GAIA SCIENCE ALERTS

Follow-up and Alerts Verification Brochure

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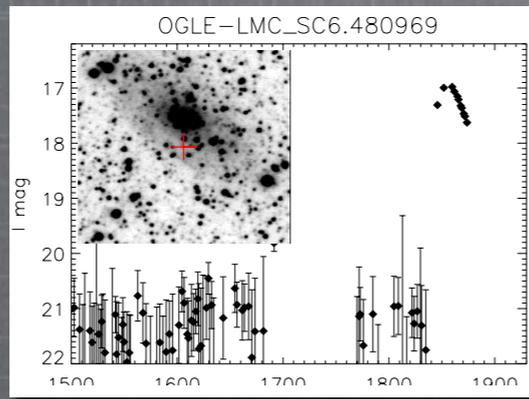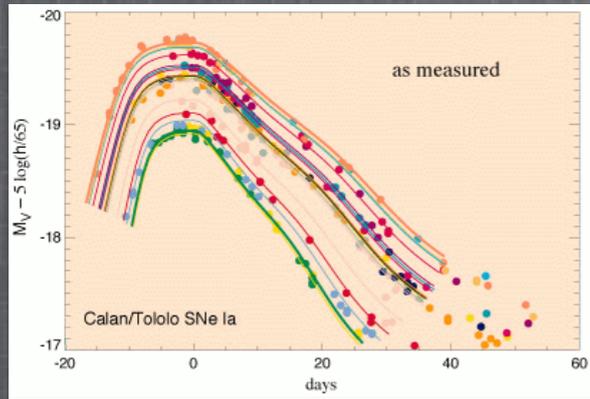
v. 04 February 2013

GAIA ALERS IN A NUTSHELL

- Gaia is the milestone ESA's space mission, to be launched in late-2013
- main target: ultra precise astrometry of billion of stars to map the Galaxy
- serendipitous project: **Gaia Science Alerts**
- alerts inform about events, which scientific value will be lost <u>if not followed-up</u> immediately
- uses daily data transmissions to detect anomalous and transient events from the whole sky
- alerts issued usually within **12-48h** after observation
- <u>limiting magnitude</u>: **~20 mag**
- <u>sampling</u>: about **70** observations per object over 5 years (grouped in pairs)
- anomalies detected and classified on **1-2** Gaia data points (photometry and low-res spectroscopy)
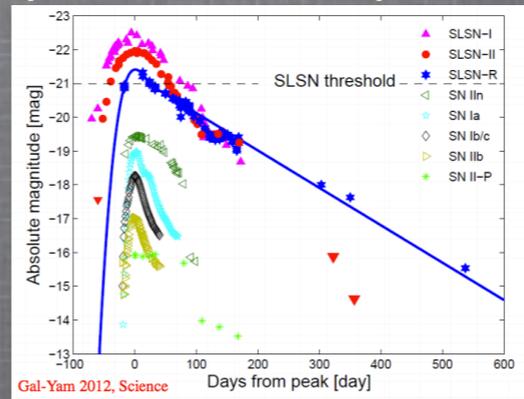- <u>thousands</u> of alerts per day possible (tuneable)

**an extensive ground-based follow-up is needed
for early verification of alerts, classification
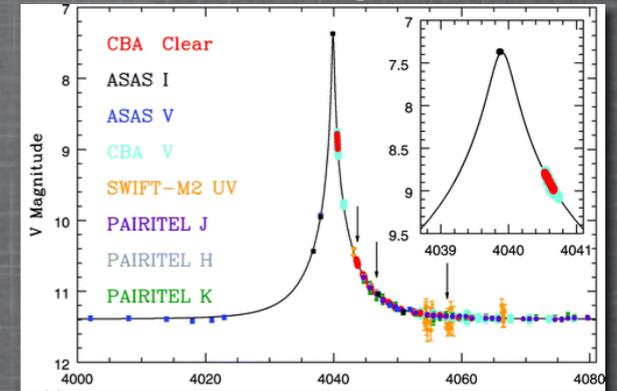and characterisation of objects**

SCIENTIFIC OPPORTUNITIES
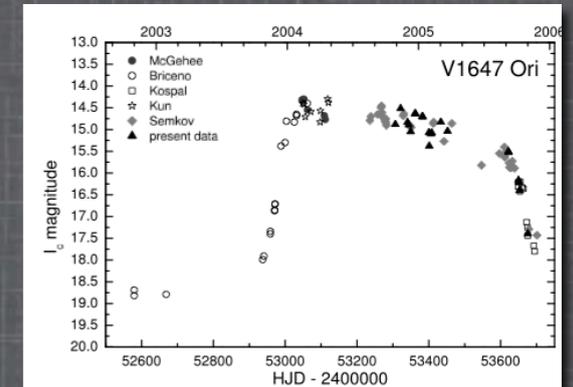
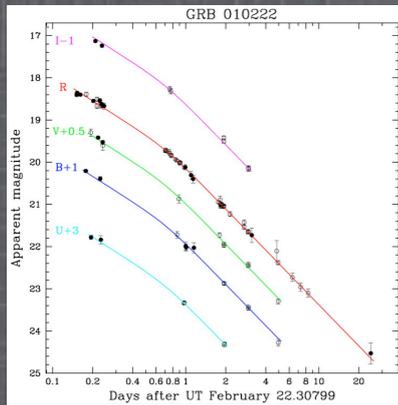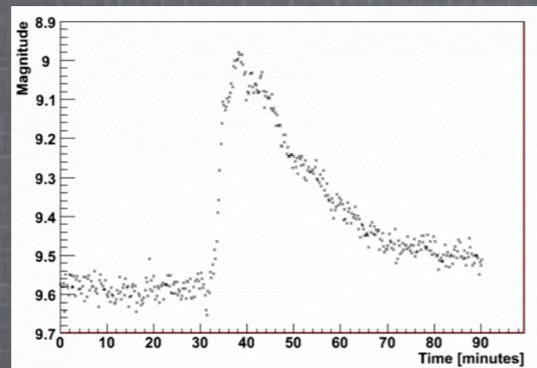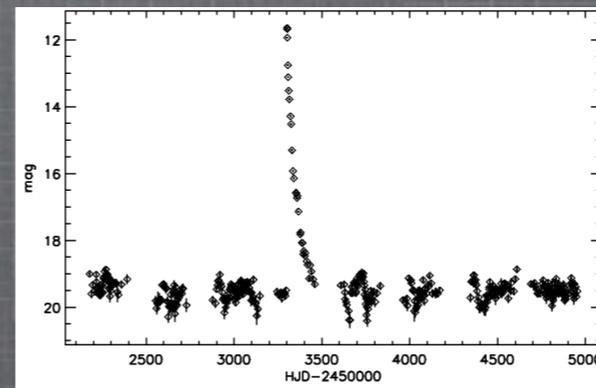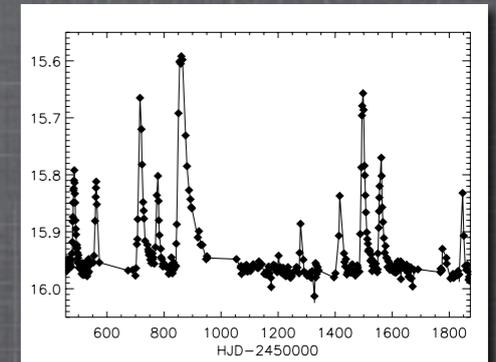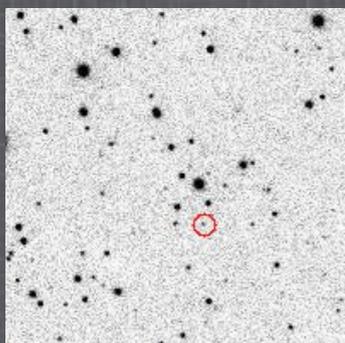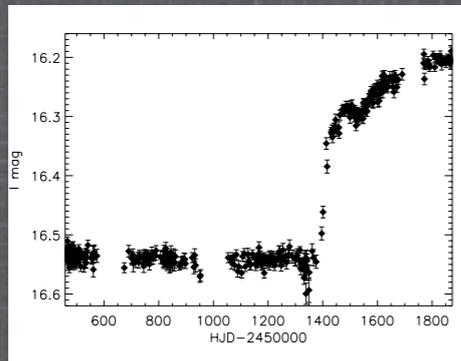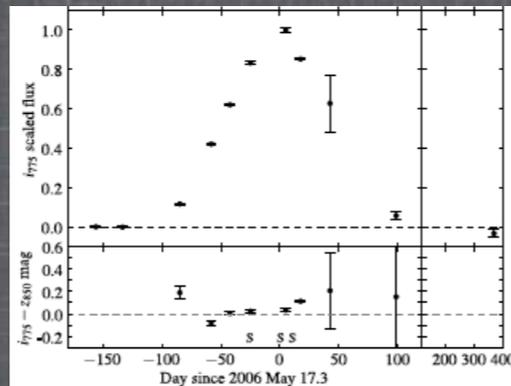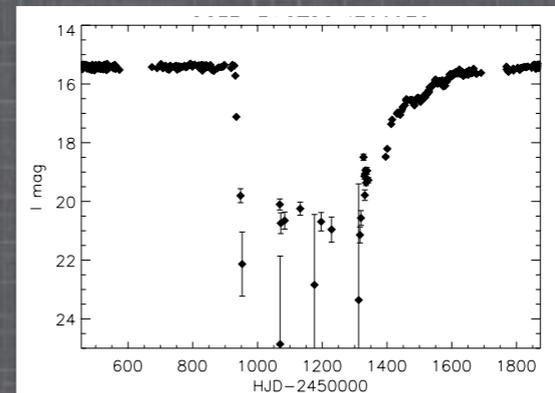# VERIFICATION PHASE

- needed to demonstrate if the Gaia detection and classification works

- test and fine-tuning of the detection thresholds

- only during the verification alerts are NOT public and are available only to a dedicated group of follow-up telescopes (Gaia-FUN-TO)

- Two main stages:
  - V1 : during the special scanning mode (Ecliptic Poles)
  - V2 : commences as soon as sufficient sky has been observed enough times to define the baseline catalogue

Verification Timeline

launch
29 September 2013

V1

V2

2013

2014

| Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov |

reaching L2
system shake-down

Ecliptic
Poles
scanning

data accumulation
over whole sky

verification phase
alerts released
internally

regular observing phase
alerts released publicly

Lukasz Wyrzykowski, 04.02.2013
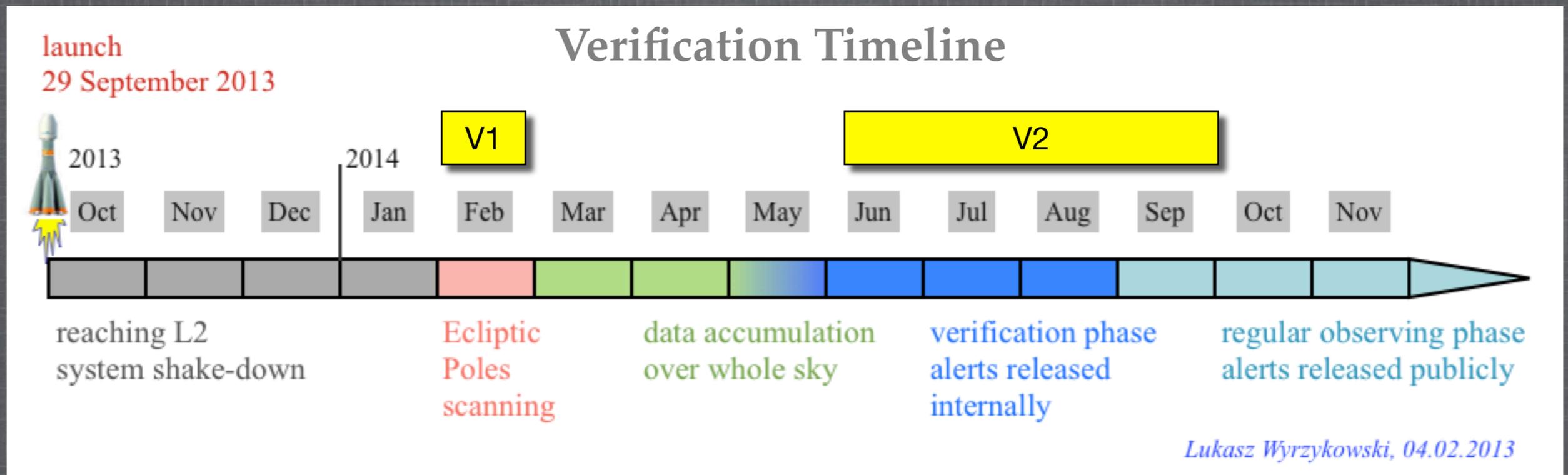
FOLLOW-UP REQUIREMENTS

Gaia Follow-Up Network for Transient Objects

- photometric follow-up (imaging) to confirm an alert
- multi-band photometric monitoring to build a light-curve and classify an alert
- low-, mid-, high-resolution spectroscopy to confirm and refine the classification of an alert based on Gaia data
- >0.5m telescopes on both hemispheres, east and west
- ideally, fully robotised telescopes, easy to schedule with ToO
- human operated telescopes also useful, response time within 24h
- reduced data available within 24h
- unified/standardised observational output, centralised repository of data
- rules on data policy, publications, etc. has to be decided and agreed (via Memoranda of Understanding)

PRE-LAUNCH TEST PHASE

◉ to prepare the telescopes and people for Gaia alerts

◉ using CRTS survey transients as proxy to Gaia

◉ a potential new partner needs to prove capability to perform the rapid follow-up in order to join the verification

◉ potential scientific outcomes
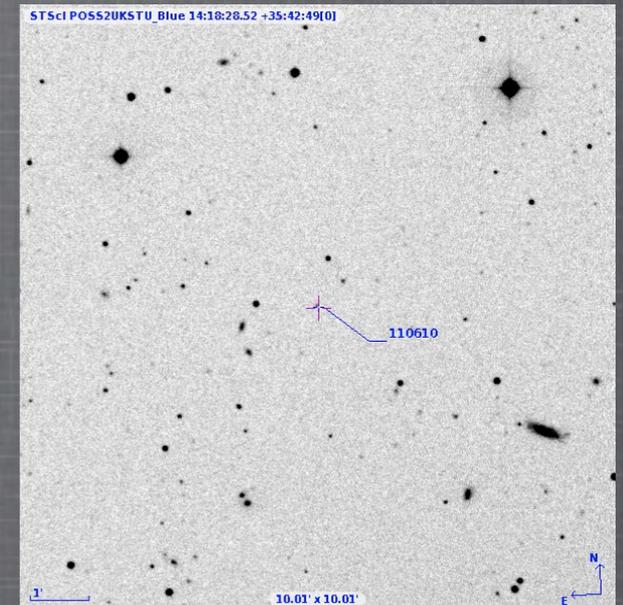
Simple guide for photometry:
1. observe any alert (e.g. from CRTS)
2. reduce the data *asap*
3. attach astrometry (WCS)
4. derive photometry (e.g. with SExtractor)
5. submit to Calibration Server
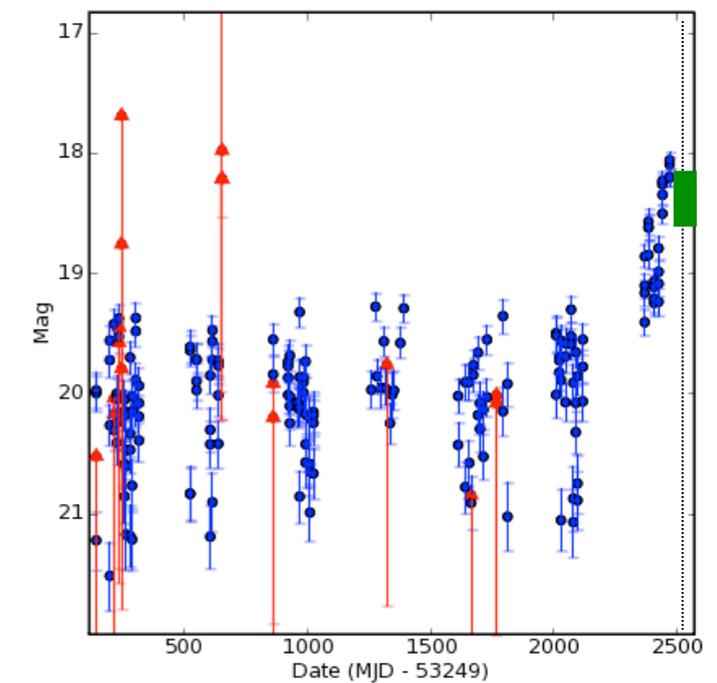
follow-up example
from Giuseppe Altavilla
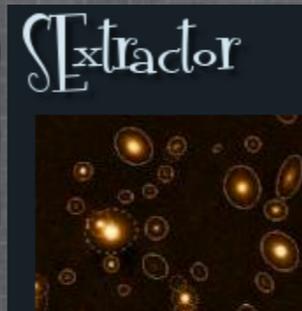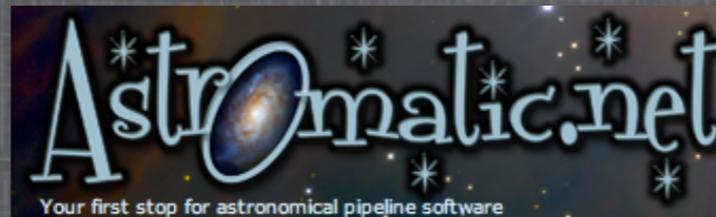
FOLLOW-UP CALIBRATION SERVER

for Gaia Science Alerts Photometric Follow-up

GAIA SCIENCE ALERTS

Cambridge Photometric Calibration Server manual

gaia

Łukasz Wyrzykowski & Sergey Koposov
Institute of Astronomy, University of Cambridge, UK
last update: 30 July 2012

UPLOADING THE FOLLOW-UP DATA

http://gaia020.ast.cam.ac.uk:5000 (temporary site)

Gaia Science Alerts Follow-u

gaia020.ast.cam.ac.uk:5000/uploader/

Follow-up Data Uploading Form

Event ID: ivo://nvo.caltech/voe
Hash tag: 536c ***************
MJD OBS: 55772.332731
Exposure time: 300
Filter: v
Sextractor catalog: [Choose File] 110621_V4.cat
[Submit]

Skyalert.org

Sponsored by the National Science Foundation
Browse Event Streams | Browse Skyalert Feeds | my Feeds and Alerts

Portfolio ivo://nvo.caltech/voeventnet/catot#1111181120424127237

From the CRTS stream.
Catalina Real-time Transient Survey
Position is 118.19689,12.37233 ± 0.0012
This portfolio initiated 2011-11-18 05:32:05
Also available is the JSON representation of this portfolio.

Your unique access name/pass
(provided by Cambridge)

RESULT OF CALIBRATIONS

Hi 536c *****************************

Upload done from IP 131.111.70.231 from hashtag 536 **********************
EventId : ivo://nvo.caltech/voeventnet/catot#1106101350644123477
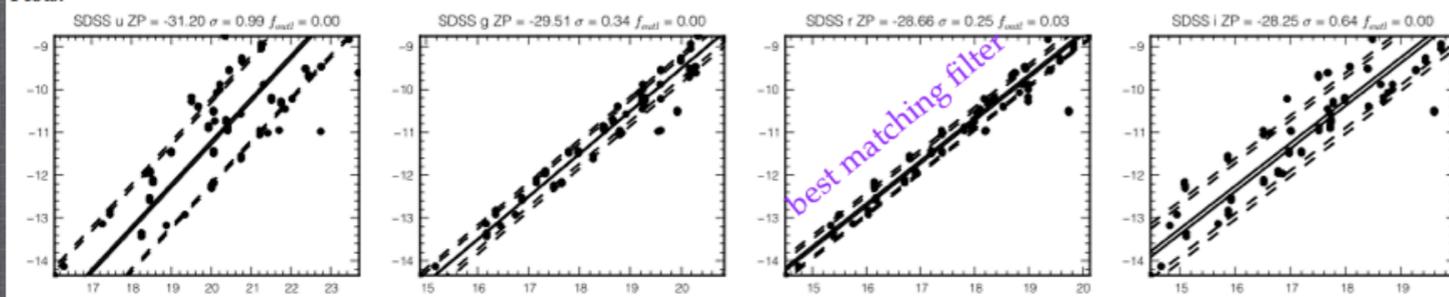Ra : 214.61884
Dec : 35.71373
Filter: SDSS / r ← best matching filter (data will be stored as in this filter)
Magnitude: 18.1738541917 +/- 0.0142 mag ← calibrated magnitude
ZP: -28.6588541917 ← zero point
Scatter: 0.248369741493 mag
Plots:

n Server

atabase:

Ra	Dec	N_follow-up
59.71914	1.55959	-
49.69022	21.57691	-

REQUIRED SEXTRACTOR FIELDS:

\# ALPHA_J2000   Right ascension of barycenter (J2000) [deg]
\# DELTA_J2000   Declination of barycenter (J2000) [deg]
then, either:
\# MAG_APER   Fixed aperture magnitude vector [mag]
\# MAGERR_APER   RMS error vector for fixed aperture mag. [mag]
or:
\# MAG_AUTO   Automatic aperture magnitude [mag]
\# MAGERR_AUTO   RMS error for automatic aperture mag. [mag]

SDSS u ZP = -31.20 σ = 0.99 f_{out} = 0.00

SDSS g ZP = -29.51 σ = 0.34 f_{out} = 0.00

SDSS r ZP = -28.66 σ = 0.25 f_{out} = 0.03
best matching filter

SDSS i ZP = -28.25 σ = 0.64 f_{out} = 0.00

access can be fully automatised

software developed by Sergey Koposov, IoA

NOW IT'S TIME TO JOIN!

Gaia Follow-Up Network for Transient Objects
GaiaFUN-TO

SIGN-IN HERE

www.tinyurl.com/telescopes-for-gaia

OR EMAIL US!

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(pron. Woocash Vizhikovsky)

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Gaia Science Alerts Working Group Wiki:
WWW: http://www.ast.cam.ac.uk/ioa/research/gsawg