Chandra Observations of the Low Mass X-ray Binary Populations of X-ray Faint Elliptical and S0 Galaxies

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[Contributed talk, 15min.]

Abstract

Chandra ACIS-S3 observations of the X-ray faint elliptical and S0 galaxies NGC 1553, NGC 4365, NGC 4382, and NGC 4697 resolve much of the X-ray emission into point sources, most of which appear to be Low Mass X-ray Binaries (LMXBs) associated with these galaxies. The dominance of LMXBs indicates that X-ray faint early-type galaxies have lost much of their interstellar gas, although there still is a small amount of X-ray emission from interstellar gas at $kT \approx 0.3$ keV. Taken together, the LMXBs have a hard spectrum, which can be fit by thermal bremsstrahlung at $kT \approx 7$ keV or a power-law. This means that the soft component in the spectra of early-type galaxies discovered with ROSAT is mainly due to hot gas. A few of the X-ray sources have very soft X-ray colors, and appear to be supersoft sources. A significant fraction of the LMXBs in these nearby ellipticals are in globular clusters, which indicates that globulars have a high probability of containing X-ray binaries compared to the normal stellar population. It is possible that most LMXBs in elliptical galaxies may have been formed in globular clusters via stellar dynamical interactions. The variation in the globular cluster specific abundance from galaxy to galaxy and particularly along the Hubble sequence might explain the variations in the X-ray–to–optical flux ratios of X-ray faint galaxies. The X-ray luminosity functions of LMXBs in early-type galaxies generally have a knee or break at $\approx 3 \times 10^{38}$ ergs/s, which is approximately the Eddington luminosity for a 1.4 $M_{\odot}$ neutron star. Thus, we suggest that the LMXBs with higher luminosities generally contain accreting black holes. This "Eddington break" luminosity might be used as a distance indicator. In the bulges of late-type galaxies, there may be an upper cut-off to the luminosity function at about the same luminosity. The high luminosities of the brightest sources suggest that they contain fairly massive black holes, if they are Eddington-limited. The presence of this large population of NS and massive BH stellar remnants in early-type galaxies shows that these galaxy, which now contain only low mass optical stars, once contained a large population of massive main sequence stars.

CATEGORY: NORMAL GALAXIES