

Homework Assignment3

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1. UNDERSTANDING χ^2

1. How χ^2 changes with free varying parameters?
2. What is *D.O.F*?
3. How χ_{red}^2 changes with *D.O.F*?
4. Is normalization a free parameter in *assignment 1*? Very important!!!
5. How to calculate the photon count of desired band?

Do not move on to following questions till you can answer all the questions above.

2. *XILLVER*

2.1 Get familiarity with *XILLVER*

Download *XILLVER* model from Dr Thomas Dauser's website.

<http://www.sternwarte.uni-erlangen.de/dauser/research/relxill/index.html>

Play with *XILLVER* by plotting *model* with different parameter values. Carefully read Dr Thomas Dauser's page and also following Dr Javier Garcia's to gain a general physics picture of this reflection model.

<http://hea-www.cfa.harvard.edu/javier/xillver/>

2.2 Rest-frame reflection spectrum of Cyg X-1

2.2.1 *Cyg X-1 in hard state*

Read chapter 3.1 – 3.3 of

Michael Parker's paper on Cyg X-1 at hard state.

2.2.2 Generate Cyg X-1 - like XILLVER model

Generate rest-frame reflection spectrum of Cyg X-1 using all the necessary parameters in *Table 4* in M. Parker et al 2015 with following requirements.

1. Viewing angle $i = 45^\circ$ (Do not use the one in the literature)
2. 2000 bins between $0.5 - 2000\text{keV}$ in log
3. Negative reflection fraction. Refer to website for more details.

Hint:

1. To set bin number— energies e_{low} e_{high} number log/linear
2. To output data— wdata filename

3. NON-KERR *XILLVER*

3.1 Prepare your ray tracing code

Prepare your ray tracing code with following settings.

1. 200 bins between 0.5 and 10keV in log(no need for 2000 bins here)
2. More photons emitted from the detector plane. Please think about this number yourself.
3. Capable of reading parameters when the program is started
4. Viewing angle $i = 45^\circ$, $a_* = 0.25$, $\epsilon = 8$

Hint: refer to PBS guidebook in Appendix

3.2 Generate non-Kerr *XILLVER*

Add up models of 2000 bins with ratio in the *XILLVER* model you generate for Cyg X-1.

4. GENERATE FIXED TABLE MODEL

4.1 Using *flx2tab* to generate a simple table model

Carefully read following *flx2tab* guide page and generate a simple table model.

4.2 Fake Cyg X-1 spectrum

4.2.1. Fake non-Kerr Cyg X-1 spectrum with following requirements.

1. Same exposure time as NuSTAR, 35ks
2. Considering LAD response, ancillary and background files.
3. Using model $TBabs * nH * (powerlaw + non - rexill)$.

4.2.2. Think about how to calculate the equivalent width of K- α iron line here. We can discuss together next time.

Hint:

1. Response files could be found here. [http : //pan.baidu.com/share/link?shareid = 181643039&uk = 67793985](http://pan.baidu.com/share/link?shareid=181643039&uk=67793985)
2. fakeit tool guide page: [https : //heasarc.gsfc.nasa.gov/xanadu/xspec/manual/XSfakeit.html](https://heasarc.gsfc.nasa.gov/xanadu/xspec/manual/XSfakeit.html)