**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, 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.

**Introduction**

Traditionally, numerical and analytical single-zone emission models, where the emission is assumed to come from a single population of electrons, were employed to explain multi-wavelength emission from the jets in radio loud AGN. This directly implies the coincidence of the radio and X-ray emitting features along the jet. But, offsets between radio and X-ray emission were reported initially in a few close by jets like M87 and 3C286 and the count grew over time.

We’ve undertaken a detailed study of all the X-ray jets that were detected by Chandra to date to study the offsets with their radio counterparts. High resolution radio maps are made, and wavelet-decomposition is used to detect sources in the co-added exposure corrected subpixel Chandra images in addition to a careful visual inspection. We are finding that offsets are common in these jets. This contradicts the predictions of single-zone models. We suggest that a careful consideration must be given to these offsets while modelling the multi-wavelength emission, especially in highly aligned sources where low resolution and projection effects can easily nullify any possible existing offsets.

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.

**Offsets!**

X-ray hotspots, where the jet presumably enters the hotspot region, are often coincident with faint radio knots both which appear upstream of a bright radio hotspot. This would appear as an offset if the fainter radio knot is not resolved in the radio image.

**More Offsets!**

VLA 8.4GHz (0.2'') core subtracted + X-ray bin size: 0.2 (0.984''). 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 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''.

**Previously proposed solutions for offsets**

- **Synchrotron times lags + downstream advection**
  - Initially used to explain offsets in M87, 3C273, 3C66B
  - But faint unresolved radio knots can be coincident with X-ray knots[2]. See Cen A for example.
  - X-ray variability in moving knots of Cen A are inconsistent with synchrotron cooling[3]

- **Faster moving knots in a slower outer flow + double shock structure (e.g.,[4])**
  - Can explain the offsets in FR II jets but fine is tiring to explain generation of different particle populations at either ends of the shock.
  - Doesn’t have any preference for synchrotron or IC/CMB

- **Slow heavier moving knots in a fast outer flow + single reverse shock ([5])**
  - Cannot explain differences in transverse profiles: wide and flat-topping in radio knots vs. narrow and gaussian in X-ray knots.

- **Upstream magnetic turbulence caused by moving knots**
  - Can explain ‘radio-first’ offsets but cannot explain the apparent bends in the jet at knot locations (See [2][8]).

- **Preliminary results**
  - ~30% of the sources show offsets between radio and X-rays
  - 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 radio jet than they are in X-rays jet.
  - Phenomenologically, no difference between knots and hotspots has emerged yet.

**References**