



Gaia Science Alerts for Outreach: publication and follow-up

Anna Hourihane et al.

gaia

<http://gaia.ac.uk>



Science with the Gaia data

Gaia data policy: no proprietary data rights - but have to wait for data: first intermediate catalogue Summer 2016 (final ~2022)



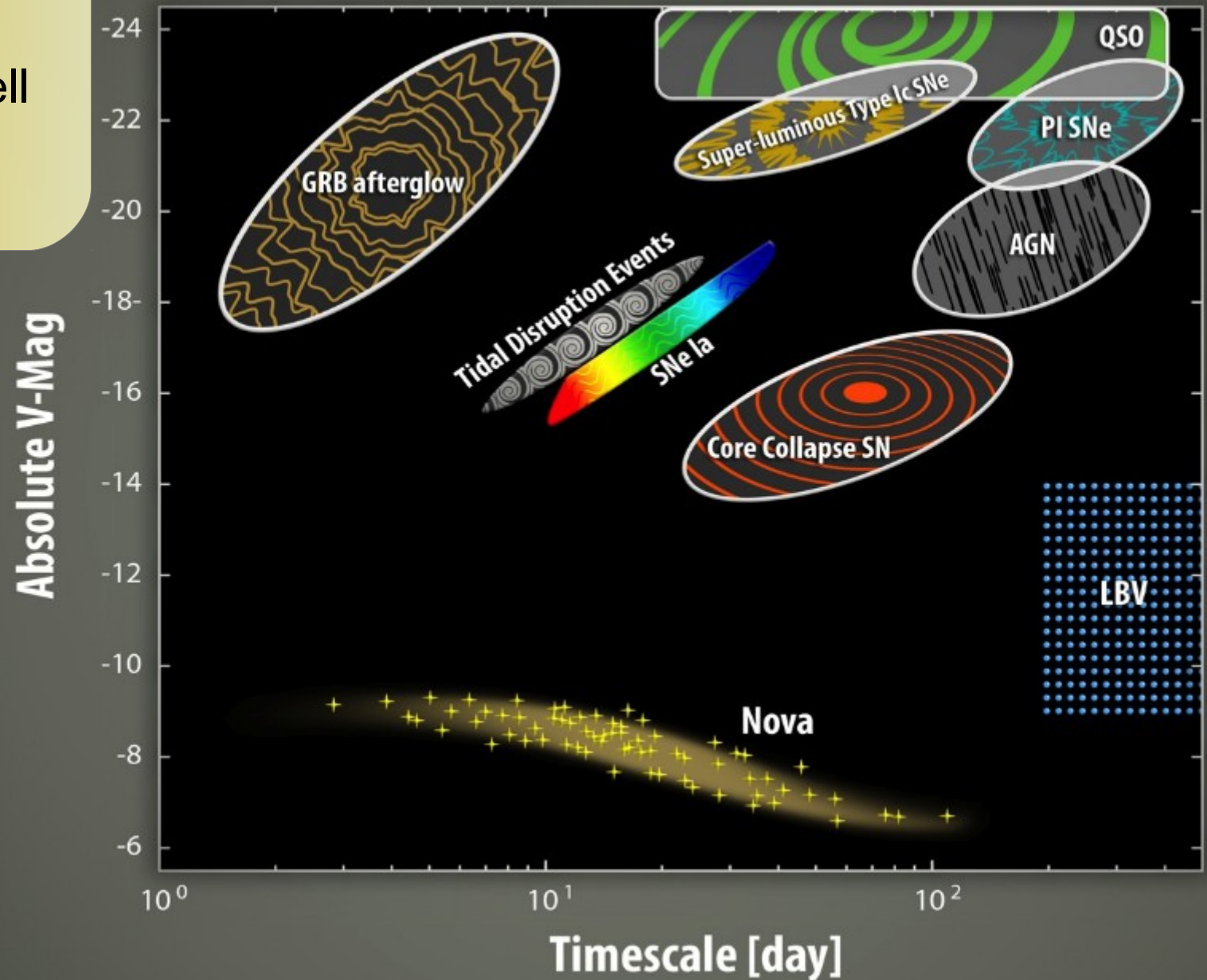
Photometric transients a.k.a. Gaia Science Alerts (GSA)
Fresh, near real-time data → exotic new objects every day!

Opportunity for schools/amateurs to get involved



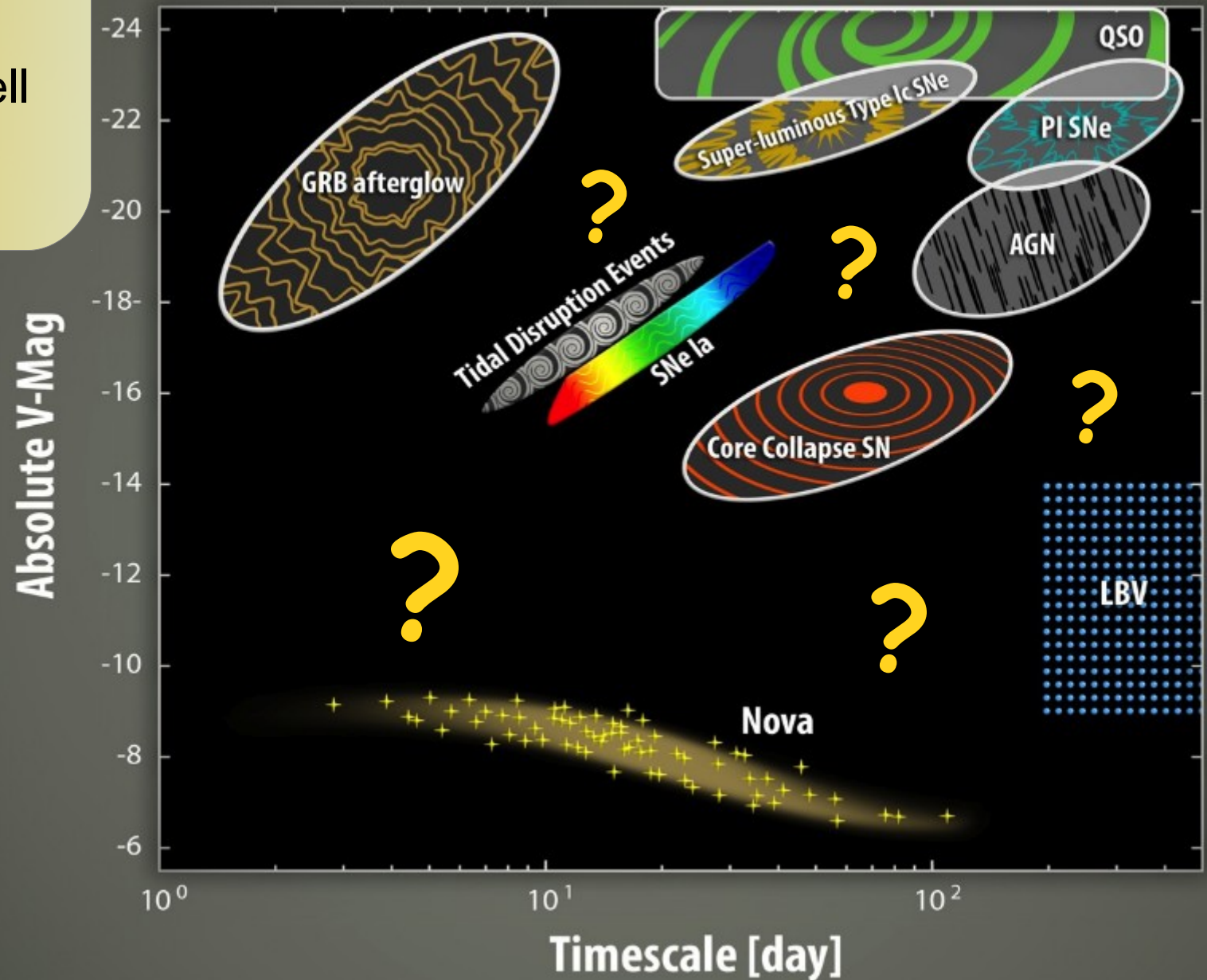
Photometric transients with Gaia

Gaia will cover 1000 sq. deg. per day with high spatial resolution and well known (but non-optimal) cadence



Photometric transients with Gaia

Gaia will cover 1000 sq. deg. per day with high spatial resolution and well known (but non-optimal) cadence






gaia

Alerts: from raw Gaia data to publication

Telemetry
ESOC

CU3
Initial Data Treatment (IDT)
ESAC 

CU5
Photometric processing
Cambridge 



Transits

Mitigation

Detection

Alert Candidates

Classification

Alerts

Publisher
Full list of alerts
Per-alert pages

Publication for outreach
gaia.ac.uk

Follow-up

Gaia Marshall

Calibration server

Alerts: from validation to automation

> 52 million alerts found by automatic detection software during validation

273 alerts published from Oct. 2014 – Jun. 2015: ~ 1 per day
112 classified

Rate is tuneable:
want few (10?) per day for outreach

Currently paused for system updates: plan to go live with automated alerts late Jan. 2016

Alerts discovered during verification ★
(Segment 0 data; coordinates are equatorial)
Scan coverage on 23 Jun 2015

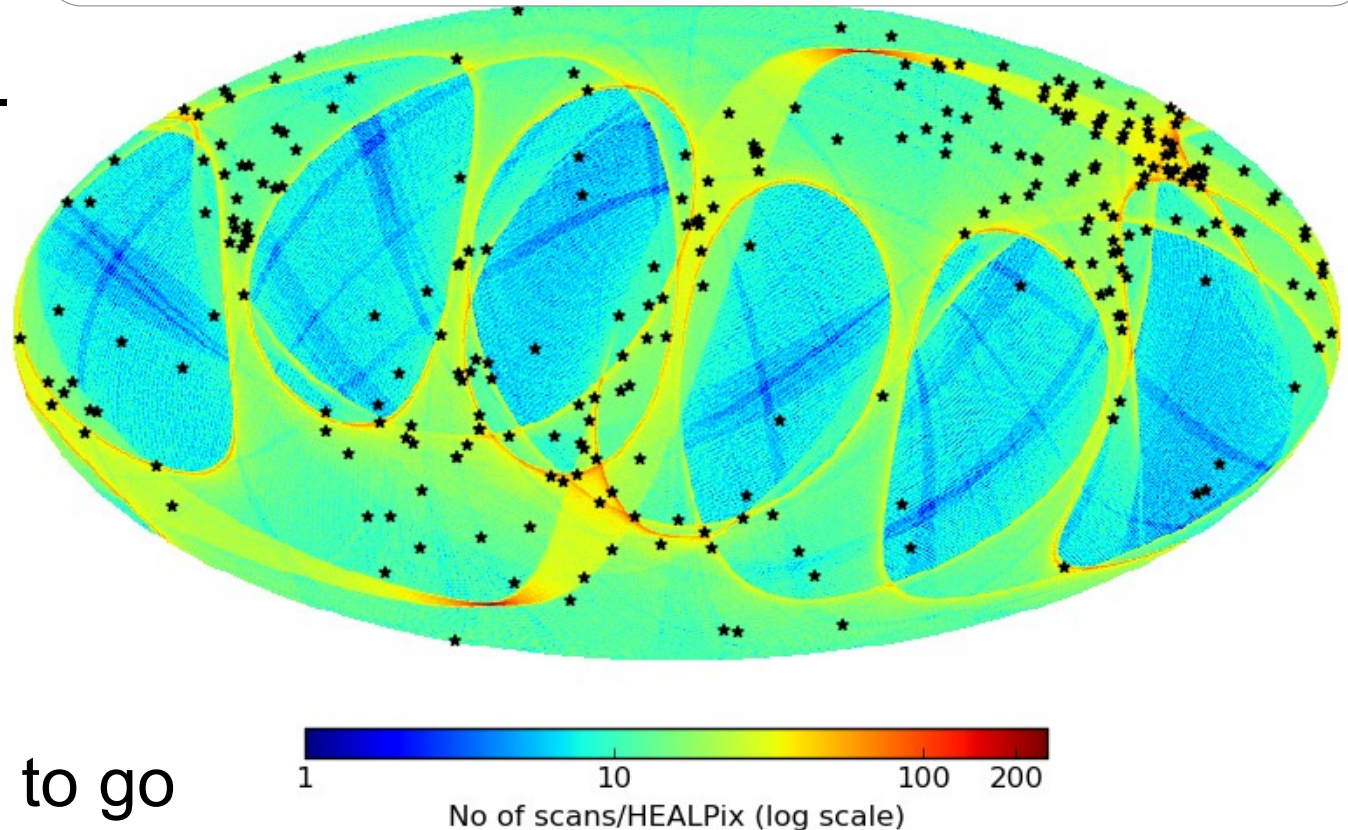


Table of Alerts published on outreach website: gaia.ac.uk/selected-gaia-science-alerts (Goska van Leeuwen)



Gaia in the UK

Taking the Galactic Census

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You are here: [Home](#) » Gaia Photometric Science Alerts: Validation Phase

Gaia Photometric Science Alerts: Validation Phase

Alerts science

▼ Guest Stars with Gaia

- Exploding stars

- Variable stars

10/7/2015 update: The Gaia Alerts Validation Phase is now complete. We are currently pausing publication of Gaia Alerts. The full Gaia alerts system will be operational by mid-2016.

Alerts

The table can be sorted by Name, UTC timestamp, RA, Dec, AlertMag, HistMag, HistStdDev, Class, Comment, or Published - click column heading to sort.

Essential data

Current

Columns:

Name	UTC timestamp	RA	Dec	AlertMag	HistMag	HistStdDev	Class	Comment	Published
Gaia15agm	2015-06-01 14:51:25	358.98623	-43.72412	17.35	Not known	Not known	SN Ia	candidate SN	9 Jun 2015, 11:27
Gaia15agl	2015-06-01 20:34:37	337.79327	-37.82735	18.71	Not known	Not known	unknown	candidate	9 Jun 2015, 11:27
Gaia14aaa	2014-08-30 02:22:31	200.25961	45.53943	17.32	19.22	0.42	SN Ia		14 Oct 2014, 12:26

Gaia's first supernova!

Last alert added: Tuesday, June 9, 2015 - 12:31

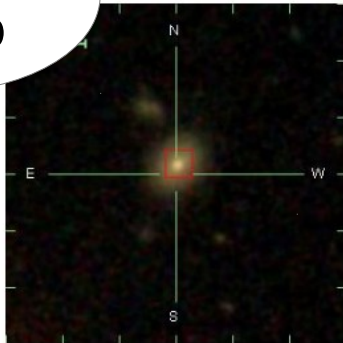
Enhanced per-Alert publisher pages to come: see presentation of A. Delgado (this meeting, Friday)

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Gaia14aaa

SDSS sky stamp

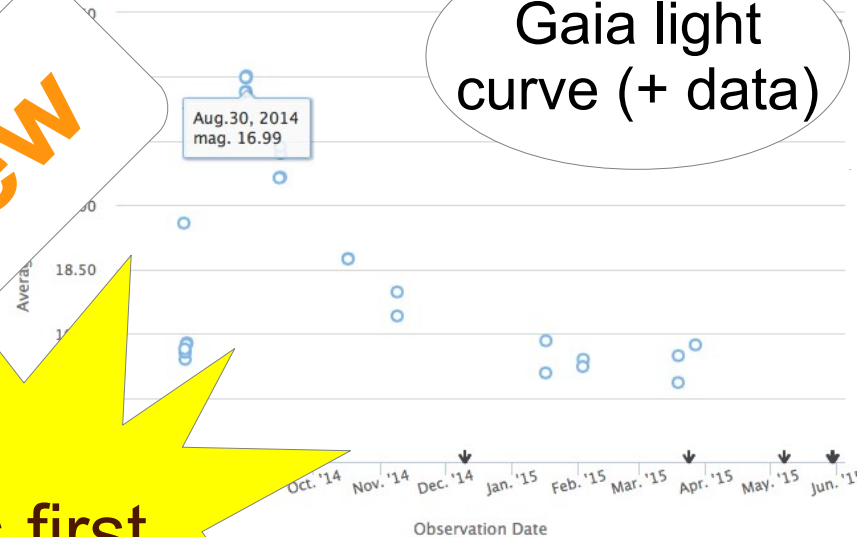


Other surveys detections
None
Comments
None

RA (deg)
200.25961
Dec (deg)
45.53943
Julian date
Observed
Aug. 30, 2014
Alert magnitude
17.32
Historic magnitude
19.22
Historic StdDev
0.42
Class
SN Ia
Published
None

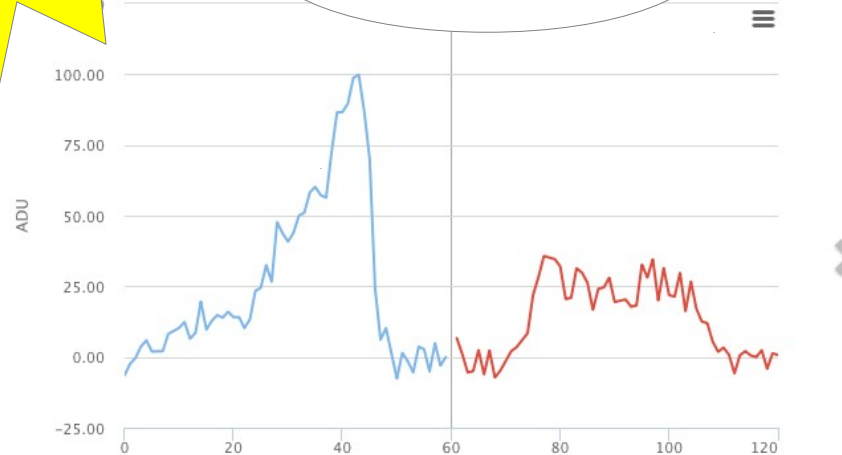
New

Gaia light curve (+ data)



Gaia's first
Supernova!

BP/RP spectra



Enhanced data

Scroll down and select one row in the table below to display the corresponding spectrum.

Date	JD	Average magnitude
Aug. 1, 2014, 6:04 p.m.	2456871.25332	19.06
Aug. 2, 2014, 7:51 a.m.	2456871.82765	19.06
Aug. 30, 2014, 12:35 a.m.	2456899.52493	17.28
Aug. 30, 2014, 2:22 a.m.	2456899.59894	17.32
Aug. 30, 2014, 6:36 a.m.	2456899.77509	17.26
Aug. 30, 2014, 8:22 a.m.	2456899.84911	17.32
Sept. 15, 2014, 12:47 a.m.	2456915.53313	17.99
Sept. 15, 2014, 2:34 a.m.	2456915.60713	18.06

Validation: follow-up observations (professionals)



Observatorio de la Roque de los Muchachos, La Palma,
Canary Islands



La Silla observatory, Chile



Mercator 1.2m, La Palma



William Herschel Telescope, 4.2m, La Palma



NTT 3.6m, Chile

Validation: follow-up observations (professional)

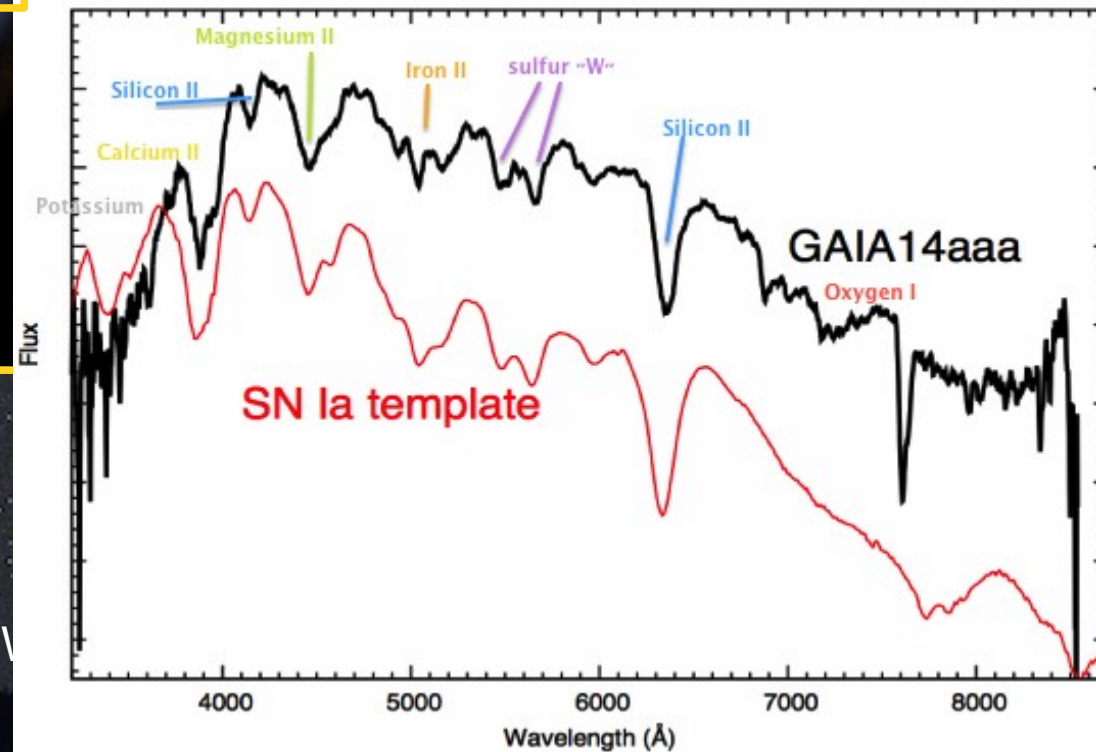
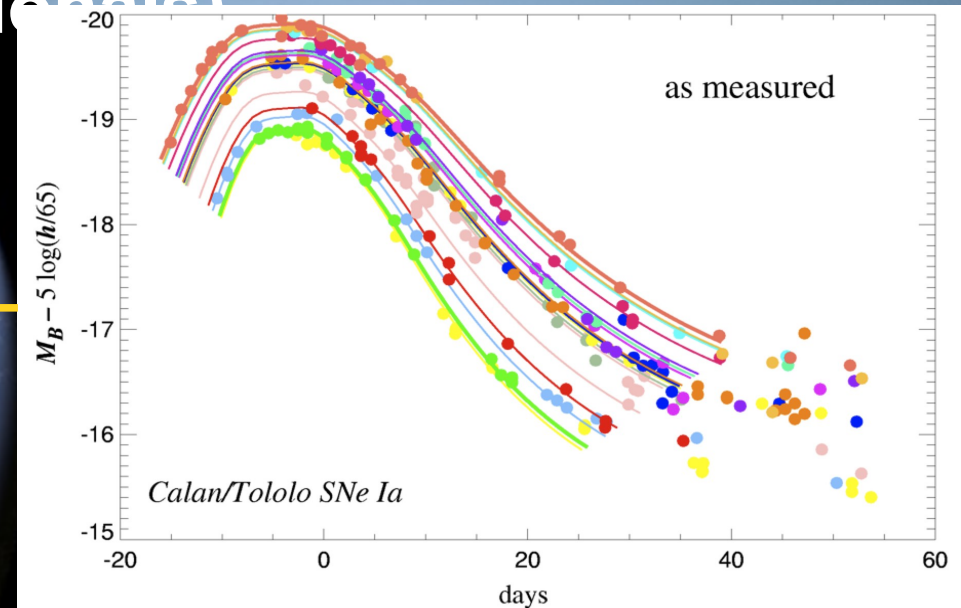
Follow-up by
professionals

Observatory de la Roque de los
Concepción, La Palma,
Canary Islands

Datasets for outreach -
High-quality:

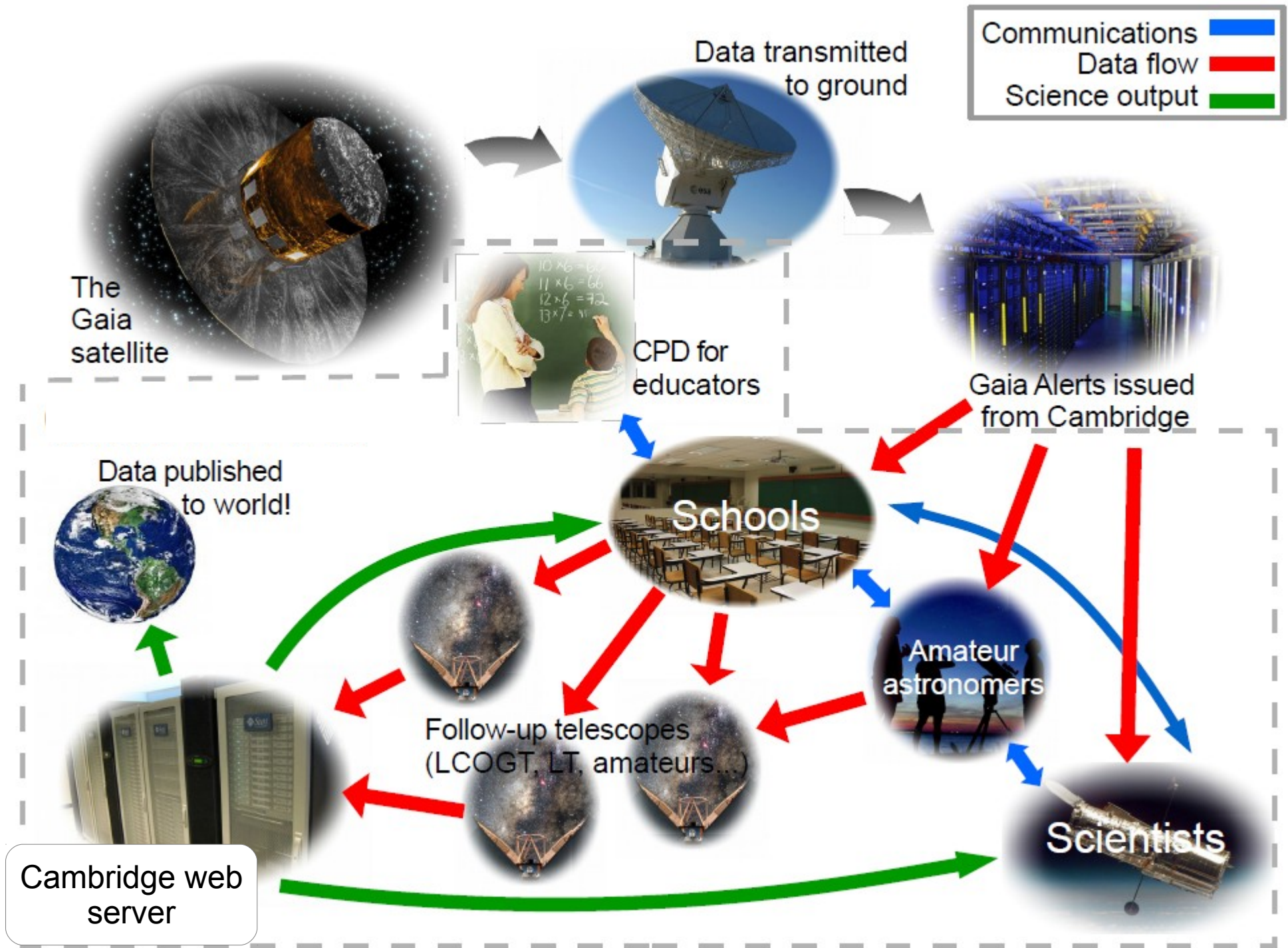
- Template light curves
- Template spectra

for educational materials
(e.g. classroom activities of
S. Bartlett)



NTT 3.6m, Chile

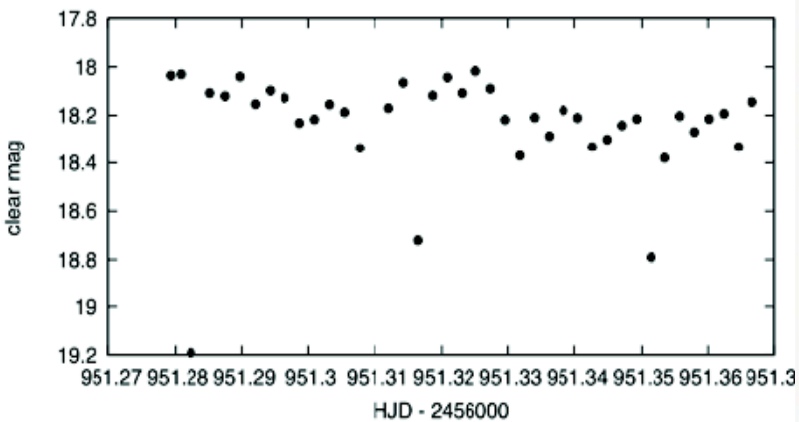
Alerts for outreach follow-up data flow



Gaia14aae:

Amateur contribution

Amateur (Enrique de Miguel, CBA) follow-up light curve: discovered eclipses



See presentation of
H. Campbell
(this meeting, tomorrow
morning)

Amateurs Help Discover Rare Eclipsing Binary

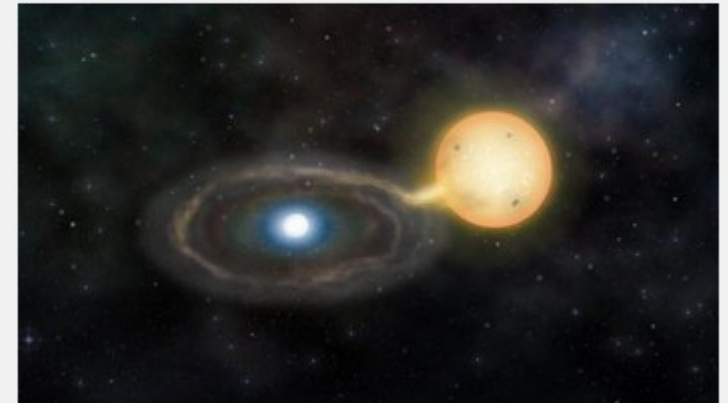
By: David Dickinson | September 1, 2015



Amateur and professional astronomers worked together to discover a rare eclipsing binary system — and a chance to study a supernova before it happens.

A collaboration of amateur and professional astronomers has uncovered a rare variety of eclipsing binaries. The European Space Agency's Gaia satellite first imaged the eclipsing pair, named Gaia14aae, in August 2014. Researchers took notice of Gaia14aae when it suddenly flared five-fold within a single day.

The Gaia14aae system is composed of a white dwarf in a tight orbital embrace with a larger (by volume) companion. The tilt of orbit is along our line of sight, so observers on and near Earth — such as the Gaia mission in space — see an eclipse of the pair once every 50 minutes.



An artist's conception of the Gaia14aae star system.
Marisa Grove / Institute of Astronomy

A worldwide pro-am collaboration carried out follow-up observations of Gaia14aae, cinching its nature as an eclipsing binary star. This effort included the Centre for Backyard Astrophysics (CBA), a group of amateurs who monitor cataclysmic variables using small telescopes in backyards around the world. CBA members kept eyes on the system after Gaia's initial sighting of its outburst, as did a collaboration of 86 professionals based at facilities including the Catalina Real-time Transient Survey, PanSTARRS-1, and ASAS-SN based in Chile and Hawaii.

z band magnitudes for Gaia14aae.

The initial determination that Gaia14aae was eclipsing was made by the "Centre for Backyard Astrophysics" project (Skillman & Patterson 1993); who established a preliminary period for Gaia14aae of 49.7 min (de Miguel 2014). Following this, an intensive photometric monitoring campaign was undertaken for Gaia14aae at a number of telescopes, as detailed in Table 1. In ad-

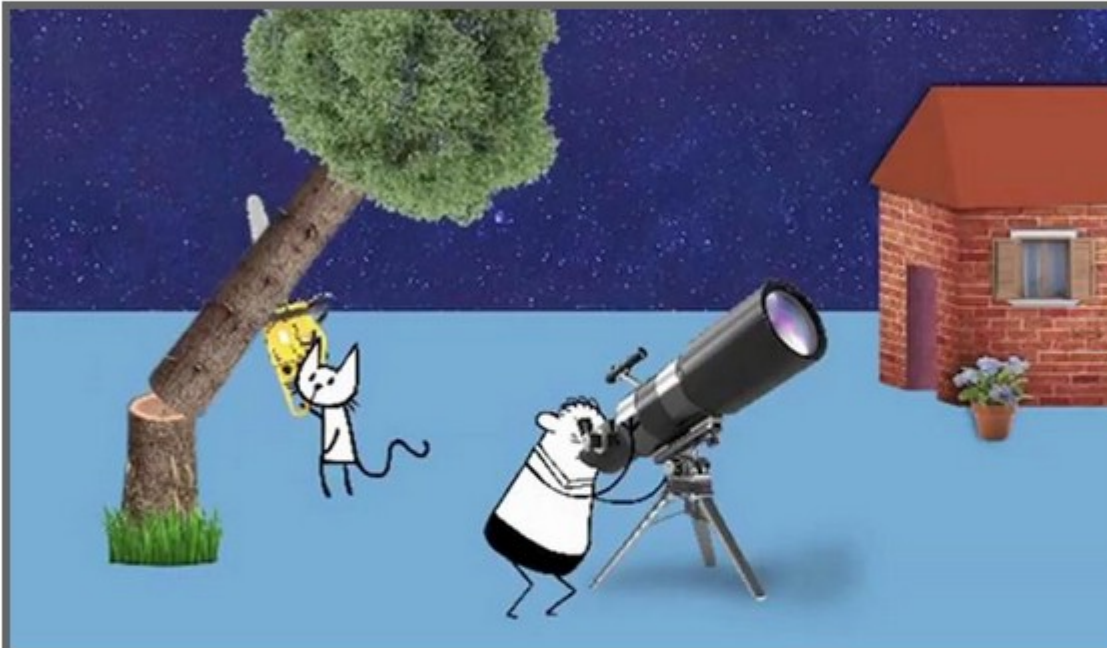


Gaia in the UK

Taking the Galactic Census

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Gaia in one minute

Watch one of our cartoons explaining Gaia and its science. [Choose a cartoon.](#)

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One billion pixels for one billion stars

Gaia is Europe's mission to take the first reliable census of the Milky Way

Launch date and time: 19 December 2013, 09:12:19 UTC. Gaia reached its operational orbit on 14 January 2014. On 25 July 2014 [Gaia started routine operations.](#)

Watch the [replay of Gaia's launch.](#)

Hosts all of our GSA outreach content:

- Published alerts
- Context
- Educational materials + multimedia
- “Useful tools” to come

Gaia in one

Why we need Gaia



What's the big about Gaia?



Watch cartoon

How do we benefit from space?



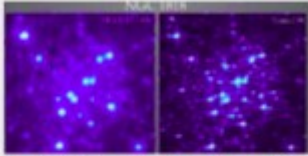
Can I be part of



Educational resources and teacher training funded by STFC. Proposal to develop further materials to deliver GSA schools outreach programme

Alerts

Alerts latest



Just a test. [Pastrami](#) [alcatraz](#) [ground](#) @round,
picanha corned beef pig chicken kielbasa ribeye
sirloin...

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Science alerts selections

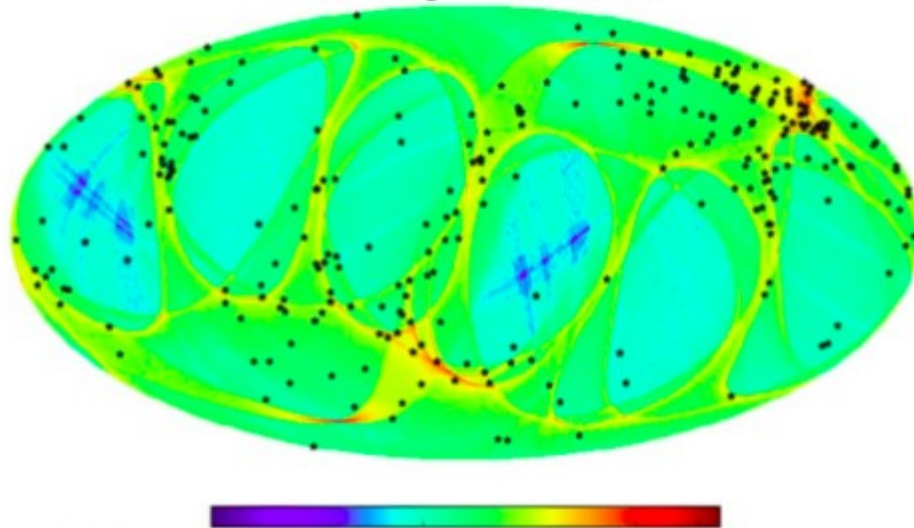
Name	UTC timestamp	RA	Dec	AlertMag	Class
Gaia15agm	2015-06-01 15:51:25	358.98623	-43.72412	17.35	SN Ia
Gaia15agl	2015-06-01 21:34:37	337.79327	-37.82735	18.71	unknown
Gaia15agh	2015-06-03 03:38:28	337.70660	-43.04732	18.80	unknown
Gaia15agj	2015-06-03 06:29:29	147.74882	37.96674	18.49	SN Ia
Gaia15agi	2015-01-24 09:32:33	43.08181	60.57638	18.97	unknown
Gaia15agh	2015-05-25 02:24:24	181.02133	14.06805	17.58	SN Ia
Gaia15agg	2015-05-29 16:41:03	64.10105	-28.49464	18.96	unknown
Gaia15agf	2015-05-29 09:17:25	330.62236	-20.52945	18.54	SN Ia
Gaia15age	2015-05-29 23:00:29	83.48209	-20.78890	16.96	unknown
Gaia15agd	2015-05-29 08:24:33	171.57245	28.36723	18.42	SN II
Gaia15agc	2015-05-30 08:38:04	184.59674	35.61824	17.84	SN Ia
Gaia15agb	2015-05-24 11:45:43	134.27829	-8.72500	18.34	unknown

[Description goes here]

[Get the latest selection.](#)

[View all alerts.](#)

Scan coverage on 08 Nov 2015



gaia.ac.uk

Alerts Gateway

Will lead schools to objects requiring data

Will provide supporting information on how to observe with LCOGT

And how to analyse the data (provided by the Faulkes Telescope Project)

Goska van Leeuwen

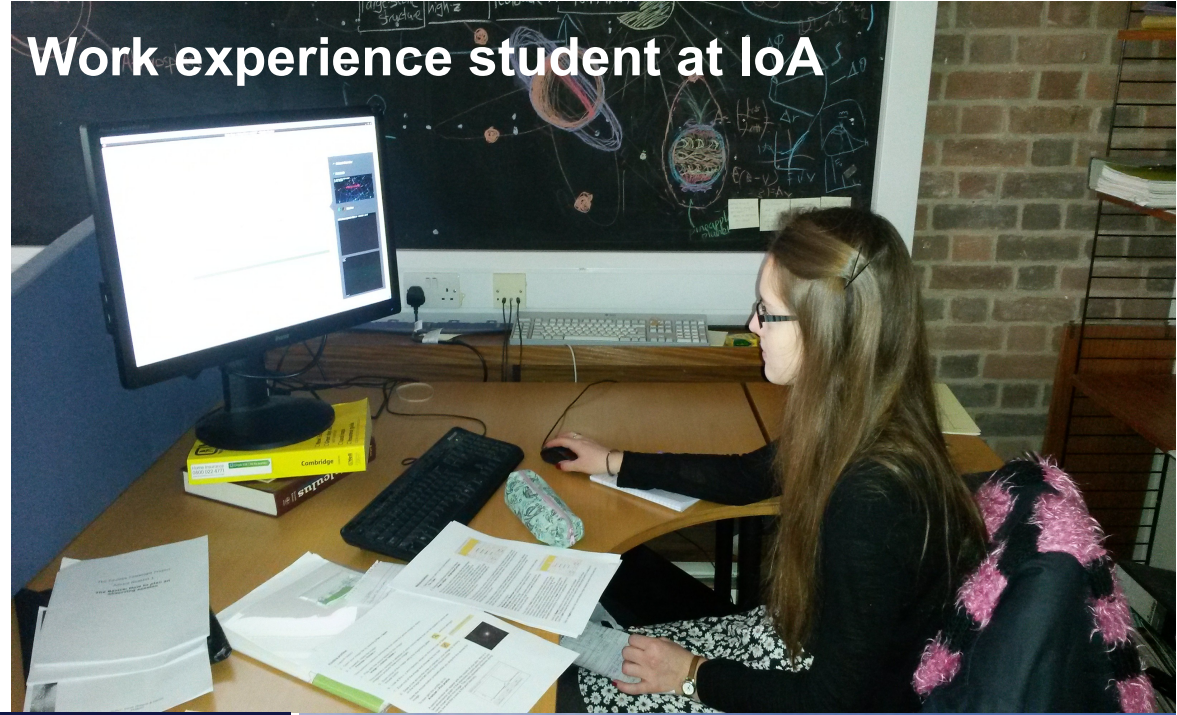
Photometric followup with robotic telescopes

Gaia sampling is sparse (not designed as transient survey):
need follow-up →
schools/amateurs: interface
through gaia.ac.uk

Robotic facilities:

- Faulkes Telescope/LCOGT (EU schools)
- National Schools' Observatory/LivTel
5% of time for schools (UK/Ireland)
- Bradford telescope
- PIRATE Telescope

Work experience student at IoA



LCOGT



Liverpool Telescope

Further activities and dissemination

Hands-on follow-up with selected schools during validation phase (mostly through FTP) – now we have the first set of resources showing how to do the follow-up (FTP/S. Bartlett):
teacher training (CPD) to start 2016



Advertise through educational networks
In UK (IoP, National STEM Centre, ESERO-UK...)
and through science fairs

Proposal for a series of
smartphone apps in the
pipeline: need funding!



Gaia outreach UK acknowledgments

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