# AT 2020xys
## Discovery, Classification, and Multi-Wavelength Observations of a Bowen Fluorescence Flare

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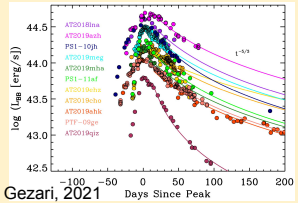
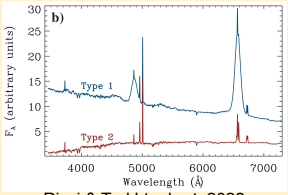
HERA 2026, CAMK PAN, WARSAW (21 - 25 Sep 2026)

# A new “zoo” of nuclear transients



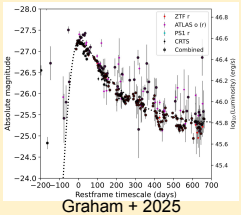

Gezari, 2021

**Tidal disruption events**



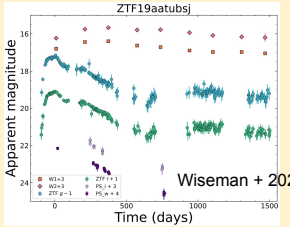

Ricci & Trakhtenbrot, 2022

**Changing-look AGN**



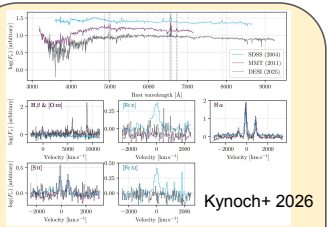

Graham + 2025

**Extremely Luminous Flare**



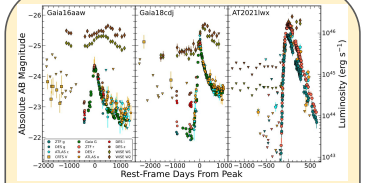

Wiseman + 2024

**Ambiguous Nuclear Transients**



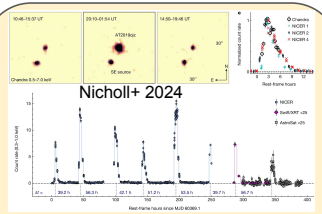
Kynoch+ 2026

**Extreme Coronal Line Emitters**




Hinkle+ 2025

**Extreme Nuclear Transients**



Nicholl+ 2024

**Quasi-periodic eruptions**

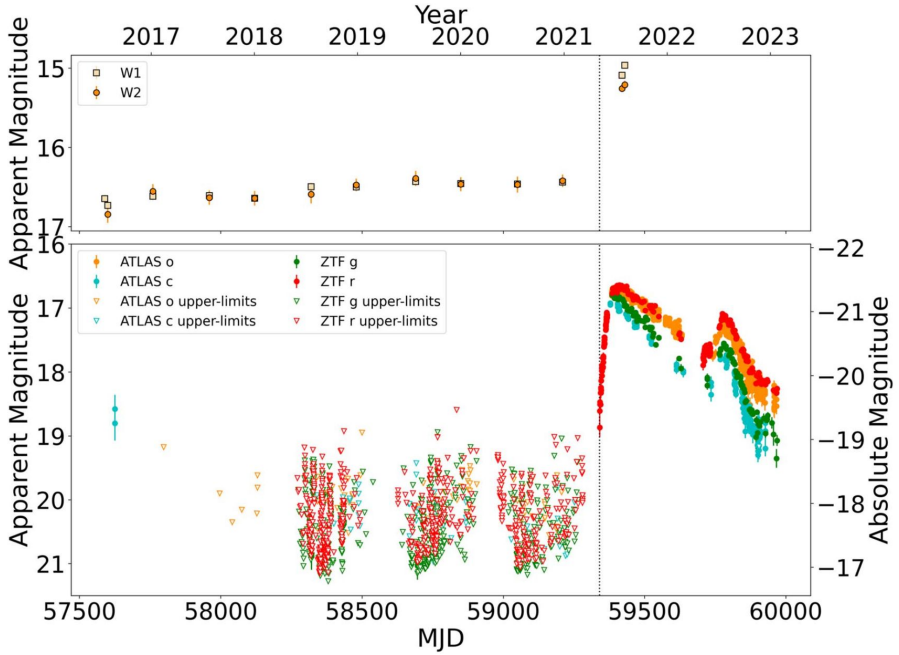
**?**

**Other nuclear transient**

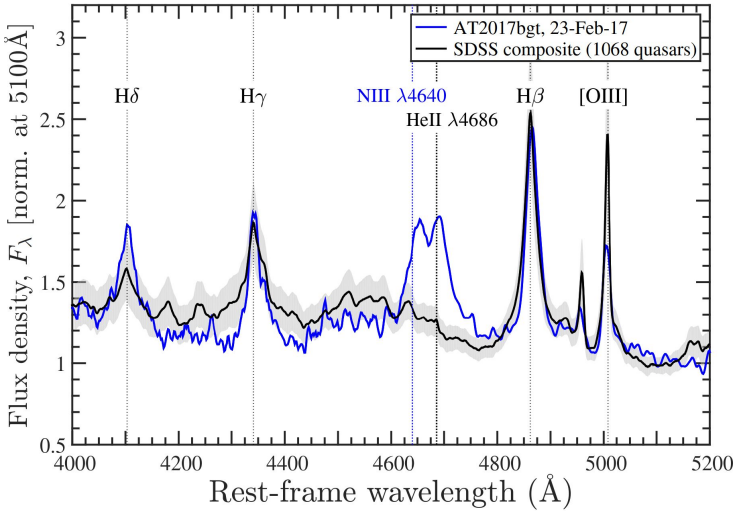
**Bowen fluorescence flares (BFFs)**

- UV-bright
- lights up HeIIλ4686, NIIIλ4640 & OIIIλ3444 lines
- Slowly-declining flare in existing AGN

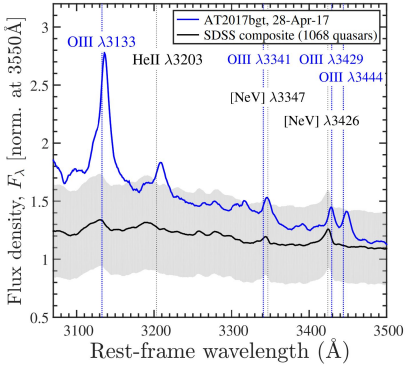
# Features of BFFs



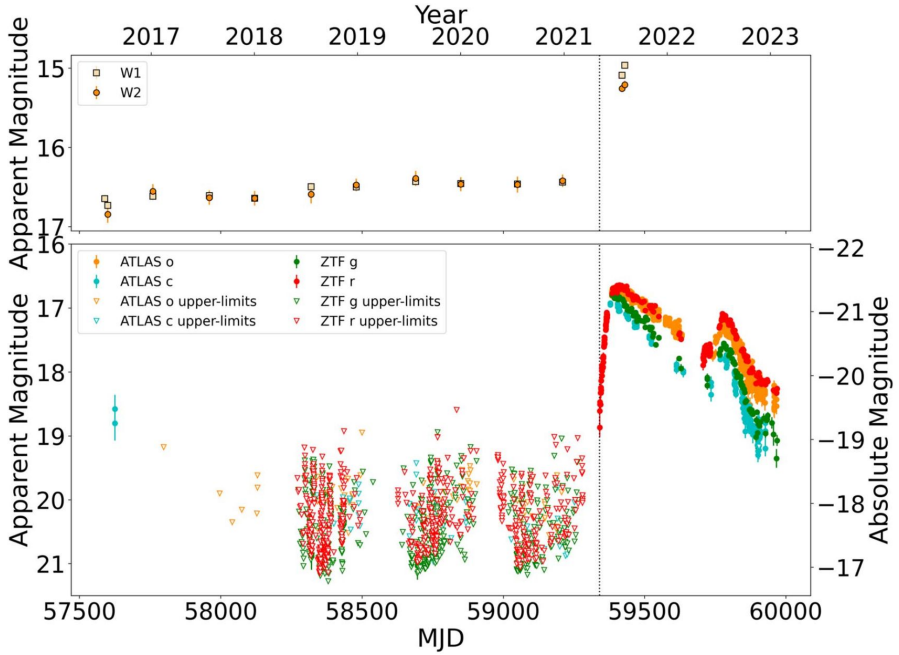

**AT 2021loi** (Makrygianni+ 2023)




**AT 2017bgt**
(Trakhtenbrot+ 2019)



# Features of BFFs

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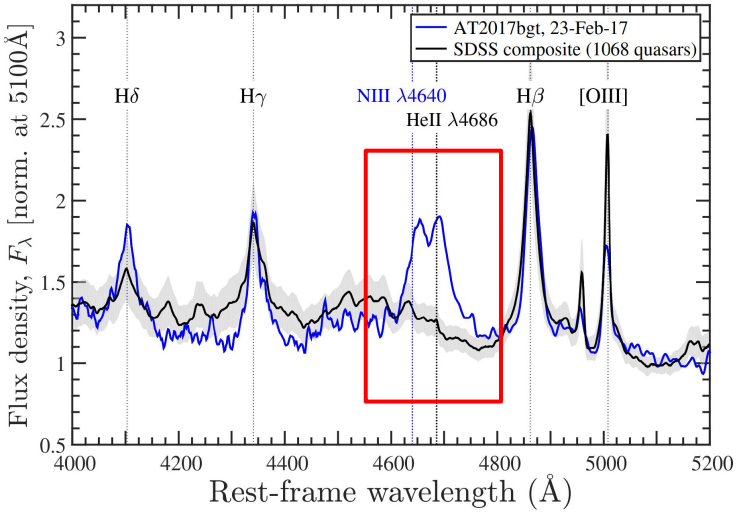


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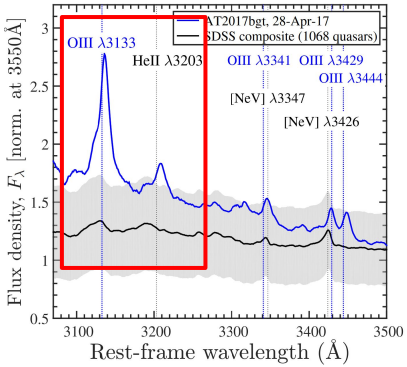
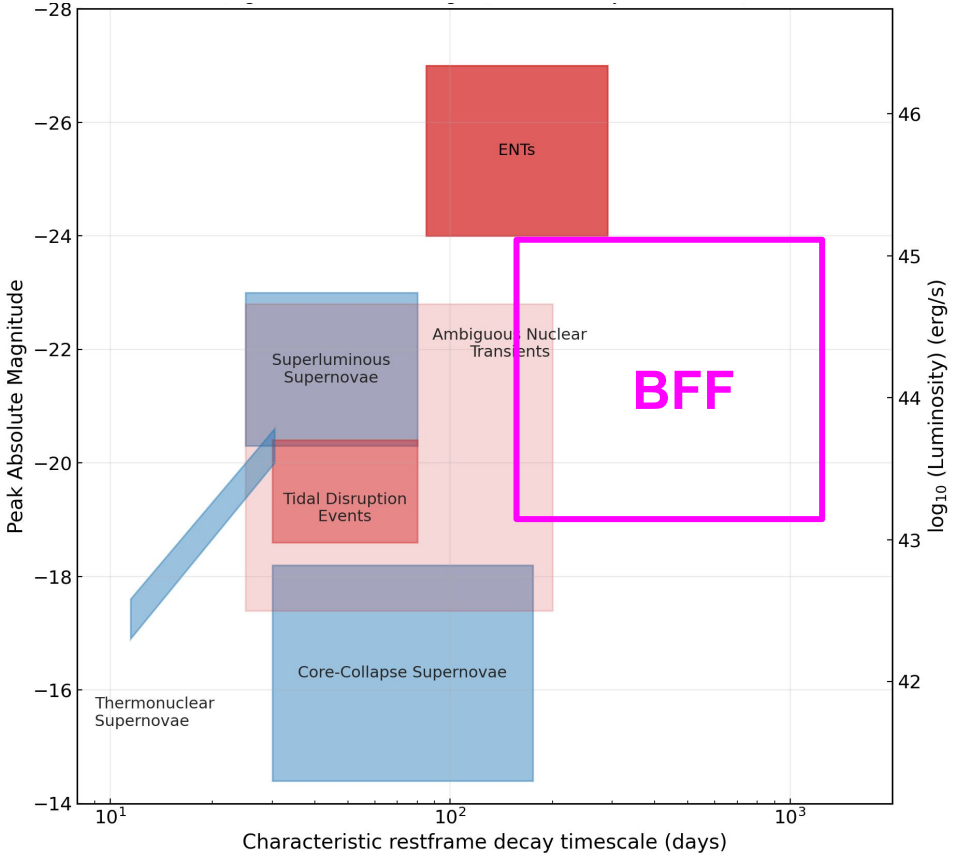
(Trakhtenbrot+ 2019)



# Already Detected Bowen Fluorescence Flares

- **Brightening event in the ULIRG F01004-2237** (Tadhunter+ 2017)
- **AT 2017bgt** (Trakhtenbrot+ 2019)
- **OGLE17aaj** (Gromadzki+ 2019)
- **AT 2019avd** (Frederick+ 2021, Malyali+ 2021)
- **AT 2019pev** (Frederick+ 2021)
- **AT 2021loi** (Makrygianni + 2023)
- **AT 2022fpx** (Koljonen+ 2024)
- **AT 2019aalc** (Śniegowska+ 2025)
- **eRASSt J012026.5-292727** (Baldini+ 2025) **- X-ray selected BFF + ECLE**

# BFF in Phase Space




The base plot is adapted from Graham+ 2025

# Mechanisms

Whatever the trigger, it has to deliver two things at once: **dense, metal-rich gas** close to the black hole, and an **extreme-UV continuum** to pump the cascade. That pairing is why BFFs are rare!

- **Tidal disruption in a gas-rich nucleus**: supplies exactly the dense, metal-rich gas the cascade needs
- **Repeated star-SMBH interaction**: Stellar envelope stripped each passage feeds a transient disc - metal-rich gas, and recurrence
- **Disc wind hits the BLR**: An outflow shocking BLR clouds can power emission for more than a year
- **Enhanced accretion onto an existing disc**
- **Binary SMBHs driving episodic accretion over several orbits**

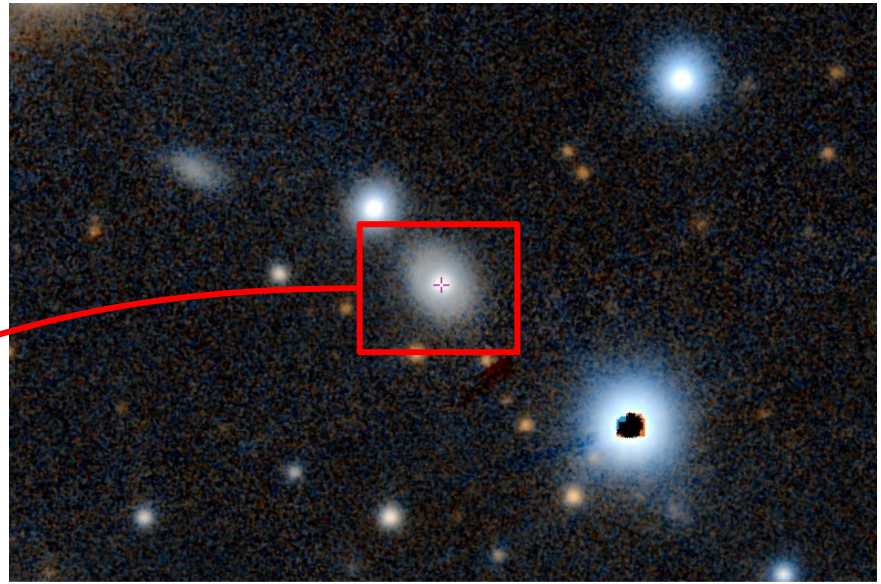
Tadhunter+ 2017; Trakhtenbrot+ 2019; Gromadzki+ 2019; Makrygianni+ 2023

**1st detected by ZTF in r-band on October 17, 2020 (https://www.wis-tns.org/object/2020xys)**

Classified as **AT2017bgt-like class of nuclear transients** October 27, 2020 by Ihanec + 2020

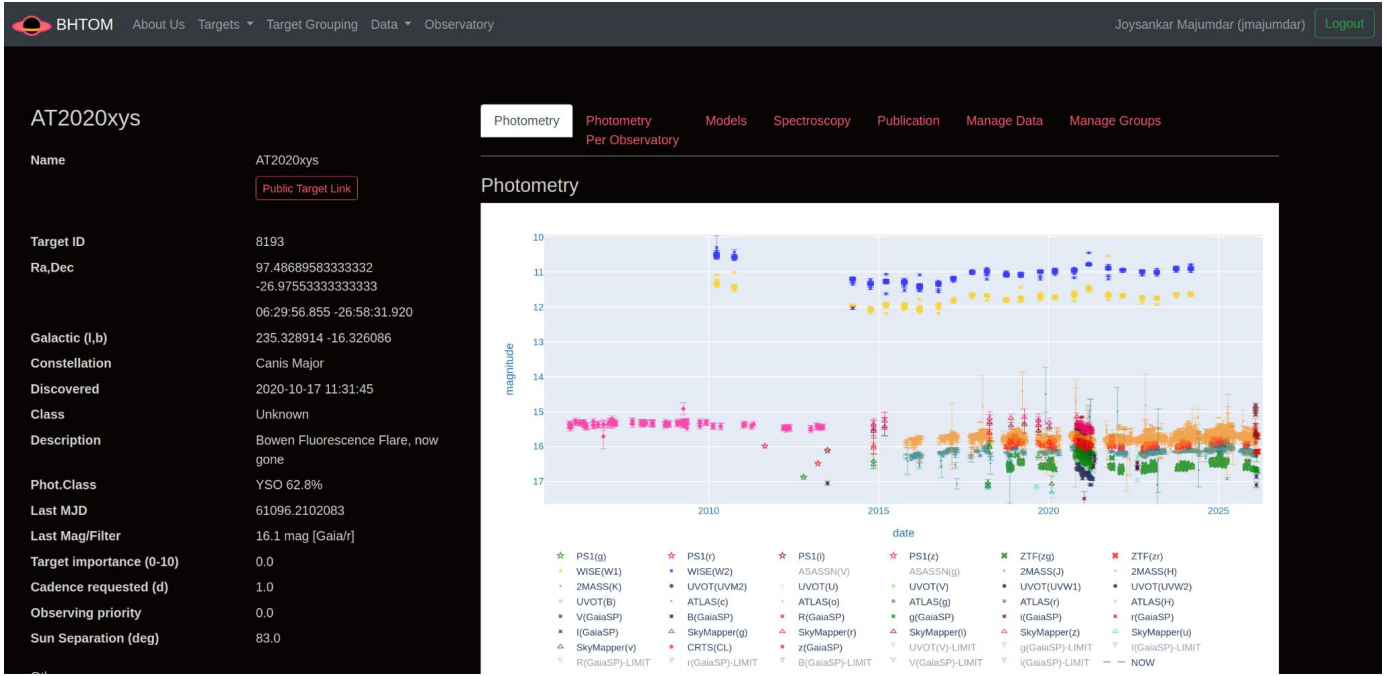
**2MASS J06295686-2658318/ 6dFGS gJ062956.9-265832**

z = **0.072**



PanSTARRS - DR1

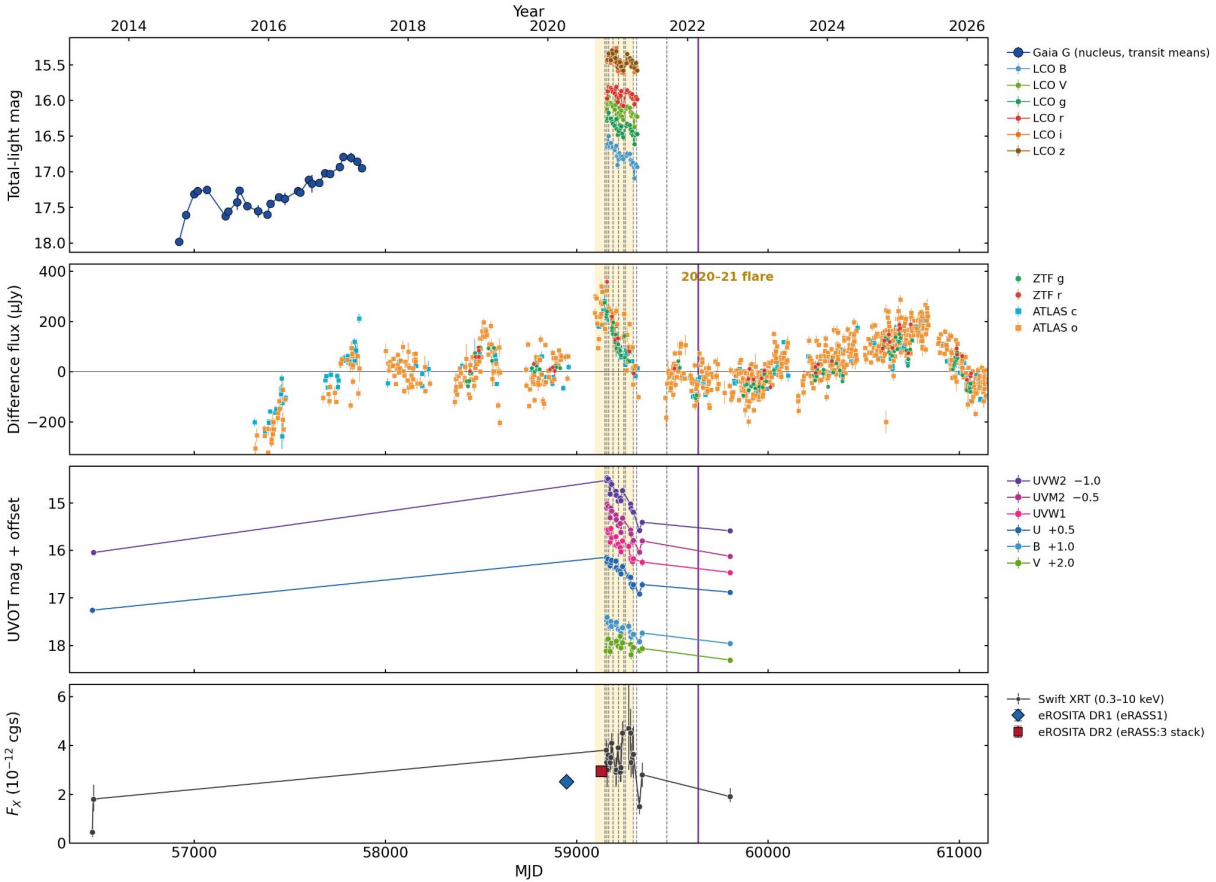
# AT 2020xys in BHTOM



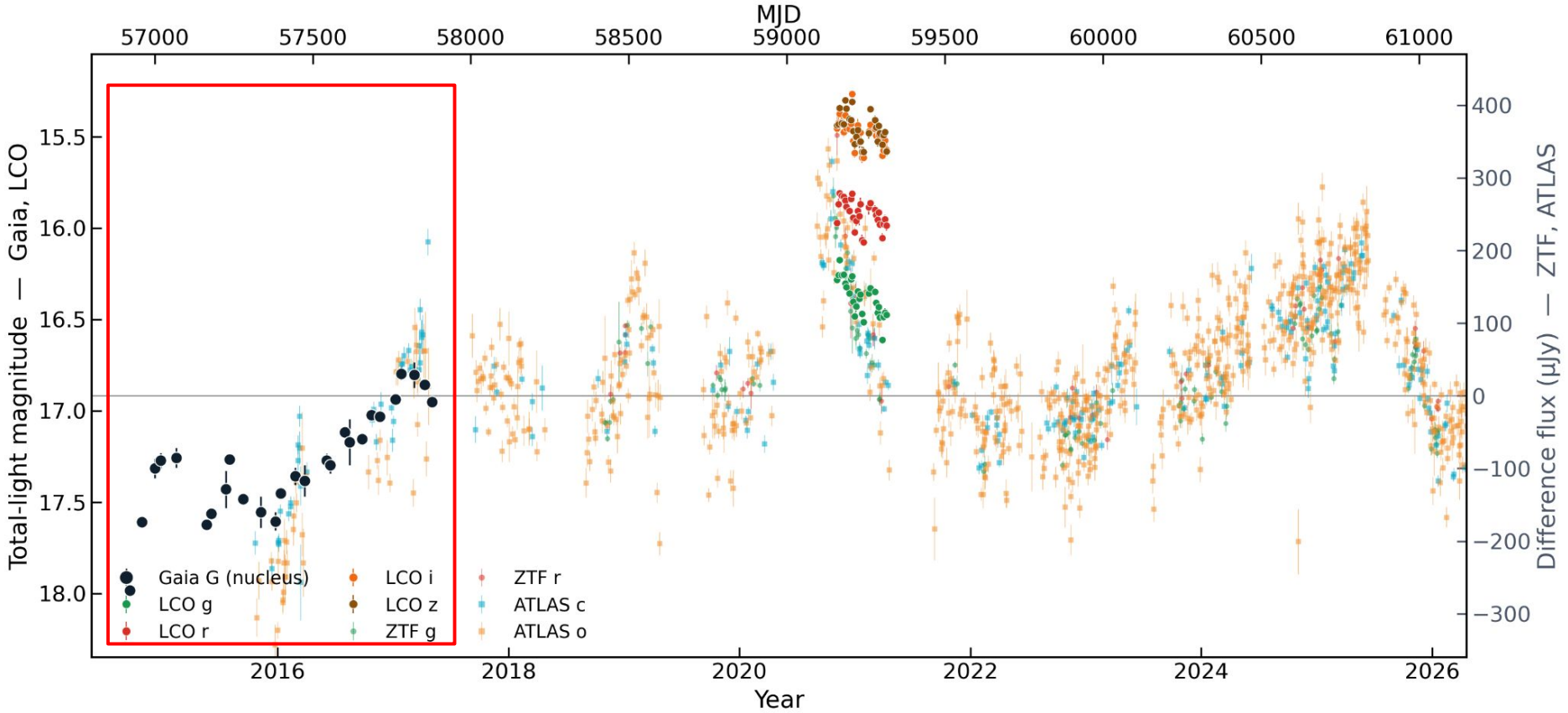

From **BHTOM.SPACE** (Wyrzykowski+2024)

**Network of 175+ optical telescopes**

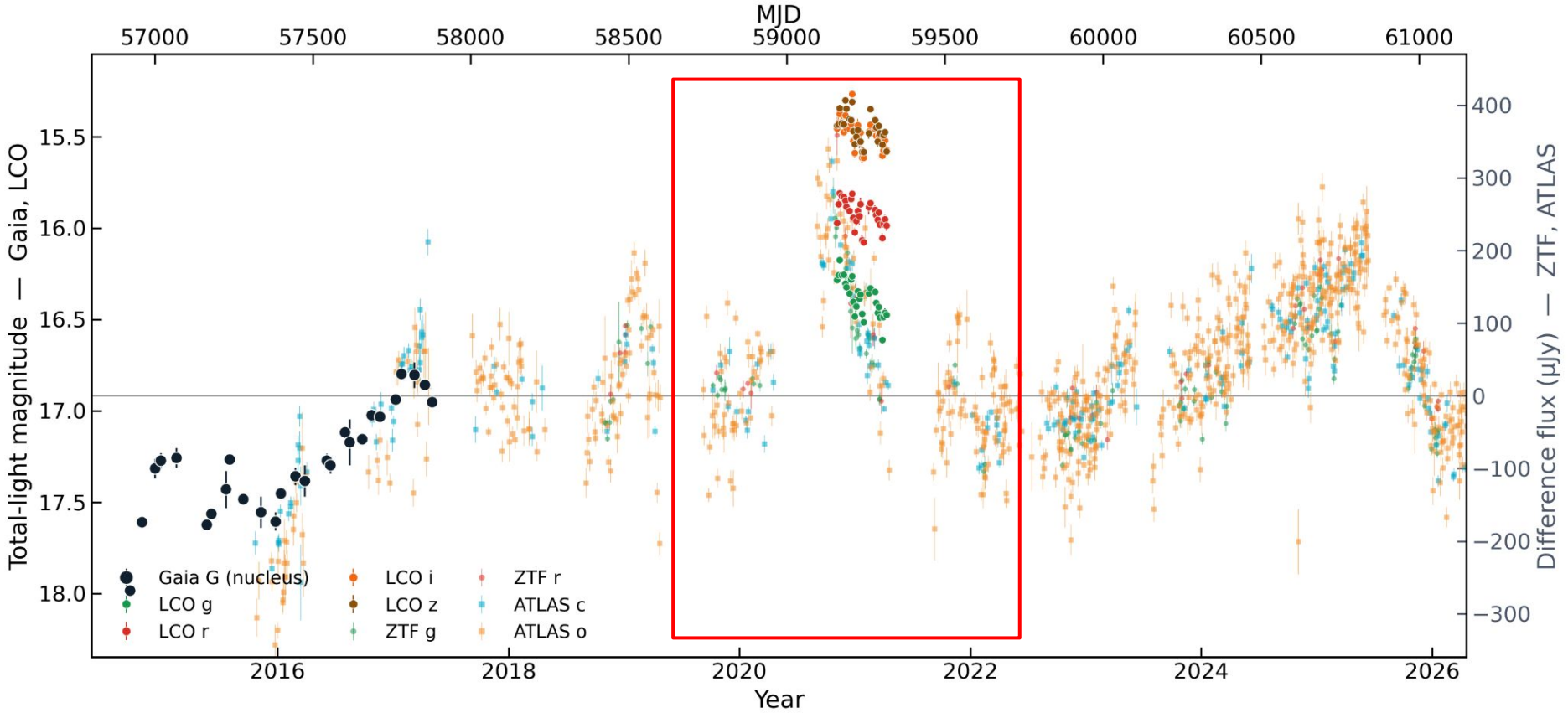
# AT 2020xys : Multi Wavelength Light Curve



# AT 2020xys in the Past & Future



# AT 2020xys in the Past & Future



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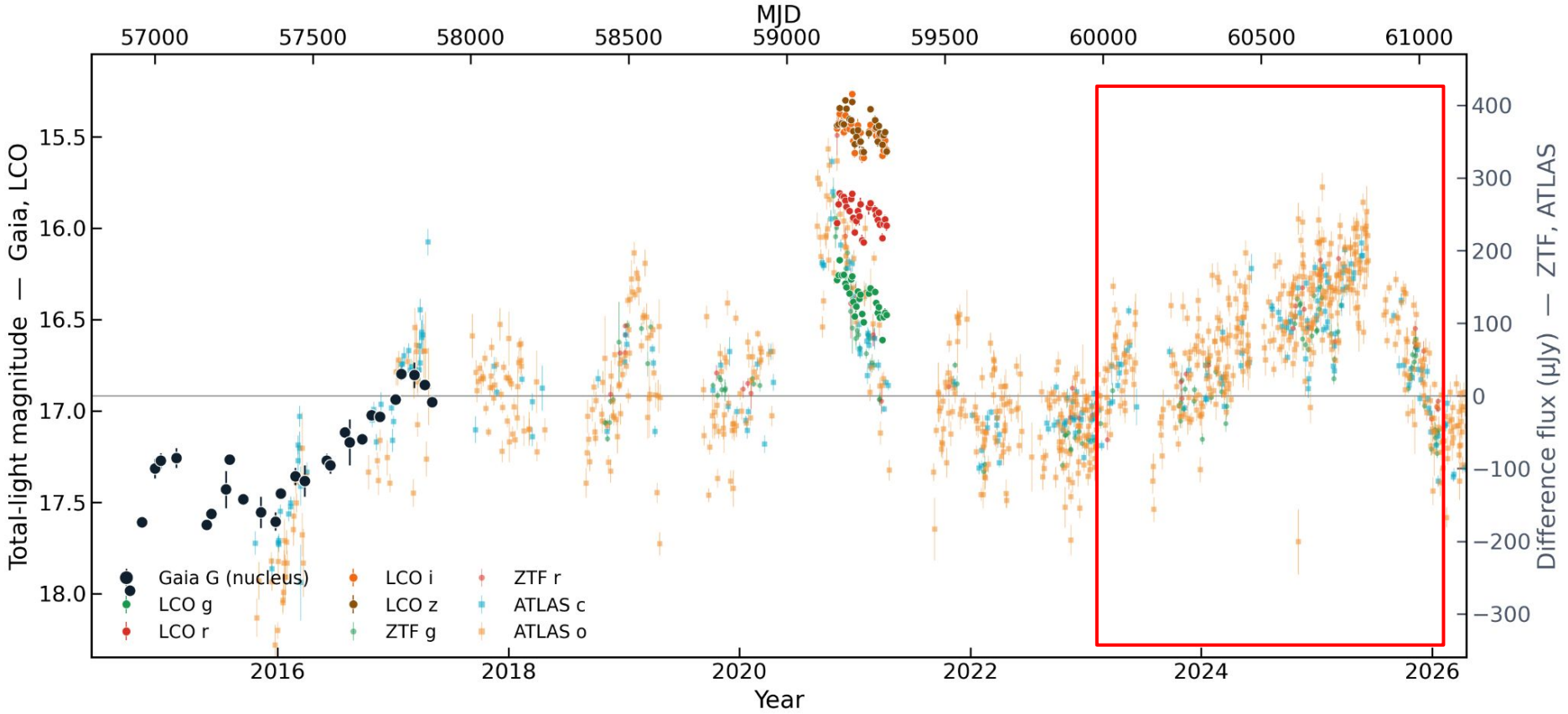
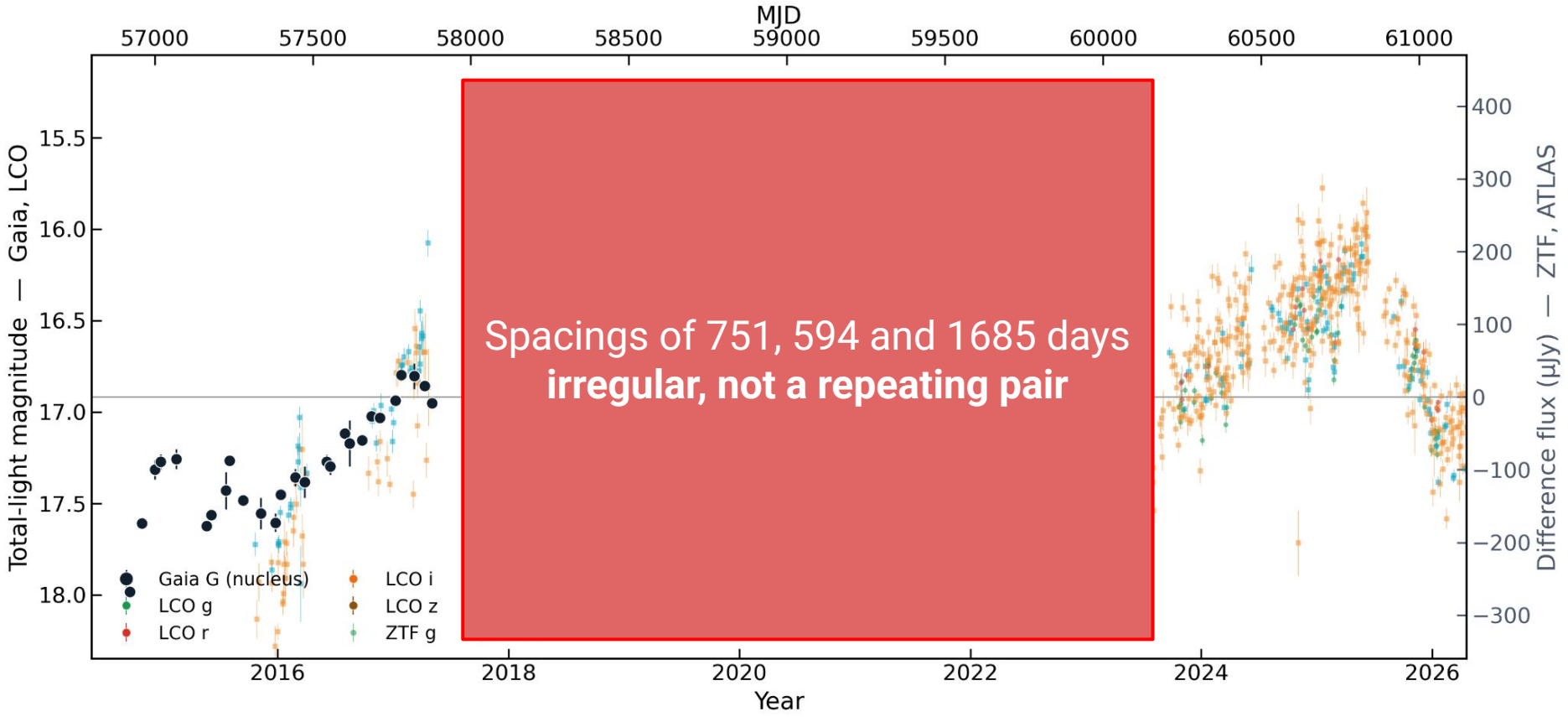
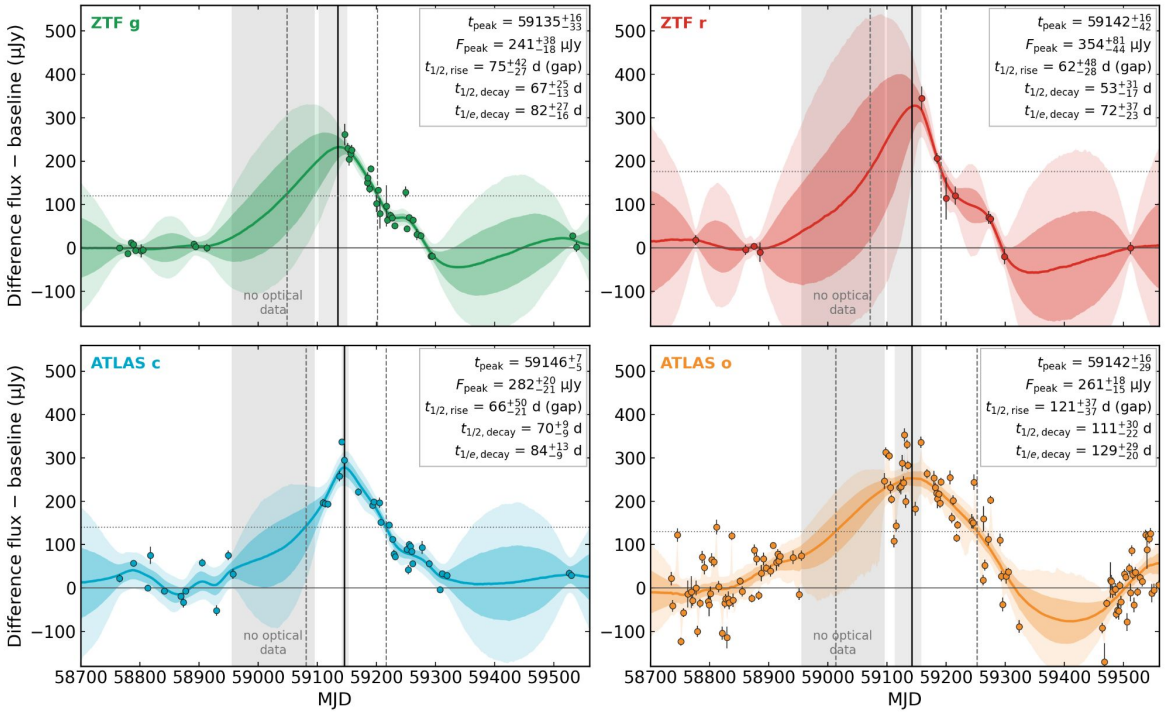


# AT 2020xys in the Past & Future

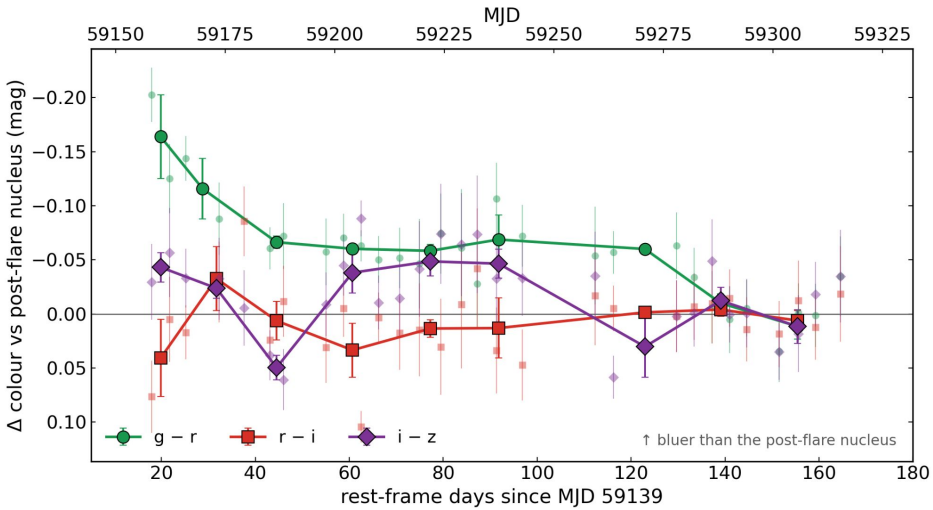


# AT 2020xys : Light Curve Fit with GP

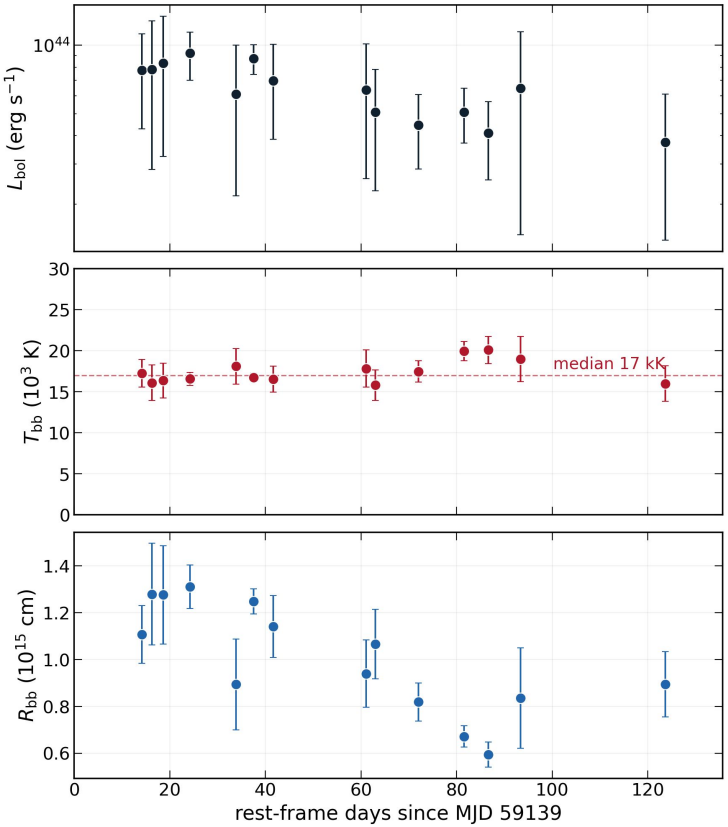



**The decay is fast ~ 78 days!**

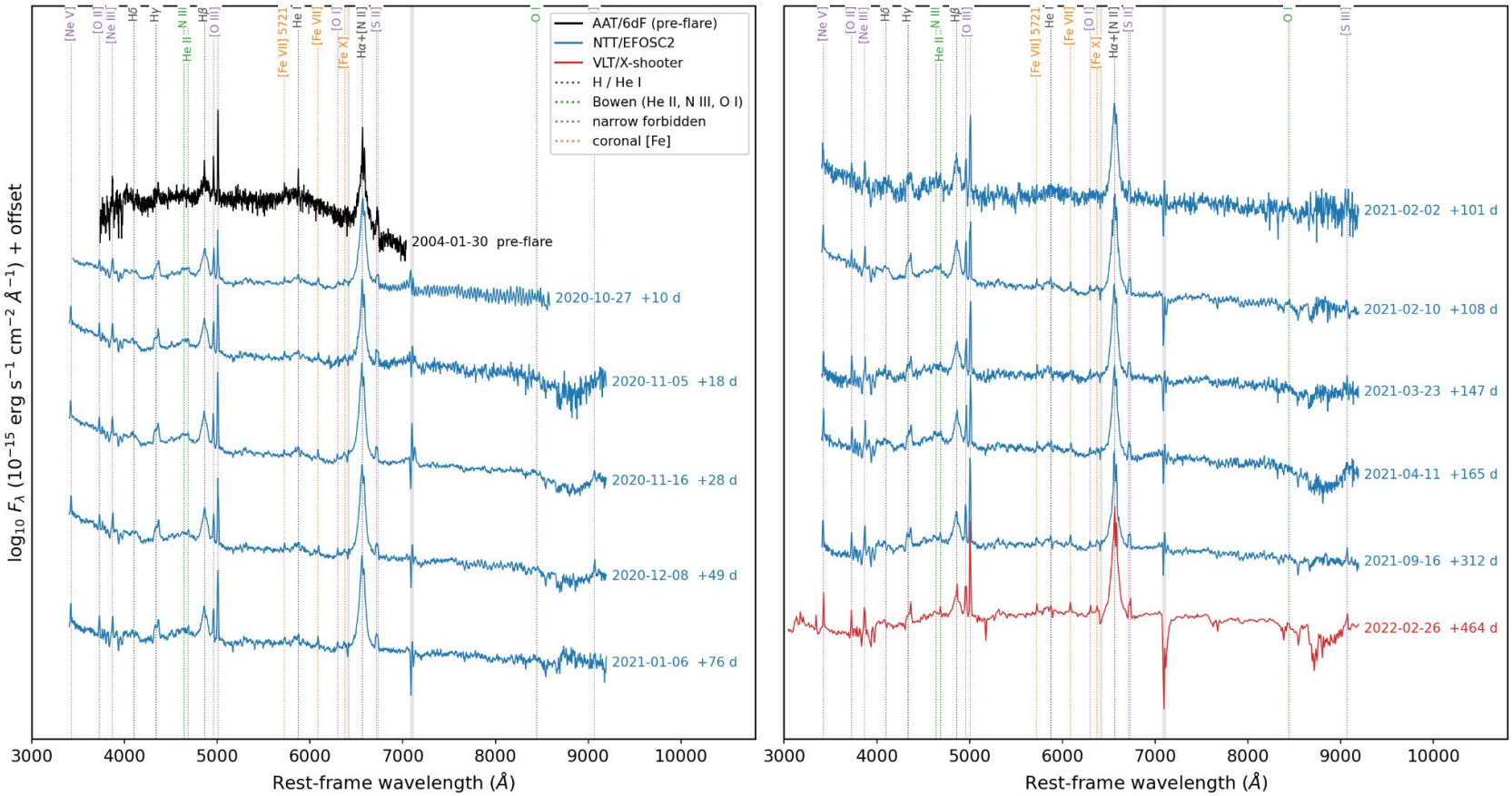
# AT 2020xys : Colour Evolution



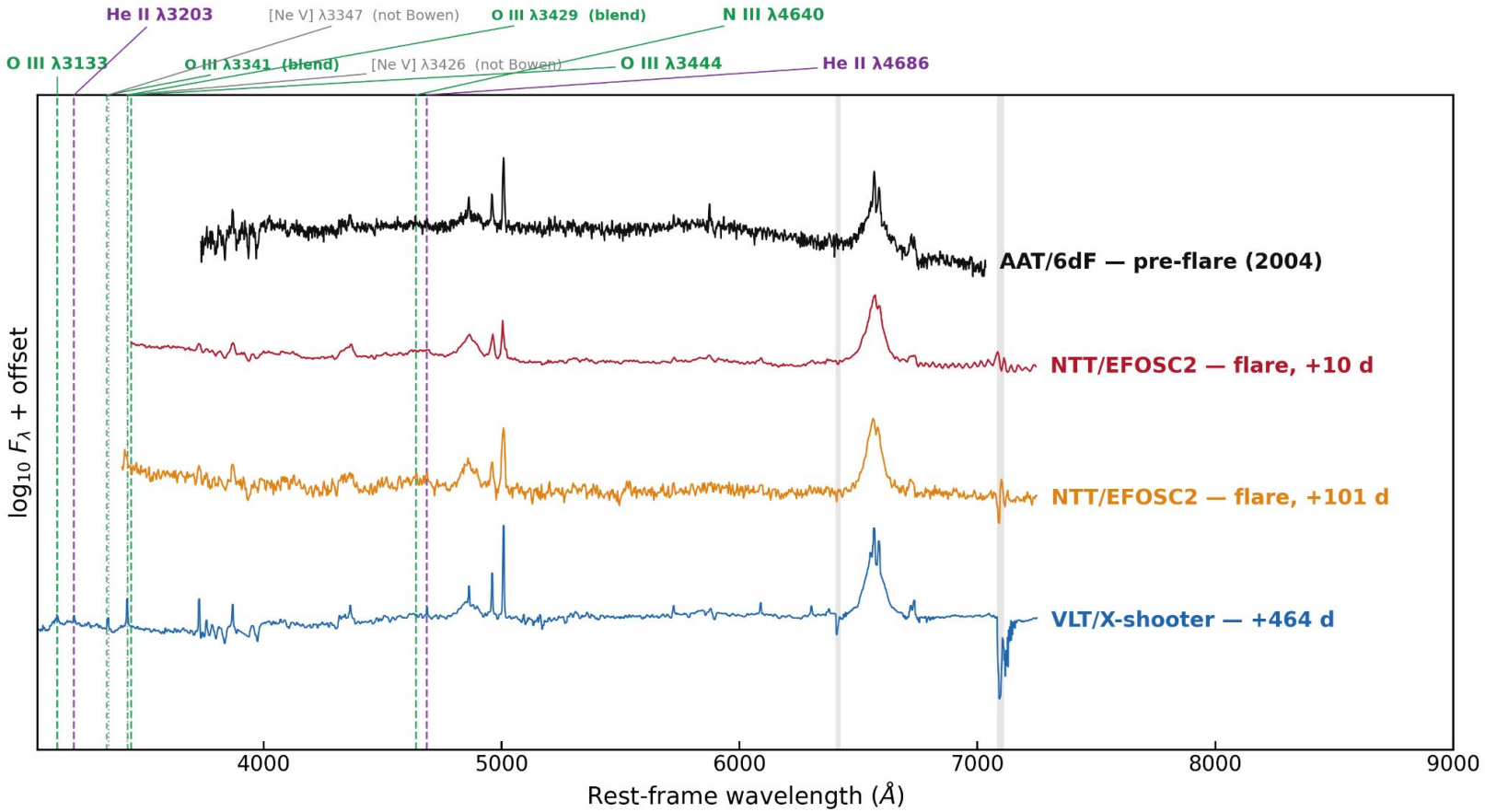

**Blackbody temperature is almost flat around 17000 K!**



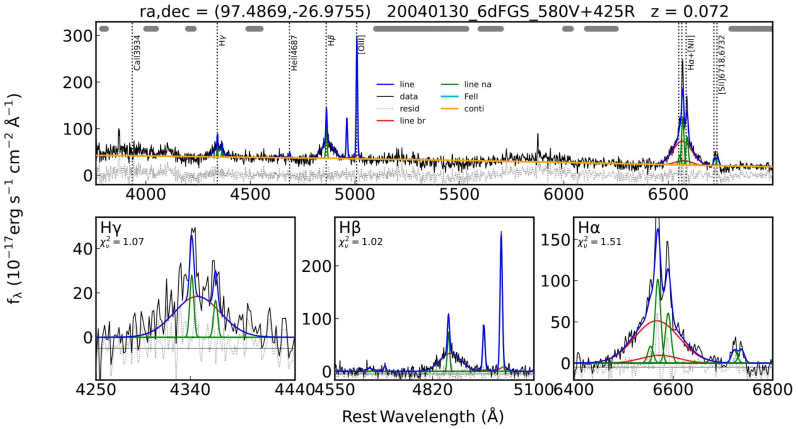
# AT 2020xys : Spectra

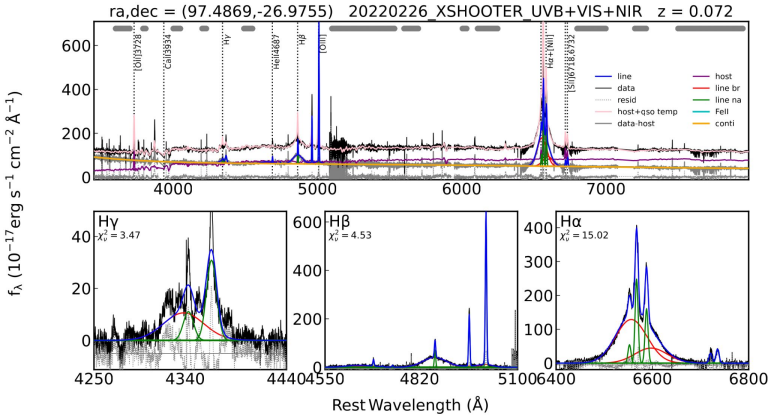


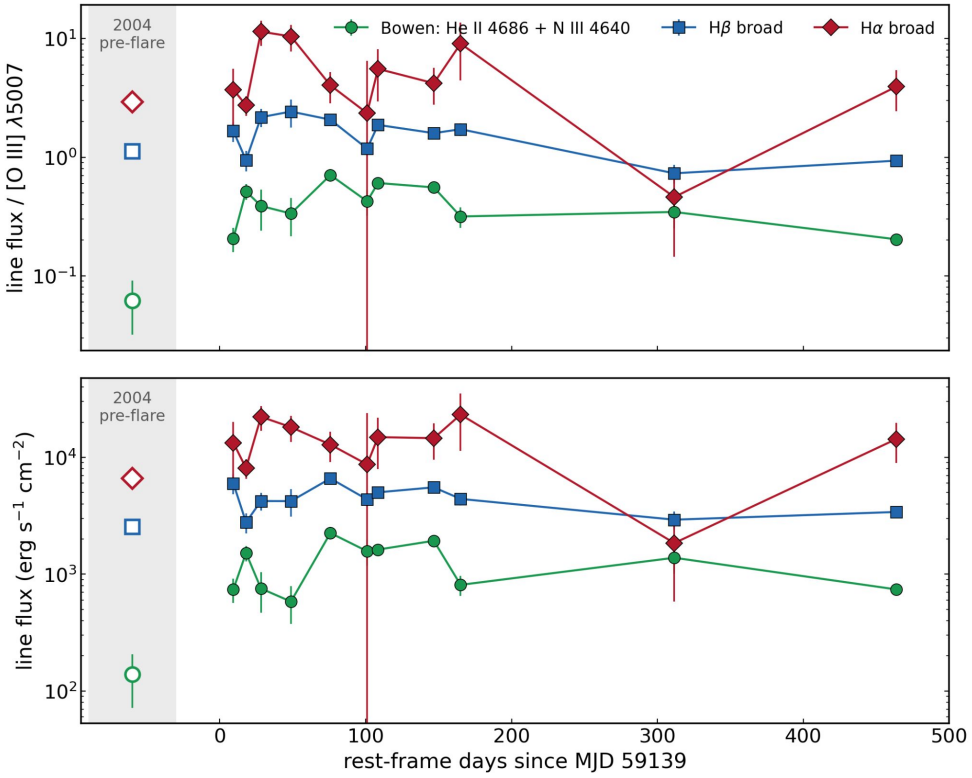
# AT 2020xys : Bowen Lines



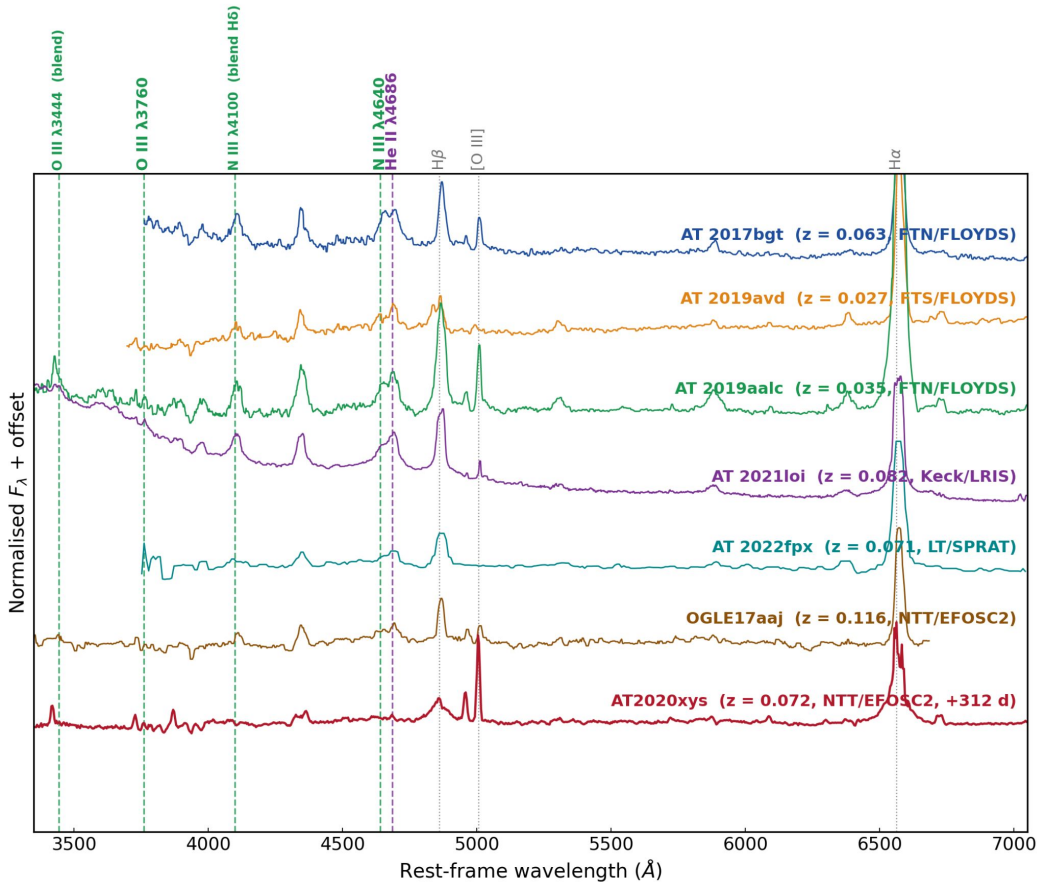
# AT 2020xys : Spectra Fit - PyQSOFit



# AT 2020xys : Comparison to other BFFs




**Not so strong compared to other BFFs !!**

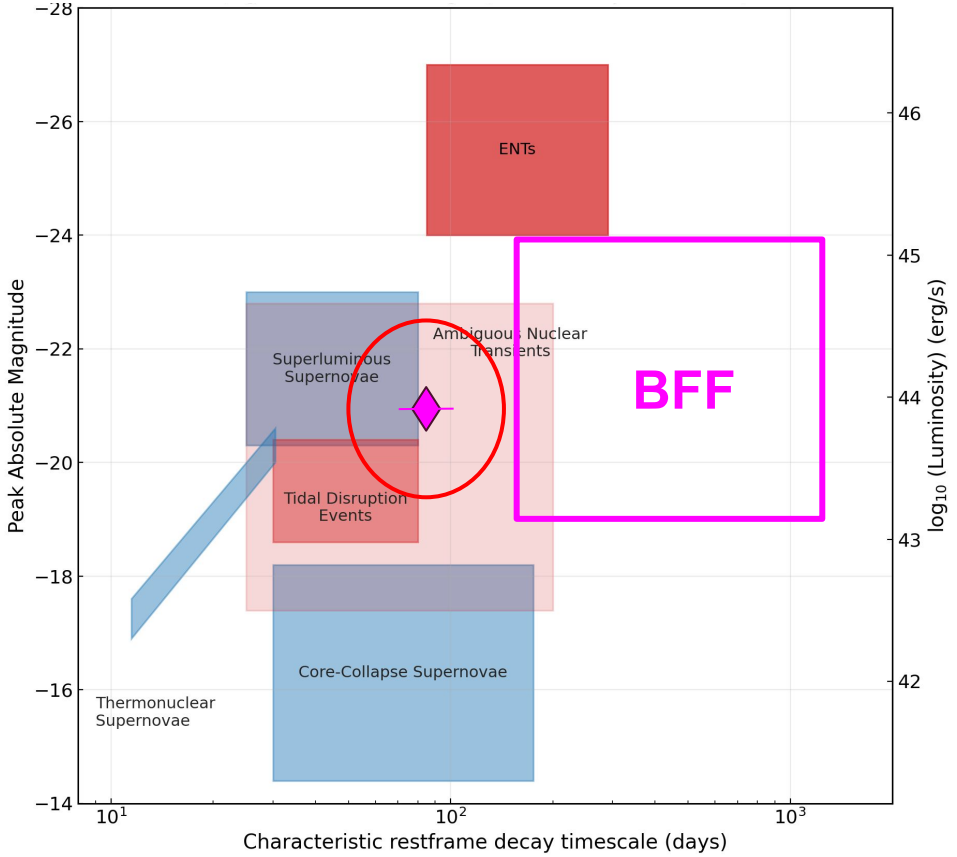
**AT2020xys has the weakest blend of the set!**

# AT 2020xys : Outlier?

| Object | Decay τ (1/e, rest) | Stayed bright for | UV amplitude |
|---|---|---|---|
| **AT 2020xys** | **~ 78 d** | **~ 5 months** | **×4 (UVW2 vs 2013)** |
| AT 2017bgt | ~ 650 d | ~ 14 months | ×75 (NUV vs GALEX) |
| OGLE17aaj | ~ 700 d | ~ 10 months | — |
| AT 2021loi | ~ 500 d | ~ 13 months | ×20 |
| F01004−2237 (2010) | ~ 1000 d | years | — |

**Photometrically it is an outlier & an order of magnitude too fast!**

# AT 2020xys in the Phase Space




**So spectra say BFF, light curve says ANT!**

# AT 2020xys: So what is it?

| Hypothesis | For | Against | Verdict |
|---|---|---|---|
| Supernova | - | Nuclear; no cooling in 125 d; | Ruled out |
| TDE in an AGN | UV-bright, T constant, decay time is TDE-like | T at the cool end; X-rays keep Seyfert hardness, never turn soft; a third episode in 2024-25 | Possible, not favoured |
| Bowen flare (BFF) | Pre-existing AGN; N III, He II and O III switch on; hot, non-cooling; Bowen present weakly before, as in AT 2021loi | 3-10× faster and 5-20× weaker than every published BFF; months, not years | Yes, spectroscopically |
| Accretion episode | Repeated episodes in 2015-17, 2020, 2024-25; disc-like broad SED | 4times UV rise in weeks is extreme for ordinary variability; the Bowen switch-on is not routine AGN behaviour | The likely driver |

**A short-lived Bowen fluorescence flare** in a Seyfert 1. A BFF candidate at the **fast, faint end of the class**, powered by an **accretion episode** rather than a disruption.

# Summary

- AT2020xys is a Bowen fluorescence flare by every spectroscopic test: N III λ4640 and broad He II λ4686 switch on from nothing, and X-shooter detects the UV cascade lines O III λ3133 and He II λ3203

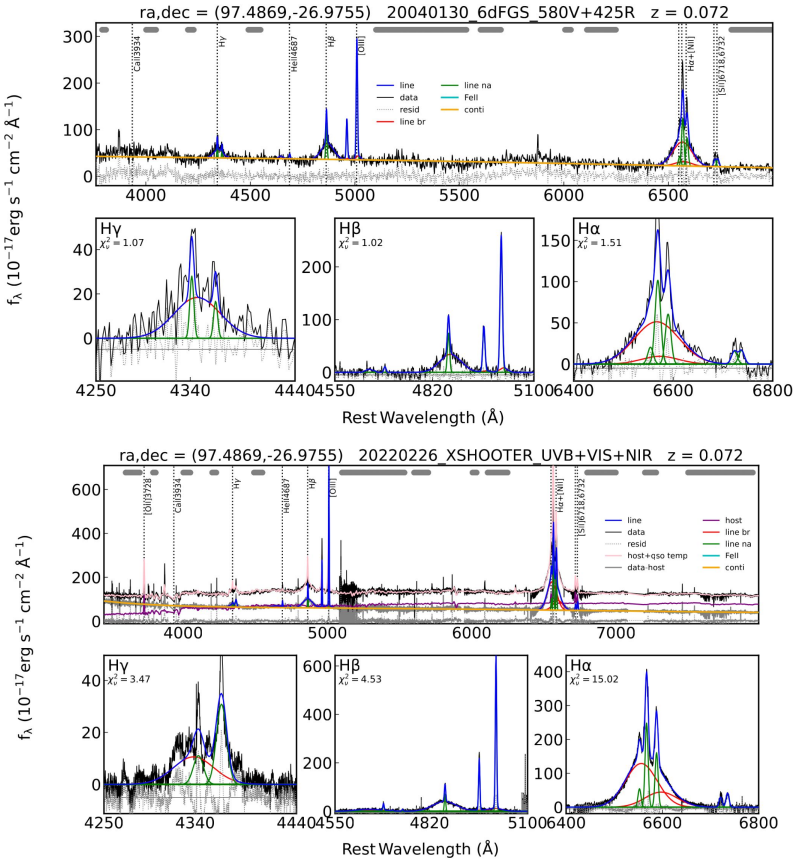
- Photometrically it is the fastest and faintest of the class: τ = 78 d and ×4 in the UV, against 500-1000 d and ×20-75 for every published BFF

- The Bowen lines outlast the continuum by ~1 year, and the soft X-rays respond more than the hard; both pointing to an EUV source we never see directly

- The nucleus flares every few years: 2015-17, 2020, 2024-25. So the driver is an accretion episode

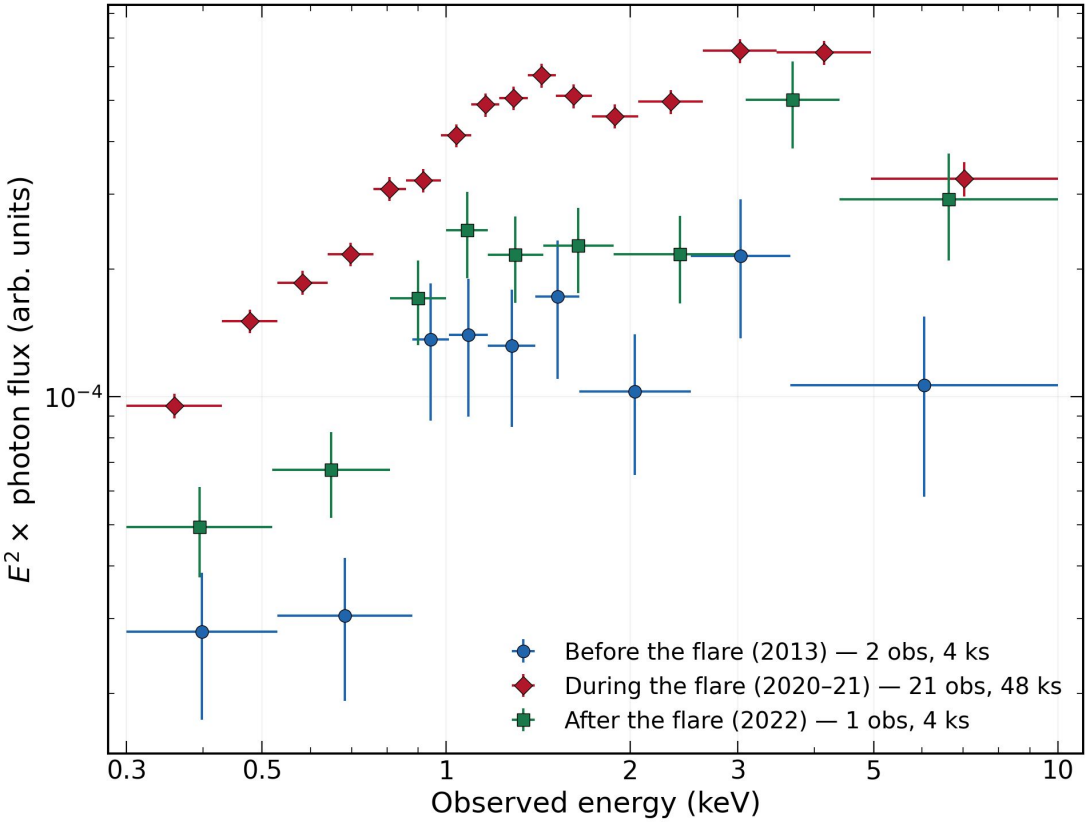
Thank You!

# AT 2020xys : Spectra Fit - PyQSOFit




| Phase | NIII/[OIII] | HeII/[OIII] |
|---|---|---|
| pre-flare | **<0.061** | **-** |
| +10 | **0.090** | **0.117** |
| +18 | **0.239** | **0.277** |
| +28 | **0.108** | **0.280** |
| +49 | **0.152** | **0.183** |
| +76 | **0.442** | **0.266** |
| +101 | **0.191** | **0.234** |
| +108 | **0.325** | **0.281** |
| +147 | **0.279** | **0.277** |
| +165 | **0.170** | **0.147** |
| +312 | **0.181** | **0.164** |
| +464 | **0.117** | **0.086** |

# AT 2020xys : X-ray spectra



# AT 2020xys : Spherex