Accretion and ejection at work in the NLS1 Galaxy 1H 0323+342: a case of intermittent activity?

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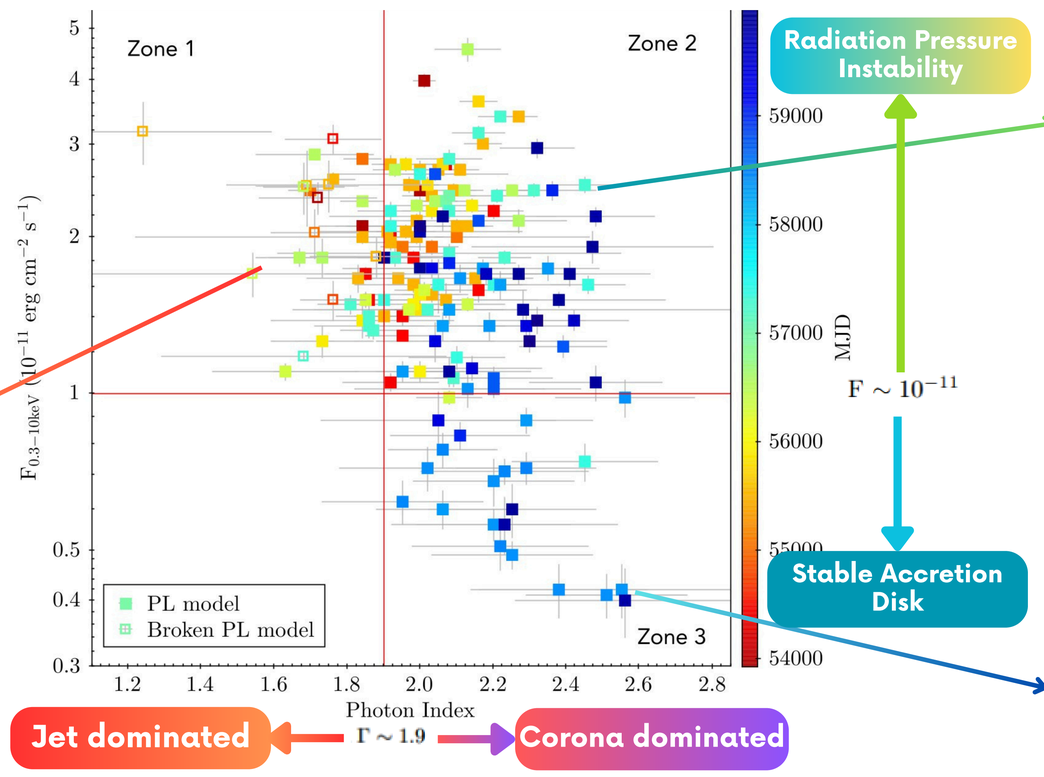
for more info!

1H 0323+342 is the closest Narrow Line Seyfert 1 Galaxy (z=0.063), analysed from 2006 to 2023. We noticed that the galaxy's jet activity decreased after 2017, likely due to radiation-pressure instability in the accretion disk.

- **X-RAY ANALYSIS**: We analyzed 172 observations from Swift XRT. Data were reduced by using HEASOFT 6.31.1, the calibration database CALDB updated on 2023 September 11. Spectra were fitted using the software XSPEC. To study the accretion-ejection interaction two models were applied: power-law and broken power-law, absorbed by the Galactic column: tbabs model with Nh=1.17e21.
- **UV-OPTICAL ANALYSIS**: UVOT magnitudes were extracted from a circular region of 5'' radius, while the background was measured from an annular region with 7'' and 30'' radii. UVOT magnitudes were then corrected for extinction using Cardelli's laws, converted to flux densities, and used to calculate two-point spectral indexes for UV and optical bands.
- **GAMMA-RAY ANALYSIS**: As the jet emission dominates the high-energy γ-ray band, we retrieved Fermi/LAT light curves in the 0.1-100 GeV energy band, with a three-day time bin and free photon index, considering only data with a likelihood test statistic TS≥10.

X-RAY RESULTS: The results show evidence of 3 zones characterised by different Photon Index, Γ, and unabsorbed Flux values in units of ergs per cm square times seconds, in the 0.3-10 keV energy range.

ZONE 1:
characterized by
$\Gamma \lesssim 1.9, F \gtrsim 10^{-11}$
likely to be dominated by the jet emission



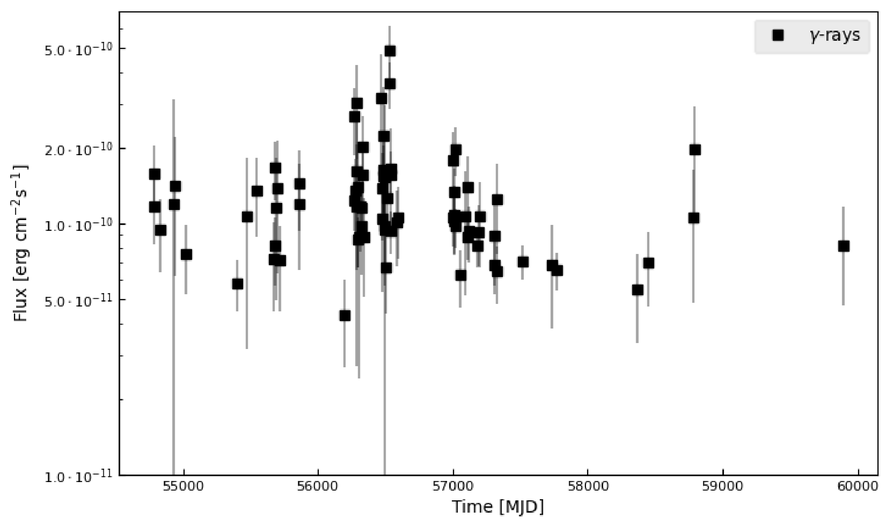
ZONE 2:
characterized by
$\Gamma \gtrsim 1.9, F \gtrsim 10^{-11}$
likely to be dominated by the corona

ZONE 3:
characterized by
$\Gamma \gtrsim 1.9, F \lesssim 10^{-11}$
likely to be dominated by the corona, softer spectra and flux values significantly lower than the other zones

UV-OPTICAL RESULTS: Since UVOT data did not display significant variability, we calculated the average fluxes and spectral indexes for each zone, finding that while Zones 1 and 2 show consistent values, Zone 3 has lower fluxes and softer indexes, indicating a change in the accretion rate.

Zone	α_{UV}	α_{opt}	F_{UV}	F_{opt}
(1)	(2)	(3)	(4)	(5)
1	-0.18 ± 0.05	0.63 ± 0.02	2.58 ± 0.07	2.13± 0.04
2	-0.23 ± 0.06	0.60 ± 0.03	2.60 ± 0.04	2.08 ± 0.02
3	-0.11 ± 0.02	0.81 ± 0.01	2.34 ± 0.10	1.94 ± 0.09

GAMMA-RAY RESULTS: We noticed that the lack of γ-ray detection corresponds to a lower X-ray flux, and steeper spectra. These data correspond to the Zone 3.



These results can be interpreted using the radiation-pressure instability theory by Czerny et al. (2009), which links high accretion rates in disks to instabilities that cause intermittent jet activity, with estimated burst timescale of about 8 years according to the equation:

$$\log T_{\rm burst} \sim 1.25 \log \nu L_\nu(5\,{\rm GHz}) + 0.38 \log \frac{\alpha}{0.02} + 1.25 \log K_{5\,{\rm GHz}} - 53.6$$

Instability should take place when the dimensionless accretion rate exceeds 0.025. In our case, considering the flux values in Zone 1 and 2, this value results approximately 0.033, according to the equation:

$$\dot{m} = \frac{\dot{M}}{\dot{M}_{\rm Edd}} \sim \frac{L}{L_{\rm Edd}} = \frac{8.6 \times 10^{43}}{2.6 \times 10^{45}} \sim 0.033$$

Continued monitoring is essential to understand its evolution, with a potential jet restart likely predicted for 2025.

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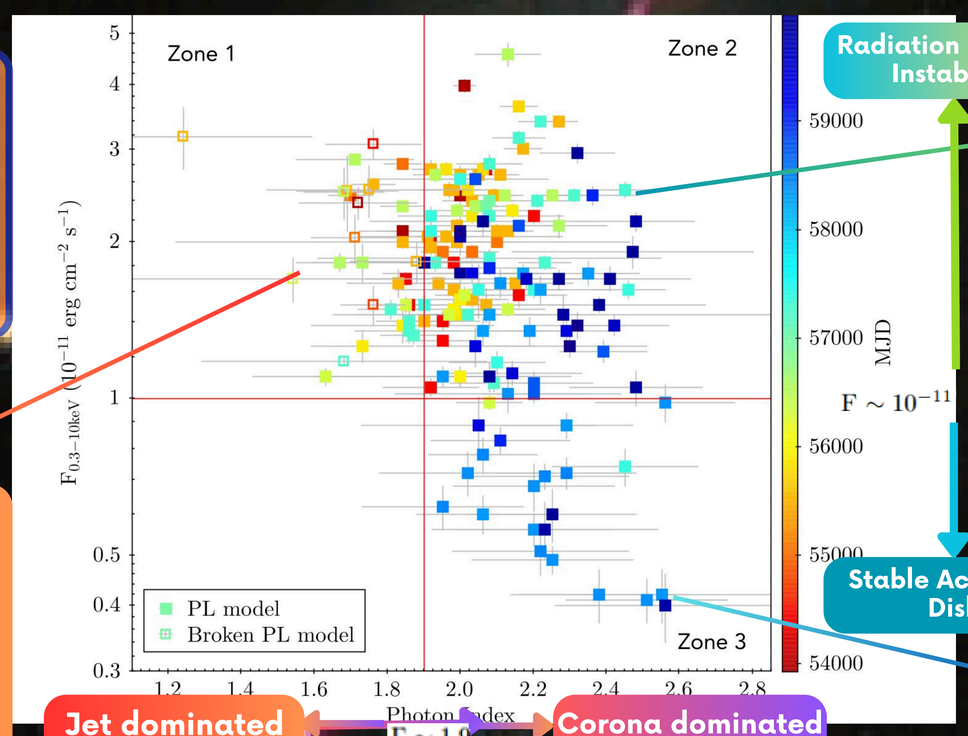

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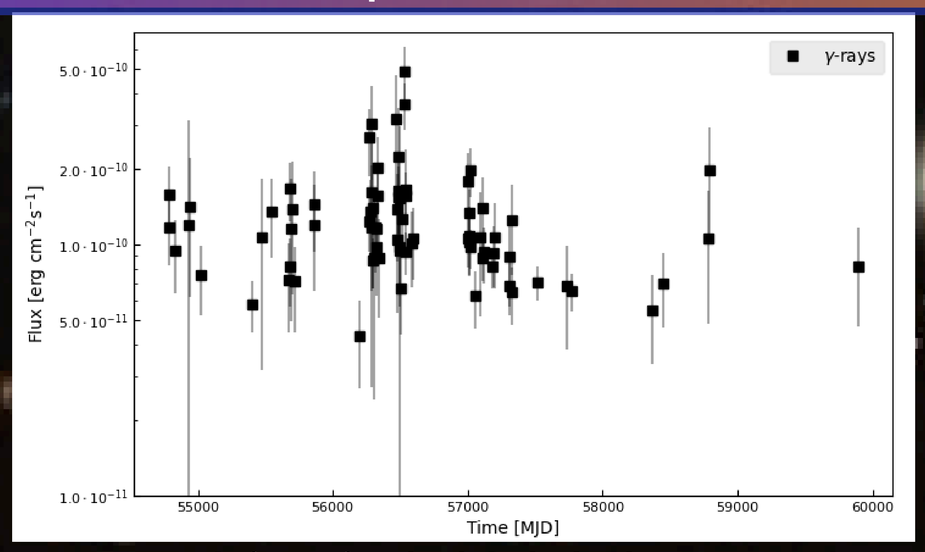

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