Xspec session (28.2.2011, Sporilov's library)

Initialization:

- first initialize Heasoft (by „heainit“ command)
- prepare your data and do re-binning with „grppha“ or „pharbn“ command (outside of Xspec)
- run Xspec, change plot device to graphical window by „cpd /xw“, define energies instead of channels by „setplot energy“
- Use Xspec manual at http://heasarc.nasa.gov/docs/xanadu/xspec/manual/manual.html.

Basic Xspec:

- **data** – load data
- **ignore**
  - e.g. **ignore **-1. 10.-**** ignore energies below 1 keV and beyond 10 keV
  - but be aware! ignore **-1 10-** means ignore channels below 1 and beyond 10
- **notice –** notice channels/energies
  - e.g. **notice all** – notice all energy channels
- **plot data, plot ldata –** display the data
- **model** M **–** define your model M (e.g. model powerlaw)
- **addc** # – add a model component # (e.g. addc 1 phabs)
- **delc** # - delete a model component #
- **fit** – fit the data with your model
  - e.g. **fit 1000 1e-3** means 1000 iterations and precision of goodness-of-the fit to 1e-3
- **show data, show all –** show data, model parameters and goodness of the fit
- **newp** # - define new parameter # to a different value
  - e.g. **newp 2 1.9 0.1 1.5 1.5 2.5 2.5** means define parameter #2 to 1.9 with delta 0.1 (for fitting purposes) and its minimal value to be 1.5 and the maximal 2.5 (it is needed to be written twice because first means soft value and the second hard value)
- **thaw/freeze** # - allow the parameter # to be fitted or force it to a fixed value during the fitting procedure
- **plot ldata ratio/delchi/model –** display the data, the data/model ratio, residuals with the 1-sigma error bars, model
- **save model/all file –** save model/everything to a file
  - e.g. **save all my_current_session.xcm**
- **@** - load a saved file
  - e.g. **@my_current_session.xcm**
- **error** # - calculate error of an interesting parameter (actual fit is necessary)
- **steppar –** produce contour plots (1D or 2D)
  - e.g. **steppar 2 1. 2. 40** – calculate chi-squared values for a grid of 40 values of the parameter 2 between 1.0 and 2.0
- **plot contour** – plot the result of steppar command
- **setp comm** – define a command
  - **setp comm we** – the other command(s) will be saved (e.g. plot contour will be saved in the files .qdp and .pco instead of to be displayed in X-window)
- **setp del 1 –** remove the command 1
- ...and some others (see the Xspec manual)
- **exit** – no need to explain :)

Exercises:

1. **„Simulate future-mission data“**

   Choose any X-ray future satellite, find a preliminary response matrix at the satellite web pages. You may use e.g. response matrix for the LOFT mission. Simulate data using „fakeit“ command in XSPEC with different exposure times and the response matrix. Use a seed model of your choice. Rebin the data. Fit them with your model and constrain the uncertainty of the chosen parameters. Use „error“ command, as well as „steppar“ command.

2. **„Use pre-prepared XMM-Newton data and try different re-binning“**

   Download data from http://astro.cas.cz/~svoboda/pub/. Group the PN spectrum with background spectrum and response matrices using FTOOL „grppha“. Use different groupings of the data. Load the spectrum in Xspec and fit with a simple model consisting of Galactic absorption, thermal disc black-body and powerlaw (e.g. phabs*(diskbb+powerlaw). Compare the resulting reduced chi-square values for different binnings.

3. **„Analyze pre-prepared XMM-Newton data of an X-ray binary and try to find the spin value“ (advanced)**

   Download data from http://astro.cas.cz/~svoboda/pub/. Use pre-prepared *_r.pi spectrum but first change the defined paths in the Spectrum Header of this FITS file. Load the spectrum in Xspec and try to find the best fit with the standard models. Load advanced models for fitting thermal disc radiation (e.g. kerrbb) and the iron line (e.g. Kyrline). Try to constrain the spin value using both models. Plot contours between the spin and any other interesting parameter (e.g. inclination).