Gaia mission and its transients

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Gaia has already been revolutionising the astronomy with its first data release and this is still just the beginning. In this poster, we present the highlights of the Gaia Science Alerts programme, which is searching for transients and temporary astrophysical events. In particular, we concentrate on an interesting cataclysmic variables, tidal disruption event candidates and microlensing events. We also present the OPTICON-supported network of small telescopes for Gaia alerts follow-up.

1 Introduction

Gaia is the key space mission of the European Space Agency (ESA), launched on 19th Dec. 2013 and collecting data from all the sky since 2014. The main aim of the mission is to collect the high-precision astrometric data (positions, parallaxes and proper motions) for about one billion bright objects on the sky (reaching $V = 20^{\mathrm{m}}$). Map of the all alerts detected as of on 15 Dec. 2017 (about 3000) is presented in Fig. 1. The map is in galactic coordinates and the background colours indicate number of Gaia scans since 2014. Currently Gaia finds about 10 alerts per day on both hemispheres, including the Galactic Plane.

The nominal mission is scheduled for 5 year during which the entire sky will be scanned on average 70 times, with some parts (around 45 deg ecliptic) will be observed for more than 200 times (Wyrzykowski & Hodgkin, 2012). Repeated observations and fairly quick data processing chain (within 48h) allow Gaia to join other surveys looking for transient events (Wyrzykowski et al., 2014; Hodgkin et al., 2013). All the alerts are publicly available for everyone[1].

Here we present the highlights from the survey from 2016–2017 in form of an illustrated guide. Fig. 2 shows multi-band follow-up observations of a mysterious cataclysmic variable, candidate for a new X-ray binary, Gaia16bnz (Wevers et al., 2018, in prep.).

The candidate for a tidal disruption event is shown in Fig. 3. Gaia lightcurve showed a slowly rising and long-lasting (more than a year) flare, coinciding with the centre of a galaxy, previously marked as a broad line QSO at $z = 0.2485$. The flare was accompanied with an increase of X-ray emission. The spectrum at the flare showed an increase in blue continuum as well as broadening of Balmer emission lines (Cannizzaro et al., 2018, in prep.).

More than 20,000 photometric follow-up data points were collected by a network of professional and amateur observers (Twitter hashtag: #gaia16aye). It reached about 11 mag at its peak and was well visible for more than a year. The event

[1] http://gsaweb.ast.cam.ac.uk/alerts

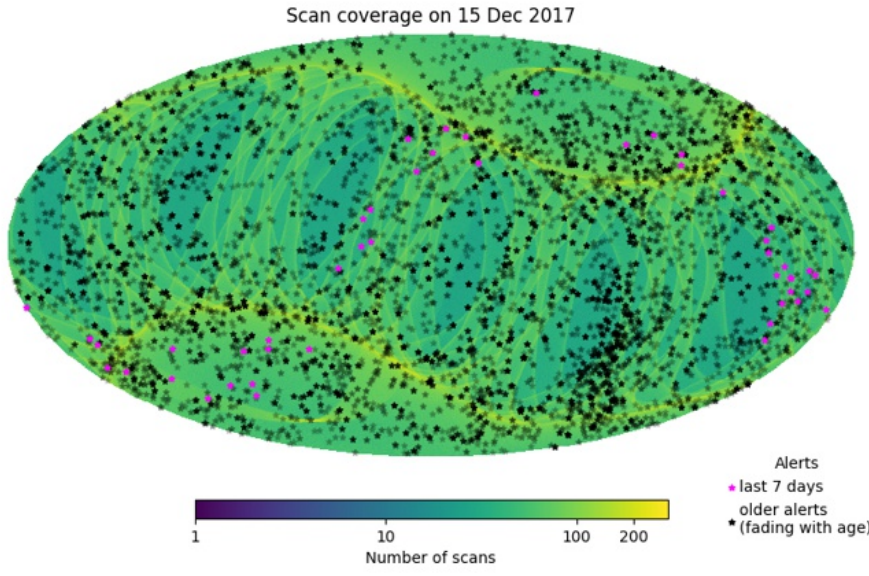

Fig. 1: Map of the all alerts detected as of on 15 Dec. 2017, with magenta marking alerts found in the previous 7 days. Credit: Gaia Science Alerts group, IoA, Cambridge.

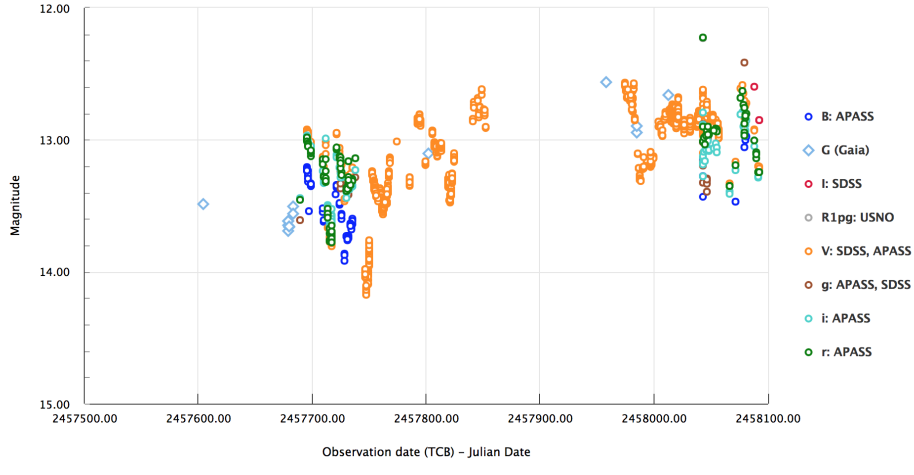

Fig. 2: Gaia16bnz and multi-band follow-up observations of a new X-ray binary.

presented in Fig. 4 showed multiple caustic crossing events due to both rotation of the binary lens and Gaia-Earth motion around the Sun (Wyrzykowski et al., 2018, in prep.). Gaia has detected already about 30 microlensing events mostly in the disk. In 2022 Gaia will provide the astrometric measurements for these microlensing events, yielding exact mass and distance determination.

Finally, the map showing the locations of numerous telescopes from around Europe and beyond, taking part in the follow-up campaigns of Gaia alerts, coordinated

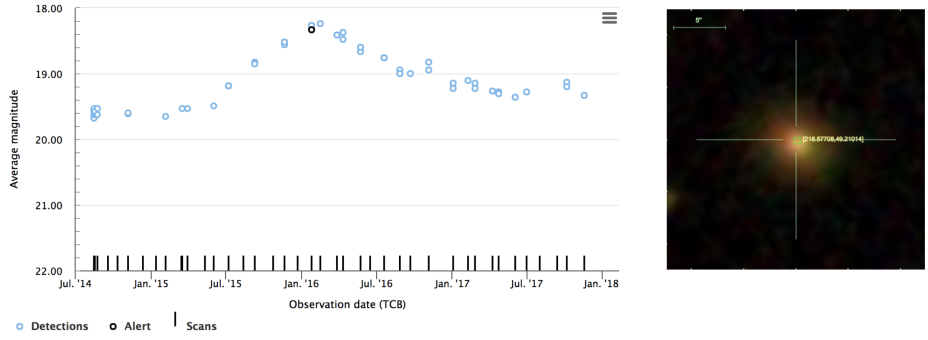

Fig. 3: Candidate for a tidal disruption event, Gaia16aax.

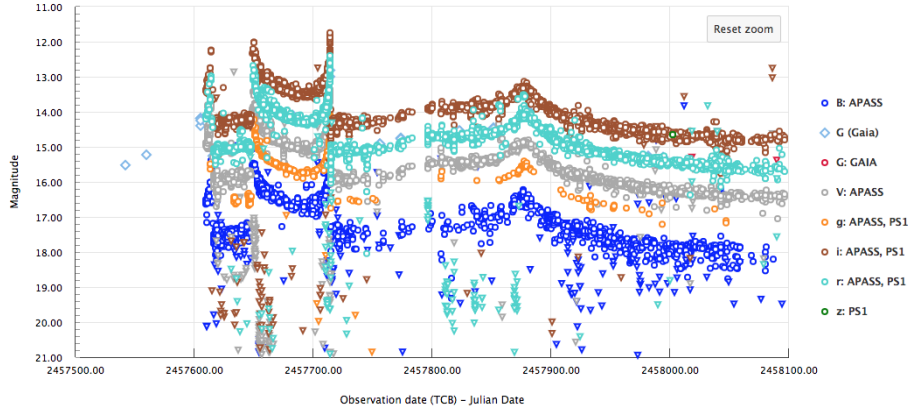

Fig. 4: First binary microlensing event found in the Northern Galactic Disk, Gaia16aye.

under the Time-domain work package of the European OPTICON H2020 grant is shown in Fig. 5. All telescopes are welcome to join the network and to take part in coordinated observations of the most interesting Gaia alerts.

2 Conclusions

Gaia is a unique transient survey, detecting supernovae, tidal disruption events, cataclysmic variables, and microlensing events. It will continue alerting on interesting astrophysical phenomena at least until 2021, so we hope for more exciting results to report on in near future.

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Fig. 5: The locations of numerous telescopes from around Europe and beyond, taking part in the follow-up campaigns of Gaia alerts.

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