A MODEL FOR BURSTING X-RAY SOURCES

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A model given by Henriksen and Chia (1972) for short duty cycle X-ray flare sources has been extended by Henriksen (1976), and applied to the recently discovered X-ray bursters. We use their notation here unless otherwise indicated. The model envisages a rapidly rotating magnetic white dwarf or neutron star located in a dense stream or cloud of gas such as might be found in close binary systems or in dense interstellar clouds. The basic charging mechanism for the flare is the accretion of matter into the hydromagnetic wave zone of the rotator at the 'Bondi' or 'tail-shock' rate (corresponding to a thermal cloud or a stream, respectively), A_B.

Accretion onto the compact star will be strongly inhibited until a critical mass $m_a=(\Omega p/2\pi)\Phi^2/GM$ has been accreted by the magnetosphere. (Here $2\Omega p$ is the solid angle subtended at the star by the critical mass.) Thereafter accretion begins at the 'equi-partition Alfven wave limited' rate (Henriksen and Reinhardt, 1974) $A_M = 2\Omega p(\frac{\Phi^2\omega}{4\pi GM})$. These considerations lead us to predict an 'off-time' $P\sim m_a/A_B$, an 'on-time' $\tau\sim m_a/A_M\sim\omega^{-1}$ and a 'pulse-energy' $E=(\Omega p/2\pi)\Phi^2/r_*$. The on time will thus be less than a rotation period (explaining the lack of modulation) and the energy will be determined by stellar quantities and thus be relatively invariant $(\Omega p\sim\pi r_*/r_{ae}\sim\pi r_*(\omega^2/GM)^{1/3})$.

This regularly bursting behaviour is expected when $A_B<A_M$ as in 3U1820-30. When $A_B>A_M$, the magnetosphere will adjust to a steady flow at the rate (Chia and Henriksen, 1972) $A'_M = 2\Omega p(\frac{\Phi^2\rho_a}{4\pi})^{\frac{1}{2}}$, as in the X-ray binaries. Should A'_M fail to equal A_B outside the stellar surface, the anisotropy is destroyed and one expects a 'photon-bubble' flare if A_B exceeds the Eddington limit, possibly as in MXB 1730-335.

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2. Henriksen, R.N., and Chia, T.T., 1972, Nat. Phys. Sci., 240, 133.
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