THE X-RAY TRANSIENT EXO 2030+375

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EXOSAT has observed a bright transient X-ray pulsar EXO 2030+375 that decayed in intensity by a factor ~5000 between 1985 May and August. The variations in 42s pulse period enable an orbital period of 37.9±1.3 days with an eccentricity of 0.31±0.02 to be determined. The spin-up timescale of $\gtrsim$30 years suggests that this is a very large outburst of order a few 10^{38} ergs/s. The mass function of $5M_{\odot}$ is consistent with the unidentified companion being a Be star, similar to many other pulsing X-ray binaries. The position of EXO 2030+375, obtained with the EXOSAT Imaging Telescope, is RA: 20 30 21.25, Decl. +37 27 51 (1950; with an uncertainty radius of 10").

The evolution of the pulse profile and spectrum were studied in detail as the intensity decayed by at least a factor ~100. At the maximum observed luminosity of 4×10^{38} ergs/s (for an assumed distance of 10 kpc) the 2-10 keV pulse profile showed a broad smooth maximum with a narrow sharp notch. As the source decayed a second feature located ~0.5 ϕ earlier than the original maximum became gradually more prominent until by the time the luminosity had fallen to 5×10^{37} ergs/s the two maxima were of approximately equal intensities. The next observation (2×10^{37} ergs/s) showed both the original maximum and the sharp notch to have virtually disappeared. These changes might be expected if the radiation beaming mechanism changes from being a fan beam at high accretion rates to a pencil beam at lower rates.

The 1-40 keV phase averaged spectrum of EXO 2030+375 is similar to those of other X-ray pulsars being well represented by a power law continuum with a high energy cut-off and significant low energy absorption. In addition an iron emission feature at ~6.5 keV is required. As the outburst decayed the spectrum became harder.

A second outburst from EXO 2030+375 was seen by EXOSAT some 50 days later. The shape of the X-ray lightcurve had changed dramatically being dominated by a series of flares that occurred every ~5 hours. The flares do not appear to be strictly periodic and were not associated with significant increases in low energy absorption. During the flares the pulse profile changed in a way consistent with the profile changes seen during the earlier decay.

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