4 Years of Radio to X-ray observations of 3C 273

T.J.-L. Courvoisier 1), E.I. Robson 2), A. Blecha 1), P. Bouchet 3)

1) Geneva Observatory, CH-1290 Sauverny, Switzerland
2) School of Physics and Astronomy, Lancashire Polytechnic, Preston PR1 2TQ, UK
3) ESO, Casilla 19001, Santiago 19, Chile

The quasar 3C273 has been repeatedly observed at radio, mm, IR, optical, UV and X-ray frequencies since December 1983. A complex pattern of continuum variations has been discovered, which can be used to provide model independent physical parameters, and to constrain different models. The main features revealed by our set of observations are:

(i) A flux decrease by 40% in the 2-10 kev flux in 20 days in early 1984 (Courvoisier et al. 1987).
(ii) Differences between the X-ray light curves at 0.5 keV and 2-10 keV.
(iii) A drop in the mm to mid-IR emission by factors 2-4 in early 1986, while the near infrared flux remained stable (Robson et al. 1986).
(iv) A decrease in the ultraviolet intensity of ~40% in about 6 months in 1987 (Ulrich, Courvoisier and Wamsteker 1988).
(v) Rapid variability in the infrared and optical emission on timescales as short as one day in 1988 (Courvoisier et al. 1988 and Robson, Courvoisier and Bouchet this conference).

The radio to X-ray energy distributions show that the components which contribute most to the cooling of the source are the optical-UV 'blue bump' and the hard X-rays (provided that the latter can be extrapolated to at least 100-200 keV). Which of these two spectral components dominates probably depends on the epoch. Within the limits of the temporal sampling, the observed flux variations were not simultaneous in the different spectral domains. Rather, a very complex picture of the variability of 3C273, showing several different types of behaviour, emerged from this program. In particular, neither the far IR (assumed to be of synchrotron origin) nor the near IR flux followed the X-ray variations.

The variations of the flux in the different bands allow different emission components to be distinguished. In particular, since the far infrared flux decreased while the near IR emission remained stable, the synchrotron contribution in the near IR region is less than the relative photometric uncertainties, i.e. less then 15% (3 sigmas). This shows that

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the '3 micron bump', is not an excess on a smooth synchrotron component, but that the near IR is a distinct emission component, the origin of which is still uncertain but may be dust. It will be important to make similar observations of variability longward and shortward of 10 microns on several quasars (both radio loud and radio quiet), to see whether this result holds generically for quasars with a 3 micron excess.

The lack of correlation between the IR (far or near) flux and the X-ray flux is in marked contrast to the excellent correlations found in large samples of AGN between these components. This excludes simple synchrotron self Compton models, since these are based on the same electrons emitting both components. It also shows that samples of AGN cannot be used to deduce properties of individual objects.

The optical and infrared flare activity observed in February and March 1988 can be readily interpreted in terms of synchrotron emission. However we note that the April 5th optical flare showed an essentially flat spectrum, in marked contrast to the earlier infrared/optical flares. Synchrotron interpretation of this event requires a very unlikely electron distribution.

The UV variations observed to date are on a much longer timescale than suggested by either dynamical timescales associated with a black hole of 1×10^9 solar masses or the size of the emission region deduced from black body fits to the UV energy distributions. This can be understood if the energy source is embedded in an optically thick region. Ulrich, Courvoisier and Wamsteker (1988) calculated that the optical depth is about 100.

The difference in the light curves at 0.5 keV and in the 2-10 keV band implies the existence of a distinct soft X-ray component in 3C273. The 2-10 keV variability timescale and flux (extrapolated to 100 keV, isotropic emission and H_o=50 km s^{-1} Mpc^{-1}) provide an estimate of the compactness parameter (Svensson 1984). It is found to be about 10, which does not allow conclusive statements as to the impact of pair production on the X-ray spectrum.

Courvoisier and Camenzind (in preparation) are using the observed properties of 3C 273 to constrain the geometry and physical parameters of the wind and shock model (Camenzind and Courvoisier 1983).

References:

Camenzind M. and Courvoisier T.J.-L., 1983, Ap.J. 266, L83.
Courvoisier T.J.-L. et al., 1987, A.&A. 176, 197.
Courvoisier T.J.-L. et al., 1988, Submitted to Nature.
Robson E.I. et al., 1986, Nature, 323, 134.
Robson E.I., Courvoisier T.J.-L. and Bouchet P., 1988, this volume.
Svenson R., 1984, MPE report 134, p. 152, Brinkmann W. and Truemper J. eds.
Ulrich M.-H., Courvoisier T.J.-L. and Wamsteker W., 1988, A.&A. in press.

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