Abstract. In this paper we calculate the number of close binaries formed during the evolution process of a globular cluster core. The globular cluster core is assumed to contain a massive black hole at its center. We show that the central black hole can drive binaries formation in the core and the rate of binaries formation depends on the mass of the black hole at its center. When the mass $M$ of the black hole is between $10^2 M_\odot$ and $3 \times 10^3 M_\odot$, there will be a few binaries formed. When the mass of the black hole is $4 \times 10^3 M_\odot \leq M \leq 6 \times 10^3 M_\odot$, the number of binary star formation will suddenly increase with a jump to the maximum value $\sim 58$. When the mass of the black hole is $7 \times 10^3 M_\odot \leq M \leq 9 \times 10^3 M_\odot$, the number of binary star will immediately decrease. Whether cluster X-ray is produced mainly by the central black hole or by binaries in the core depends on the mass of the central black hole. Therefore, two cases arise: namely, black hole accretion domination and binaries radiation domination. We do think that we cannot exclude the possibility of the existence of a central black hole even when binary radiation characteristics have been observed in globular cluster X-ray sources.

1. Introduction

Since the discovery of X-ray emission from several globular clusters sixteen years ago (Giacconi et al., 1974; Clark et al., 1975; Canizares and Neighbours, 1975; Seward et al., 1976; Lewin et al., 1976), much interest has been raised in both new observation and new theory. Twelve X-ray sources have now been identified with globular clusters: 1E002151 – 72215 (47 Tuc); MX0513 – 40 (NGC 1851); XB1724 – 31 (Terzian 2); 4U/MXB1728 – 34; MXB1730 – 335; the Rapid Burster (Liller 1); XB1733 – 30 (Terzian 1); XB1745 – 25 (Terzian 5); 4U1746 – 37 (NGC 6441); 4U1820 – 30 (NGC 6624); A/4U1850 – 08 (NGC 7612); 4U2131 + 11 (NGC 7080, M15). In addition, there are a few possible X-ray associations with NGC 6440, NGC 6553, and the SMC cluster Kron 3 (Markert et al., 1975; Makishima et al., 1981; Grindlay, 1978a, b; Shapiro, 1977; Stella et al., 1987; Faulkner, 1984). This discovery has since revitalized research activities in the cluster dynamics and it becomes a long-standing puzzle in the dynamical theory of globular cluster concerning the phenomenon of ‘core collapse’ which is predicted to occur in most clusters but is not clearly observed (King, 1975). Many theories and simulations of the evolution of globular clusters have been put forward. Although the dynamical interpretation of these data is not yet clear, the results are a strong incentive to further study. The typical theories for explaining the observed X-ray emission from these sources are very briefly shown in the following.

* Permanent address: Yunnan Observatory, Academia Sinica, Kunming, China.
It was suggested that there is the possibility that some collapsed stellar remnants (mass is \(\sim 2.5 M_\odot\)) resulting from supernova events in the early history of the cluster might, during the subsequent cluster lifetime, accrete sufficient mass to become the type of \(\sim 10 M_\odot\) black hole. These materials are present in globular cluster cores (Larson, 1984). Faulkner and Coleman (1984) used Monte-Carlo simulations to simulate the orbital and mass development of a collapsed stellar remnant which might have been retained in a massive, tightly bound globular cluster following a primordial supernova event. The remnant is subject to accretion from a gas reservoir in the cluster core and to encounters with nearby cluster stars which gradually modify its orbit. The gas reservoir of the same hydrogen number density is \(n_H \approx 3 \times 10^4 \text{ cm}^{-3}\) as is required to explain the present X-ray production in globular cluster. But there is at present little observational evidence for such gas in cluster cores (Faulkner, 1984). There is still considerable uncertainty as to the gas content of massive globular cluster. On the other hand, it could well be the difficulty of retaining any collapsed remnants from supernovae that explain why some massive, tightly bound clusters display no X-ray sources at all.

A current explanation for X-ray sources in globular clusters is to use the close binary system located in cores because of the large number density of stars in these regions (Sutantyo, 1975). In binary stars a normal companion transfers mass on to a collapsed star, thereby producing X-rays. Although the luminous \((\geq 10^{36} \text{ erg s}^{-1})\) X-ray sources located in globular clusters have similar properties to some of the low-mass X-ray binaries (LMXRB) located in the galactic disk (e.g., Lewin and Joss, 1983), their binary nature remain unconfirmed. Clark (1975) discussed in detail the X-ray radiation generated by binaries located in the cores. He divided binaries in globular clusters into two kinds, one is the primordial binaries formed \(\sim 10^{10}\) years ago during the original condensation of a globular cluster, the other is X-ray binaries formed by capture from the remnants of massive single stars that exploded with sufficient isotropy to remain bound in the cluster. It appears to be very unlikely that primordial binaries in globular cluster have evolved to produce high-luminosity X-ray sources. Therefore, it is suggested that the cluster X-ray sources are the latter binaries formed during the evolution of a cluster. The total number of these potential X-ray sources in all globular cluster is \(\sim 100\), the effective life cannot be much longer than \(\sim 1.4 \times 10^9\) yr. Fabian et al. (1975) calculated the probability of forming very close binaries via tidally dissipative two-body encounters in the dense cores of globular clusters and show that, if clusters contain large numbers of compact stellar mass remnants (neutron stars or black holes), the present X-ray data can be understood. Strong evidence for the low-mass binary picture has been developed from the discovery of a coherent 685 s periodicity in the X-ray source 4U1820–30, which is located in the globular cluster NGC 6624 (Stella et al., 1987; Haberl et al., 1987). Consequently, Stella and White (1987) discovered 15–30 Hz quasi-periodic oscillations in the X-ray flux of 4U1820–30. The orbital period of AC211 has been discovered to be 9.1 ± 0.5 hr (Naylor et al., 1988), which was first proposed as the optical counterpart of the M15 X-ray source 4U2127 + 11 by Aurèlle et al. (1984). The precise \((\sim 1")\) positions of the luminous X-ray sources in eight globular clusters have been measured with the EXOSAT (Grindlay et al., 1984). Parmar et al.