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Hunting Down Black-Holes with Gaia

Abstract

Understanding the connection between the properties of black-holes (BHs) and their progenitors is interesting in many branches of astrophysics. Traditional methods such as detection through X-ray, radio, or gravitational-wave emission are sensitive towards a small subset of all BH binaries expected to form in nature. In my talk I will explore the exciting possibilities for detecting BHs in detached binaries with luminous companions (LCs) in the Milky Way (MW) via astrometric and photometric measurements. The photometric variability shown in these binaries is a result of strong tidal effect and relativistic effects like relativistic beaming and gravitational lensing. We create highly realistic models of BH-LC binaries expected to be there at present in the MW using the binary population synthesis code COSMIC. Taking into account Gaia's astrometric precision, spectroscopic resolution, and interstellar extinction and reddening, we find that Gaia in its 10 year mission should detect around 30-300 BH candidates through astrometry and ~800-1500 using photometry. Through Gaia's unprecedented astrometric measurements, about one-third of the detected population will have strong mass constraints confirming the nature of dark companion. Furthermore, since the LC's properties, such as age and metallicity, can be constrained relatively easily, and it is expected that the BH's progenitor must have had the same zero-age properties as the LC, if detected in large numbers as our models suggest, for the first time, we will be able to constrain the highly uncertain map connecting BH properties with those of their progenitors.