MULTIFREQUENCY OBSERVATIONS OF THE SEYFERT GALAXY 3C 120 IN 1983-1986

L.Maraschi[1], L.Chiappetti[2], S.Cristiani[3], J.Danziger[4], R.Falomo[5], M.A.Malkan[6], G.Tagliaferri[7], E.G.Tanzi[2], A.Treves[1], W.Wamsteker[8]
1) Dept.Phys.Univ.Milan, Italy; 2) IFC CNR Milan, Italy; 3) ESO La Silla, Chile; 4) ESO Garching, Germany; 5) Asiago Obs., Italy; 6) Dept.Astr.U.C.L.A., USA; 7) ESOC Darmstadt, Germany; 8) VILSPA, Spain.

1. INTRODUCTION

3C 120 (z=0.033) has the optical spectrum typical of a Seyfert I Galaxy, however unlike most Seyfert Galaxies it exhibits strong radio emission with a compact component where VLBI observations indicated superluminal expansion. It could therefore be classified as a mini Radio Loud Quasar.

With the start of the Exosat mission a programme for coordinated observations of 3C 120 at optical, UV and X-ray frequencies was organized, of which we report here some preliminary results.

2. OBSERVATIONS

The X-ray data derive from the Medium Energy (1-10 kev) (ME) and Low Energy (0.05-2 kev) (LE) experiments on board of Exosat (Taylor et al.1981). Most observations were taken by us. Those of days 276, 277, 280, 284 and 286 of 1984 derive from Exosat archives.

For the ME data reduction the background subtraction is critical at intensities like that of 3C 120. This, as well as the spectral results, will be discussed in detail elsewhere. We performed preliminary best fits to the background subtracted spectra with a power law with a fixed value of the hydrogen column density $N_H=10^{21}cm^{-2}$, which is the foreground column in the direction of 3C 120 as derived from the HI mapping. This value of N_H is somewhat lower, but not inconsistent with what would be expected from the extinction determined from the observed 2200 A dip. $A_V=1.2\pm0.2$ (Oke and Zimmermann 1979, Tanzi et al. 1984). The best fits yield values of the energy spectral index between 0.7 and 1 which were used in the computation of integrated fluxes from 1-8 keV. These are reported as a function of time in Figs.1 and 2.

As for the LE data, we chose to report in Figs 1 and 2 the count rates in the Lexan filter, after background and dead time corrections, since the conversion to flux units depends heavily on the assumed spectrum, especially for this source in which absorption is important below 1 keV.

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The ultraviolet spectra were obtained with IUE. We used preferentially the short wavelength camera (1200-2000 A) when the available time was insufficient for exposing both cameras. The mean flux in a 100 A bin centered at 1350 A was derived from the IUESIPS extracted spectra.

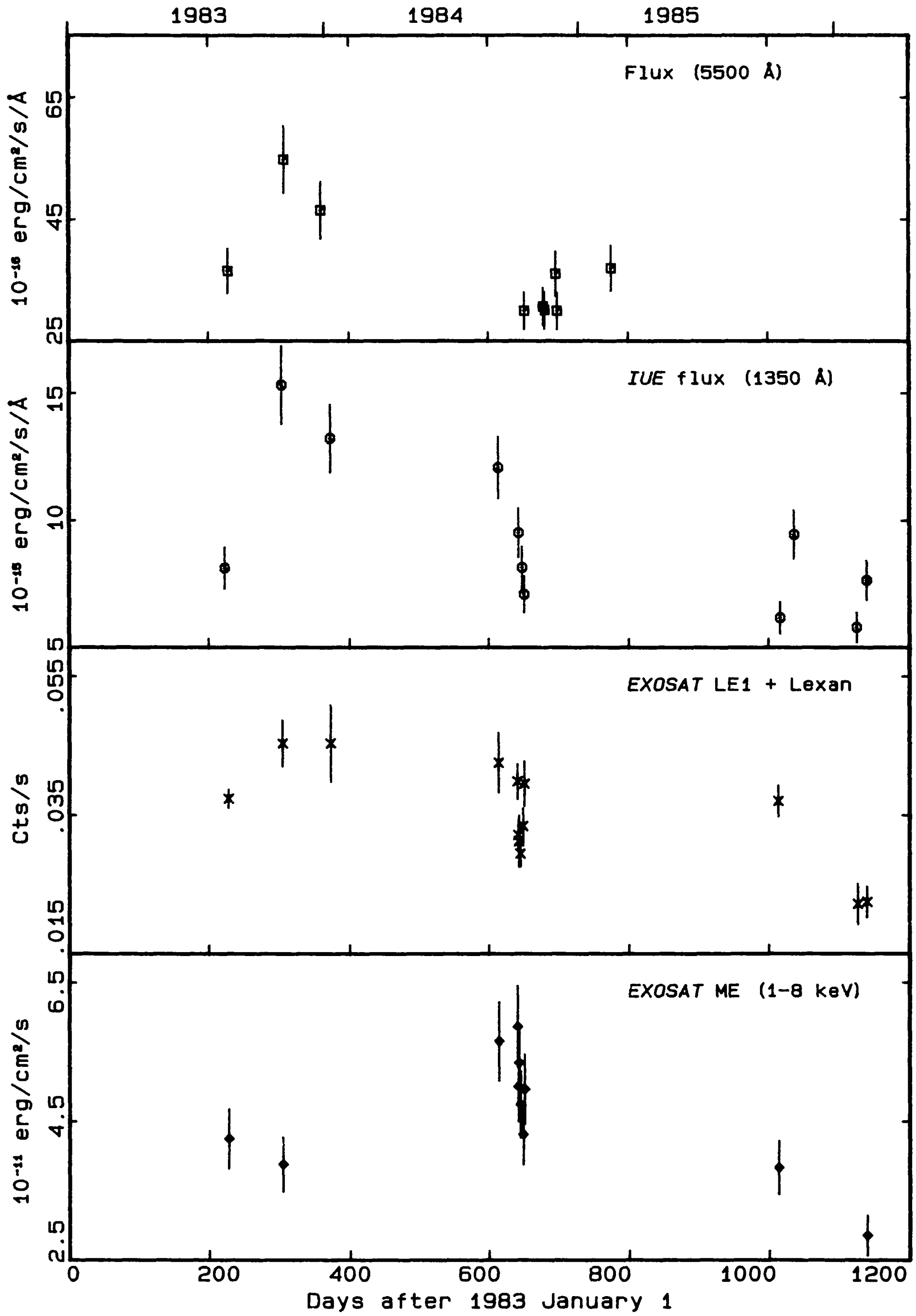

Figure 1. Light curves of 3C 120 in different energy bands

The optical data were collected mostly at ESO with the 1.5m and 2.2m telescopes and in some cases with the 1.8m of the Asiago Observatory and with the 90" of Steward Observatory. All the spectra were calibrated by repeated observations of standard stars. The fluxes at 5500 A are reported in Fig.1.

3. RESULTS

The light curves at 5500 A, 1350 A and in the LE and ME bands of Exosat are compared in Fig.1. The time coverage is uneven; 7 observations are concentrated in 40 days in Sept-October 1984 (these are shown on an expanded scale in Fig.2) while the other six are at intervals of months in 1983 and 1985/86. In most cases UV and optical observations obtained within one or two days from the X-ray ones are available.

It is remarkable that in all bands the maximum observed variation is of a factor 2. The 5500A and UV light curves are indicative of a close correlation. Between day 228 and 304 (of 1983) the two fluxes increased by a factor 1.5 and 2 respectively. The subsequent data indicate a decline to a relatively low state except for a 25% flare in the UV on day 1037. The October 1984 UV data do not show variability on a few days time scales (see Fig.2).

The issue of the correlation between the optical-UV fluxes and the X-ray ones and, within the X-ray range, of the LE and ME data is less clear. In 1983 the LE flux increased by 20% in correspondence to the doubling of the visual and UV fluxes, while the ME flux was constant. In September 1984 (day 614) the ME flux was significantly larger than in 1983, which was not the case for the LE flux. The more frequent sampling around October 84 (see Fig.2) shows a significant dip of the LE count rates (25%). The ME data show a trend, globally consistent with the LE data though with lower significance. The latest observations (days 1014, 1140) show a significant fading in both the LE and ME bands.

In the ME band the maximum and minimum fluxes are similar to those measured by Halpern (1985) with the Einstein MPC in 1979-1981.

4. DISCUSSION

The fact that the UV and optical fluxes vary together suggests that a single component is present in these bands and varies in intensity with constant spectral shape. The shape of the overall energy distribution of 3C 120 (Tanzi et al 1984) shows a large UV excess with respect to an extrapolation of the infrared continuum, which may be due to thermal radiation from an accretion disk (Malkan and Sargent 1982). The rapid variation observed simultaneously in the optical and UV bands suggests that the emission is due to thermal reprocessing of the central high energy radiation, rather than to viscous dissipation in the disk, since in the latter case spectral changes and a much longer time scale would be expected.

In the first observations the soft X-ray flux variation appears to relate to the UV-optical one, though with greatly reduced amplitude, but not to the medium energy X-ray flux. Later the fluxes in the two X-ray bands appear correlated between themselves and also, though weakly, to the UV fluxes. This may be understood in terms of two components contributing to the soft X-ray emission, one associated with the high energy tail of the optical UV-emission, the second associated with the low energy end of the medium energy X-ray emission.

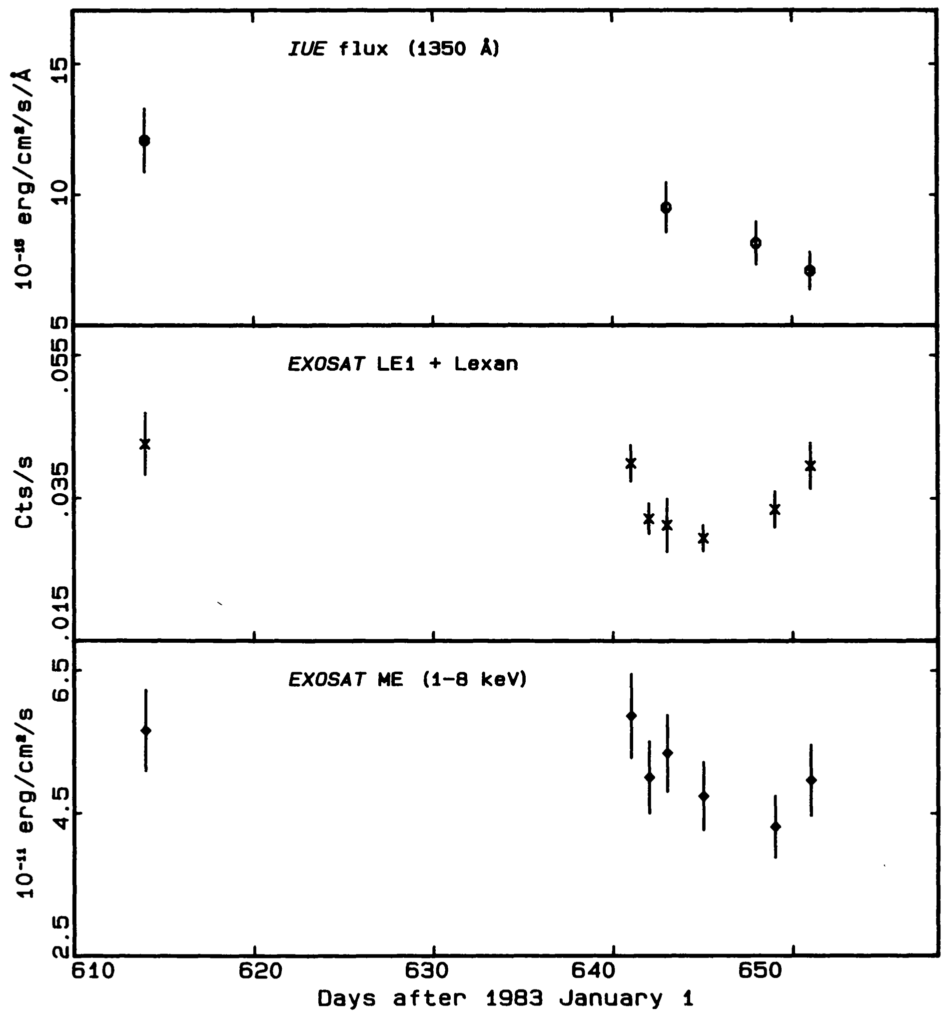

Figure 2. Detail of the UV and X-ray light curves of 3C 120 in September-October 1984

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