X-rays from Isolated Black Holes

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Abstract

Galactic stellar-population-synthesis models, chemical-enrichment models, and, as we will show, long-duration Bulge microlensing events all indicate about $\sim 10^8$ stellar-mass black holes reside in the Milky Way. Although black holes are fewer in number than neutron stars, their higher masses, $\sim 6 M_{\odot}$, and smaller space velocities, $\sigma_v \sim 40$ km/s result in Bondi-Hoyle accretion rates $\sim 2 \times 10^3$ times higher than for neutron stars. The greatest uncertainty in computing the brightness of accreting black holes is the unknown efficiency of X-ray production. We demonstrate that radiative feedback reduces the accretion rate for higher efficiencies so that the luminosity varies by a factor of less than 40 for efficiencies from 10^{-5} to 10^{-1} and velocity of 40 km/s. Consequently, the number of detectable isolated accreting black holes is comparable to or greater than the number of detectable accreting neutron stars. We estimate that up to 10 isolated black holes within the Milky Way should accrete at $\dot{M} > 10^{15}$ g/s, comparable to accretion rates inferred for black-hole X-ray binaries. We make predictions for the number of isolated accreting black holes in our Galaxy that can be detected with X-ray surveys, concluding that all-sky surveys require a depth of $< 10^{-14}$ erg/cm^2/s/dex to find isolated accreting black holes or neutron stars, given the assumptions of our calculation. Deeper surveys of the Galactic plane with Chandra or XMM may find a few to hundreds of these objects.

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