LOW LUMINOSITY GLOBULAR CLUSTER X-RAY SOURCES

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ABSTRACT: Two classes of globular cluster X-ray sources are known. Each consists of compact objects accreting material from a close binary companion. The brighter class has a neutron star primary, and the low luminosity class has a white dwarf primary. These sources formed by tidal capture of the compact object by a main sequence dwarf in the core of the globular cluster. Their presence and number has implications on the end points of stellar evolution in globular clusters and on the formation of binaries in cluster cores.

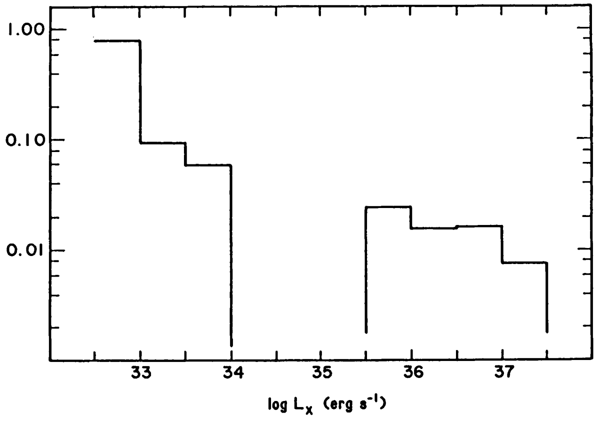

Fig. 1. Luminosity function of the brightest X-ray sources in globular clusters. From Hertz and Wood (1985).

Low luminosity globular cluster X-ray sources were discovered during a survey of galactic globular clusters with the <u>Einstein Observatory</u> (Hertz and Grindlay 1983b). These sources are 10^3 times less luminous than classical globular cluster X-ray sources. The luminosity function has a 1.5 decade gap between the two source classes. The low luminosity sources are ~100 times more numerous than the luminous sources (see Fig. 1). Every globular cluster has at least one source brighter than 10^{32} ergs s^{-1}.

Several considerations lead to the conclusion that the low luminosity sources are accreting white dwarfs in close binaries, similar to cataclysmic variables (Hertz and Grindlay 1983a): (i) the factor of ~1000 difference in X-ray luminosity is comparable to the difference in surface gravity between a neutron star and a white dwarf; (ii) the maximum luminosity observed agrees with the theoretical maximum predicted for accretion onto a low mass white dwarf; (iii) the low luminosity

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sources are located at larger radial offsets, indicating a lower mass than the luminous sources (Hertz 1985); (iv) the total number of sources observed is in agreement with the number expected from tidal capture of white dwarfs by main sequence dwarfs.

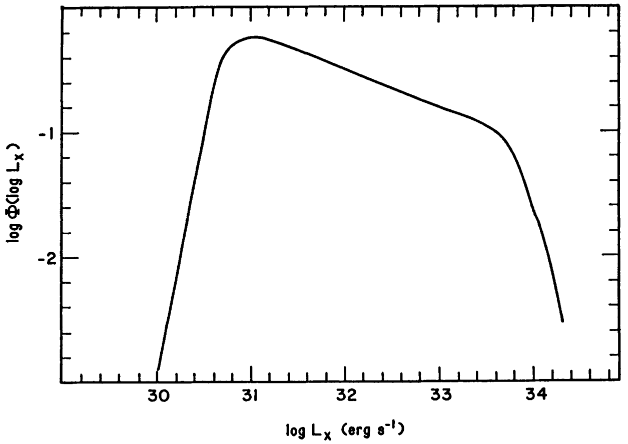

Fig. 2. Model luminosity function for low luminosity globular cluster X-ray sources. From Hertz and Wood (1985).

A simple model predicting the X-ray luminosity function for the low luminosity sources has been constructed (Hertz and Wood 1985); see Fig. 2. Comparison of the theoretical luminosity function with the data indicates remarkably good agreement and this agreement is insensitive to most input parameters. The model requires a typical cluster to have ~10 low luminosity sources (cf. Krolik 1984) and to have luminosities $L_X < 10^{34.5}$ ergs s^{-1}.

The low luminosity globular cluster X-ray sources are several orders of magnitude brighter in X-rays than galactic plane cataclysmic variables. This can be accounted for by the difference in the number of sources observed even if the X-ray luminosity functions are identical (Hertz 1985). The model predicts that X-ray surveys in the galactic plane will eventually discover X-ray luminous cataclysmic variables.

Optical identification of a globular cluster X-ray source will allow study of a tidally captured binary in the core or halo of a globular cluster. We have an ongoing program searching for the counterparts of low luminosity sources. The counterpart of the source in M15 has recently been discovered (Aurière et al. 1987).

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