RevMexAA (Serie de Conferencias), **49**, 103–103 (2017)

HUNTING STELLAR-MASS BLACK HOLES IN X-RAY BINARIES

J. M. Corral-Santana[1,2]

In the last 50 years of X-ray astronomy we have detected nearly 60 Galactic stellar-mass black hole (BH) candidates in transient X-ray binaries, i.e. systems with low-mass companions and sporadic outburst episodes. In addition, we have detected 2 more systems with high-mass companion stars. Only 17 out of the ∼60 transients have been dynamically confirmed although we have established strong constrains in two more systems. In this contribution, we will introduce the X-ray binaries, summarise their status and present the latest advances in the field.

X-ray binaries are systems formed by either a neutron star or a black hole fed by an accompanying star, oftenly in the main-sequence, usually through an accretion disc.

Most of the BHs have been found in a type of X-ray binaries called *transients*. These are systems with low-mass companions and characterized by sporadic outburst episodes produced by thermal-viscous instabilities in the accretion disc (which usually last months) followed by long quiescent states where the systems stays more of their lifetimes (years to centuries). During the outburst state, they increase the brightness in all wavelengths being detected by the X-ray satellites and follow a very characteristic hysteresis pattern in an hardness-intensity diagram (see e.g. Belloni et al. 2011). All systems that follow the same behaviour are classified as *BH candidates*. However, to firmly confirm the true nature of the compact object, we need to perform dynamical studies. These must be done during the quiescence state, when the star dominates the optical emission. The dynamical confirmation depends on two observational parameters: the orbital period and the radial velocity of the secondary star. They provide an estimate of the mass function of the compact object (which is an absolute lower limit to the real mass), and, given that neutron stars cannot exceed 3 $M_\odot$, a compact object more massive than that value must be a BH. Despite our huge efforts, in the 50 years of the X-ray astronomy era we have detected nearly 60 BH transients but we have only confirmed the presence of BHs in 17+1 out of them, i.e. only a third of the detected population (Corral-Santana et al. 2016). This clearly indicates the difficulty to obtain the dynamical parameters.

Recently, Casares (2015) has found a new empirical relation that will allow us to obtain the radial velocity of the companion star by measuring the full-width at half-maximum of the Hα line. Therefore, with a single spectrum we will be able to confirm the nature of the compact object in fainter objects. One of the most exiting BHs lately discovered is Swift J1357.2–0933. It was detected in 2011 during an outburst episode. During this phase, we discovered very unique properties (see e.g. Corral-Santana et al. 2013) suggesting an edge-on inclination and we could measure an orbital period of only 2.8 ± 0.3 h, the second shortest reported so far in an X-ray binary. With data taken in quiescence, we used the relation reported by Casares (2015) to pinpoint the value of the radial velocity of the secondary star to 967 ± 49 km/s (Mata Sánchez et al. 2015). These values imply a mass of the BH of at least 9.3 $M_\odot$, being the most massive BH transient in the Galaxy. However, we have not been able to detect the companion star yet and, therefore, strictly speaking it is not a dynamical confirmation. In addition, we were able to place a lower limit to the mass of the BH candidate KY TrA of > 9 $M_\odot$ using the same relation.

In summary, this new way to obtain the radial velocity without the need of the radial velocity curve will help us to increase the sample of systems, at least among the already discovered population of BH candidates.

REFERENCES

Belloni, T. M., Motta, S. E., & Muñoz-Darias, T. 2011, arXiv:1109.3388

Casares, J. 2015, ApJ, 808, 80

Corral-Santana, J. M., Casares, J., Muñoz-Darias, T., et al. 2013, Science, 339, 1048

Corral-Santana, J. M., Casares, J., Muñoz-Darias, T., et al. 2016, A&A, 587, A61

Mata Sánchez, D., Muñoz-Darias, T., Casares, J., Corral-Santana, J. M., & Shahbaz, T. 2015, MNRAS, 454, 2199

[1]Pontificia Universidad Católica de Chile, Vicuña-Mackenna 4860, Macul, Santiago, Chile.

[2]European Southern Observatory (ESO), Alonso de Córdova 3107, Vitacura, Casilla 19001, Santiago, Chile (jcorral@eso.org).

XV Latin American Regional IAU Meeting (Cartagena de Indias, Colombia, 3-7 October 2016)
Editors: Mario Armando Higuera Garzón & Santiago Vargas Domínguez