Pictor A’s Jet
Optical Detection and Analysis

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Overview

Pictor A
- FRII radio galaxy at $z = 0.035$
- Known x-ray, radio jet

X-ray image with radio contours
Overview

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New Observations
- HST images show optical component of jet
  - Faint; previously undetected features

Sample optical jet knot, 32” from the AGN
Overview

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Radiative transfer models
- Optical constrains indicated previous hypothesized mechanism unlikely
- X-ray flux too large for inverse Compton scattering from the same electrons responsible for the radio, optical synchrotron flux
Before HST Images

radio contours
Before HST Images

X-ray image with radio contours
Before HST Images – SED

$\nu S_{\nu}$ [Jy Hz]

Frequency [Hz]

 Detected Flux
Sample Optical Image

Infrared image with x-ray contours
Sample Optical Image

F160W

Infrared image

Right Ascension

Declination

48:00

46:00

-45:47:00

Eric Gentry
Galaxy Subtraction – Before
Galaxy Subtraction

Eric Gentry
Galaxy Subtraction – After

F160W

F814W

F475W

Eric Gentry
Knot Images: $\lambda = 1600\text{nm}$
Knot Images: $\lambda = 800\text{nm}$
Knot Images: $\lambda = 400\text{nm}$
Images – Knots

1600nm detection

400nm non-detection
SED – Before HST
SED – After HST

\[ \nu S_\nu [\text{Jy Hz}] \]

- Detected Flux
- Upper Limits
SED – After HST – With Models

\[ \alpha = 0.94 \]

for \( S_\nu \sim \nu^{-\alpha} \)
SED – After HST – With Models

\[ \alpha = 0.50 \]

for \( S_\nu \sim \nu^{-\alpha} \)
SED – After HST – With Models

$$\alpha = 0.25$$ for $$S_\nu \sim \nu^{-\alpha}$$
Recap

Electrons at knots distinguishable from the rest of jet electrons
Recap

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Synchrotron models explain radio – optical data
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Can’t explain x-ray data with the same electrons
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Suggests second, distinct electron population, emitting synchrotron radiation
  ◦ Suggested by Hardcastle 2005, based on similar work by Kraft 2005
SED – 112” knot

![Graph showing frequency vs. flux density](image-url)
SED – all knots

![Graph showing frequency vs. flux density with different knot markers]

- 32” knot
- 43” knot
- 106” knot
Doppler Boosting – Analytics

If the electrons have a bulk velocity, $\beta c$, get Doppler boosting:

$$\delta = \frac{1}{\Gamma(1 - \cos \theta)}$$

$$\Gamma = \frac{1}{\sqrt{1 - \beta^2}}$$

Would require:

$$\theta < 1^\circ$$

$$\Gamma > 40$$

Implying jet length $\geq 5$ Mpc