MS/DD (Astro) - Lab Manual
X-ray Data Analysis

Session: 3 (Timing Study)

This session is dedicated towards timing studies of the same source. We are going to ask the questions: Is there any time variability in the data? If, so what is the time duration? How to characterized the variability?

12. Plot the light curve:
Type "lcurve" and follow the steps
Number of time series for this task[1] 1
Ser. 1 filename +options (or @file of filenames +options)[] **niNNNNNNNNNN.lc**
Name of the window file ('-' for default window) **-**
Newbin Time or negative rebinning[0.003] **Provide bin time**
Number of Newbins/Interval[8192] **(take maximum new bin no)**
Number of Intervals/Frame[93] **1**
Do you want to plot your results?[yes] **yes**
Enter PGPLOT device[/XW] XW
Note: Look at the output in the terminal

Save data: wd filename.qdp
save in postscripts: h filename.ps/PS
TYPE "help" in >PLT to see the options.

Task 12: plot (using line) and save the source light curve

Task 13: What is the maximum, minimum and average counts rate in the original source lightcurve?

Powspec is a tool to create Fourier Transformation or power density spectrum (PDS: power vs frequency) of light curve or time series (count rate vs time).

13. Powspec
Ser. 1 filename +options (or @file of filenames +options)[] **niNNNNNNNNNN.lc**
Name of the window file ('-' for default window)[] **-**
Newbin Time or negative rebinning[0.003] **Provide bin time**
Number of Newbins/Interval[8192] **(number power of 2)**
Number of Intervals/Frame[93] **choose all intervals to get one frame**
Rebin results? (>1 const rebin, <-1 geom. rebin, 0 none)[-1.02] 0**, try other options and see differences**
Name of output file[P20402-binned] **output file name**
Do you want to plot your results?[yes] **yes**
Enter PGPLOT device[/XW] **XW**

Task 14: *Plot the PDS of the entire light curve. Is the power distribution uniform? If not why? What is the minimum bin time possible for the given data set?*

Task 15: *Use two different rebin time (a) minimum bin time and (b) ten times the minimum bin time and redo the PDS. Save the result. Justify the differences in results in (a) and (b). Why do the minimum and maximum frequency in the PDS (a, b) different?*

14. Model the PDS and find the quasi periodic oscillation (QPO frequency)

Generate a PDS with time bin ... and Newbins/Interval .. Fit the PDS with model like Lorentzian, power law, constant etc. Use the "help" command to see model details.

PLT> model lore (use the model Lorentzian to match the peak and width of QPO)
1. LC: VAL(0.4384), SIG(0.1168), PLO(0.000), PHI(0.000)?
2 LW: VAL(6.814), SIG(7.8472E-02), PLO(0.000), PHI(0.000)?
3 LN: VAL(20.95), SIG(0.4062), PLO(0.000), PHI(0.00)?

Check the fitting. Are you satisfied? If no use additional Lorentzians and powerlaw or constant (to shift the vertical level)

15. Model PDS using XSPEC
Generate PDS using 'powspec' and dave data. Convert the data into a PHA file and generate a response. (files will be provided)

Task 16: *Save the model fitted PDS. Make a table for all model fitted parameter with errors and* χ^2 *value with degrees of freedom.*

Task 17: *What is the frequency of QPO (LC value)? The significance of the QPO is defined by Q-factor (ratio of the centroid frequency with width of the peak). Calculate the Q-factor.*