THE X-RAY JET IN 3C 273

D.E. Harris and C.P. Stern
Harvard-Smithsonian Center for Astrophysics
60 Garden St.
Cambridge, MA 02138, USA

ABSTRACT. A subtraction technique is applied to the X-ray image of 3C 273 in order to determine the location and other properties of emission associated with the jet.

I. INTRODUCTION

Willingale (1981) demonstrated the existence of X-ray emission from the jet of 3C 273 by applying the maximum entropy method to the observation made with the high resolution image (HRI) of the Einstein Observatory. In order to determine the location and intensity by a different method, we have reanalyzed the HRI image by attempting to subtract the core emission with a Point Response Function (PRF), thereby ridding the residual array of the scattering wings of the PRF. In the following sections we summarise the method and results, and then compare them to new radio and optical maps. Details will be published elsewhere (Harris and Stern, 1986).

II METHOD

The first step is to create an image by accepting only those time intervals during which the star trackers were "locked" onto the pre-assigned guide stars. From experience with many HRI images, we have found that the "locked" images of unresolved sources have a narrower and more circular response than the usual images produced with standard processing.

The chief problem of our method is the difficulty of finding a PRF which matches that of the observation. Imperfect aspect solutions and spatial corrections necessary for rectifying the image compromise the integrity of the PRF in minor ways which are different for each observation. After examining several exposures of bright sources which were unresolved, we chose Cyg X-2 to define the PRF even though the core of Cyg X-2 was slightly broader than that of 3C 273 in one dimension. The image of Cyg X-2 was rolled to match the detector coordinates of 3C 273 and then shifted in RA and DEC to align the cores to ± 0.02 arcsec. Normalization was based on the relative counts in the core of the PRF. The sub-

G. Swarup and V. K. Kapahi (eds.), Quasars, 275–276.

traction was imperfect, leaving a residual positive bar with negative pits on each side (caused by the wider core width of Cyg X-2).

III. RESULTS

The residual map clearly shows a feature located 15.8" from the core in PA = 222°2, well above the local fluctuations. This feature contains 0.7% of the total counts of 3C 273 and the derived flux for a power law energy spectrum with exponent 0.8 is 5E-13 erg $cm^{-2}S^{-1}$ (0.5 - 3.0 keV). The corresponding luminosity (Ho = 50 km s^{-1} Mpc^{-1}) is 8E43 erg s^{-1} (0.5 - 4.5 keV). There is no evidence that the feature is extended along the jet. Because of the uncertainties in the subtraction, it is difficult to ascertain if the distribution is wider than the 6" resolution which results from the 3.5" PRF and the Gaussian smoothing function applied after subtraction.

Our X-ray position is located on the radio and optical jet approximately in the center of the optical "plateau" discussed by Roser and Meisenheimer (1985), which corresponds to the rising part of the radio jet (see Davis et al. 1985 for recent radio maps). Thus we find a curious progression: moving out from the core, the brightest peak in the X-ray occurs before that of the optical, which is followed in turn by the brightest radio feature at the end of the jet.

Estimates of parameters for various emission mechanisms have not provided encouraging results. For a stationary source (no relativistic beaming) a synchrotron model (radio/optical/X-ray) would require high energy electrons with a half-life of only 8 days ($\nu = 10^{18}$HZ). For thermal bremsstrahlung, a mass of order of 10^{10} $M_{\odot}$ is required, and although inverse Compton models are possible, there is no obvious photon population of high energy density.

Beaming is often a panacea for quasar problems, but the absence of corresponding optical and radio features has dissuaded us from suggesting ad hoc X-ray beaming.

ACKNOWLEDGEMENTS

We thank T. Muxlow and H.J. Roser for sending us their results in advance of publication. This work was supported by a student aid grant from Harvard University and by NASA contract NAS8-30751.

REFERENCES

Davis, R.J., Muxlowe, T.W.B., Conway, R.G. 1985, Nature (in press).
Harris, D.E., Stern, C.P. 1986 (to be submitted, Ap.J.Letts).
Roser, H.J., Meisenheimer, K. 1985 (preprint).
Willingale, R. 1981, Mon. Not. R. astr. Soc. 194, 359.

https://doi.org/10.1017/S0074180900152866 Published online by Cambridge University Press