

RXTE Observations of LMXB XTE J1701-407; new outburst likely

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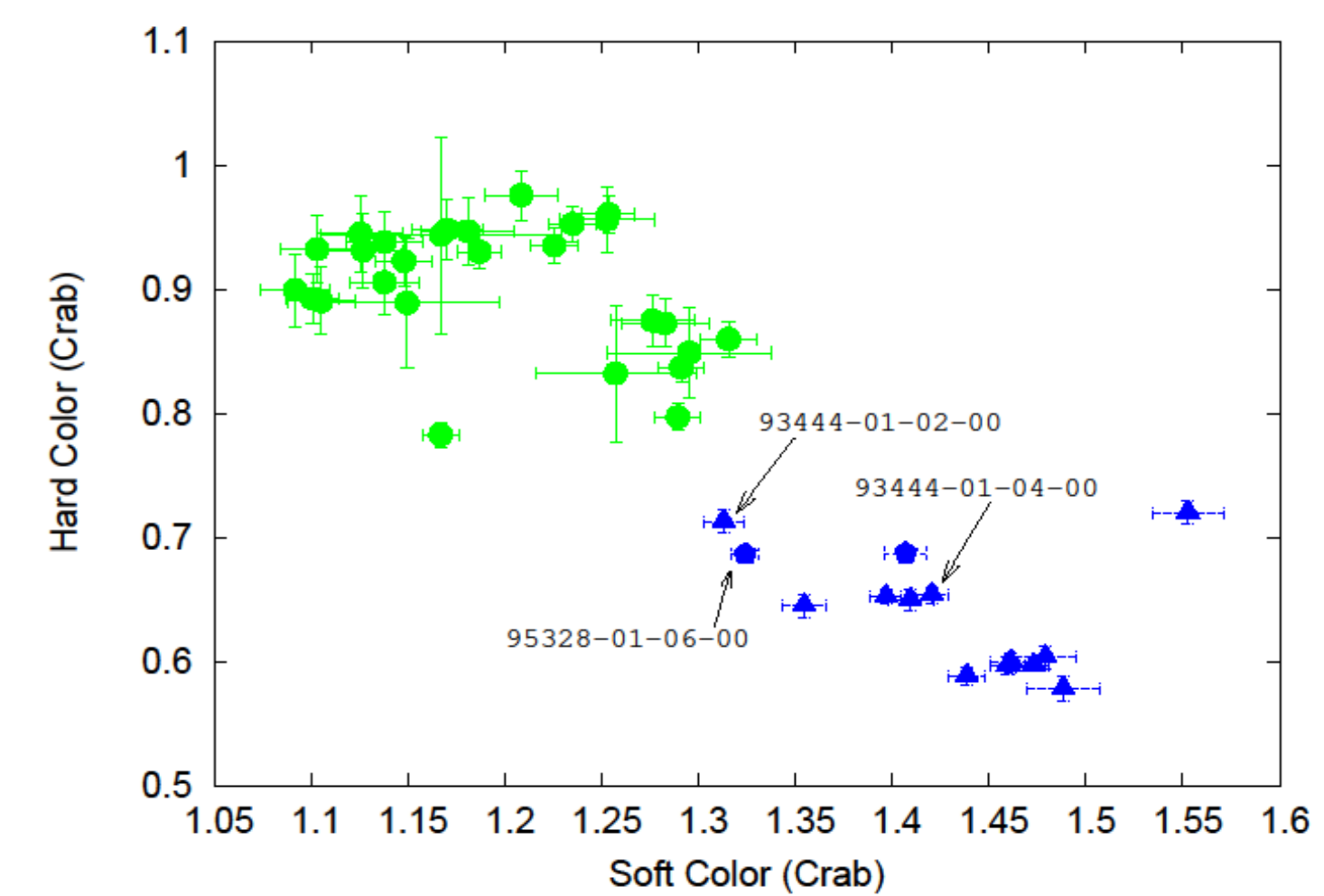
We report the detection of kHz quasi periodic oscillations (QPOs) in the Rossi X-ray Timing Explorer (RXTE) observations of the low mass x-ray binary (LMXB) XTE J1701-407. The source behaviour in the colour-colour diagram and its power spectra indicates the atoll nature of the source. The kilohertz QPOs were detected when the source was in a soft high-intensity state. A QPO of frequency 1156 ± 3.6 Hz was detected in one observation. The fractional root mean square (rms) of this QPO ($\sim 30\%$) is one of the highest observed amongst known atoll sources. Twin QPO peaks were detected twice in observations separated by \sim two years. Their frequencies $\sim 742 \pm 3.4$ Hz and $\sim 1133 \pm 8.9$ Hz. The frequency difference of 372 ± 17 Hz is one of the highest for known atoll sources and is same within errors in both the observations. Also the XTE J1701-407 is one of the least luminous LMXB observed ($L_x \sim 0.01 L_{\text{EDD}}$) in which kHz QPOs have been detected. The ~ 30 Hz QPO detected in this source is not accompanied by broad components usually detected in other atoll as well as Z sources.

Light Curve

Figure 1: Upper panel : Long term light curve of XTE J1701-407 obtained from the PCA galactic bulge scan monitoring observations. The 39 pointed observations of year 2008 were obtained in the time between the dashed vertical lines. 15 more observations in were obtained till 2011 in a number of campaigns. The arrows mark the approximate time and intensity of the observations in which kHz QPOs are detected.

Color-Color Diagram

Figure 3: Colour-colour diagram of XTE J1701-401 using the 41 pointed observations. Arrows point to the observations in which kHz QPOs are detected. The soft state observations are the blue triangles. The hard state observations are shown in green circles.

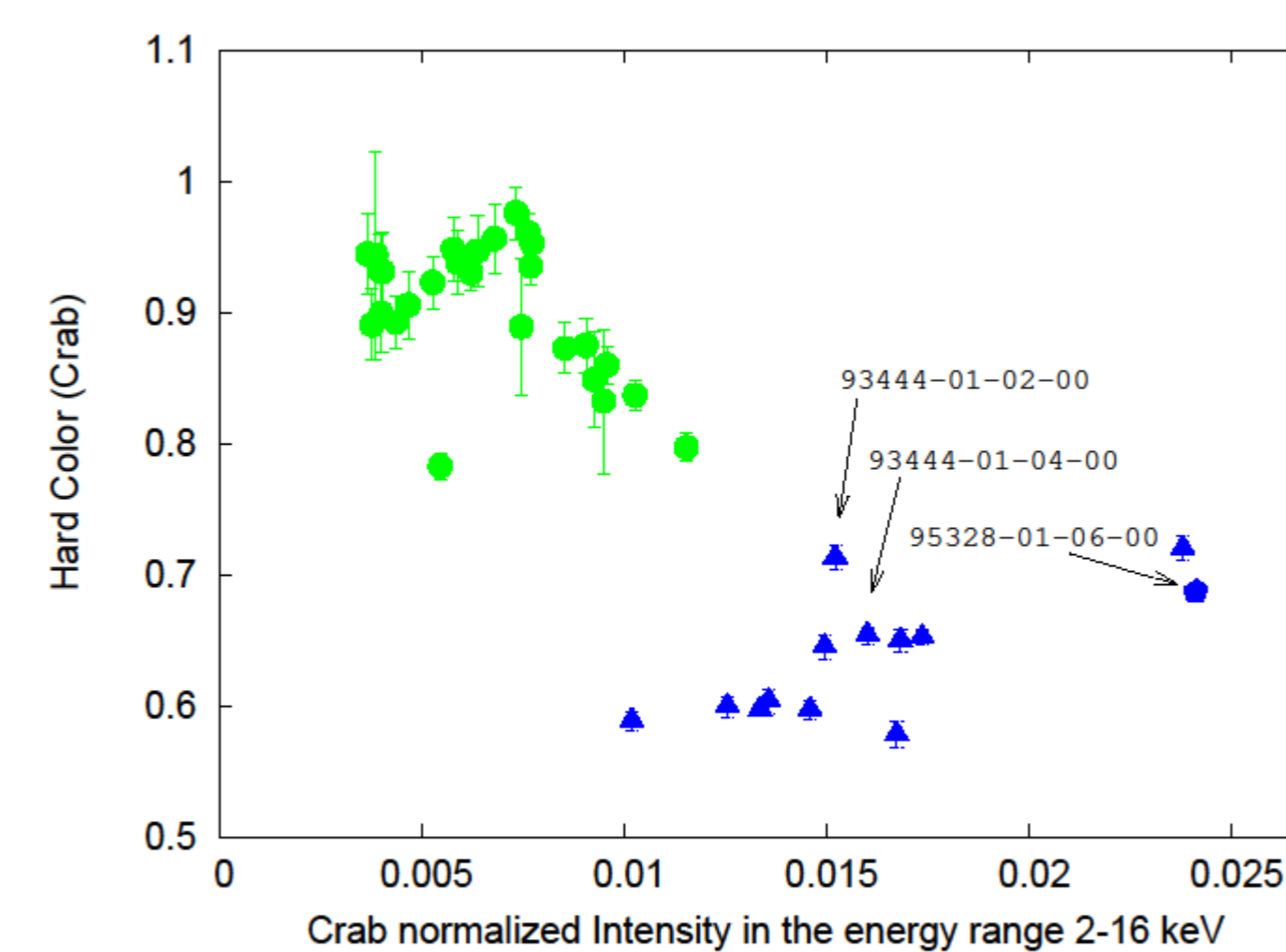


3 Year Outburst, and probably a new begins!!!

After a outburst of ~ 3 years the source went into quiescence (below PCA detection level, see Atel #3604 of 2011/08/29) and within few days it was detected at ~ 142 cts/s/5PCU on 2011/09/16. This may be the beginning of a new outburst.

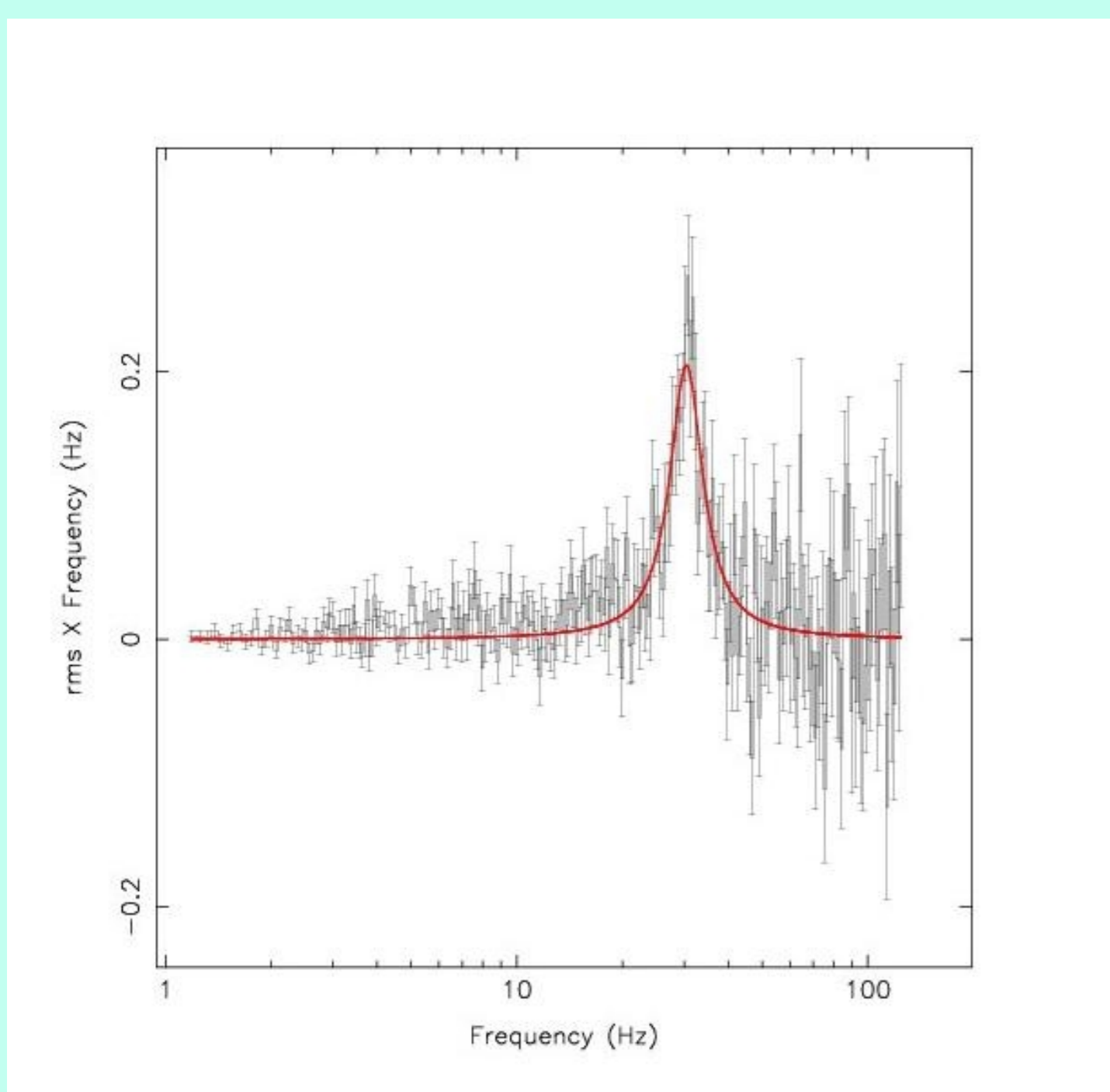
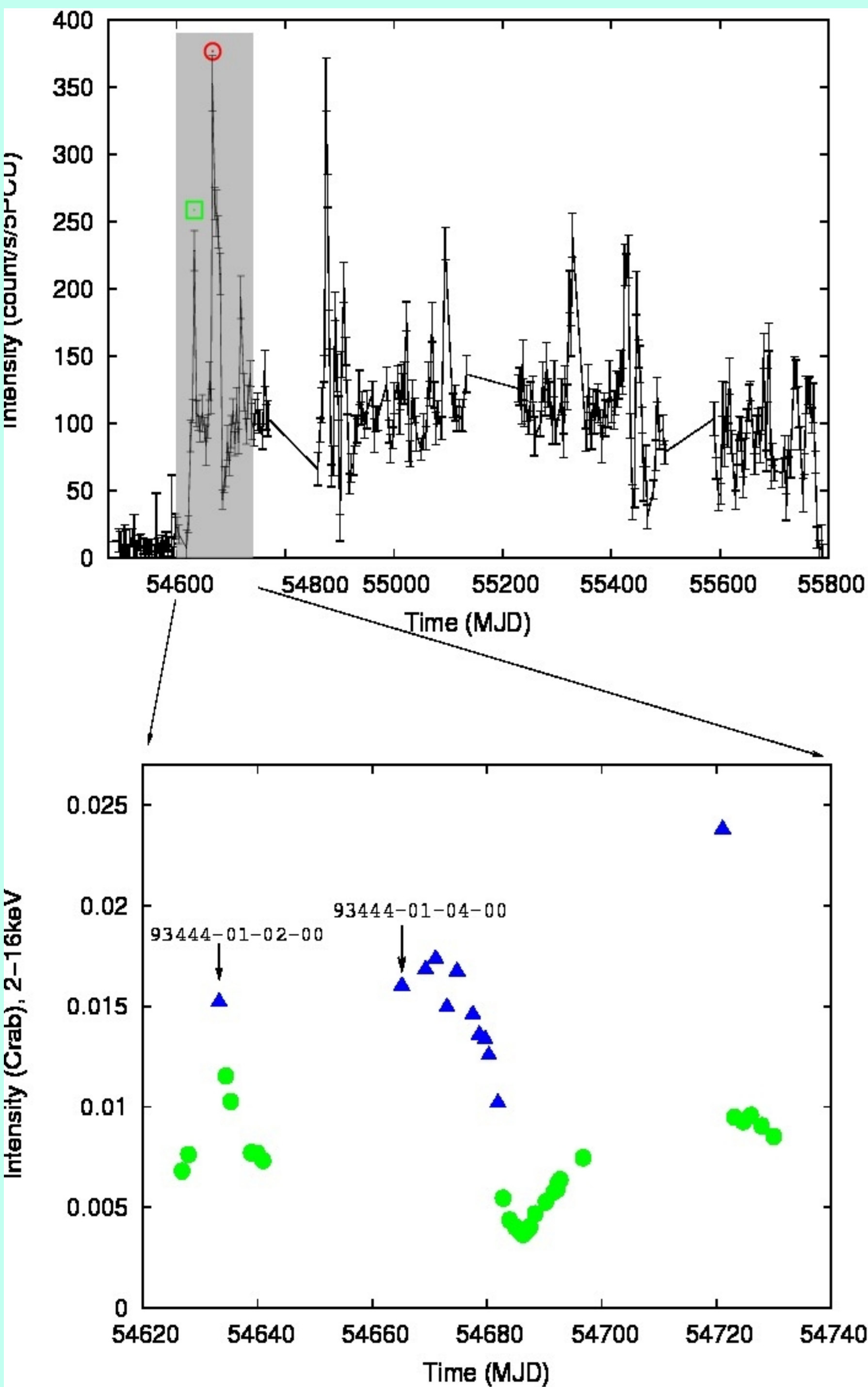
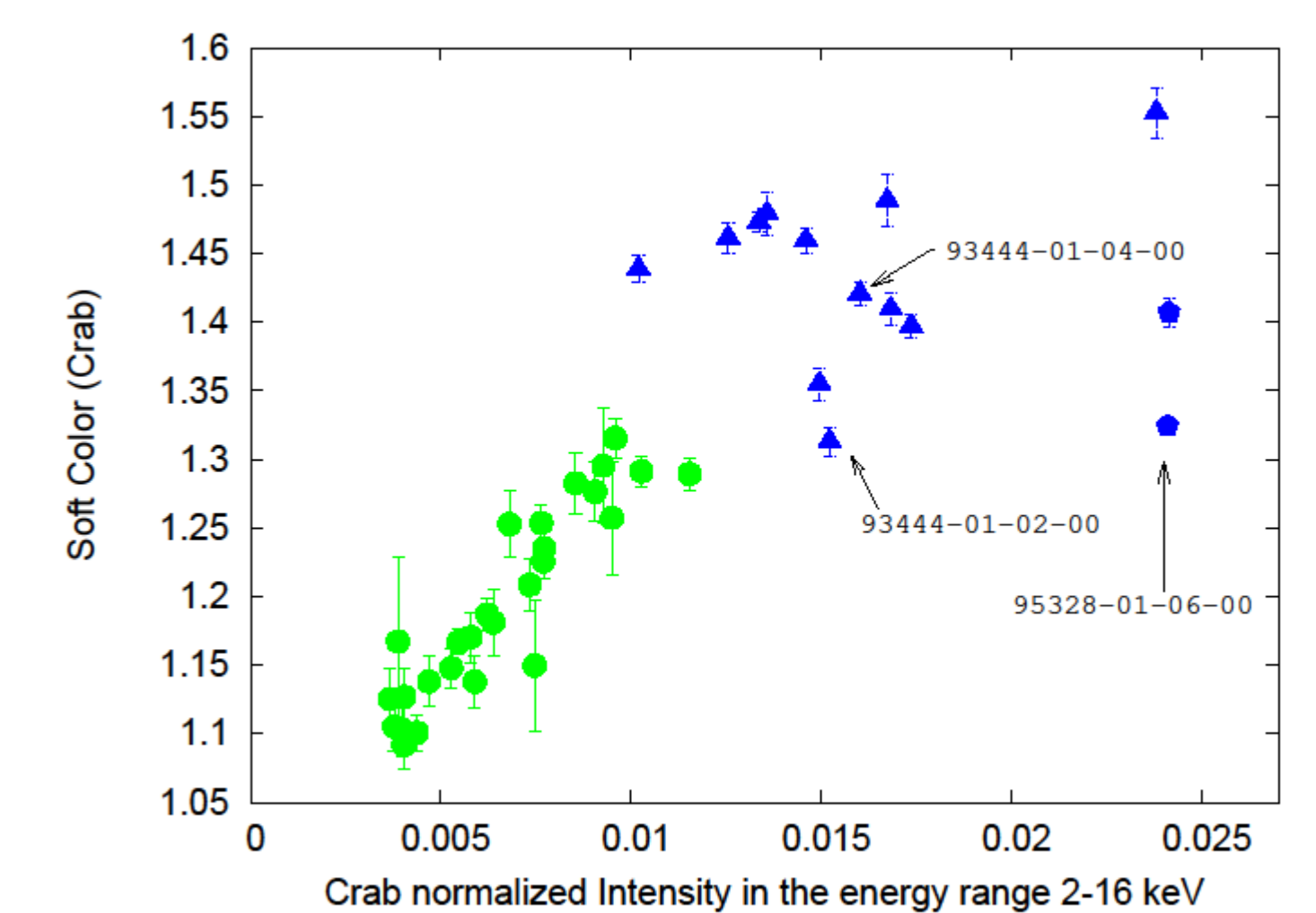
Crab Normalized Light Curve

Figure 1: Lower panel : Crab normalized light curve of the 39 pointed observations of June to September 2008. The hard state observations are marked with green circles and soft state observations with blue triangles. The arrows mark the observations in which QPOs are observed.



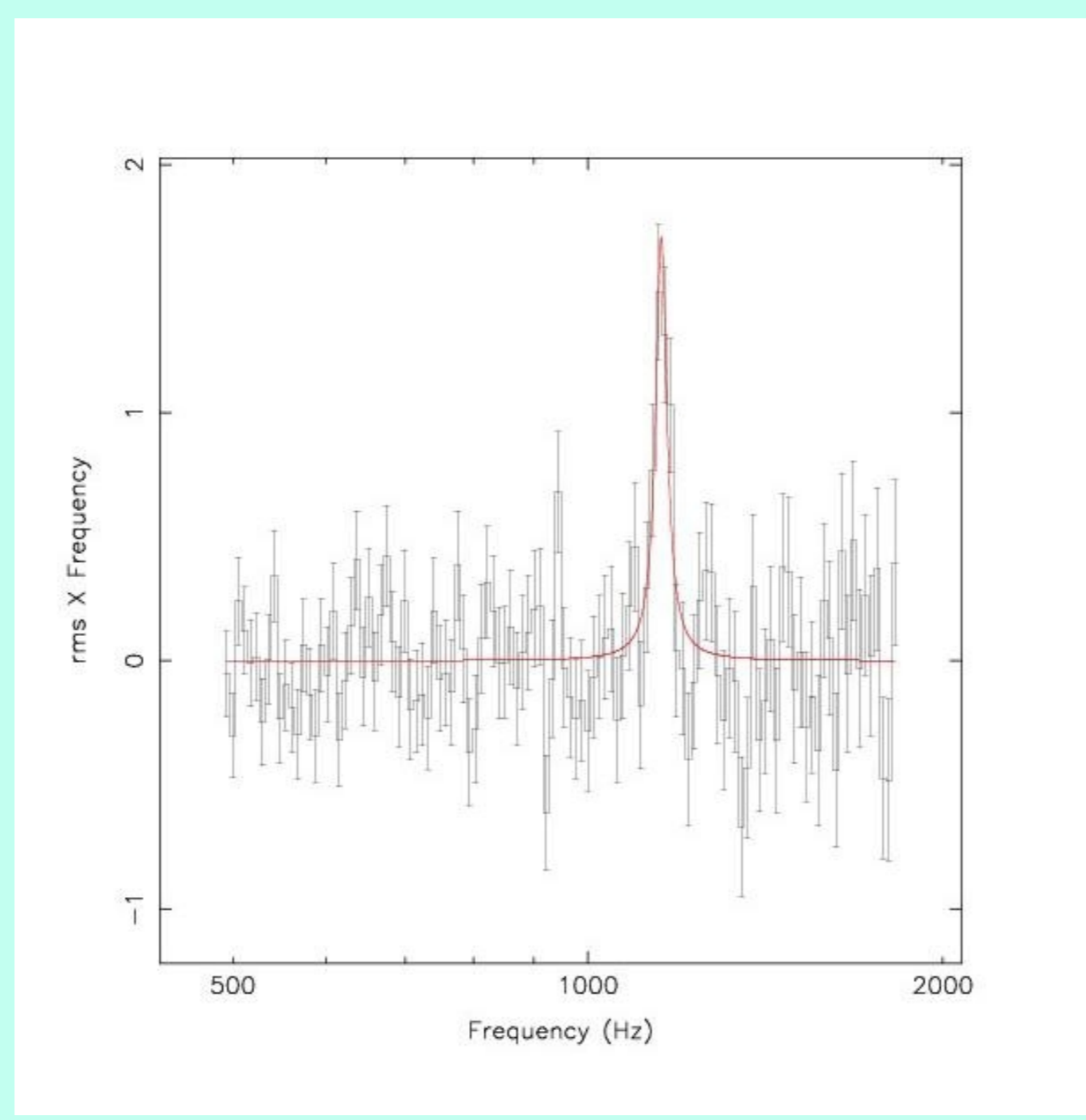
Color-Intensity Diagram

Figure 4: Right panel is the plot of the soft colour with Crab normalized intensity in the 2-16 keV energy range. Left panel is the plot of hard colour with Crab normalized intensity in the 2-16 keV energy range. In this plot the spectrum is seen to become softer as the Luminosity increases.



Quasi Periodic Observations

Figure 5: A ~ 30 Hz QPO is detected in the observation 93444-01-02-00 dated 16th June 2008. This QPO is accompanied by a 1156 Hz QPO (see first panel of Figure 6).

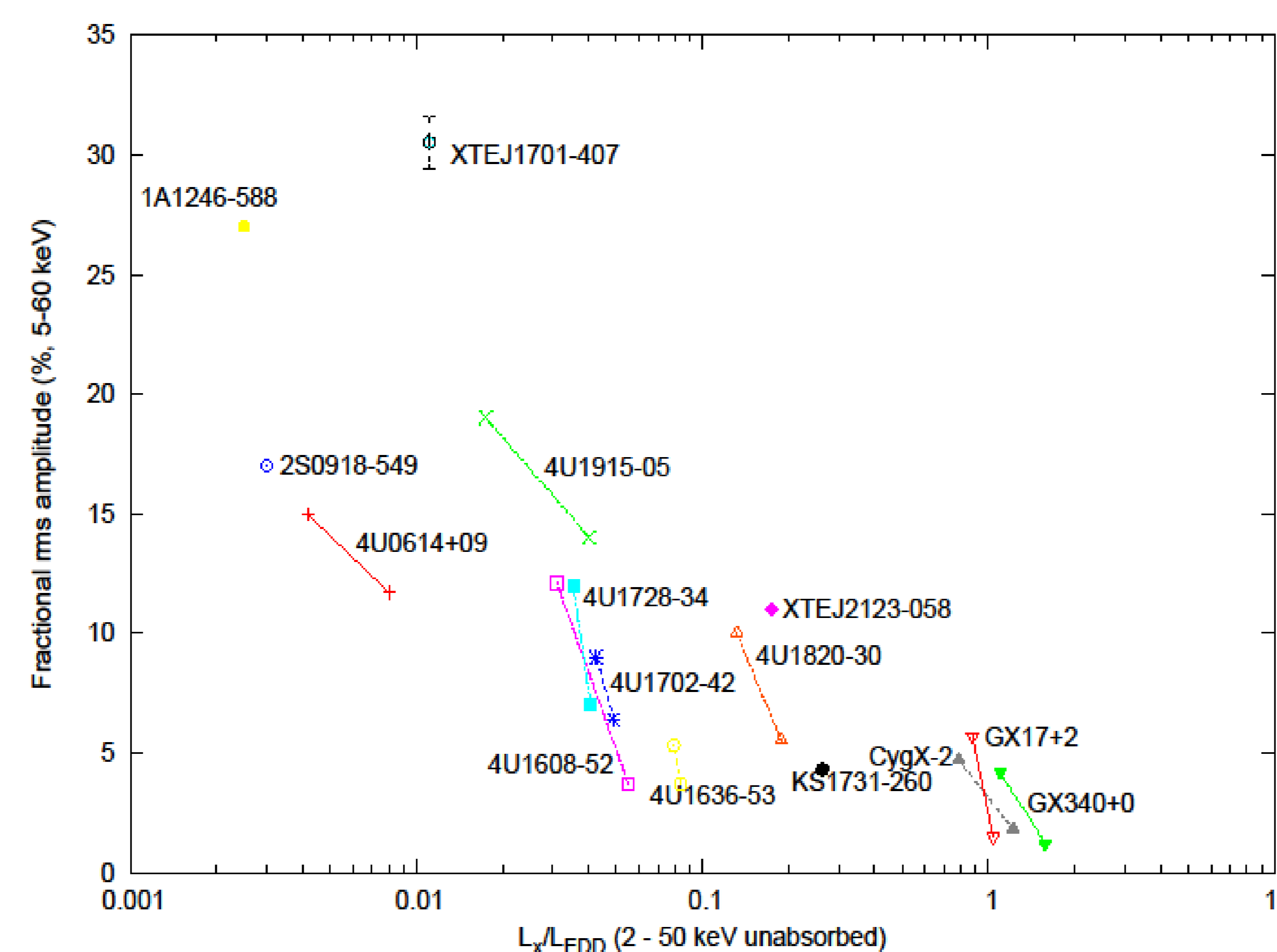


kHz Quasi Periodic Observations

Figure 6: kHz QPOs have been detected in three observations. The first panel shows a 1156 Hz QPO detected in the observation 93444-01-02-00 dated 16th June 2008. In the observations 93444-01-04-00 dated 18th July 2008 and 95328-01-06-00 dated 17th August 2010 twin kHz QPOs were detected. The difference in the frequency of the twin kHz QPOs is ~ 370 Hz. It is interesting to note that the frequency difference is same (within errors) for the two observations separated by ~ 24 months. In case of the upper kHz QPO observed in 93444-01-04-00 (second panel), the root mean square (rms) amplitude is $\sim 30\%$ in the 5-60 keV energy range. This is the highest rms observed in a kHz QPO in a low mass X-ray binary.

Luminosity Vs fractional rms

Figure 7: Luminosity Vs fractional rms amplitude in the energy range 5 -60 keV of the upper kHz QPO in various LMXBs. There is a decrease in the fractional rms amplitude as the source luminosity increases, both within one source and between sources. In addition to the low luminosity atoll sources this plot also contains the following Z sources: Cygnus X-2, GX 17+2 and GX 340+0.



Low Mass X-ray Binary XTE J1701-407

Discovery	8 th June 2008
Co-ordinates	17 ^h 01 ^m 53 ^s , -40 ^o 47'00".96
Distance	4 to 6 kpc

Some references for XTE J1701-407:

- The Swift Capture of a long X-ray burst from XTE J1701-407, Linares M., Wijnands R., van der Klis M., A. W., P.S.P.D.N.C., R. S., 2009, MNRAS
- The new intermediate long bursting source XTE J1701-407, Falanga M., Cumming A., Bozzo E., Chenevez J., Mar. 2009, A&A, 496, 333
- RXTE Observations Of LMXB XTE J1701-407, Devraj P., Maithili K., Diego A., Shanthi K., Dipankar B., (to be submitted in MNRAS)
- ATel #3604; N. Degenaar, R. Wijnands, D. Altamirano (University of Amsterdam), Et al.