Offsets between X-ray and Radio Emission: A step towards understanding the structure of extragalactic jets

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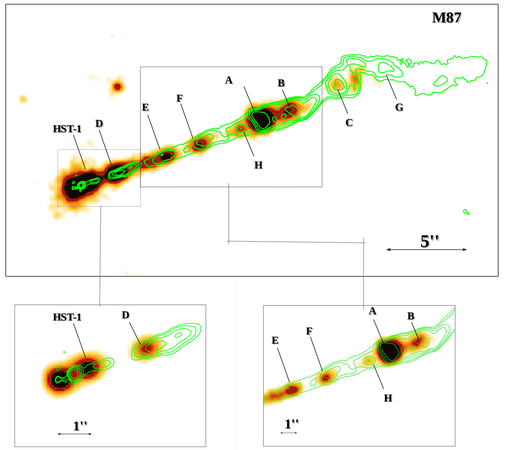
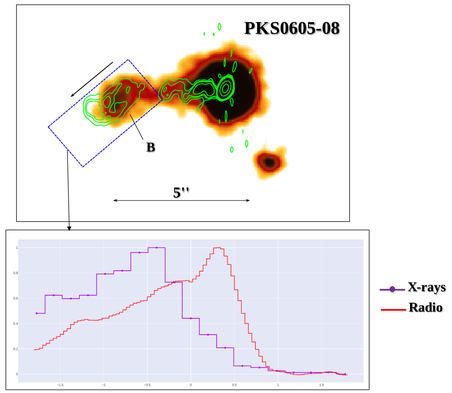
Abstract

Reported in the literature are a few extragalactic jets which show significant offsets between X-ray and radio emission in knots and hotspots. These offsets have occurred in jets with a wide range of jet powers. Despite this fact, various single-zone emission models were employed to explain the X-ray emission from the jets. We have undertaken a detailed study on all the Chandra detections and are finding that offsets are more the norm than an exception. This questions the applicability and conclusions of single-zone models.

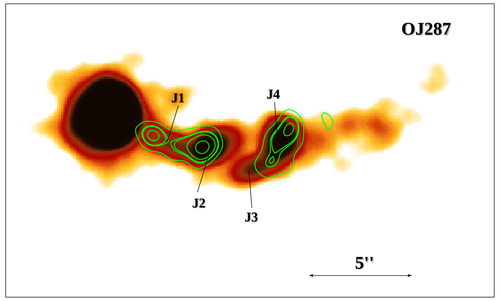


VLA 8.4GHz (0.2''; core subtracted) + X-ray bin size: 0.125(0.0615''). This is one of the early jets that was reported to have offsets between X-rays and radio. Here, high resolution images reveal a radio knot between the core and HST-1. Knots B,D,F show small X-ray first offsets while the X-rays are coincident with the radio in knots A and H.

More offsets!

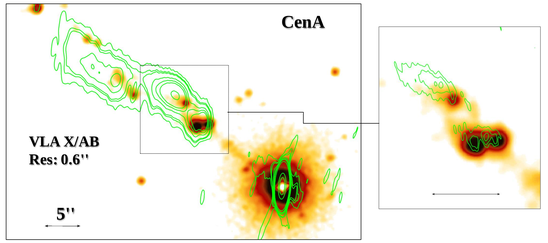


VLA 8.4GHz (0.2'') contours + 0.2 X-ray bin size. The X-rays fade away before the radio in knot B. And, the distance between the X-ray and radio peaks is at least 0.5''(3.3 kpc projected) which is much greater than the astrometric error of ~0.1''.



VLA 1.4GHz (1.3'') contours + X-ray bin size: 0.2 (0.984''). X-ray knot J3 and J4 display X-ray first offsets while J2 displays a radio first offset. Also, there is a faint radio knot possibly overlapping J1. Previously, J4 was reported as a radio first offset while offsets in J3, J3 weren't reported.

Previously proposed solutions for offsets



- **Synchrotron times lags + downstream advection[1]**
- **Faster moving knots in a slower outer flow + double shock structure (e.g., [4])**
- **Slow heavier moving knots in a fast-outer flow + single reverse shock[5]**
- **Upstream magnetic turbulence caused by moving knots.**

Preliminary Results

- **Offsets between radio and X-ray emission appear to be common in many X-ray jets. This warrants the use of multi-zone models to explain the X-ray emission.**
- **X-ray first offsets, where X-rays peak closer to the core than radio are much more common than their counterparts, the radio-first offsets.**

References

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