STELLAR EVOLUTION

In search of black holes

Astrophys. J. (in the press); preprint available at https://arxiv.org/abs/1909.11328

Finding black holes (BHs) is not easy. We typically detect BHs through emission powered by accretion onto them. Outside the gravitational-wave domain, stellar-mass BHs are only observed in X-ray binaries, where the compact object is accreting mass from its companion. However, there should exist a significant population of non-accreting stellar-mass BHs with a normal, main sequence, star companion. Yong Shao and Xiang-Dong Li perform binary population synthesis modelling and find that hundreds to a few thousand detached BH binaries should exist in our Galaxy.

Modelling the formation and evolution of such systems is not trivial. Some of the factors that come into play are the transfer of mass and angular momentum, the duration and accretion efficiency of the common-envelope phase and the natal kicks that may be imparted onto the newly formed black holes. The authors include all of these considerations into their calculation and then, also taking into account dust extinction effects, calculate how many BHs in detached binaries should be detectable with a Gaia-like facility through the proper motion of their companion star.

As it turns out, unsurprisingly, different assumptions about the possible range of the BH progenitor mass — traditionally thought to be >25 $M_{\odot}$, but new models allow for progenitor masses as low as 15 $M_{\odot}$ — and the natal kicks of the BHs lead to significantly different numbers. The former changes numbers by an order of magnitude, while the latter only leads to changes of a factor of ~3. For their most optimistic models, Shao and Li conclude that several hundred detached BH binaries should be detectable by Gaia, around ten of them having a giant companion with mass <5 $M_{\odot}$.

Marios Karouzos

Published online: 28 October 2019
https://doi.org/10.1038/s41550-019-0952-3