# Constraining the full Population of Black Hole X-ray Binaries in the Galaxy

---

Author: Jonathan Grindlay (Harvard)

Co-Author(s): Sebastian Gomez (Harvard)

## Abstract

Stellar mass black holes in the Galaxy have all been first detected by their luminous X-ray emission -- either as very bright persistent emission in black hole high mass X-ray binaries (BH-HMXBs), as epitomized by Cyg X-1, or as very luminous (but rare) outbursts of black holes accreting from low mass companions (BH-LMXBs), as first discovered by McClintock and Remillard (1986) for A0620-00. Luminous BH-HMXBs are rare, with only Cyg X-1 as incontrovertible and quite possibly also MWC 656 as well. This is due to the very short lifetimes of their giant or super-giant massive companions that supply the high mass-loss winds required for their luminosity. We report the discovery of a "Cyg X-1 progenitor", the single-line spectroscopic binary (SB1) HD96670 with a "weak wind" O8.5V-IV star feeding a $\sim$ 6 M$_\odot$ BH as required by both its hard X-ray emission detected with NuSTAR (Grindlay et al 2018a) and detailed optical spectroscopy (Gomez and Grindlay 2018). In this talk, we estimate the total population of such SB1 systems in the Galaxy. BH-LMXBs are similar in that most are missed in both X-ray and optical surveys, since they spend $\>99\%$ of their time in deep quiescence as very low luminosity objects. Their typical $\<1\%$ Duty Cycle for being in a high accretion state is derived both from X-ray outburst data (Teterenko et al 2016) and now the rapidly emerging $\sim$100 year photometric database being released by the DASCH survey, which has discovered historic transient outbursts for most of the dynamically confirmed BH-LMXBs with low optical extinction (Grindlay et al 2018b). We report on the likely total population of BH-LMXBs within moderately low Av regions and extrapolate to a plausible full population in the Galaxy and implications for their formation vs. NS-LMXBs. This talk is dedicated to Jeff McClintock, who was following the early development of this work.