



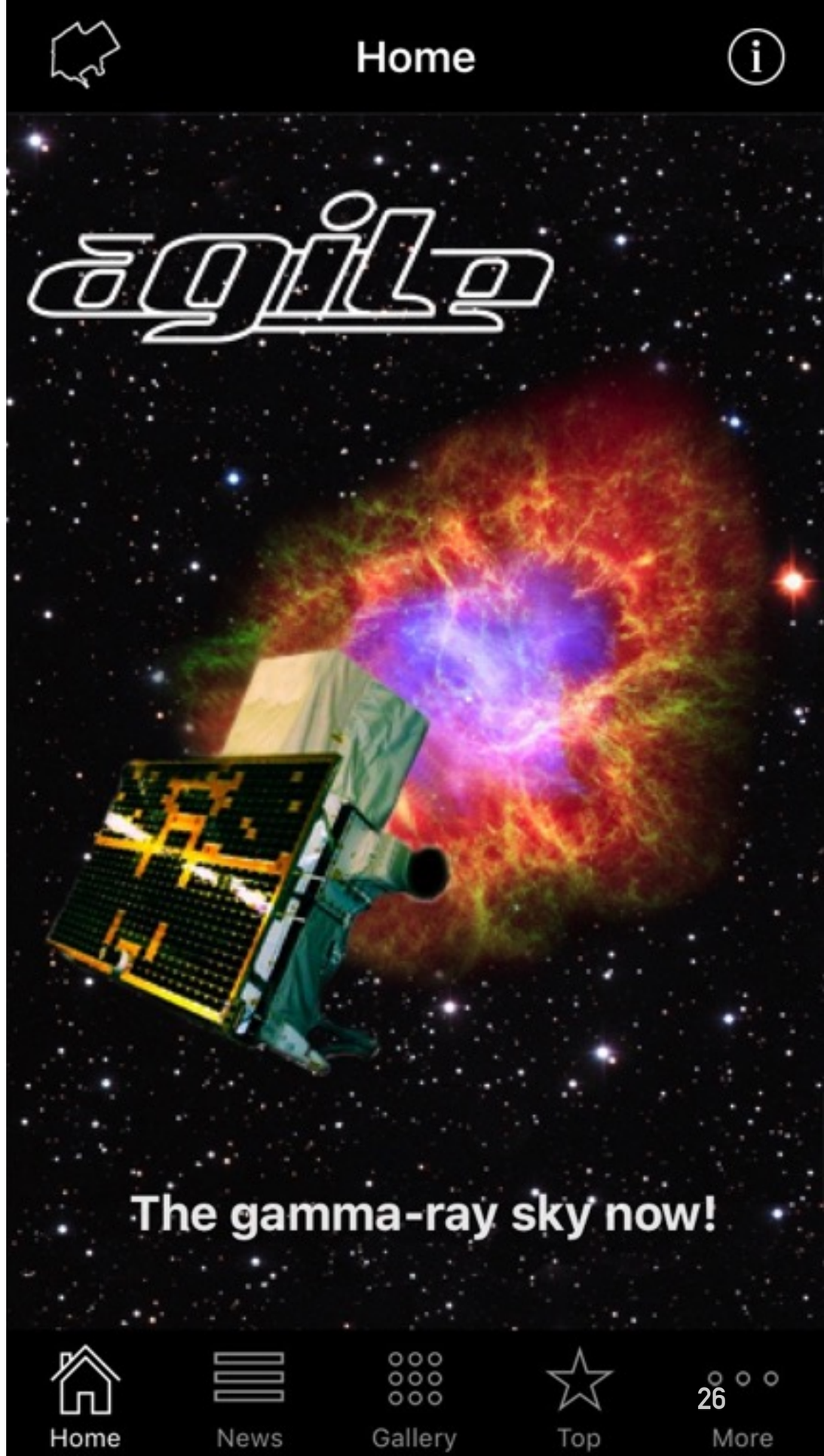




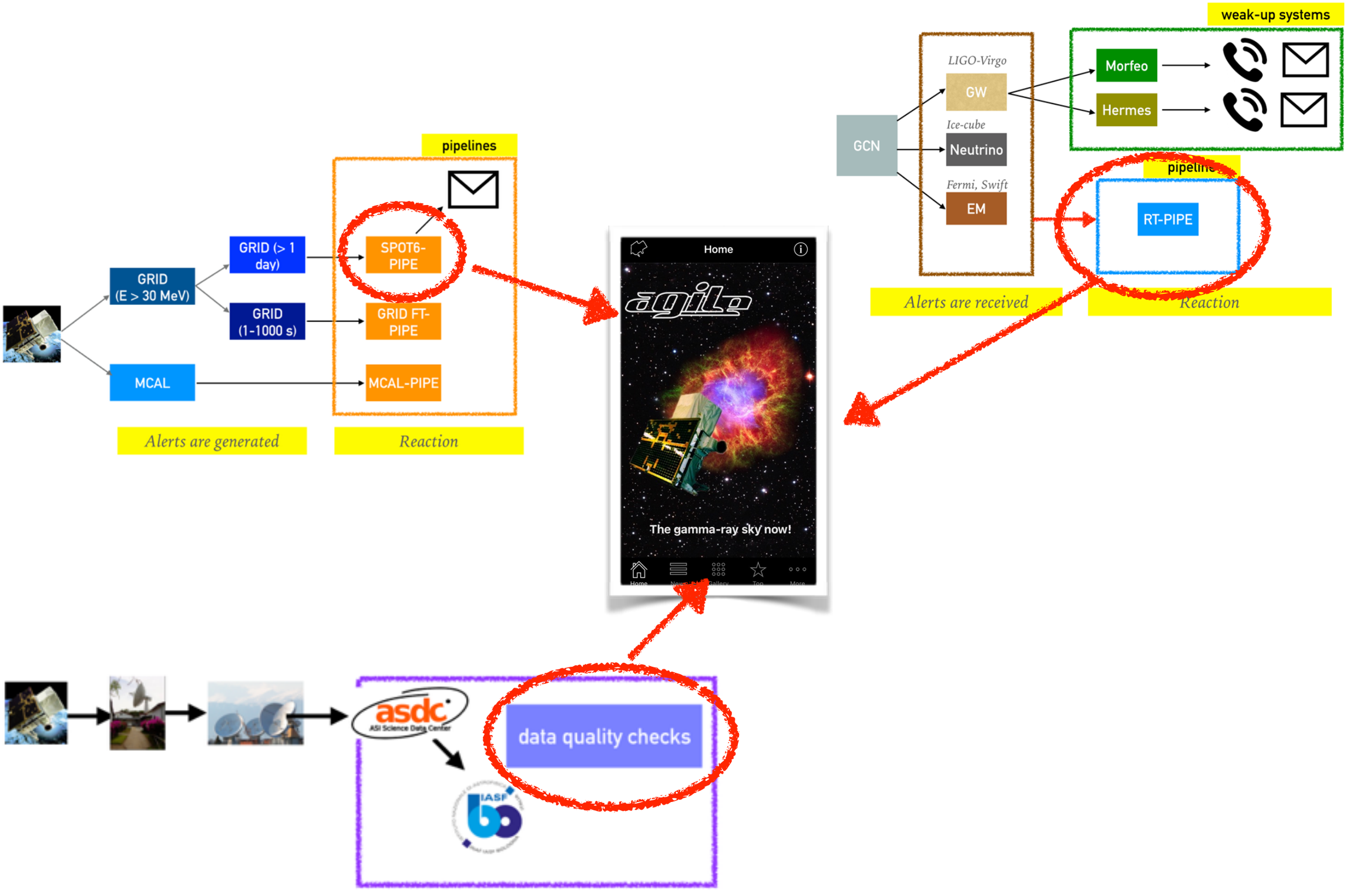


AGILESCIENCE: GAMMA-RAY DATA ANALYSIS "ON THE ROAD"

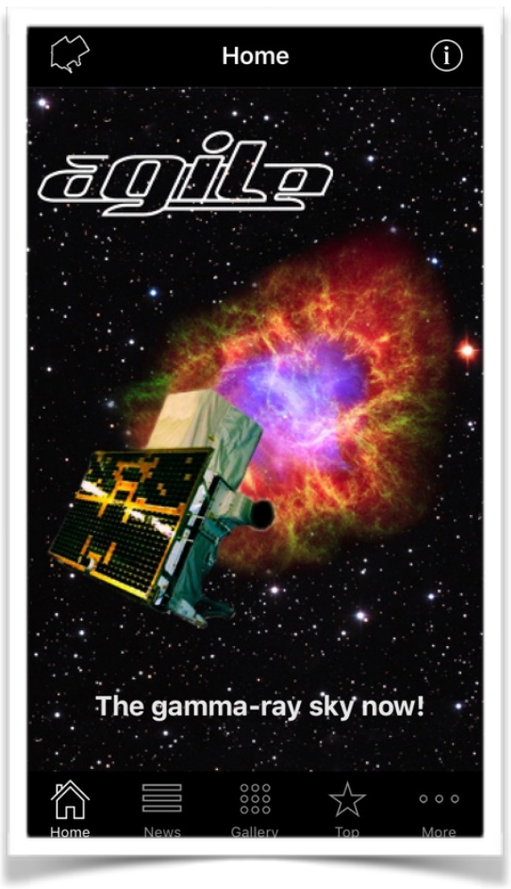
7/24??? We need an App…



AGILE ON-LINE ANALYSIS AND AGILESCIENCE APP

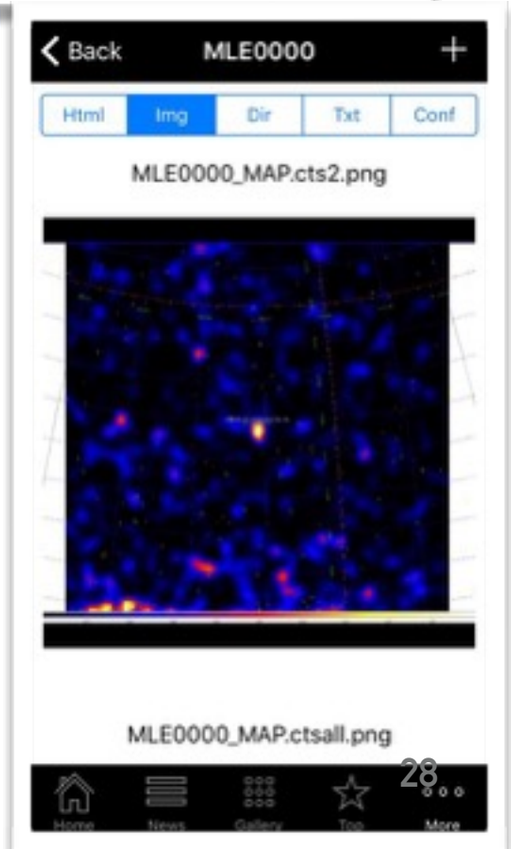


FULL AGILE-GRID MANUAL ANALYSIS FROM MOBILE PHONE



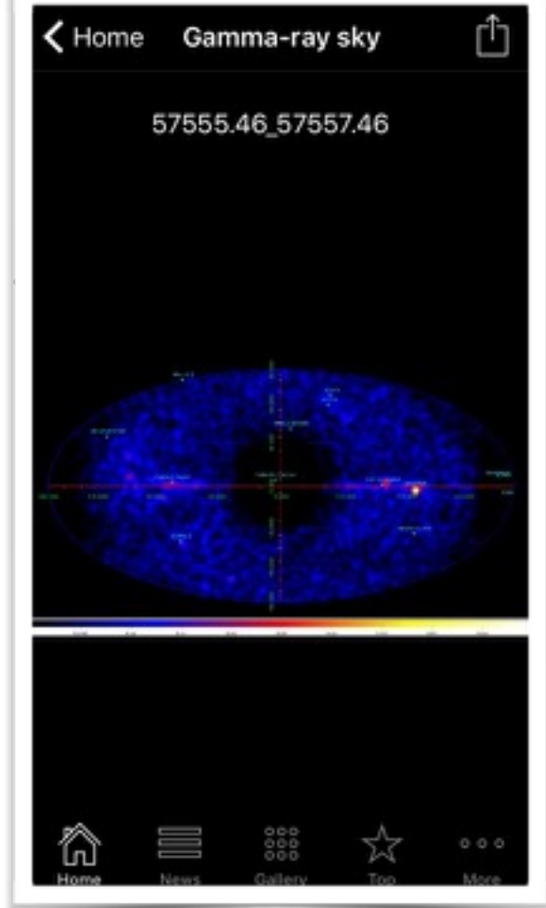
Insert parameters for analysis

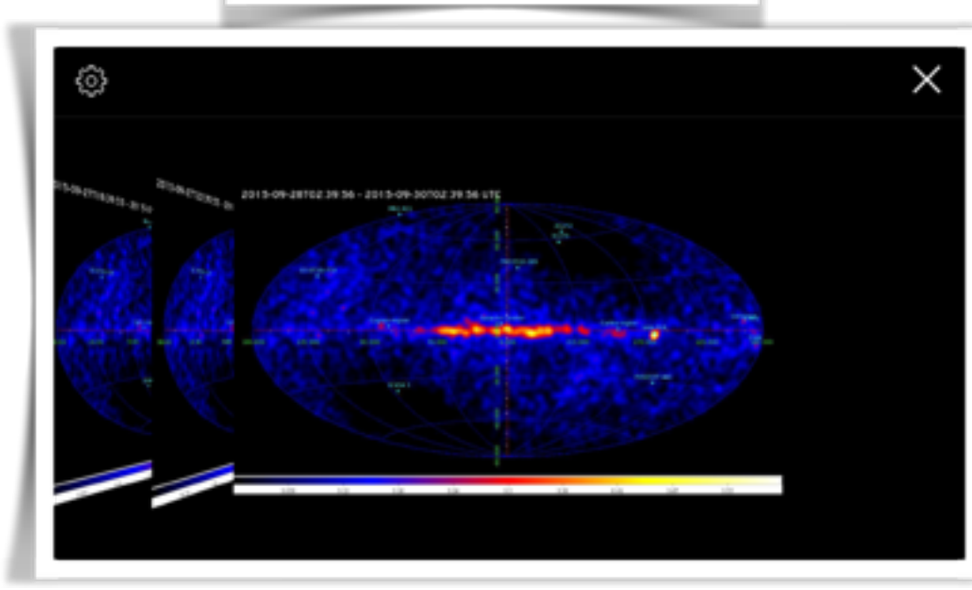
Results



CONCLUSION AND NEXT STEPS

- Fastest gamma-ray ground segment of the world: **data** in the right time
- **Pipelines** under development:
  - GRID-FT on-line analysis
  - MCAL GRB on-line analysis
- Deep integration between **people** and systems with well defined **procedures**
  - deep integration with mobile technology: AGILEScience App
- We are planning to make some products publicly available





The history of the gamma-ray sky

The gamma-ray sky now…