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Transient characterization using the Virtual Observatory



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(4) ISDEFE

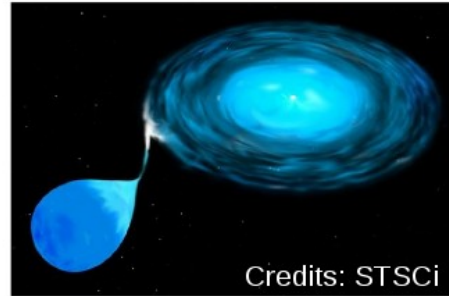
Transients can be defined as astrophysical phenomena whose duration is significantly lower than the typical timescale of the stellar and galactic evolution (from seconds to years in contrast to millions or billions of years). Supernovae, novae, gamma-ray burst, ..., are some examples of transient events.

In most cases, a **fast, multiwavelength characterization** is required to properly understand the true nature of the transient. Follow-up observations made by both professional and amateur astronomers using ground- and space-based facilities are key to achieve this goal.

Here we propose an alternative approach using the existing information in astronomical archives and benefiting from the advantages that the **Virtual Observatory** offers in terms of discovery, access and analysis of astronomical data. Using STILTS and two services developed in the framework of the Spanish Virtual Observatory (SVO Discovery Tool and VOSA) we will describe the work done so far in the **validation and characterization of the Cataclysmic Variables identified by the Gaia Science Alerts project**.

Target selection: Gaia alerts

Cataclysmic Variables



- H α emission due to accretion.
- Close binaries (WD+Main Seq)
→ composite SEDs.
- Well defined locus in the HR diagram.

On a daily basis:

- Object selection: class “unknown” & comments “candidate CV”

Gaia Alerts Alerts Index All-Sky Alerts Search Surveys-ATels Tools About

Index to Gaia Photometric Alerts

If you publish any results based on these Gaia discoveries, we would appreciate an acknowledgement along the lines of: "We acknowledge ESA Gaia, DPAC and the Photometric Science Alerts Team (<http://gsaweb.ast.cam.ac.uk/alerts/>)"

These are all the alerts raised to date. You might wish to view or download these as a [table in CSV format](#) or using any of the tools described in [this page](#). See [here](#) for an explanation of the columns.

Show entries Search:

Name	TNS	Observed	RA (deg.)	Dec. (deg.)	Mag.	Historic mag.	Historic scatter	Class	Published	Comment
Gaia19egw	AT2019qw	2019-09-23 18:15:40	48.90355	42.47055	19.28	20.31	0.22	unknown	2019-09-25 13:50:32	Known dwarf nova QY Per gets brighter by 1 mag.
Gaia19egu	AT2019qu	2019-09-18 02:50:57	44.05362	-10.56652	15.10	18.44	1.69	unknown	2019-09-25 13:48:10	Gaia source brightens by ~4 mags, previous outburst, candidate CV

- **Automated workflow:** SVO Disc. Tool, VOSA and STILTS → **List of candidates**

VO Service #1 : SVO Discovery Tool



Gaia Alerts search

980 alerts of a total of 12824 are of class "unknown" and contains "CV" in the comments field.

Gaia Alerts list updated: Sat Jul 04 02:01:07 CEST 2020

Results summary updated: Sat Jul 04 06:45:17 CEST 2020

[Download table \(CSV\)](#)

[Send Table to SAMP Hub](#)

Alert	Date	Pub. Time	RA	Dec	Closest Simbad Target	Params	Spectra	HR diagram
Gaia20dbd	2020-07-01 08:44:44	2020-07-02 08:37:10	111.30532	-40.0292	2MASS J07251447-4003200 Star dist: 95.858 arcsec	21 Parameters	0 Spectra	No good Gaia-DR2 parallax found
Gaia20dau	2020-06-30 09:19:47	2020-07-02 08:32:11	156.07049	-42.89801	TYC 7717-1707-1 Star dist: 163.453 arcsec	6 Parameters	0 Spectra	Main Sequence? Plot
Gaia20dai	2020-06-29 03:18:59	2020-06-30 18:34:32	156.26114	-38.44571	CRTS J102516.2-382803 Variable Star of RR Lyr type dist: 177.554 arcsec	1 Parameters	0 Spectra	No good Gaia-DR2 parallax found
Gaia20daf	2020-06-27 15:25:35	2020-06-29 21:46:54	164.16589	-31.37005	Gaia DR2 5451246777838453888 Quasar dist: 0.355 arcsec	6 Parameters	0 Spectra	CV cand. Plot

Physical parameters

Parameter	Number of results found	Number of valid results	Min	Max	Mean	StdDev	
Sptype	0						
SpaceVel	0	0	?	?	?	?	
Teff	8	8	5108.75	6538.82	5815.43	542.66	See results
Vsini	0	0	?	?	?	?	
Logg	4	4	4.233	4.493	4.401	0.121	See results
M/H	3	3	-0.784	-0.097	-0.419	0.346	See results
ColorExcess	4	4	0.115	0.386	0.265	0.113	See results
Parallax	4	3	0.395	0.395	0.395	0	See results
RadialVel	0	0	?	?	?	?	
Age	0	0	?	?	?	?	
ProperMotion	22	22	-128	16	-7.577	36.205	See results
GAIA_RV	2	0	?	?	?	?	See results
GAIA_PARALLAX	2	1	0.395	0.395	0.395	0	See results

Physical parameters gathered after querying all Vizier catalogues

VO Service #1: SVO Discovery Tool



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Alert	Date	Pub. Time	RA	Dec	Closest Simbad Target	Params	Spectra	HR diagram
Gaia19fdn	2019-11-16 14:48:51	2019-11-18 14:26:12	151.31404	19.18553	SDSS J100515.38+191107.9 Cataclysmic Binary Candidate dist: 0.273 arcsec	5 Parameters	40 Spectra	CV cand. Plot
Gaia19fcr	2019-11-15 05:19:02	2019-11-17 12:52:04	6.92182	-24.66303	1RXS J002743.1-243951 X-ray source dist: 25.793 arcsec	7 Parameters		

VO Spectrum Services

Services	Results
	2
	40

Service name	Results
EHST/HST/SSAP	13
ESO Spectra	27

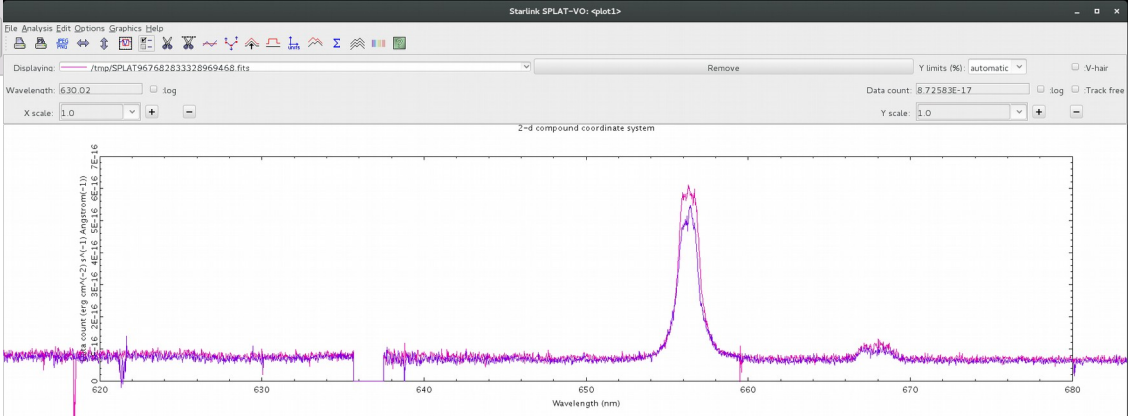
Object: 151.31404 19.18553

ESO Spectra (datalink)
(27 results found):

Download selected

Instrument	Product	
<input type="checkbox"/> XSHOOTER	ADP.2015-03-03T11:28:22.910	Send to SAMP Hub
<input type="checkbox"/> XSHOOTER	ADP.2015-03-03T11:28:23.257	Send to SAMP Hub
<input type="checkbox"/> XSHOOTER	ADP.2015-03-03T11:28:23.797	Send to SAMP Hub
<input type="checkbox"/> XSHOOTER	ADP.2015-03-03T11:28:25.060	Send to SAMP Hub
<input type="checkbox"/> XSHOOTER	ADP.2015-03-03T11:28:25.200	Send to SAMP Hub

Search for spectra in all VO services



VO Service #1: SVO Discovery Tool



Gaia Alerts search

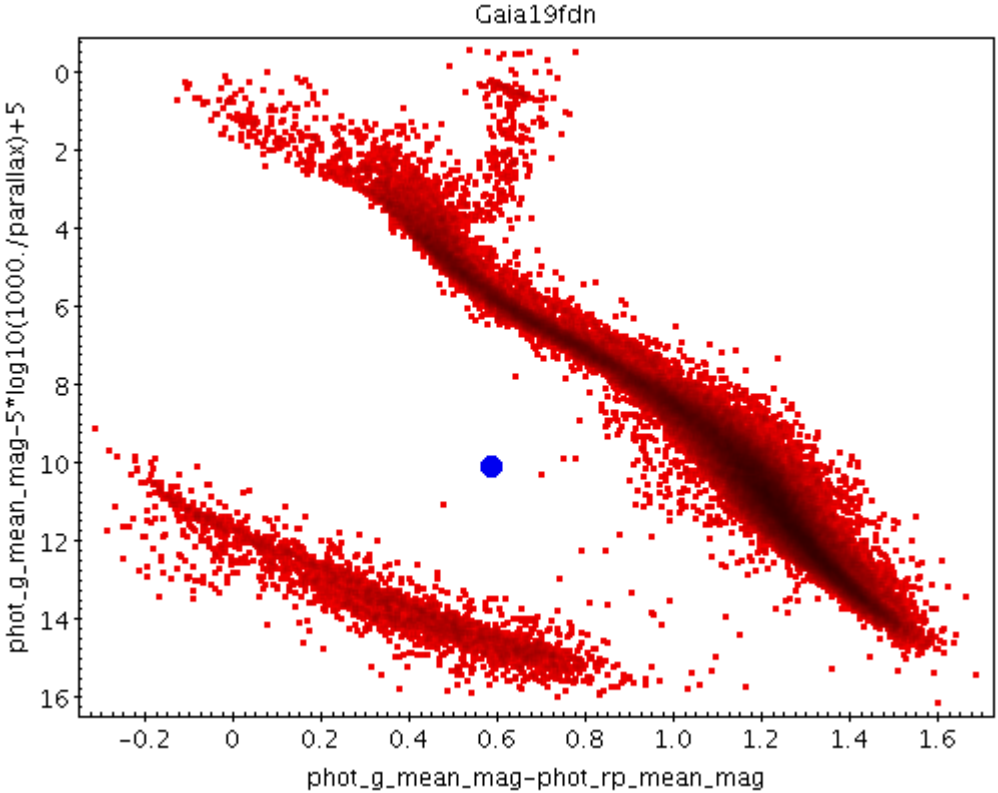
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Gaia19fcr	2019-11-15 05:19:02	2019-11-17 12:52:04	6.92182	-24.66303	1RXS J002743.1-243951 X-ray source dist: 25.793 arcsec	7	0	CV cand. Plot



Location of the alert in the HR diagram

VO Service #2: VOSA

SVO theoretical services VOSA Filters Models Documents Other Services My data Newsletter Uploads LogOut

SVO theoretical services

Control of processes for VOSA "automatic" files

Alerts Auto Uploads Auto VOSA procs. Alerts results Documentation

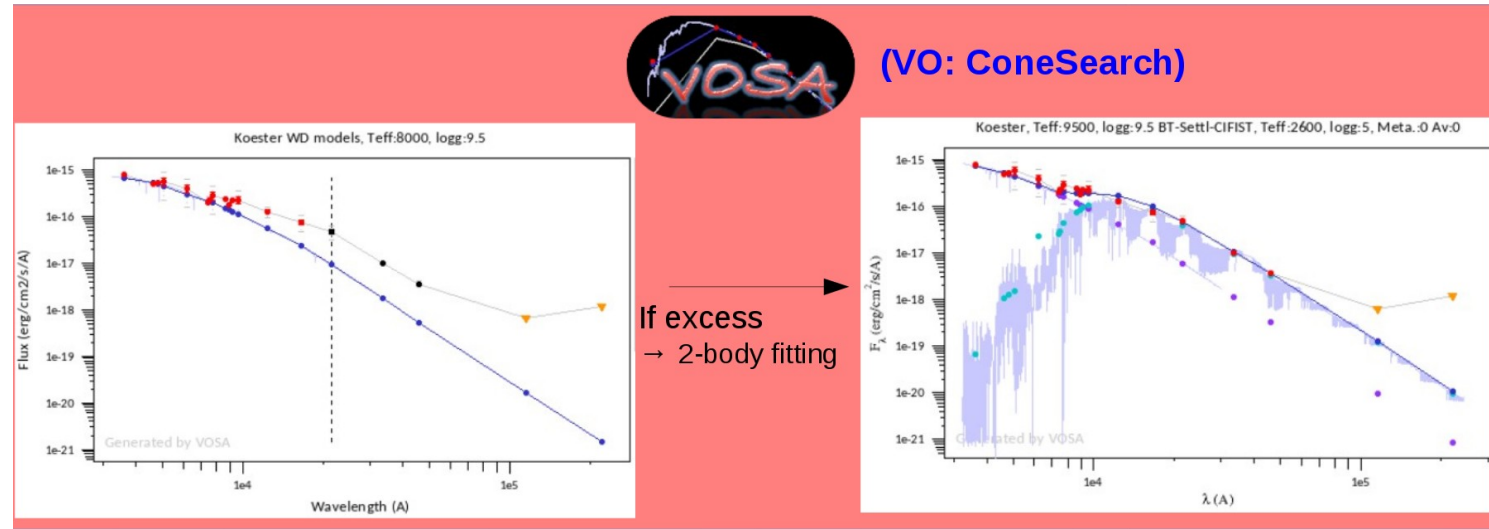
Alert process results ?

Show columns: [+ GAIA] [+ VOSA] [+ VOSA FIT.] [+ VOSA Bin.] [+ Admin] Show Include all fields Hide all fields

Show status: --- No data candidate confirmed discarded

filename	name	RA	DEC	Comm.	VOSA fid	SED plot	Nphot	excess	Fit plot	Fit model	Fit teff	Fit excess	Fit vgfb	Bin. plot	Bin. model1	Bin. teff1	Bin. model2	Bin. teff2	Bin. vgfb	status	coments
alerts.cV.2020-07-02.1	Gaia20dbd	111.30532	-40.0292	See	35873	See	17		See	Kurucz	3500	WISE/WISE.W1	55.1588	See	koester2	5000	bt-settl	2800	66.0468	---	
alerts.cV.2020-07-02.1	Gaia20dau	156.07049	-42.89801	See	35873	See	14		See	Kurucz	5000		9.10123	See	koester2	5000	bt-settl	4900	8.8431	---	
alerts.cV.2020-06-30.1	Gaia20dai	156.26114	-38.44571	See	35865	See	2														
alerts.cV.2020-06-29.1	Gaia20daf	164.16589	-31.37005	See	35853	See	17	WISE/WISE.W2	See	Kurucz	4000	WISE/WISE.W1	46.2934	See	koester2	5000	bt-settl	3200	50.8899	---	
alerts.cV.2020-06-28.1	Gaia20czk	22.17554	11.514	outburst in candidate CV	35835	See	22		See	Kurucz	7500	UKIRT/UKIDSS.K	25.2102	See	koester2	10500	bt-settl	3000	9.06082	---	

VOSA to query photometric catalogues, build the SED and estimate parameters from the model that best fits.



Impact and prospects for the future

- Fine-tuning of two existing SVO tools (SVO DiscTool and VOSA) for the characterization of Gaia alerts.
- All the characterization process (gathering of physical parameters, spectroscopic information, location in the HR diagram and SED building and fitting) is conducted in an automated way.
- The system has been successfully tested on cataclysmic variables. A follow-up programme for the spectroscopic characterization of the most promising candidates is on-going.
- **Future prospects: YSO, Be-type outburst and microlensing events.**