X-ray binaries and ultraluminous X-ray sources

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PhD thesis abstract

In this thesis I investigate the population of X-ray binaries (XRB) and ultraluminous X-ray sources (ULX) in order to approach several contemporary astrophysical conundrums. My main method of analysis is the population synthesis, which allows for a comprehensive comparison of theoretical models and observations. I provide an introduction with fundamental knowledge concerning XRBs and ULXs.

Firstly, I approach a problem of the mass gap, i.e., the lack of compact objects with masses between $2-5\,M_{\odot}$. I show that the rapid supernova explosion mechanism can provide a natural explanation for the observed separation between neutron stars and black holes.

Afterwards, I investigate the common envelope. This important phase of evolution of binaries still escapes the grasp of our understanding. I show that, although the common envelope phase is essential for the formation of XRB, none of currently available models is able to reproduce the observations.

I analyse also the formation of the most luminous ULXs. I show that it is possible to obtain mass transfer rates high enough to power such a source in regular XRBs. The phase of powerful emission will be very short but present in the evolution of numerous systems.

Finally, I present the preliminary results of the investigation of accretion models in the context of the ULX population. I compare the synthetic population, which is based on our best knowledge of astrophysical processes, with the observations in order to understand the nature and formation processes of these systems.

keywords:

binary stars, stellar evolution, neutron stars, black holes, X-ray binaries, supernovae, accretion disks

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