

containing hot and cool supergiants (Cyg X-1 and GRS 1915+105) and many compact systems containing K-dwarf secondaries. Considering all 20 BHBs (Table 1), only 3 are persistently bright X-ray sources (Cyg X-1, LMC X-1 and LMC X-3). The 17 transient sources include 2 that are unusual. GRS 1915+105 has remained bright for more than a decade since its first known eruption in August 1992. GX 339-4 undergoes frequent outbursts followed by very faint states, but it has never been observed to fully reach quiescence (Hynes et al. 2003).

The second half of Table 1 lists 20 X-ray binaries that lack radial velocity data. In fact, most of them even lack an optical counterpart, and only three have known orbital periods. Nevertheless, they are considered black-hole candidates (BHCs) because they closely resemble BHBs in their X-ray spectral and temporal behavior (McClintock & Remillard 2006; Tanaka & Lewin 1995). Some X-ray and radio characteristics of the BHCs are given in Table 4.3 in McClintock & Remillard (2006); also given there is a subjective grade (A, B or C) indicating the likelihood that a particular system does contain a BH primary. The seven A-grade BHCs are: A 1524-617, 4U 1630-47, GRS 1739-278, 1E 1740.7-2942, H 1743-322, XTE J1748-288, and GRS 1758-258.

3 X-ray Observations of Black-Hole Binaries

We first discuss X-ray light curves obtained by wide-angle X-ray cameras that are used to discover X-ray novae and to monitor hundreds of sources on a daily basis. We then discuss timing and spectral analyses of data obtained in pointed observations that reveal, in detail, the properties of accreting BHs. Throughout this work we feature RXTE results derived from the huge and growing archive of data amassed since 1996 by the **All-Sky Monitor (ASM)** and the large-area **Proportional Counter Array (PCA)** detector (Swank 1998).

3.1 X-ray Light Curves of Black-Hole Binaries in Outburst

Nearly all BHBs are X-ray novae (see §2 and Table 1) that are discovered when they first go into outburst. Their discovery and subsequent daily monitoring are largely dependent on wide-field X-ray cameras on orbiting satellites. The light curves of all 20 BHBs and many BHCs (Table 1) can be found either in McClintock & Remillard (2006) or in a review paper on pre-RXTE X-ray novae by Chen et al. (1997). These researchers discuss the striking **morphological** diversity among these light curves, which show broad distributions in their timescales for rise and decay.

For X-ray outbursts that last between ~ 20 -days and many months, the generally accepted cause of the outburst cycle is an instability that arises in the accretion disk. When the accretion rate from the donor star is not sufficient to support continuous viscous flow to the compact object, matter fills the outer disk until a critical surface density is reached and an outburst is triggered. This model was developed initially for dwarf novae (e.g., Smak 1971; Lasota 2001) and extended to X-ray novae (e.g., Dubus et al. 2001).

This model predicts recurrent outbursts; indeed, half of the BHBs are now known to recur on timescales of 1 to 60 years (Table 1). Outbursts on much shorter or longer timescales do occur, but these are not understood in terms of the **disk instability model**. Sources such as GRS 1915+105 and 4U 1755-338 exhibit “on” and “off” states that can persist for $\gtrsim 10$ years. The behavior of