

LMXB populations in galaxy outskirts: evidence for natal neutron star kicks

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Neutron stars (NSs) receive natal kicks during their formation in the core collapse supernova (SN) explosions. This effect was well studied from the proper motion of pulsars in the Milky Way. A small fraction of binary systems are expected to survive the kick, obtain a systematic velocity and travel to large distances, producing a distribution broader than that of stars. However, not much observational evidence of the above was obtained.

For the first time, we systematically explored the population of discrete X-ray sources in the outskirts of nearby early-type galaxies. Based on a broad sample of 20 galaxies observed with Chandra we revealed over density of X-ray sources in galaxy outskirts, extending out to at least ~ 10 times effective radius (r_e). These extended LMXB halos are composed of sources fainter than $\sim 5 \times 10^{38}$ erg/s, suggesting their NS origins. We propose the extended LMXBs may be comprised of two independent components: (i) LMXBs located in blue (metal poor) globular clusters (GCs), which GCs are known to be more extended than stars; and (ii) NS LMXBs kicked out of the main body of the parent galaxy by the supernova explosion. The evidence for the kicked LMXBs is strongly indicated in massive galaxies with low GC content. We further confirm this finding with deep optical and X-ray data of NGC 4365, that $\sim 60\%$ of 60.1 ± 10.8 excess sources are not located in GCs, which are interpreted as kicked NS binaries.