K band monitoring of GRS 1915+105 during 1999/2000

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Abstract. We report on long-term K band photometry of the galactic microquasar GRS 1915+105 since March 1999. We see variations of more than 1 mag, which are seemingly correlated with variations in X-ray intensity and spectral slope.

Keywords: X-ray binary, GRS 1915+105, infrared observations

1. Introduction

GRS 1915+105 is the prototypical microquasar, a galactic X-ray binary ejecting plasma clouds at v≈0.92 c (Mirabel & Rodriguez 1994). Three different sources of infrared (IR) radiation are expected from a X-ray binary, namely thermal emission from the outer part of accretion disk, thermal emission from the companion star or synchrotron emission from the jet(s). Previous IR observations of GRS 1915+105 include, besides a few single measurements since 1993, some few hrs photometry in conjunction with X-ray/radio measurements (Eikenberry et al. 2000), and a 2 month monitoring in 1996 (Bandyopadhyay et al. 1998).

2. Observations and Results

K band observations have been performed with the 1.55-m telescope of the US Naval Observatory Flagstaff equipped with the 256×256 pixel HgCdTe IRCAM camera during 8–10 day intervals around full Moon. Because the main interest was in the long-term behaviour, "only" about 1–3 observations per month were done, consisting of groups of 3 or 4 individual observations per night. Each group represents a set of coadded integrations with an exposure of 400 sec. In total, observations were performed on 34 nights between 05 May 1999 and 15 Jun 2000.

These observations show GRS 1915+105 to be variable between 12.1 $\lesssim$ K $\lesssim$ 13.7 mag (not extinction-corrected; Fig. 1). Our long coverage allows to search for correlations with other emission characteristics, e.g. the RXTE All-Sky Monitor (ASM) quick-look results provided by the ASM/RXTE team. After selecting those K band observations which

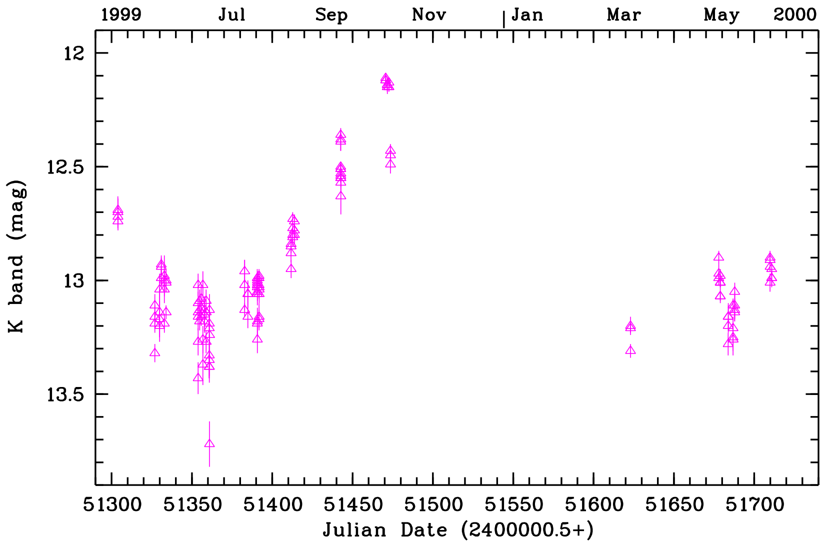

Figure 1. K band light curve of GRS 1915+105, showing the mean of all "groups".

were done within 4 hrs of an ASM scan, we find that both the X-ray flux as well as the X-ray hardness ratio (flux ratio of 5–12 keV vs. 3–5 keV band) are positively correlated with the K band flux.

A regression analysis suggests that a doubling of the X-ray count rate (flux) leads to a 33% increase in the K band flux. This argues against an explanation due to illumination of the secondary. Instead, it rather could be synchrotron radiation related to (small) ejections/flares as seen also at shorter time scales (Eikenberry et al. 2000). In this picture the correlation of the K band flux with the X-ray hardness ratio is compatible with the correlation of X-ray spectral slope and radio flux found by Rau & Greiner (2001). A large (small) value of the hardness ratio corresponds to a flat (steep) X-ray power law slope, and therefore a high (low) temperature of the electrons in the corona if the general comptonization paradigm is adopted. These correlations then imply that strong K band flux and weak radio flux occur during times of a flat X-ray power law, i.e. most of the synchrotron power is radiated either in the infrared or radio band depending only on the temperature of electrons in the corona.

References

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