Gaia Science Alerts in Italy

Bologna, Catania, Napoli, Teramo, … Padova

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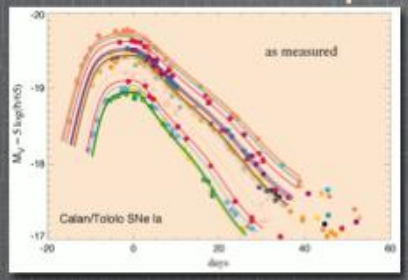
L'Italia in Gaia - Roma

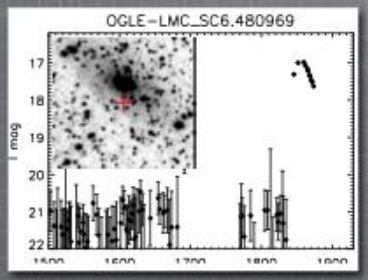
What are the Gaia Science Alerts?

- **Detected events whose value is lost if not immediately alerted and followed-up**
- Sampling: about **70** observations per object over 5 years (grouped in pairs)
- Daily data transmissions of **anomalous** and **transient** events from the whole sky
- Issued usually within **12-48h** after observation
- Limiting magnitude:~20mag
- Anomalies detected and classified on **1-2** Gaia data points (photometry and low-res spectroscopy)

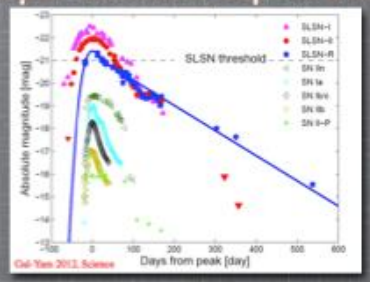
SCIENTIFIC OPPORTUNITIES

Supernovae

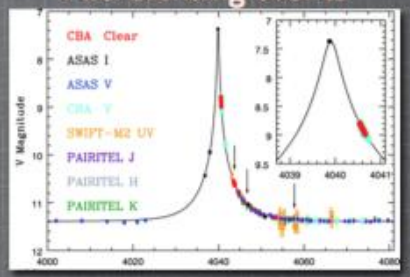




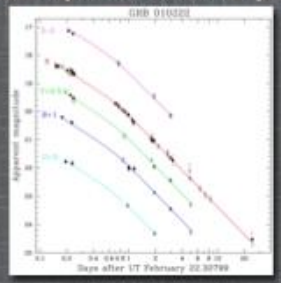
Super-luminous Supernovae



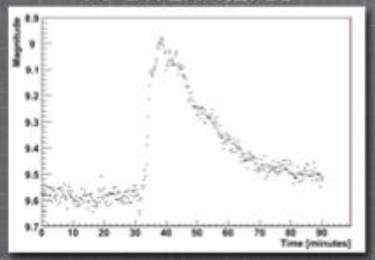
Microlensing events



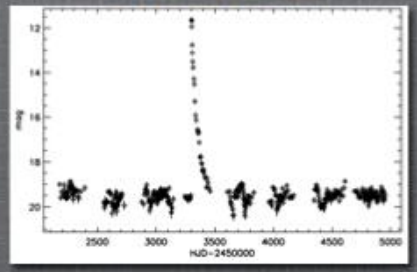
GRBs optical counterparts



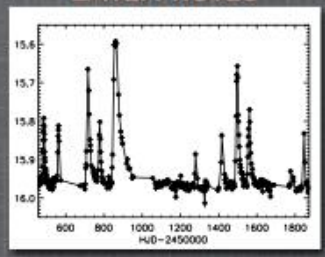
M-dwarf flares



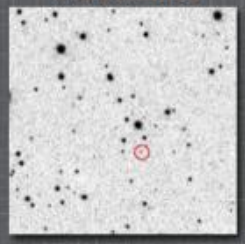
Classical novae



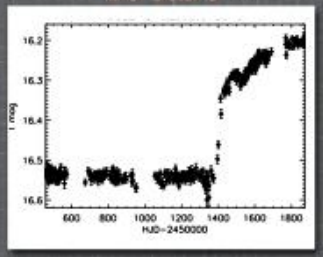
Dwarf novae



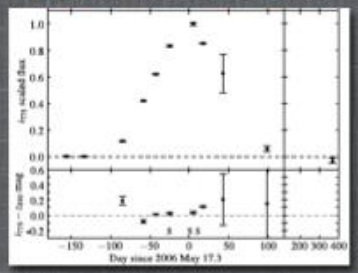
Asteroids



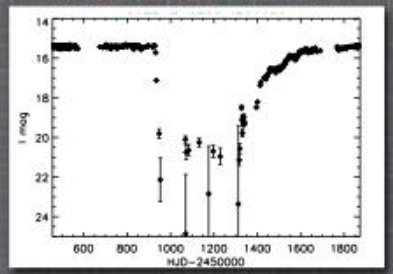
Be stars



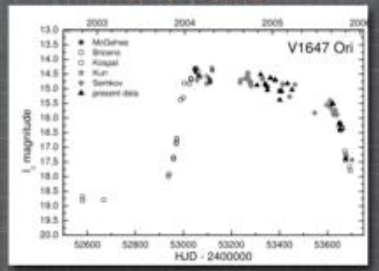
NEW THINGS??



R Coronae Borealis



FU Orionis



Alert dissemination

- Publication of Alerts to the entire community: no proprietary data.
- VOEvent - machine-readable format, can be displayed in e.g. Google Sky
- Skyalert.org - will host both alerts and follow-up data

GSA organization

Gaia-FUN-TO (Gaia Follow-Up for Transient Objects, analogy to Gaia-FUN-SSO)
Aim: extraction of science from GSA

3 meetings (2010 Cam, 2011 Cam, 2012 Bo)
White books

Involved in the Alert Verification Phase

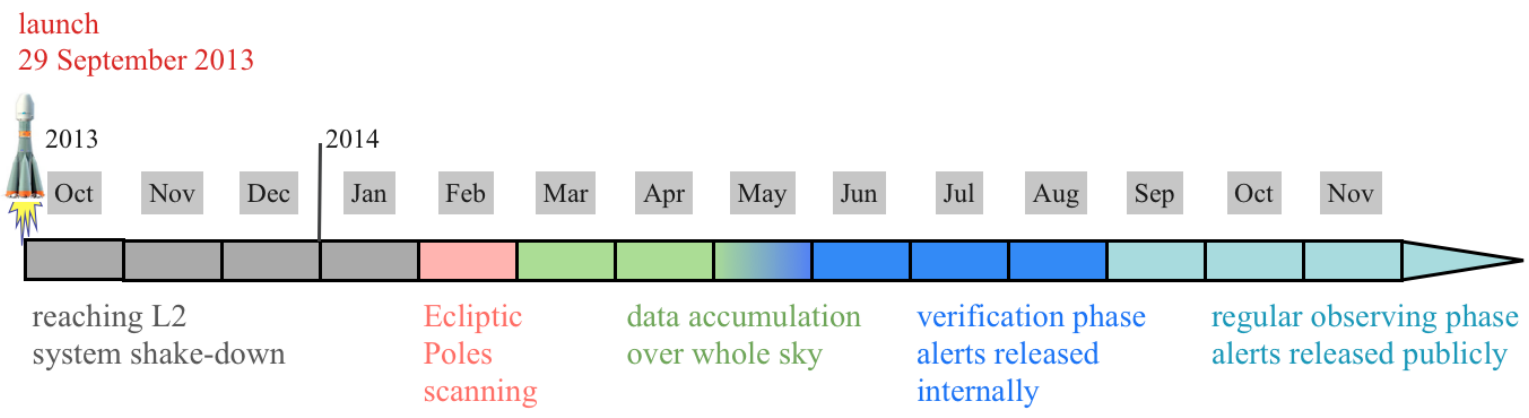
Science Alerts Verification Phase (SAVP)

Only period during which data are NOT public

- To validate and set-up the processing pipeline (detection, classification, detection thresholds, ..)

[Potential alerts are 1000s/day]

- To be started as soon as sufficient sky has been covered



SAVP

Makes use of
- Network of mid-size telescopes
- Centralized data repository (IoA)
- *ad hoc* SW (IoA)

Telescope requirements:
- multi-band photometric capabilities with moderate astrometric capabilities
=and/or
low-, mid-res spectroscopy for the classification
- both hemispheres, east and west
- flexible scheduling (ToO) ➔ ideal robotized/automated telescopes
- unified/standardized observational output,

Large number of European groups/telescopes

Still To Be formalized via a MoU (weeks ?)

Italian involvement in Gaia-FUN-TO and SAVP

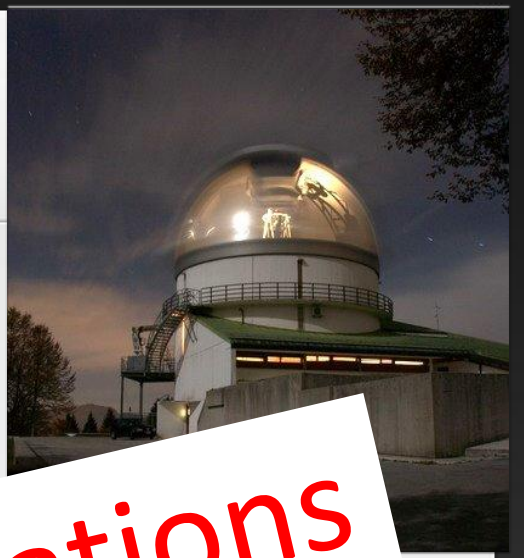
Opportunity for :
(1) better understanding of the Gaia alerts stream
(2) preparation and readiness of the observatory/people for GSA exploitation
Aim: scientific exploitation of GSA (throughout the mission) from the beginning

Italian telescopes:
-(TNG/NOT mini-XShooter)
-mid-size telescopes

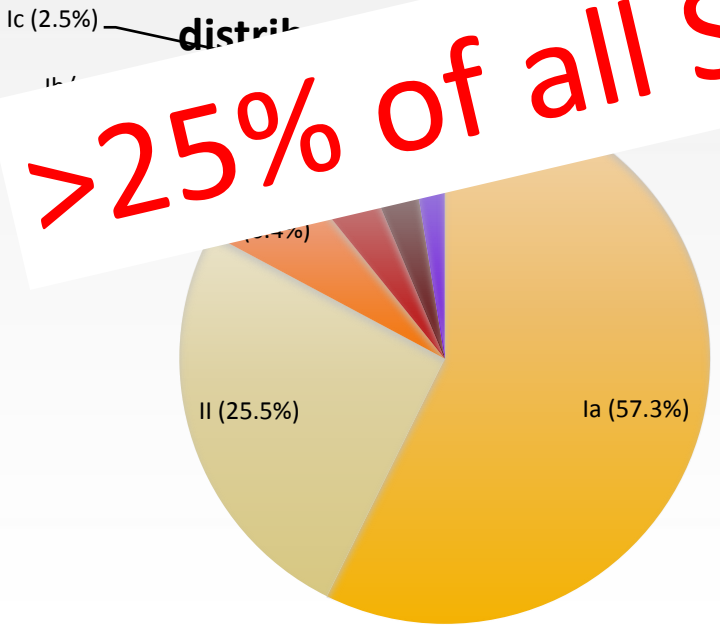
Other telescopes :
- NTT/PESSTO (we !!)
- 1.2m, Belgian Mercatore, La Palma
- 1.2m, Swiss Euler, La Silla
- 1.5m, Danish, La Silla
- several more

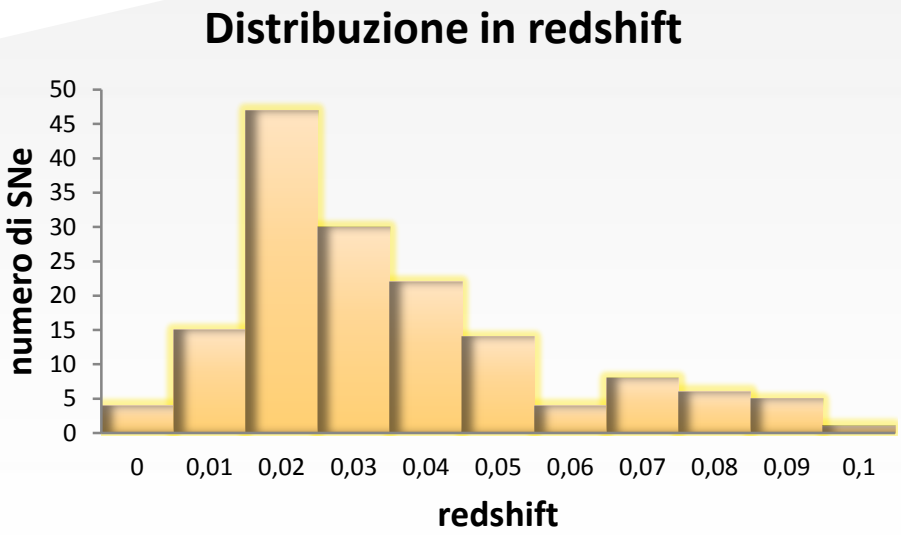
Asiago New Operation Model

- **no night assistance/support**
- simplification in operations (AFOSC/ECHELLE, Peltier, ..)
- improved safety controls
- **remotization** (currently from the Asiago main site)
- few, large, **self-funded** programs (SNe, Exo-Transits, …)



>25% of all SN classifications



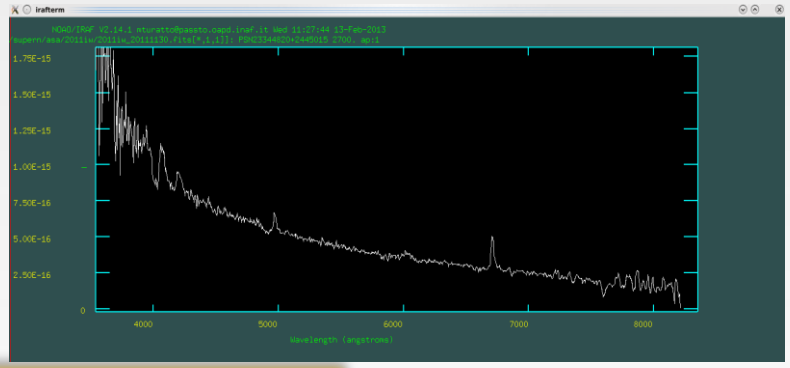


Pre-launch SAVP tests (IoA - INAF)

Gaia Alert system is highly heterogeneous
➔ Test on data released via Skyalert (CRTS)

- Preliminary test (07/2011) in Loiano
- Coordination test of italian facilities with IoA (26-30/11/2011):

Science Results:
- Several targets observed ph+spec
- 1 SN classified, CBET 2941
- 1 SN classified as *second*



Le supernovae di Gaia

I telescopi Italiani coinvolti nel Gaia Science Alerts Follow-up Programme confermano 2 nuove supernovae. L'esperimento condotto ha visto per la prima volta i telescopi nazionali lavorare in sinergia fra loro.

di Gisella Clementini 08/12/2011 18:30

+ server & SW works, instruments are suitable, expertise in place
- vulnerable to strong competition (good!!)

A Science Case: Gaia SNe

perhaps the most appealing

Context:

- key interdisciplinary field (from stellar evolution to cosmology ….)
- large surveys era: PS1, PTF, LSQ, CRTS, SkyMapper, VST-Sudare, DES … LSST
- spec-surveys: PESSTO, nearby SN Factory

Migration toward *proprietary* data (only exception is PESSTO)

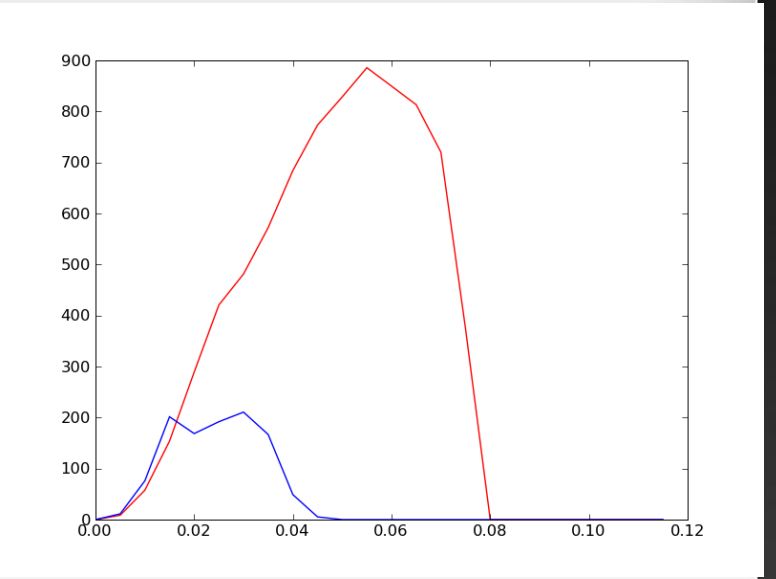
Pros:
- Large number of objects
- Early discovery
- Often good photometric follow-up

- Unbiased =>> New discovery Space

Cons:
- Yes/Not
- Targets announced a posteriori

=> limited spec study

GAIA SNe (space, all-sky)



In 5yr (Cappellaro 2011, g~ 19):

- 6300 SNe (87% Ia, 13% CC)
- 1800 SNe pre-max (95% Ia, 5% CC)
- 500 SNe < -5 d (97% Ia , 3% Ib/c)

Cons:

- significant fraction daytime objects => small interest
- variable/poor average cadence (many rediscoveries)
- …

Pros:

- **all sky (unbiased)**
- **deep, wide, available within 2 days**
- **the only public SN search of the next future**

Conclusions

- Gaia Science Alerts are the first data released by Gaia
- Strong scientific interest on GSA in Europe and in Italy
- Facilities well suited for GSA **verification** and **exploitation**
- Expertise in place
- **Unique opportunity for Transients Science**