

New X-Ray Clues

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Why in News?

Researchers from the Aryabhata Research Institute of Observational Sciences (ARIES), Nainital published a study analyzing broadband X-ray emissions from four classical high-energy blazars.

Target Objects

- **Target Blazars** - Studied four classical **TeV blazars** (active galaxies emitting very-high-energy gamma rays at tera-electronvolt scales):
 - **Mrk 421** (Markarian 421)
 - **Mrk 501** (Markarian 501)
 - **PG 1553+113**
 - **PKS 2155-304**
- **Space Telescopes Combined**
 - **NASA's NICER (Neutron star Interior Composition Explorer)** - Captured lower-energy (soft) X-ray spectra.
 - **NASA's NuSTAR (Nuclear Spectroscopic Telescope Array)** - Captured higher-energy (hard) X-ray spectra.

Key Astrophysical Findings

- **Detection of Accretion Flow Contribution**
 - In standard blazar models, X-ray emission is completely dominated by intense, beamed non-thermal radiation from the **relativistic jet** pointed toward Earth.
 - When **Mrk 421** and **Mrk 501** entered moderate-to-low active (quiescent) states, researchers detected an additional low-energy spectral component.
 - This confirms that when jet emission dims, thermal/non-thermal radiation from the **accretion disk** surrounding the black hole becomes observable—providing the **first evidence of a direct accretion disk contribution in Mrk 501** (and confirming earlier hints in Mrk 421).
- **Unresolved Gaussian Feature in Mrk 421** - A minor extra emission peak (Gaussian feature) was detected in Mrk 421's spectrum.
- It indicates localized energy excess (potentially linked to instrumental artifacts or localized magnetic activity near the jet base).
- **Curved Spectral Profile in Other Blazars** - For PG 1553+113 and PKS 2155-304, the X-ray spectra strictly followed standard synchrotron models.
- The curved spectral shape reflects differential rates of particle energy gain (acceleration) versus radiative loss.

New X-ray Clues on **Blazars**

Could Provide Insights into Powering Active Galaxies

What are Blazars?

- Active galaxies** with a supermassive black hole at the centre.
- Powerful jets** pointed almost directly towards Earth.
- Among the brightest** and most energetic objects in the universe.

The New X-ray Clues

- Advanced X-ray observations** reveal new details about blazar emissions.
- Helps identify** the processes that power their extreme energy output.
- Provides clues about** how active galaxies are fueled.

Why It Matters

Improves our understanding of galaxy evolution

Unravels the mystery of supermassive black holes

Builds a clearer picture of the high-energy universe

★ ——— More X-ray clues → **Deeper cosmic answers.** ——— ★

Significance for Active Galactic Nuclei (AGN) Physics

- It challenges the traditional assumption that blazar X-rays originate purely from jet dynamics, establishing that AGN X-ray spectra are multi-component systems influenced by accretion state transitions.
- It enables astronomers to disentangle how central accretion disks feed matter into supermassive black holes while simultaneously launching relativistic jets.

Reference

[DST | New X-Ray clues from blazars](#)