Homework Assignment2

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(Dated: March 27, 2016)

1. IRON LINE IN JP METRIC

During following assignment, please set $\epsilon_t = \epsilon_r == \epsilon$ to recover JP metric. Read Chap 3 in *J. Jiang et al*(2015) concerning JP metric and understand why only ϵ_3 is considered here.

Plot 1.1

Use the code in *Assignment*1, which you modified to calculate ISCO, to generate that with following grids in the background of JP metric. Plot ISCO in colorful scheme on ϵ vs. *spin* plane.

$a_* = [0.0; 0.95]/0.01$ and $\epsilon = [-2; 8.0]/0.1$

Hint: Refer to Fig 3 in arXiv 1509.03884

Plot 1.2

Plot the iron line models with following parameters.

$a_* = 0.5$ and $\epsilon = [-2; 8.0]/1.0$

Compare this result with *Plot*1.1 and explain the spin degeneracy of this theory.

Plot 1.3

Remind *Question*4 in *Assignment*1 and calculate χ^2 between the same reference and following models. (With fixed viewing angle.)

$a_* = [0.0; 0.9]/0.1$ and $\epsilon = 3$

Plot this χ^2 vs. a_* together with *Plot*4.2.1 in *Assignment*1.

Hint: Spin degeneracy: two non-Kerr iron line with different spin parameters may not be distinguished within the instrument measurement ability.

2 XSPEC 101

2.1 Basic Fit

LAD is one panel from eXTP, China's future satellite. Here we learn how to analyse simple data with simple model. Fit given LAD spectrum ("ass2.1.fak", "ass2.1.bkg", "ass2.1.arf") with following model.

$const * (powerlaw + kerrbur * gauss)$

Hint: please consider the energy range $1.0 - 10.0keV$ of this spectrum and fix following parameters.

$index2 = 3.0$ $\sigma = 0$ $Eline = 6.4$ $z = 0$

2.2 Plot Results

Have a table of fit parameter values with error.

Plot following pictures:

1. 2.2.1 Apparent instrument spectrum and ratio
2. 2.2.2 Unfolded spectrum (eeuf)
3. 2.2.3 Effective area of this instrument
4. 2.2.4 Model (eemodel)
5. 2.2.5 Plot χ^2 contour on *viewing angle* vs. *spin* plane.

Do following calculations:

1. 2.3 Flux between $3 - 10keV$ and calculate the total flux LAD obtains.
2. 2.4 Calculate the equivalent width of your line model

Hints

Here are basic Xspec commands you need to know.

To log into cluster

>ssh -X -p 122 [youraccountname]@10.92.2.922

To load model

> model powerlaw+kerrconv*gauss

Then input the initial parameters your fit begins with. Refer to Xspec Manual for more information about this part.

To load data

> data [yourdatafilename]

To begin fit

>fit

To change parameters

>newpar [parameternumber]

With negative delta, this parameter is fixed.

To open plotting window

> cpd /xs

To plot model

> plot model

or > plot emodel [energy*model]

or > plot eemodel [energy*energy*model]

To calculate equivalent width iron line

> eq [modelnumber]

To show all the parameters

> show all

To show all free parameters

> show free

To ignore energy1 to energy2

> ignore [energy1]-[energy2]

To ignore energy range below energy3

> ignore **-[energy3]

You want to calculate the flux between 3 and 10 keV

> flux 3 10

To calculate error of a parameter

> error [parameternumber]