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GRS 1915+105: Flares, QPOs and Other Events at 15 GHz

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Abstract. Monitoring with the Ryle Telescope at 15 GHz of the Galactic X-ray transient source GRS 1915+105 has revealed a remarkable range of rapid and extended flares which appear to be related to the X-ray emission as recorded by the *RXTE* all-sky monitor. Quasi-periodic oscillations in the range 20–40 min have been found and are probably related to oscillations in the soft X-ray flux.

1. Introduction

The Galactic X-ray transient GRS 1915+105 has proved to have a rich structure in its high- and low-energy X-ray emission. In the radio regime, it is no less remarkable: Mirabel & Rodríguez (1995) discovered a double-sided relativistic ejection for which they derive a velocity of 0.92c. The distance is estimated, from H I absorption measurements, to be 12.5 kpc. Radio monitoring had already shown the emission to be highly variable (Rodríguez et al. 1995, Foster et al. 1996), and we started monitoring the source at 15 GHz in mid-1995. The observational details and further results are described by Pooley & Fender (1997).

2. Results

Figure 1 shows the data for some 17 months. Individual observations lasted from less than 1 hour to about 6 hours. It can be seen that the variations are unpredictable and frequently very rapid; the flux density can increase from less than 1 mJy to 100 mJy and back in less than a day. The major flare event starting in 1996 July was characterized by relatively smooth variations during the first month or so; subsequently the source became highly variable and showed frequent examples of quasi-periodic variations.

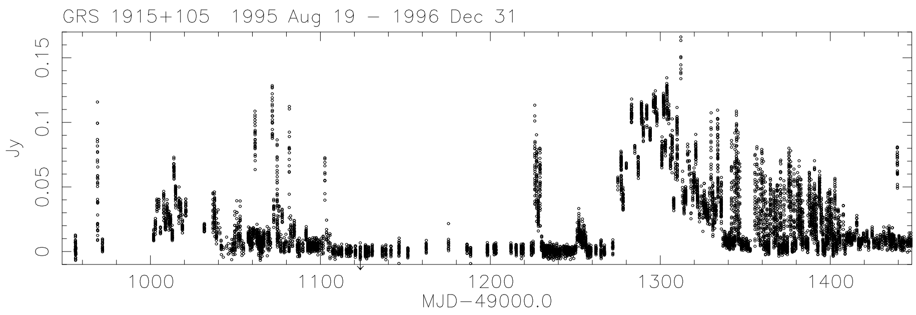

Figure 1. Flux density of GRS 1915+105 at 15 GHz over 17 months. Each point plotted is a 5-min integration.

2.1. Quasi-Periodic Oscillations

A characteristic form of the outbursts observed at 15 GHz is an event with a rise-time of less than 5 min, followed by a roughly exponential decay with time constant between 12 and 25 min. These may be isolated, they may recur with apparently random intervals, or they may repeat with some regularity; the QPOs seem to favor intervals near 25 and 40 minutes, although not exclusively so. Some examples are shown in Figure 2.

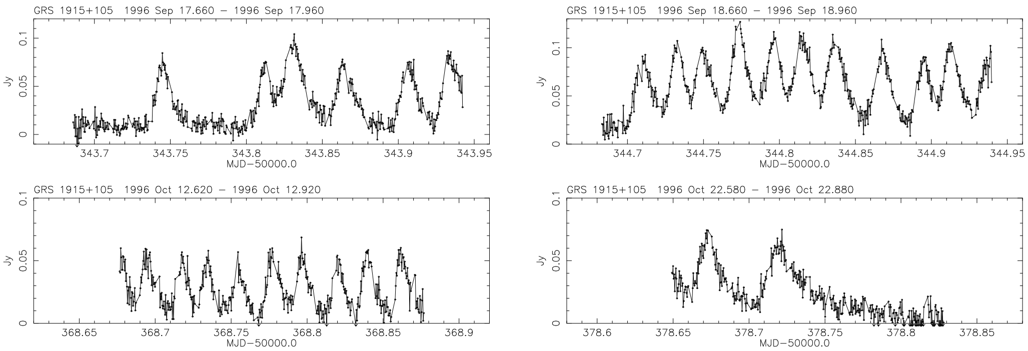

Figure 2. QPOs in GRS 1915+105 at 15 GHz; the integration time is 32 s.

2.2. Comparison with Other Wavebands

The pattern of radio emission is related in a rather complex way to that of the soft X-ray, as recorded by the *RXTE* all-sky monitor. Active (rapidly-varying) X-ray emission is usually, but not always, accompanied by radio emission. During the 1996 July radio flare, the X-ray emission was unusually constant.

Obtaining simultaneous observations of the rapid QPO events is difficult, since they are very unpredictable, but we believe that these observations will be necessary for a better understanding of the source. Perhaps the most intriguing simultaneous observation is that on 1996 Oct 24, when the PCA on the *RXTE* satellite detected oscillations which appear, on the basis of only a few cycles, to be related in phase with the 15-GHz data.

One observation with the VLBA at 8 GHz, on 1996 May 24, overlapped with a Ryle Telescope observation; the variations at 15 GHz appear about 4 minutes earlier than those at 8 GHz (Dhawan, Mirabel, & Rodríguez, these Proceedings, page 341).

Fender et al. (1997) have observed outbursts in the infrared with timescales and flux densities similar to those of the radio events. We do not yet have simultaneous IR and radio data for these flares.

References

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