



X-RAY ASTRONOMY 2019

Current Challenges and New Frontiers in the Next Decade

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Classification of X-ray activities of GRS 1915+105 based on 10-year monitoring with MAXI and Swift.

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GRS 1915+105 is a black hole X-ray binary known for its characteristic variabilities of X-ray fluxes on timescales of minutes to hours, sometimes showing limit-cycle behavior in its X-ray light curves. More than ten patterns of light curves has been recognized and classified. However, its long-term behavior, in particular, transitions among these variability classes have been difficult to study, since their classification required dedicated pointed observations.

Here, we investigated the long-term behavior of GRS 1915+105 using the data obtained over 10 years (2009-2019) with the Gas Slit Camera (GSC) of Monitor of All-sky X-ray Image (MAXI) on the ISS and the Burst Alert Telescope (BAT) of the Neil Gehrels Swift Observatory. MAXI scans the source for about 60 seconds every 92 minutes (ISS orbit). While it is difficult to recognize the variability class by the light curves within such short transits, we find it is possible to classify its activity state using the flux and the hardness ratio averaged over one day. With the appropriate choice of the energy bands for the flux and hardness ratio, the daily X-ray activities of GRS 1915+105 can be classified into four distinct branches in the hardness-intensity diagrams. We also find rules in transitions among the branches.

We attribute these state transitions in GRS 1915+105 to a “state machine” in the GRS 1915+105 system that can hold the memory of its state over several months.

We suspect that the unique temporal behavior of this source among black hole X-ray binaries arises from its unusually large accretion disk.

Topic

Multi-messenger and transient astronomy

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