

Steps of LAXPC data analysis using LAXPC software (Format A) available at link
<http://astrosat-ssc.iucaa.in/?q=laxpcData>

Software having individual routines to extract spectra, light curves, power spectra, energy and frequency dependent time-lag, Dynamic power spectra, flux resolved spectroscopy, faint source background estimation (May 19 2018 version)

You can download publicly available LAXPC data from the webpage

https://astrobrowse.issdc.gov.in/astro_archive/archive/Search-Record.jsp

Sample source is crab data (observation id : 9000000778, observation date : 8th November 2019)

1. Create a data folder to store level 1 laxpc data

>mkdir laxpc_data

Path of data folder is : /home/user_name/walkthrough/LAXPC/laxpc_data

>cd /home/user_name/walkthrough/LAXPC/laxpc_data

>ls

LEVL1AS1LXP20161108A02_090T01_9000000778_06050.zip

LEVL1AS1LXP20161108A02_090T01_9000000778_06051.zip

This will create a folder 20161108_A02_090T01_9000000778_level1.

2. Unzip level 1 data files

>unzip LEVL1AS1LXP20161108A02_090T01_9000000778_06050.zip

>unzip LEVL1AS1LXP20161108A02_090T01_9000000778_06051.zip

INITIALIZE HEASOFT (*heainit in the terminal*)

3. Now create an analysis folder (working directory)

>mkdir analysis_laxpc

Path of analysis directory is : /home/user_name/walkthrough/LAXPC/analysis_laxpc

4. In the analysis_laxpc folder (Path: /home/user_name/walkthrough/LAXPC/analysis_laxpc) Set the variable \$LAXPCDATAPATH to where your data is ending with the laxpc directory.

> export LAXPCDATAPATH="export

LAXPCDATAPATH="/home/user_name/walkthrough/LAXPC/laxpc_data/20161108_A02_090T01_9000000778_level1/laxpc/"

5. Make data file lists by giving the command

> laxpc_make_filelist

this will produce two text files "*eventfiles*" and "*filterfiles*"

(check files with **>more eventfile**)

6. Check the content of eventfiles and filterfiles for appropriate path of data and .mkf files.

>more eventfiles

"/home/user_name/walkthrough/LAXPC/laxpc_data/20161108_A02_090T01_9000000778_level1/laxpc//06050/lxp1/modeEA/AS1A02_090T01_9000000778lxp1EA_level1.fits"

"/home/user_name/walkthrough/LAXPC/laxpc_data/20161108_A02_090T01_9000000778_level1/laxpc//06050/lxp2/modeEA/AS1A02_090T01_9000000778lxp2EA_level1.fits"

"/home/user_name/walkthrough/LAXPC/laxpc_data/20161108_A02_090T01_9000000778_level1/laxpc//06050/lxp3/modeEA/AS1A02_090T01_9000000778lxp3EA_level1.fits"

"/home/user_name/walkthrough/LAXPC/laxpc_data/20161108_A02_090T01_9000000778_level1/laxpc//06051/lxp1/modeEA/AS1A02_090T01_9000000778lxp1EA_level1.fits"

"/home/user_name/walkthrough/LAXPC/laxpc_data/20161108_A02_090T01_9000000778_level1/laxpc//06051/lxp2/modeEA/AS1A02_090T01_9000000778lxp2EA_level1.fits"

"/home/user_name/walkthrough/LAXPC/laxpc_data/20161108_A02_090T01_9000000778_level1/laxpc//06051/lxp3/modeEA/AS1A02_090T01_9000000778lxp3EA_level1.fits"

>more filterfiles

"/home/user_name/walkthrough/LAXPC/laxpc_data/20161108_A02_090T01_9000000778_level1/laxpc//06050/AS1A02_090T01_9000000778lxp_level1.mkf"

"/home/user_name/walkthrough/LAXPC/laxpc_data/20161108_A02_090T01_9000000778_level1/laxpc//06051/AS1A02_090T01_9000000778lxp_level1.mkf"

7. Make FITS event file by giving the command

>laxpc_make_event eventfiles

this will produce a file called '*level2.event.fits*'.

8. Make gti file

>laxpc_make_stdgti filterfiles

which will produce a file called '*usergti*' which has the GOOD TIME INTERVALS (GTI) which removes earth occultation and SAA.

(Note: "laxpc_make_occultgti filterfiles" will instead make occultgti having the time when the source was occulted).

9. To make source spectrum using usergti [see README_SPEC]

> laxpc_make_spectra -u usergti.fits level2.event.fits

This command will generate spectrum of the source (example: spectrum_20.pha) and grouped spectrum (example: spectrum_grp_20.pha) of source. This will automatically select appropriate rmf (example: lx20cshm04v1.0.rmfm) files for the data sets for each detector and copy it in current directory.

10. To generate laxpc background spectrum [see README_BACKSPEC]

>laxpc_make_backspectra -u usergti.fits filterfiles

This command will generate simulated spectrum of the background (example: backlxp20.pha) for each detectors.

11. create an energy input file **eneinput** and save the energy ranges as per science interest.

>**vi eneinput**

Save two energy ranges in the file 3-5 keV and 5-20 keV

3.0 5.0

5.0 20.0

10. To create lightcurves in 3-5keV and 5-20 keV energy bands, combining laxpc 10 and 20, applying usergti file and 1 sec binning: [see README_LC]

>**laxpc_make_lightcurve -p 12 -t 1.0 -u usergti.fits -e eneinput level2.event.fits**

Output files: ***lightcurve_3.0_5.0keV.lc and lightcurve_5.0_20.0keV.lc***

(User can plot the lightcurves using ftools fv, fplot or lcurve in heasoft.)

11. To generate background lightcurves in 3-5keV and 5-20 keV energy bands, combining laxpc 10 and 20, applying usergti file and 1 sec binning: [see README_BACKLC]

>**laxpc_make_backlightcurve -p 12 -t 1.0 -u usergti.fits -e eneinput filterfiles**

Output files: ***Back_lightcurve_3.0_5.0keV.lc and Back_lightcurve_5.0_20.0keV.lc***

(There is a detailed readme file provided for each task mentioned above, along with the software.)