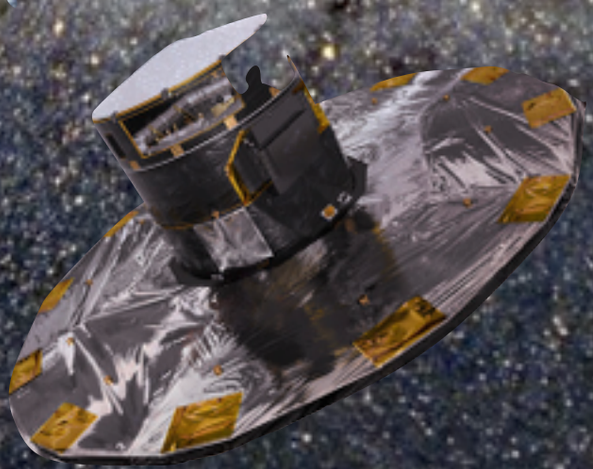
NUCLEAR TRANSIENTS

from OGLE and Gaia

and hunt for Black Holes

David Buckley



SAAO, November 2017

GROUP

Łukasz Wyrzykowski

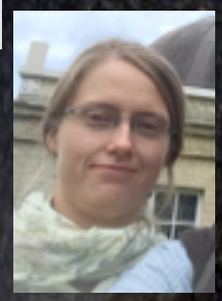
(pron: Woo-cash Vi-zhi-kov-ski)

Alex Hamanowicz

(Master student -> PhD@ESO)

Mariusz Gromadzki

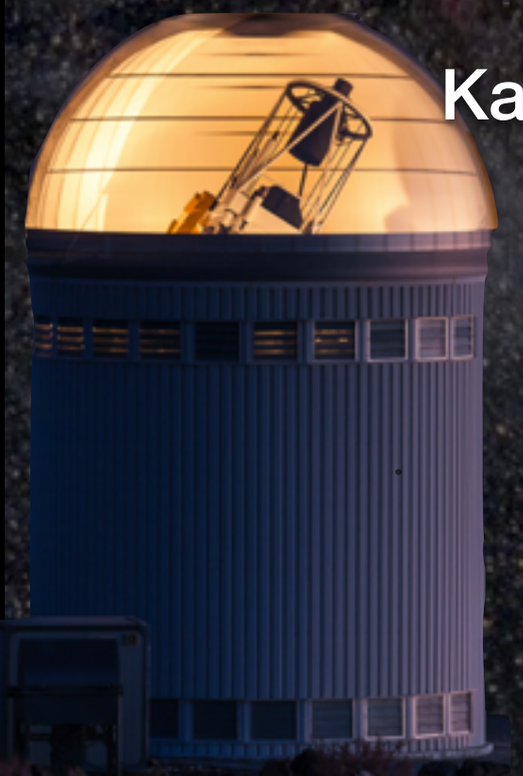
(postdoc)



Zuzanna Kostrzewa-Rutkowska

(postdoc at SRON, NL)

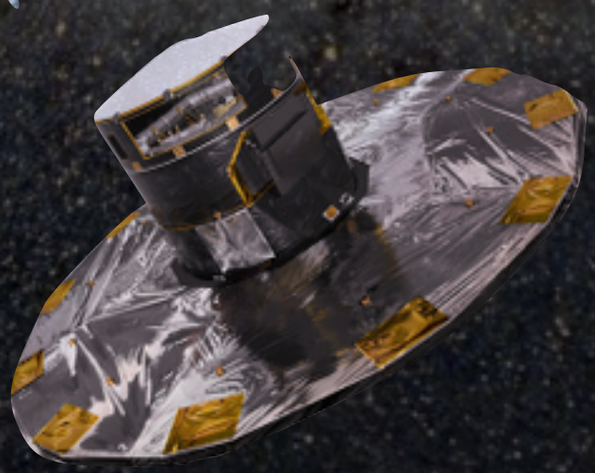
Katarzyna Kruszyńska, Kris Rybicki, Paweł Zieliński
Seppo Mattila, Peter Jonker,
Kirill Sokolovsky, Iair Arcavi



OGLE team in Warsaw

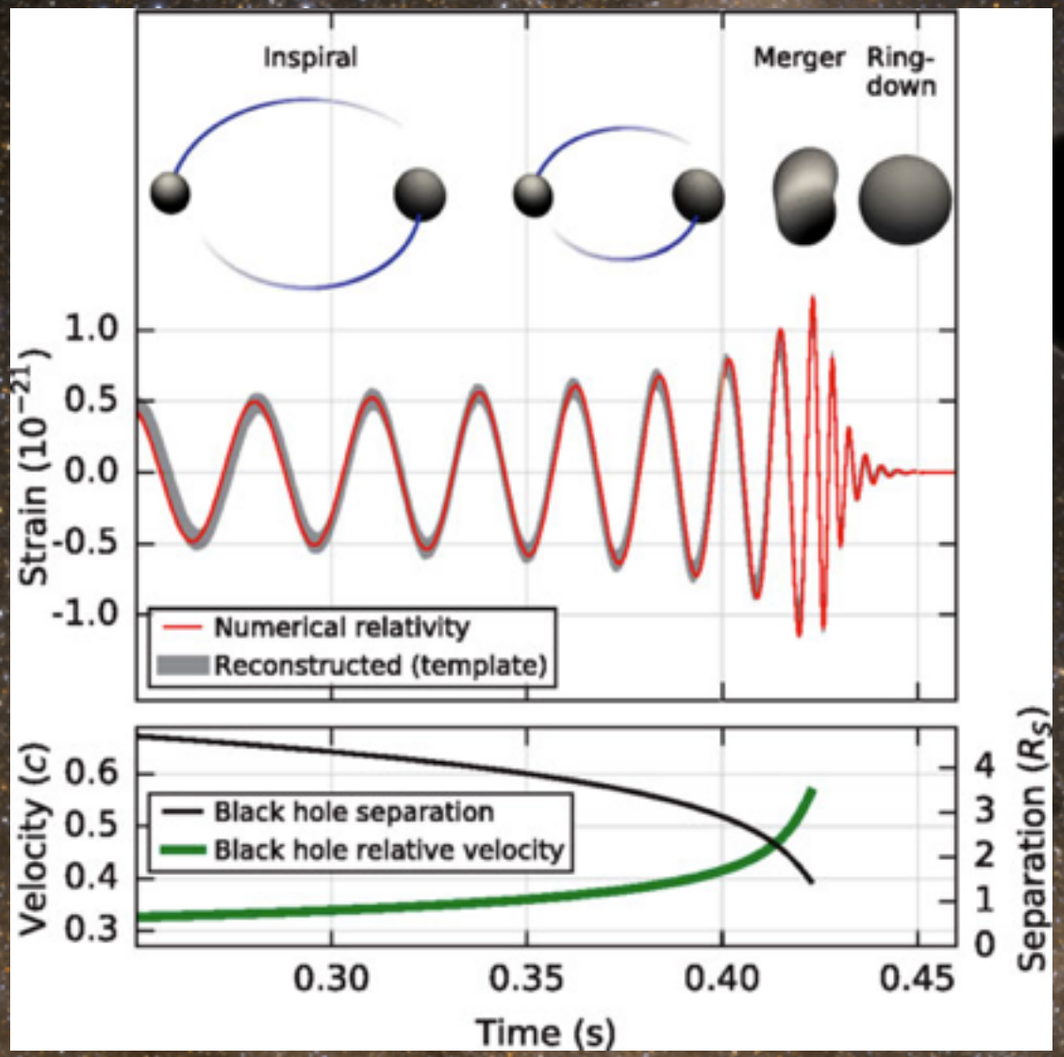
Gaia Alerts team in Cambridge

Gaia DPAC

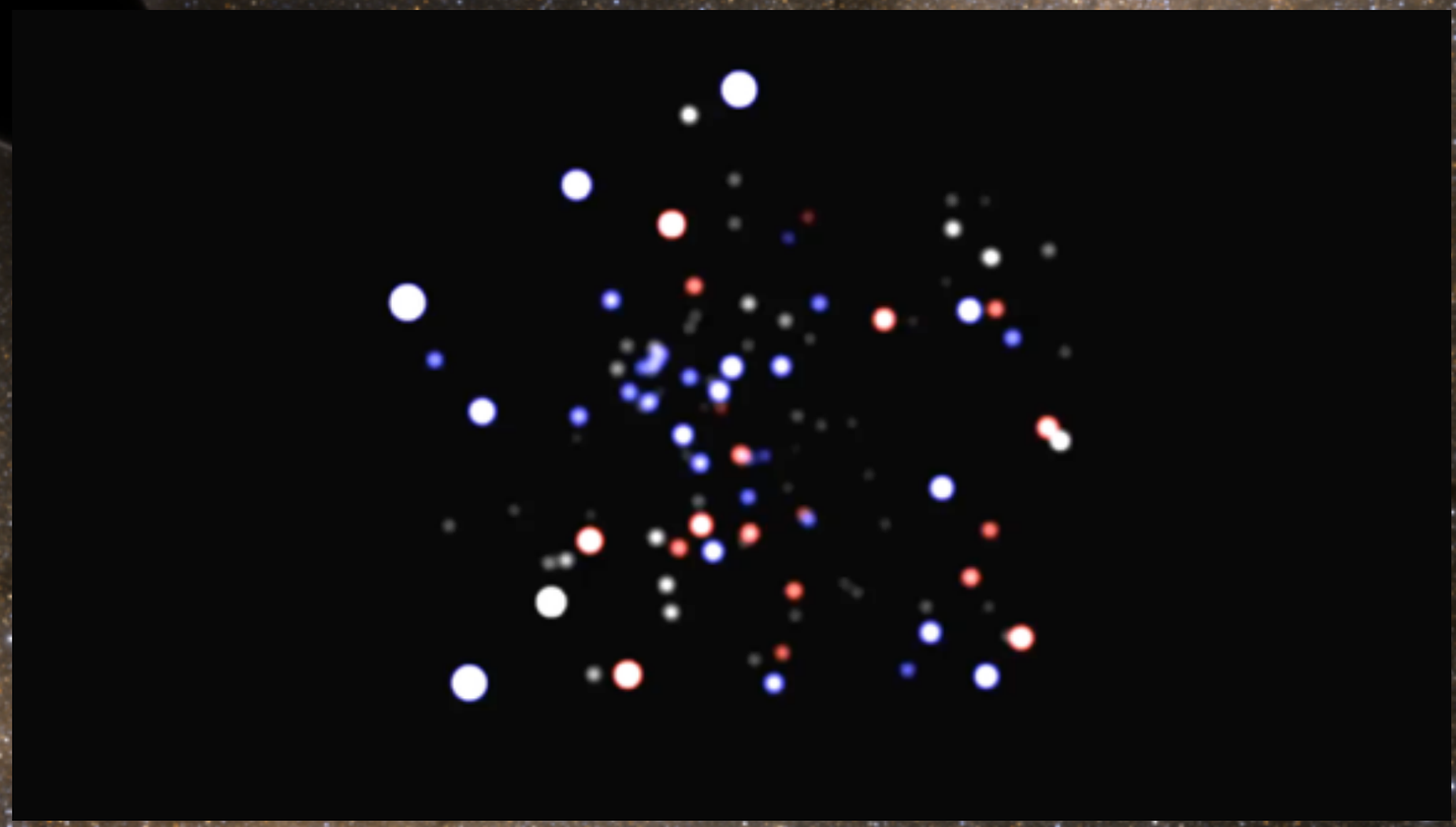


BLACK HOLES DO EXIST!

GW150914: 36 + 29 MSun BHs



4 MMSun SMBH in the Centre of the Milky Way



HOW TO FIND BLACK HOLES?

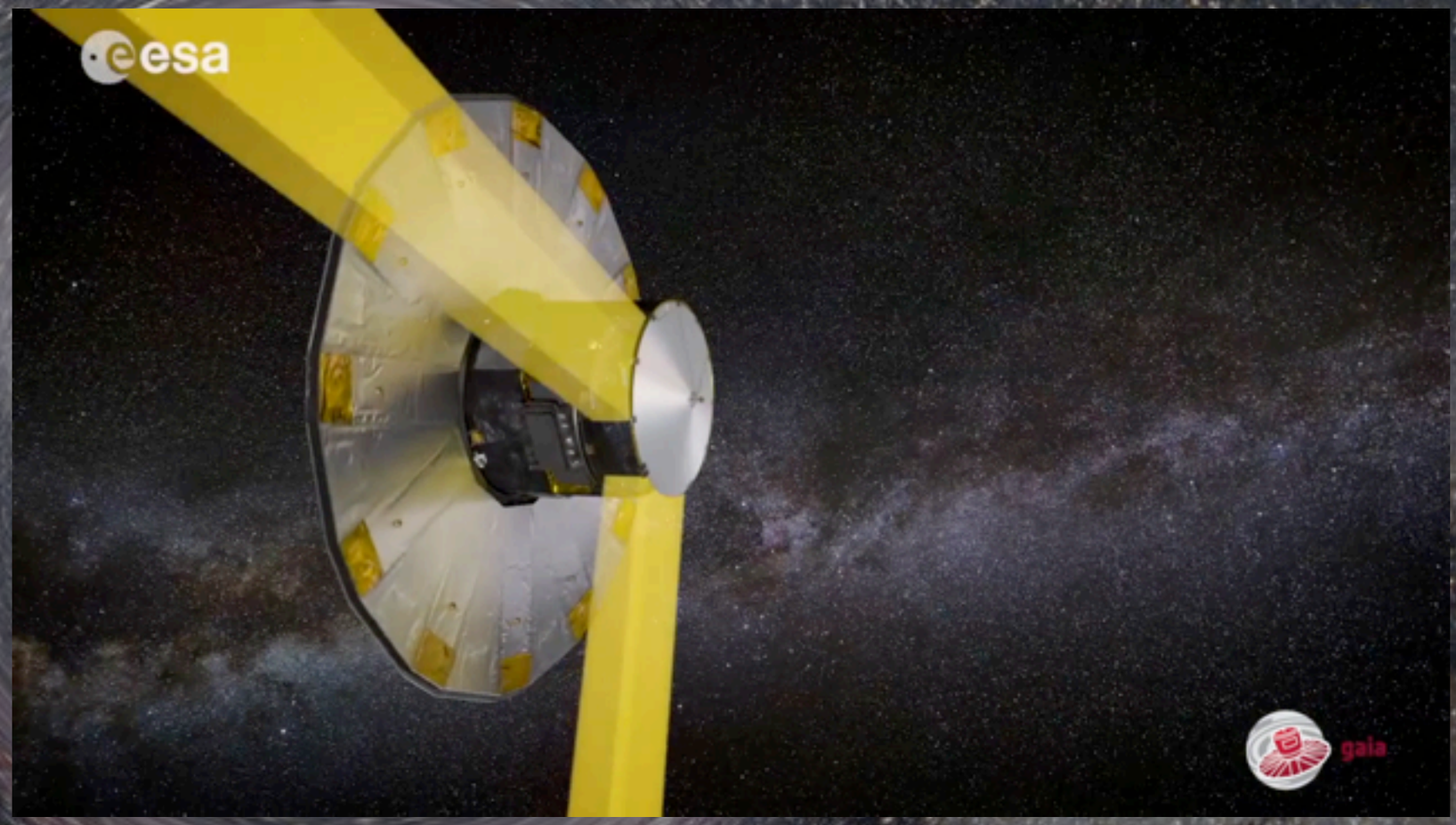
OGLE

http://ogle.astrouw.edu.pl

Polish 1.3m dedicated telescope
in Las Campanas, Chile
Surveying continuously since 1992.

Gaia Science Alerts

http://gsaweb.ast.cam.ac.uk/alerts



ESA space mission with 2x1.4m telescopes located in L2.
In operation since 2014.

First Gaia Data Release DR1: 14.Sep 2016

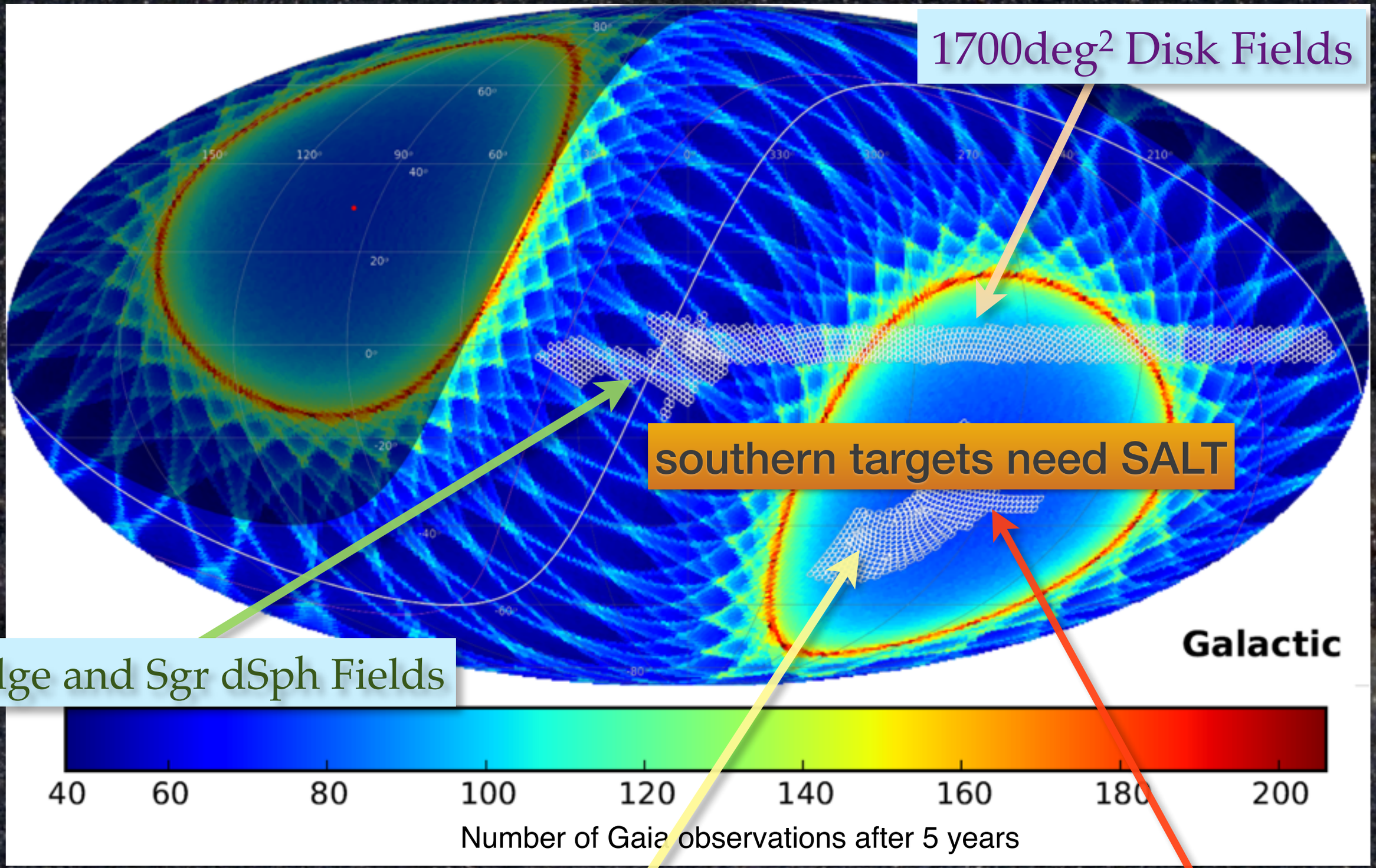
Second Gaia Data Release DR2: ~Apr 2018

TRANSIENTS SURVEYS

	Gaia	ASAS-SN	OGLE-IV	Catalina Sky Survey	PTF	LSST (from 2020??)
deg^2 day^{-1}	**≈ 1230**	~20,000	150	1200	1000	5000
Avg Cadence	**4.5s-30d**	1-3d	0.01-5d	14d	5d	4d
Limiting mag	**G=20.7**	V=14	22	19.5	21	r=24.7
f_{sky}	**all sky**	all sky	0.07	0.6	0.2	<0.48

Łukasz Wyrzykowski

OGLE-GAIA SKY



Gaia figure by Nadia Blagorodnova, OGLE fields by Jan Skowron

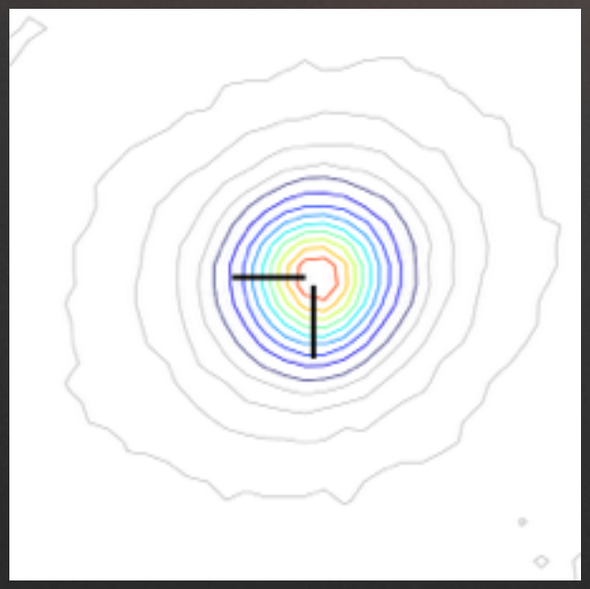
Łukasz Wyrzykowski

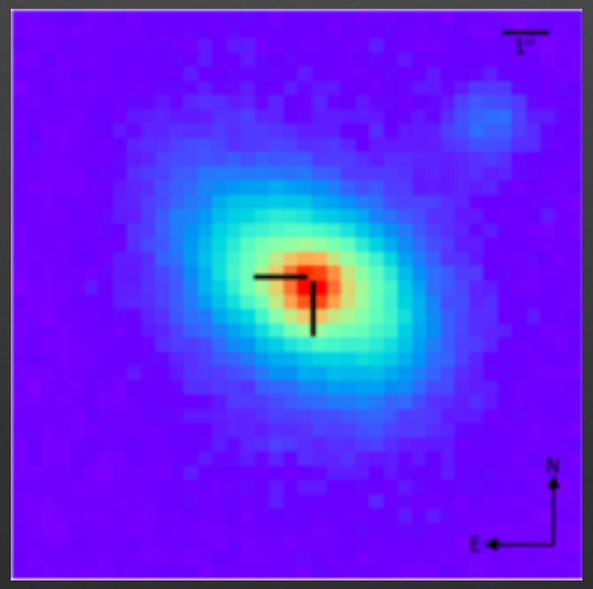
TIDAL DISRUPTION EVENTS

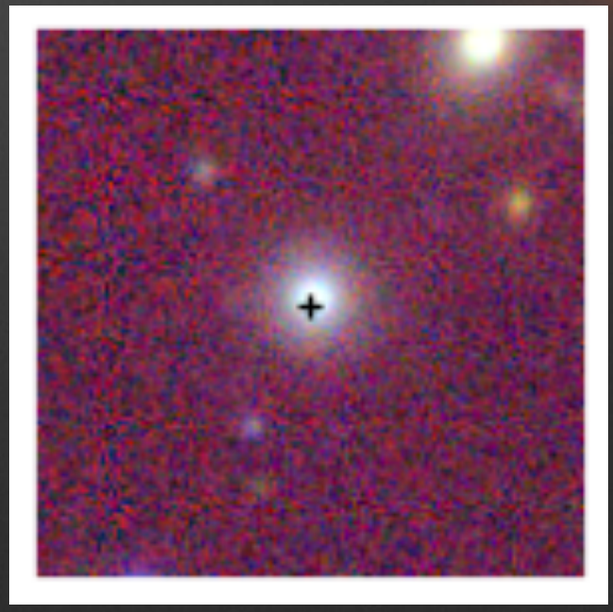
Quiet SMBH disrupting a star

TIDAL DISRUPTION EVENTS

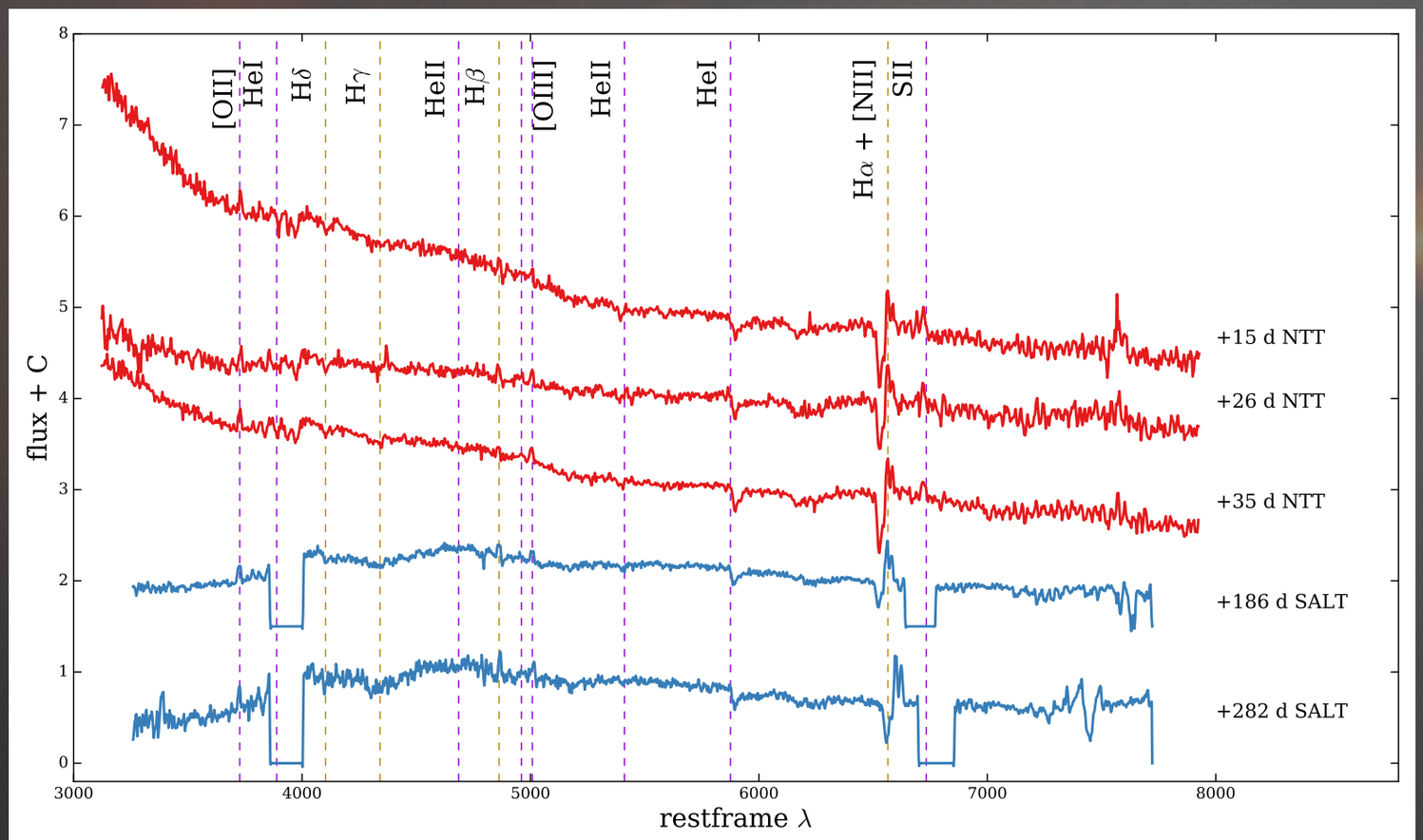
the most difficult transients to study

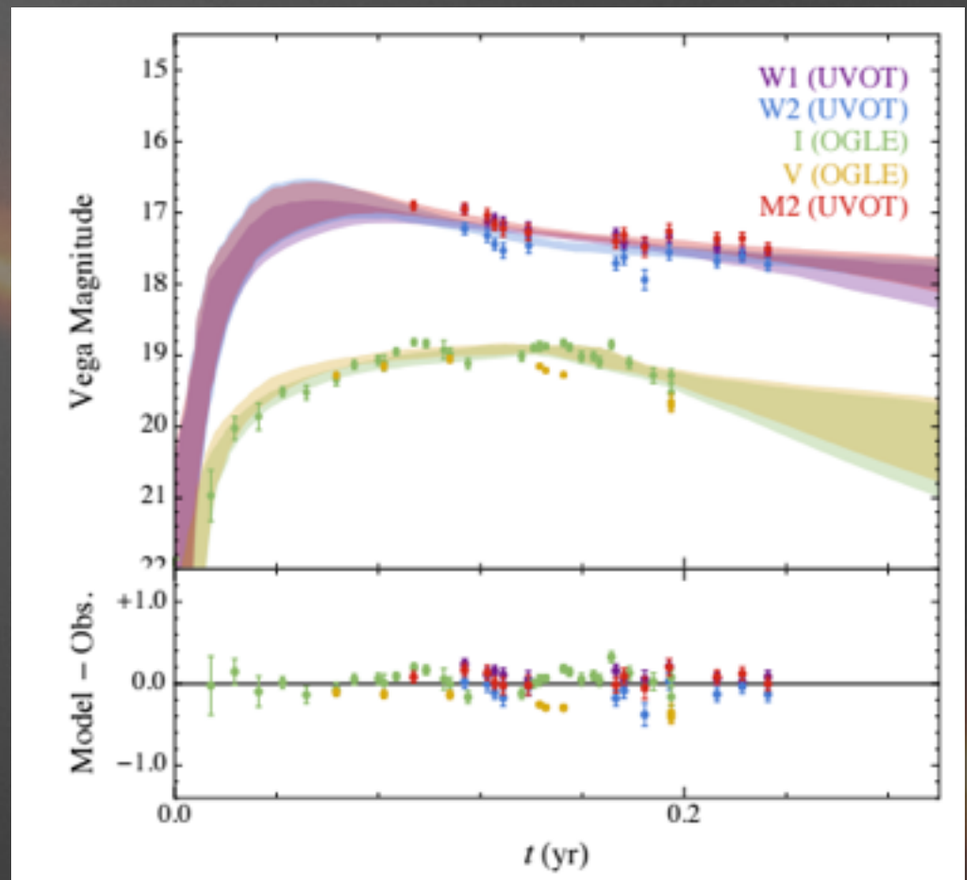


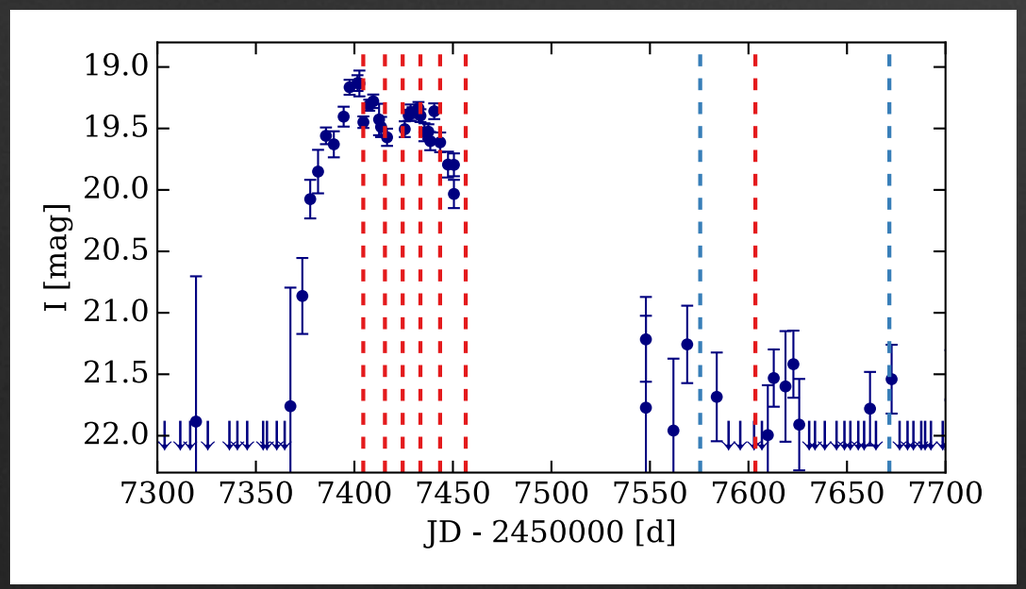




OGLE16AAA - HUNGRY BLACK HOLE



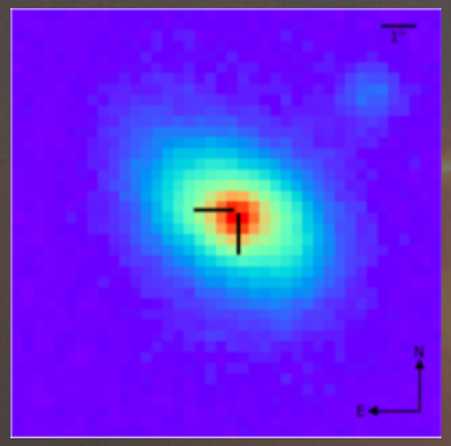


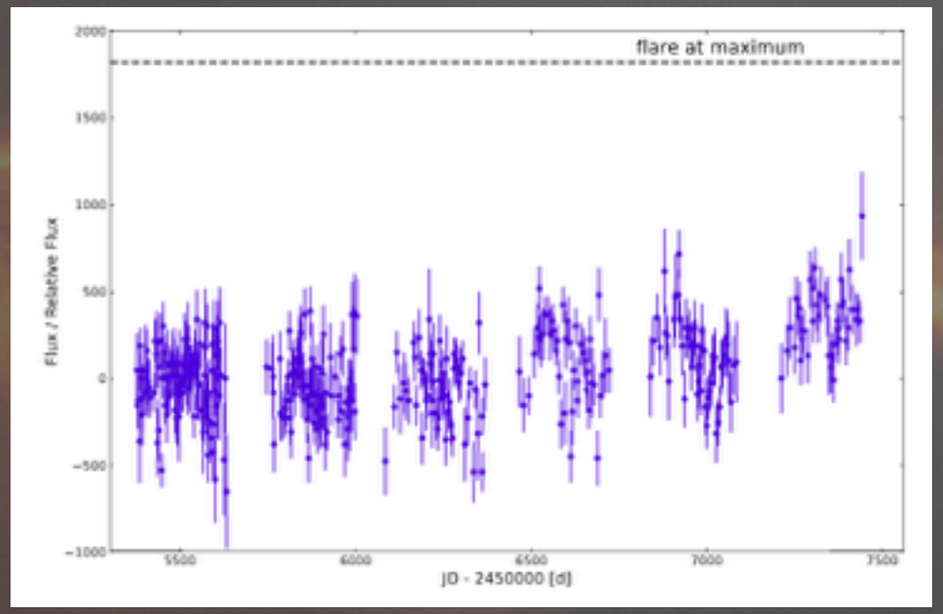


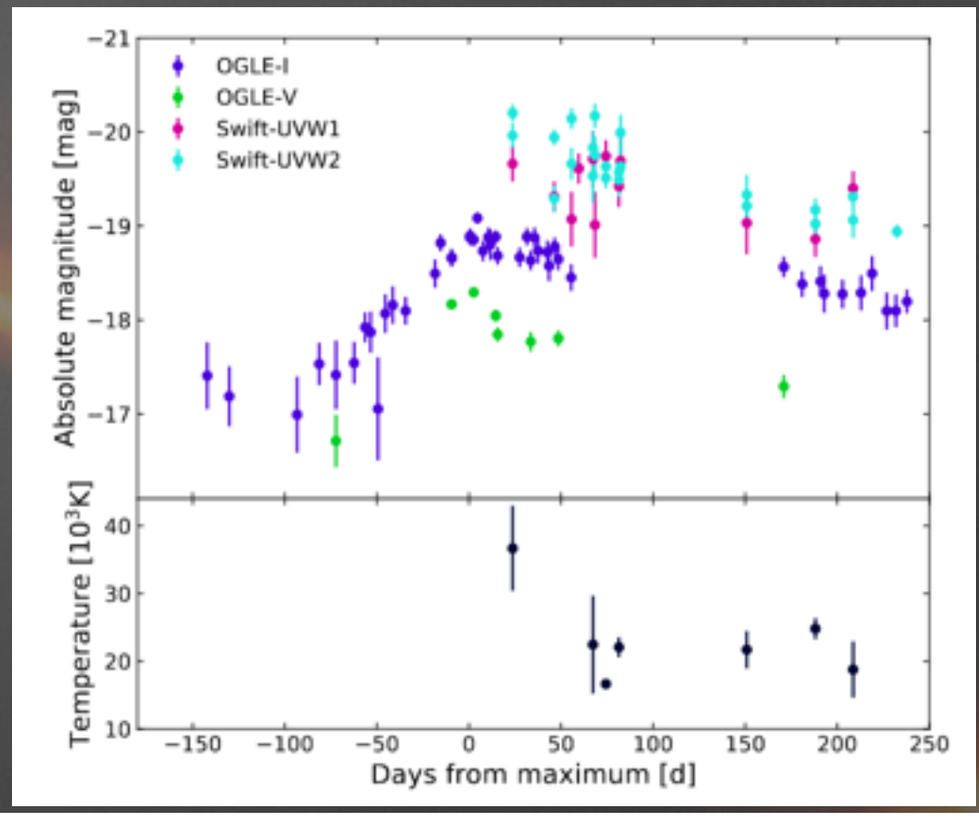
- z=0.167, peak absolute mag M=-20.5 mag
- slowly rising I-band light curve (~30d) - unlike in most SNe
- very broad HeII and Hα emission
- hot black-body flare spectrum: 22,000K
- weak narrow AGN lines
- SMBH: $10^{6.5}$ MSun, star: 0.3 MSun

Wyrzykowski+2017

OGLE17AAJ - NEW CLASS OF AGN FLARES OR TDE?







long 60d rise to peak, 2 mag

constant temperature >20000K

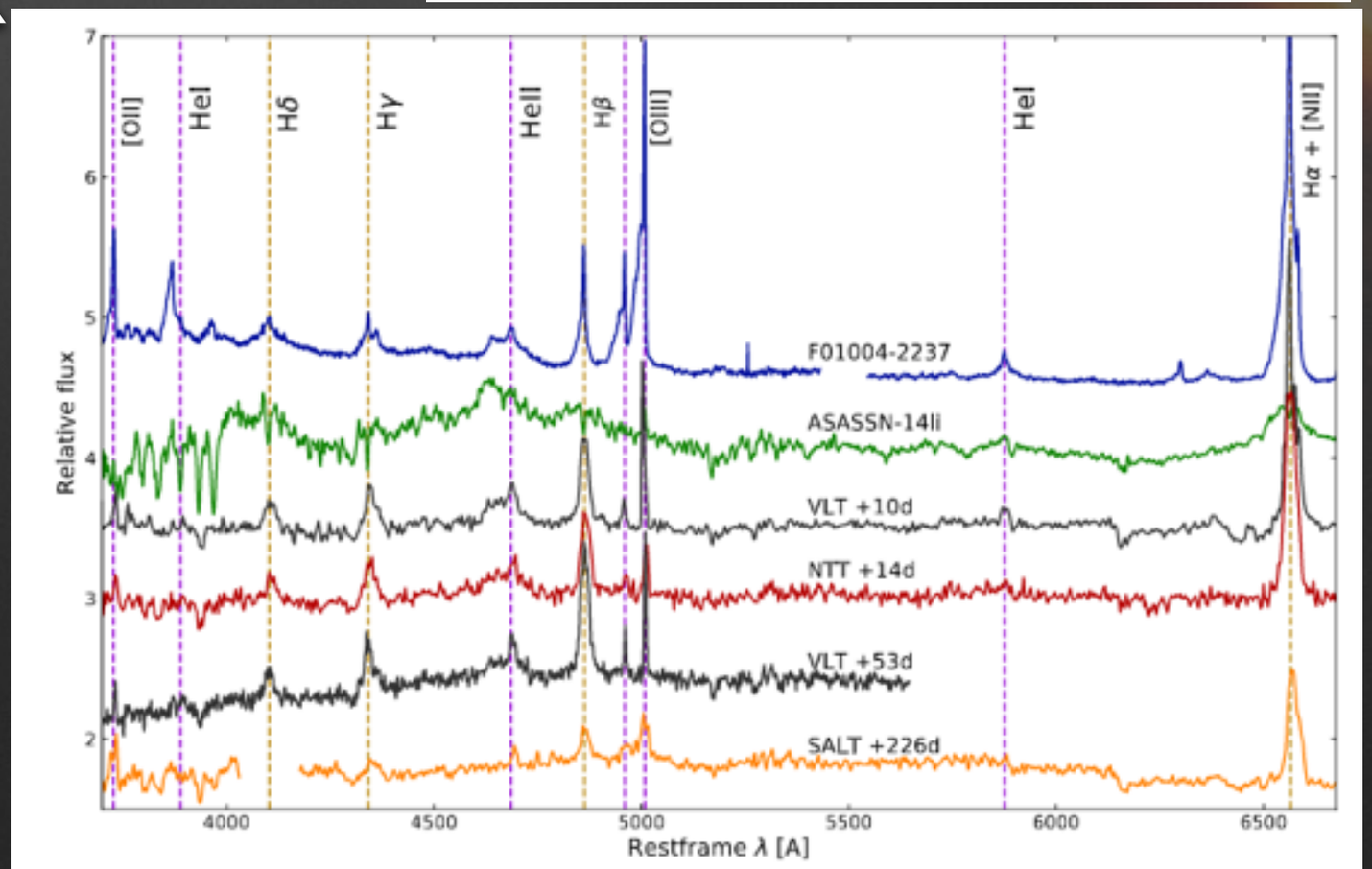
z=0.116

absolute magnitude
M_I = -18.8 mag
(host subtracted)

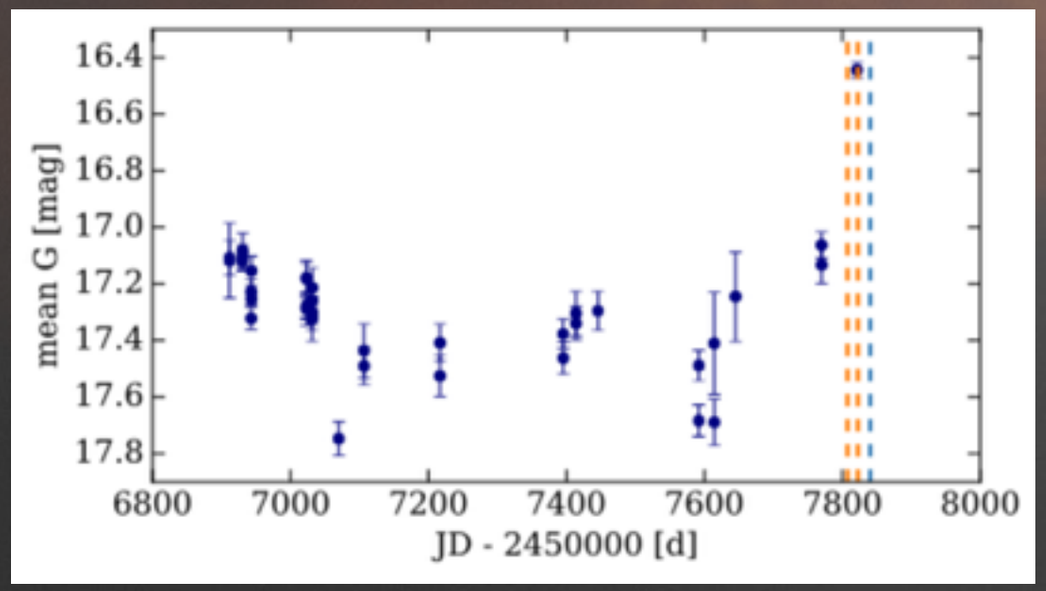
previous low-level variability

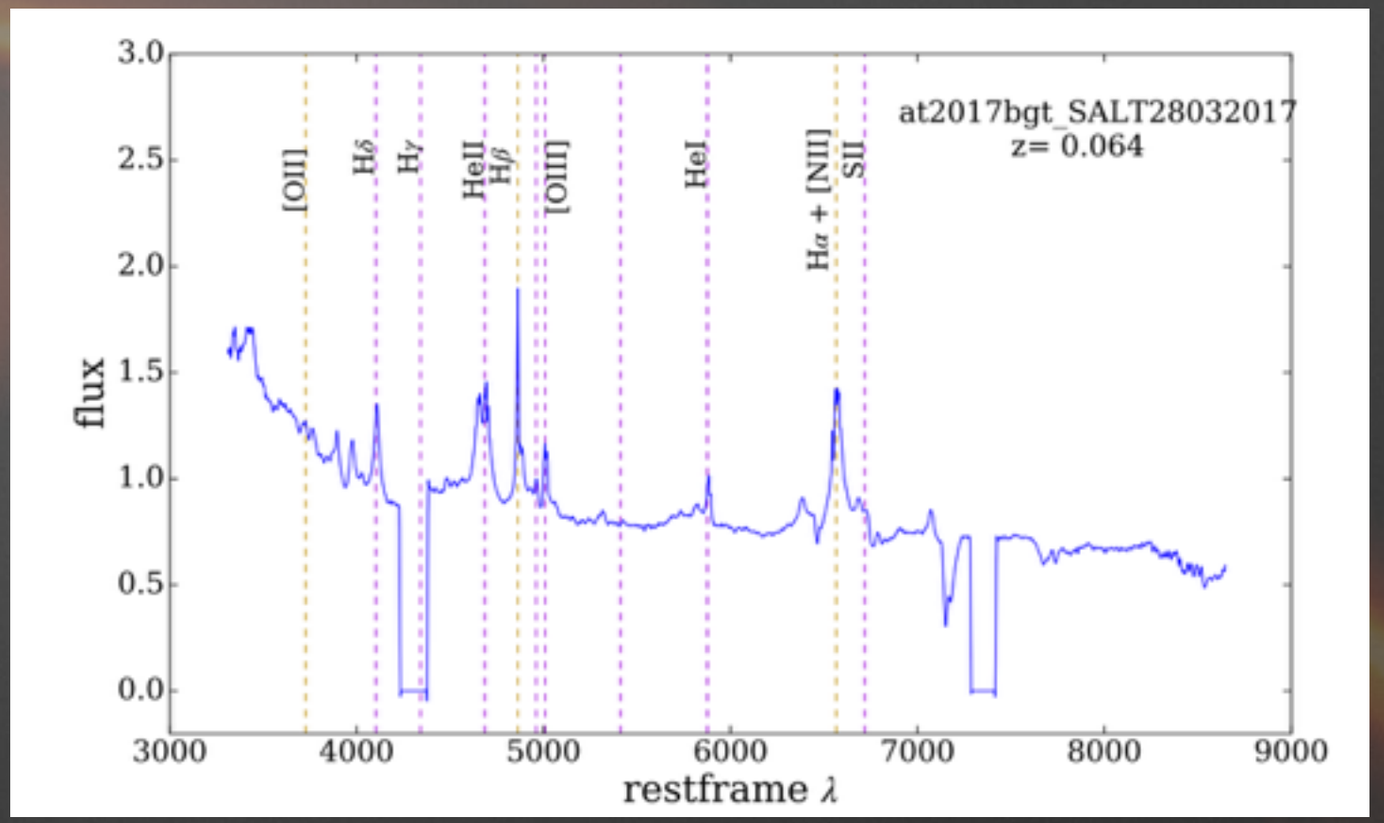
TDE? New kind of AGN flare?

(Gromadzki in prep.)



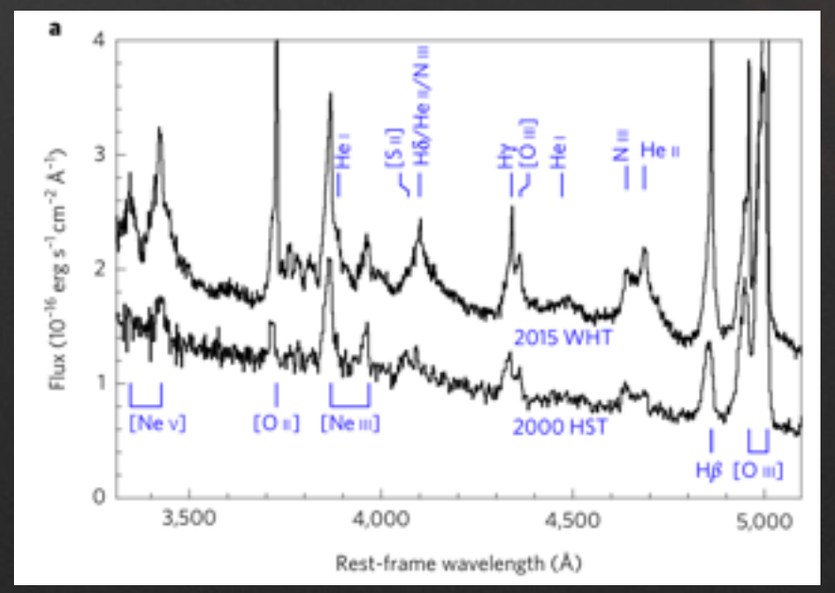
ASASSN17CV/2017BGT (BOGOTA)





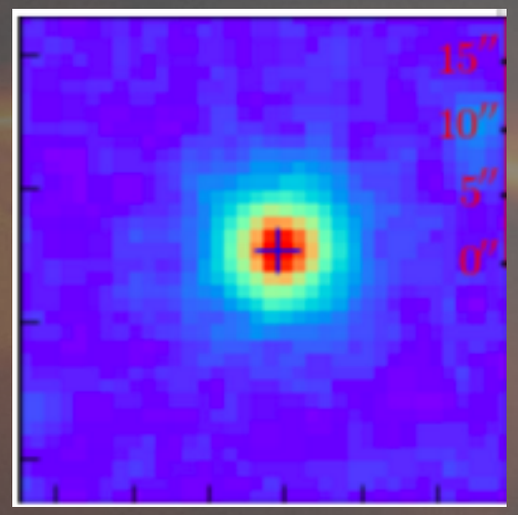
- multi-component HeII
- Swift: X-ray signal
- hot UV emission ~20,000 K
- candidate TDE (new class of TDEs?)

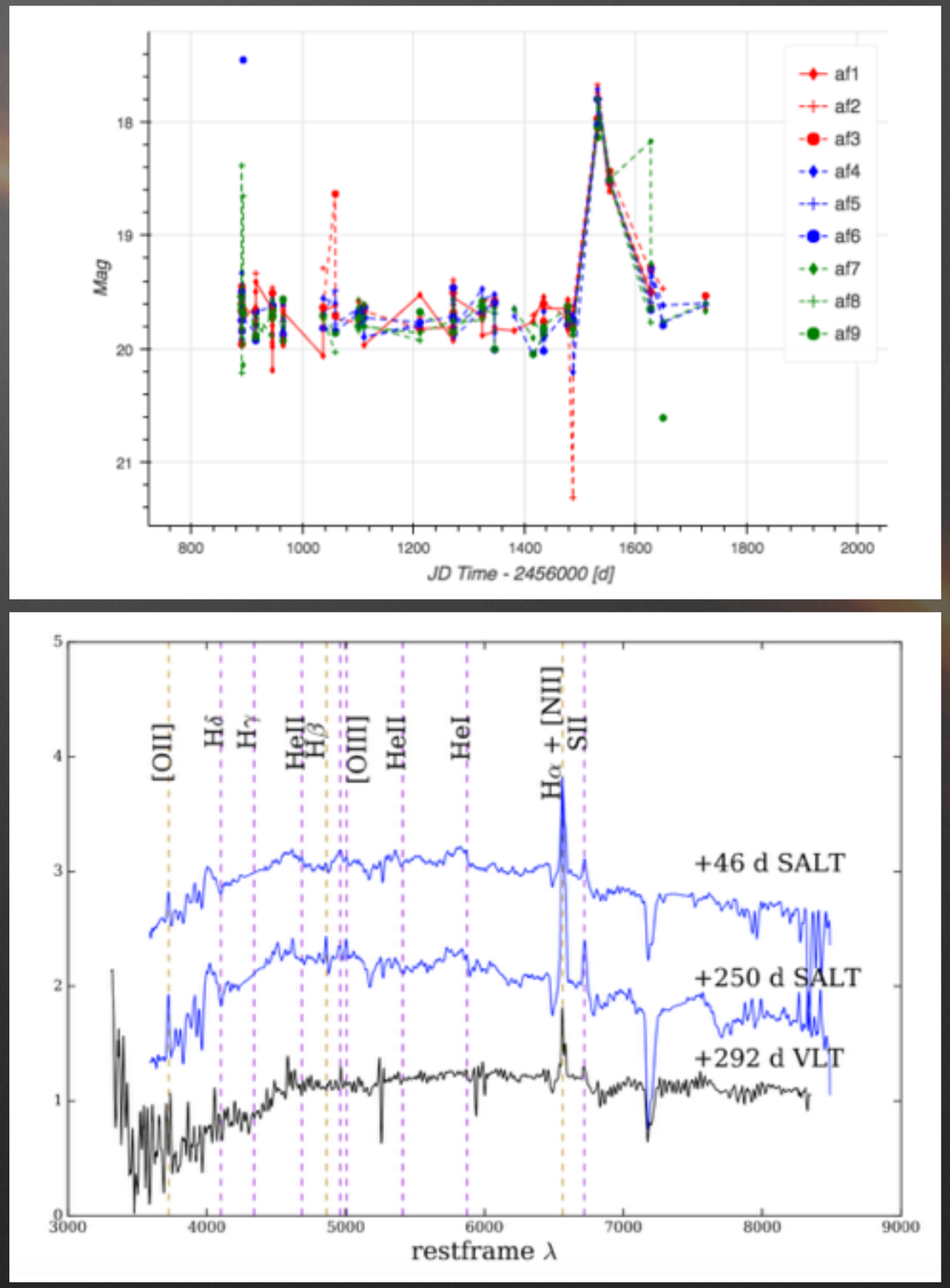
- similar to OGLE17aaj and Tadhunter+17



Tadhunter+17, NatAst.

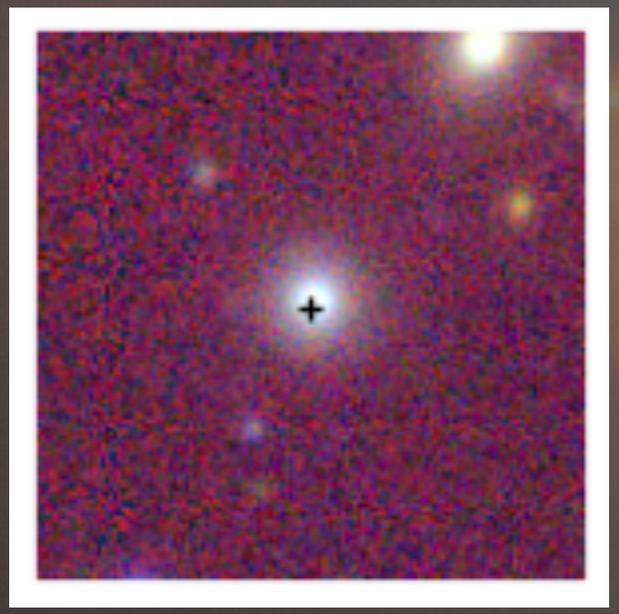
GAIA16AQG - BORING SN IA



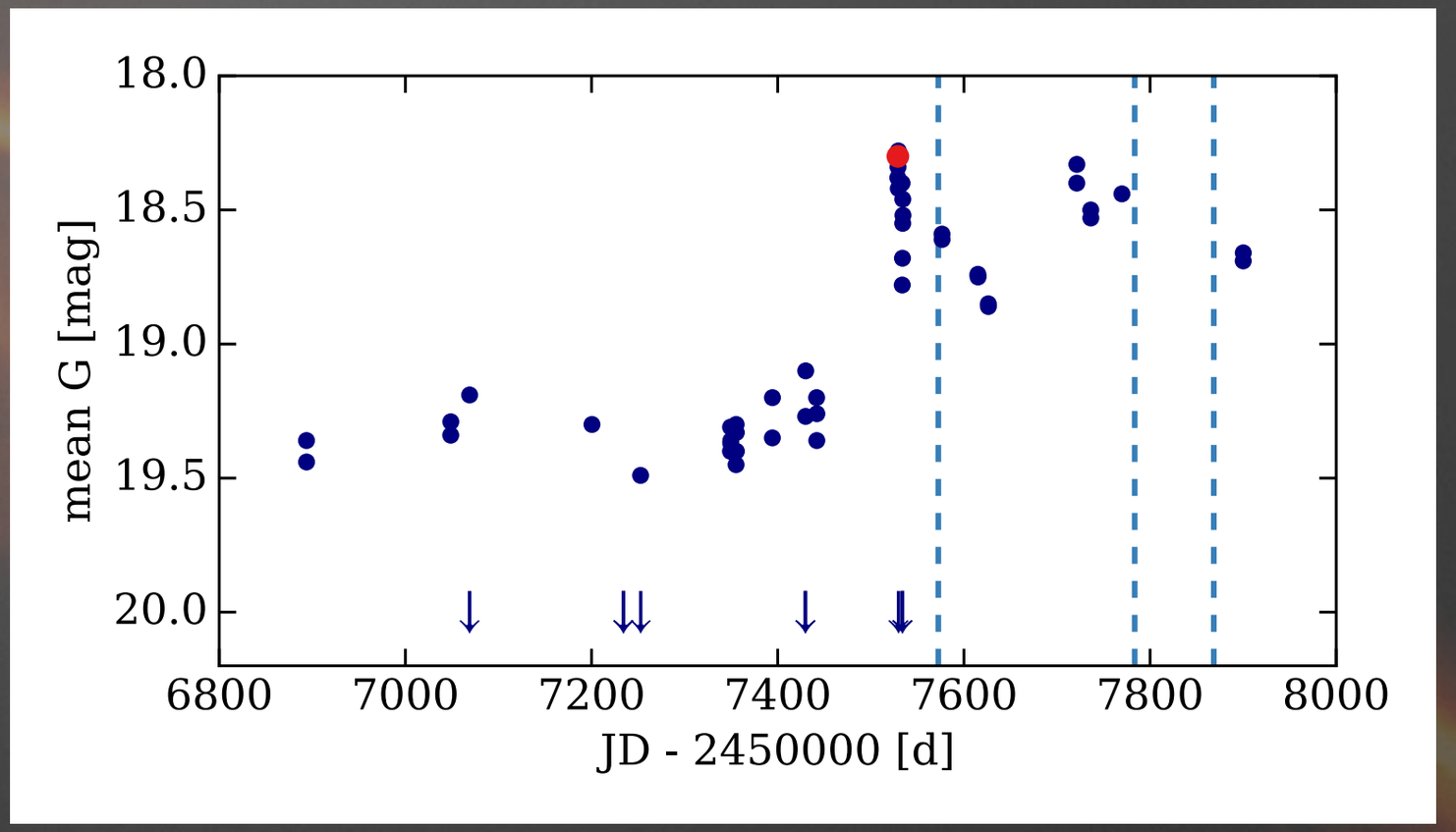


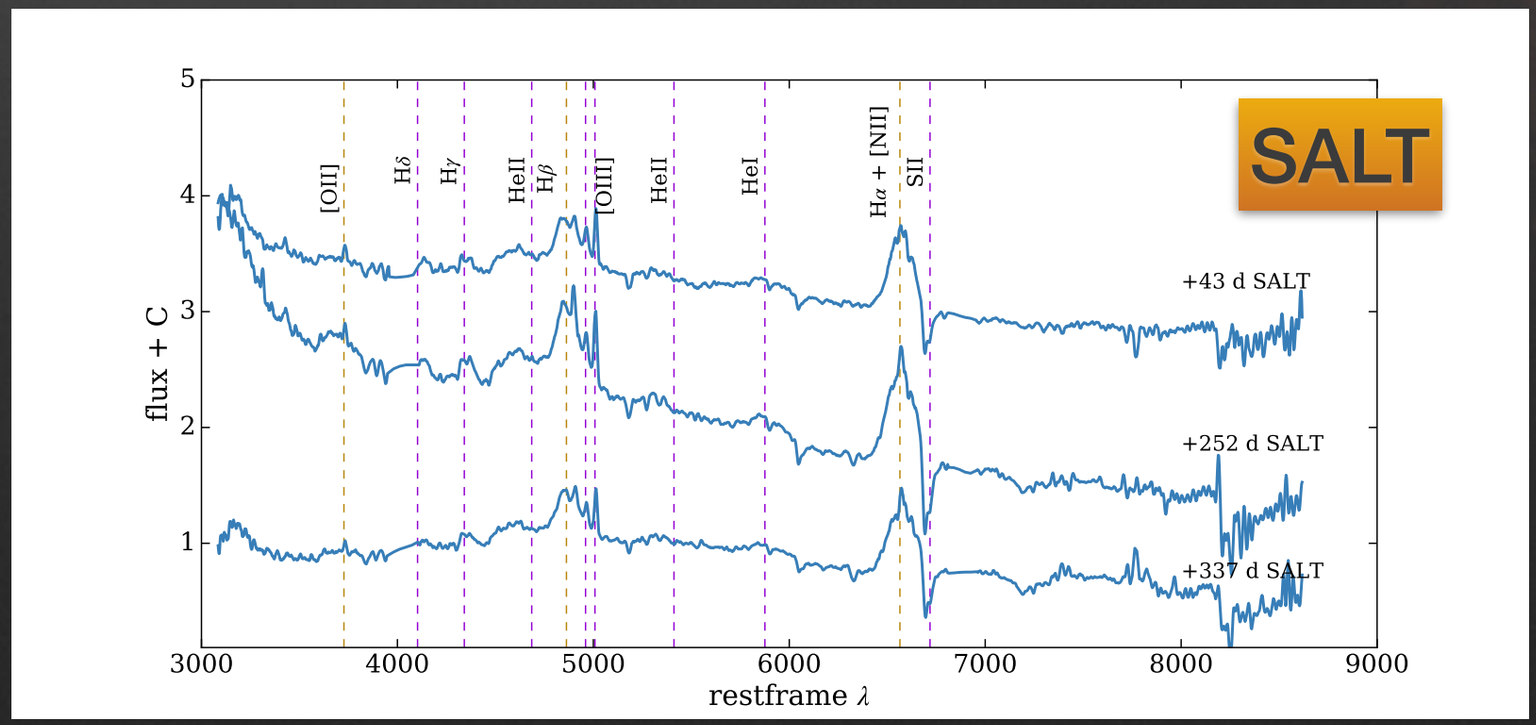
- z = 0.06
- transient HeI (but no HeII)
- abs -19.2 mag (host subtr)
- no prior variability
- subtle signal of the transient
- SN Ia revealed after host subtracation

GAIA16APT - A RIDDLE?



- z = 0.13650
- weird Gaia light curve
- no previous variability
- long transient or AGN?
- TDE on a binary SMBH?
- Disk-like broad Hbeta/gamma





SUMMARY

- OGLE and Gaia can find nuclear transients, but spectral classification needed on few dozens every year.

- 2 candidate TDEs from OGLE + 1 from ASASSN: SALT+VLT follow-up

- no (obvious) TDEs found in Gaia in 1 year - lower rates? lower detection efficiency?? new kinds of TDEs?

- nearly 40 transients observed with SALT/RSS (often within 12h from the request - special thanks to David Buckley!)