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The rise and fall of the iron-strong nuclear transient PS16dtm

Petrushevska, Leloudas, Ilic et al. (2023), A&A, 669, A140

email

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TIDAL DISTRUPTION EVENTS IN AGN

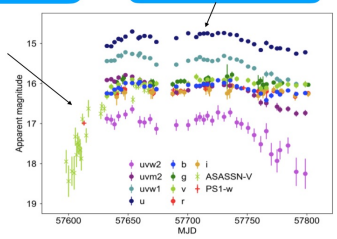
- Since identification of TDEs in AGN galaxies is complicated by the possibility such an event is due to AGN variability, search for TDEs was usually done by excluding galaxies with known AGN
- No physical process that prohibits that a TDE can happen in AGN, some have even suggested that TDEs in AGN galaxies may exhibit more efficient accretion due to interaction with the pre-existing disk
- Recently, the discoveries of transients in AGN are rising, but there is no single smoking gun signature that allows us to classify luminous nuclear transients:
- We need to study TDE candidates in AGN to get the whole picture (handful number of events and sparsely sampled data)

PS16dtm history

- Discovered by Pan-STARRS Survey for Transients on 12 August 2016
- Atel: Optical and UV Re-brightening of Hydrogen-rich Super-Luminous Supernova PS16dtm/SN 2016ezh)
- host galaxy of PS16dtm at z=0.0804 is a NLSy1 galaxy with SMBH with $\sim 10^6\ M_\odot$
- Blackbody fits indicate temperature of ~ 17000 K
- At Eddington luminosity of the SMBH.

brightened for approximately two magnitudes above the archival host brightness in ~50 days

stayed in the plateau phase for ~100 days with no color evolution (viscous delay time or L being capped by L_{Edd}?



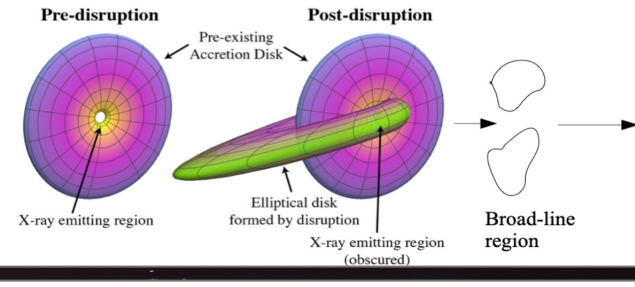
Blanchard, Nicholl, et al. 2017 showed PS16dtm evolution of the first 200 days

PS16dtm is blocking the pre-existing X-rays from the AGN host

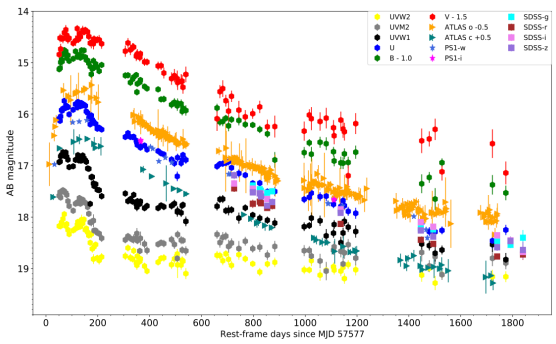
Blanchard, Nicholl, et al. 2017

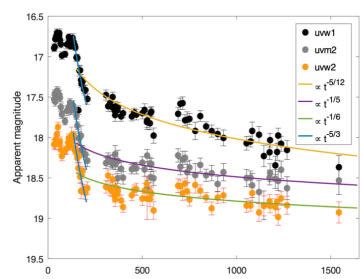
PS16dtm is undetected in the X-rays to a limit an order of magnitude below an archival X-ray detection of its host galaxy

Blanchard, Nicholl, et al. 2017 predicted that X-rays will reappear as the accretion rate decreases



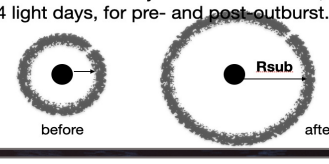
Our study - 2000 days of photometric and spectroscopic monitoring

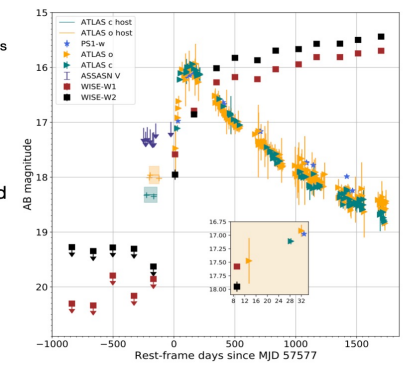




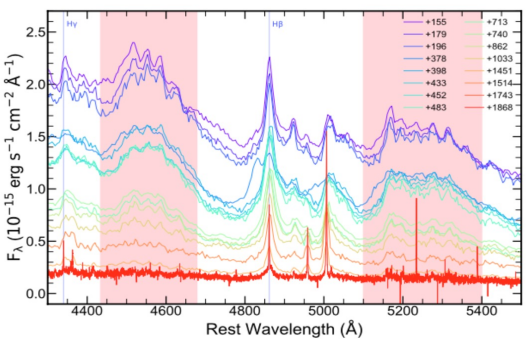
Mid-infrared light curve peaks (will peak) much later than the UV/optical

- TDEs with mid-infrared flares in the literature have been successfully interpreted as dust echos. (Jiang et al. (2021) found 11 with MIR emission; the time of the MIR peak ranges from 0 to 800 days after the optical peak, and their duration are from tens to more than 1000 days.)
- Time delay of the MIR peak relative to the UV/ optical peak -> the distance to the dust medium
- The inner radius of the dusty torus can be estimated from the sublimation radius from the AGN bolometric luminosity. For PS16dtm host, is 18 and 144 light days, for pre- and post-outburst.



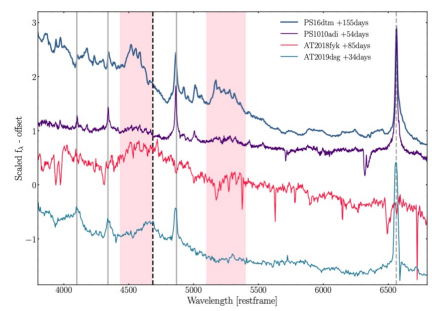


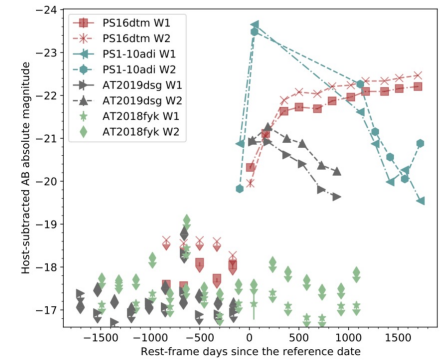
PS16dtm spectra - strongest iron emission in a nuclear transient



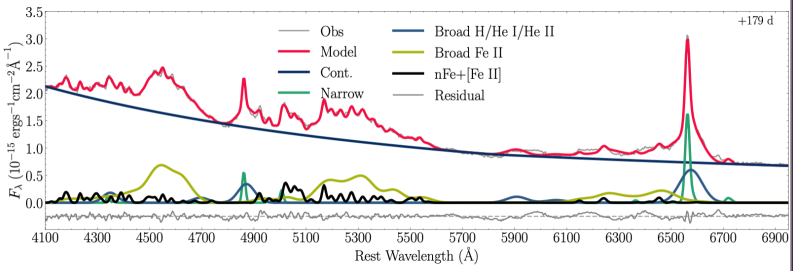
- Strong Fe II emission complexes (common features in NLSy1 spectra but not so strong usually)
- broad Fe II emission is transient: not present in the archival pre-outburst spectrum and almost completely disappeared in our last spectrum at +1868 days
- Result of sublimation of dust grains located in the inner torus due to the sharp increasing of the central emission?

Nuclear transients with claimed iron emission and MIR LC





Thanks to our semi-empirical model, we were able to identify and study evolution of the emission lines.



» FANTASY - Fully Automated pythoN tool for AGN Spectra anaIYsis
https://fantasy-agn.readthedocs.io/en/latest/

- the MIR, optical and Fe II lightcurve evolve on different timescales -> not possible to establish a direct link between the dust and the iron emitting regions.
- The X-ray has not returned to pre-outburst levels despite that the optical photometry and spectroscopy indicate that the emission is returning to the pre-outburst level.
- Short rise NUV/optical LC, but long-lived, extraordinary transient Fe complexes, strong MIR response, where do they come from?
- At least one coronal line detected at the last spectrum - hard to explain, as the X-ray emission continues to be suppressed while the optical data has returned to pre-outburst levels
- some AGN extreme variability can be explained as a change in the accretion state in the SMBH triggered by a TDE?