

Durations of spectral state transitions in X-ray binaries and the implications

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Physics of the X-ray state transition are still not well understood. Comparisons between the black hole systems and the neutron star systems or between the persistent sources and the transient systems are very valuable. We performed a systematic study of the spectral state transitions of Galactic X-ray binaries in the period between 2005 and 2012 with the RXTE/ASM and the Swift/BAT. We find that the duration of hard-to-soft state transition of black hole X-ray binaries is longer than that of neutron star X-ray binaries, and that of the persistent sources is longer than that of the transient sources. But there was no obvious difference between the duration of soft-to-hard state transition of neutron star X-ray binaries and black hole X-ray binaries. We compared the duration of soft-to-hard state transition to that of hard-to-soft state transition and found that the former is longer than the latter for neutron star X-ray binaries, but opposite for black hole X-ray binaries. There was no statistical relation between the duration and the orbital period, indicating the spectral state transition was due to properties of the inner accretion flow. There was also no correlation between the duration of hard-to-soft state transition and the peak luminosity of the following soft state for both persistent and transient sources, indicating the durations of the state transitions are statistically quite independent of the luminosity scale of the flares or outbursts. We discuss the implications of the results and the mechanisms for the spectral state transitions.

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