

CZTI Simulation Tools

Gulab Dewangan

IUCAA

(for CZTI Team)

Count rate estimates for CZTI

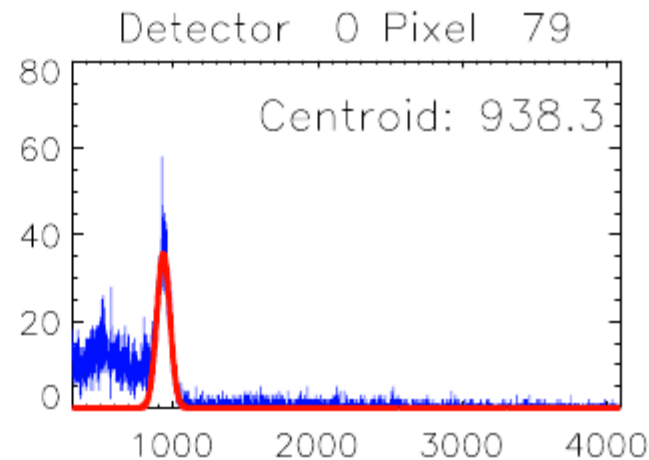
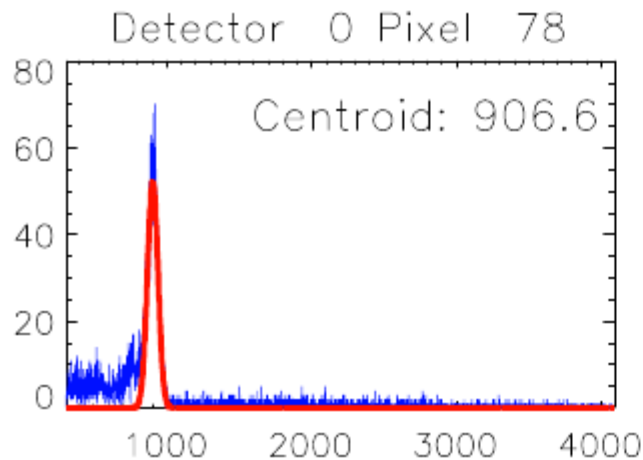
- [NASA Heasarc Tool PIMMS](#)
(Portable, Interactive, Multi-Mission Simulator)
 - estimate count rate based on flux and simple spectral model
 - [Updated CZTI effective area being incorporated.](#)

Spectral Simulation Tools

- General purpose X-ray spectral fitting/simulation tools
 - XSPEC, ISIS or SHERPA
- Requirement
 - RMF
 - ARF
 - Background PHA

Redistribution Matrix (RMF)

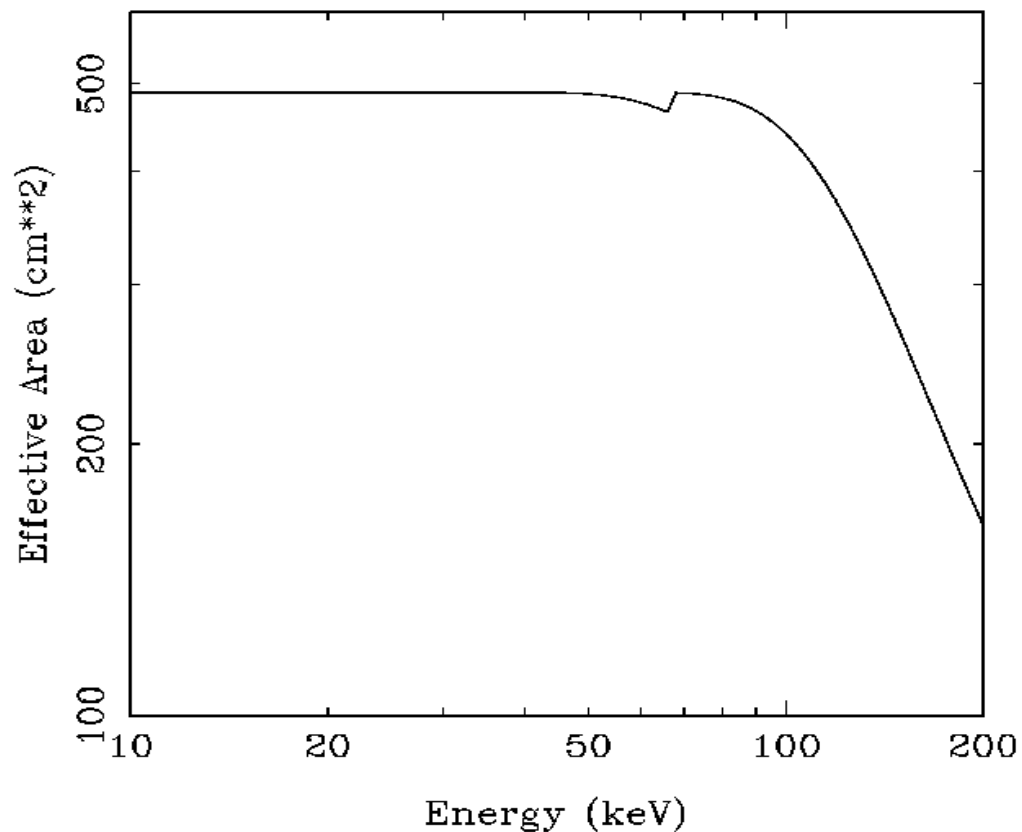
- RMF – 0th order response matrix based on the Gaussian photopeaks at three different energies available.



Sample ^{241}Am spectra of a few pixels in FM2, Module 0. The X axis is channels, and Y axis is counts per channel as measured in a 4 hr integration. Data were acquired at 5°C with threshold set at 10 keV. A Gaussian fit to the 59.56 keV line is overplotted on the

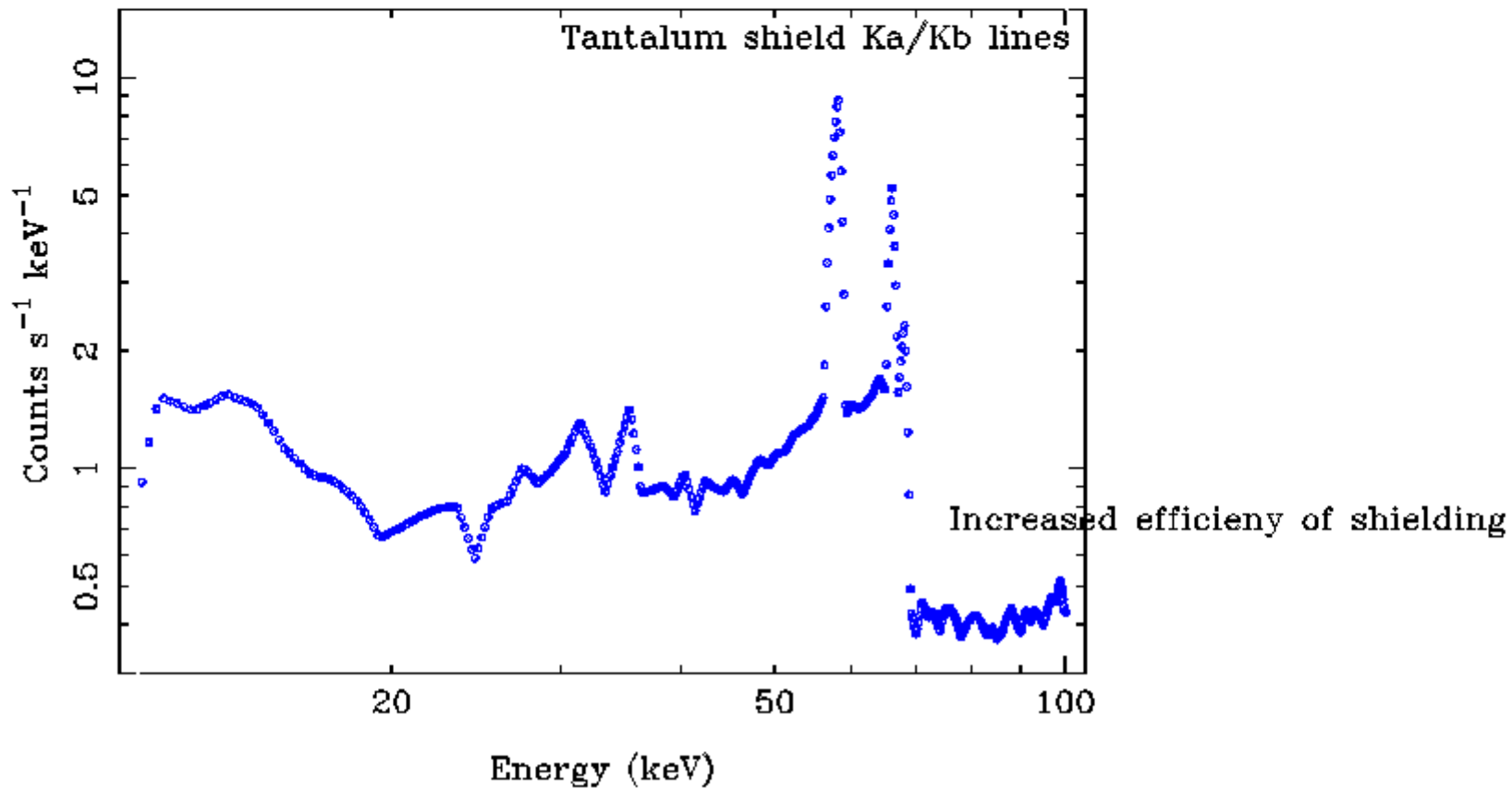
Effective Area (ARF)

- Theoretical effective area for on-axis observations
– an ARF file available



Background Spectrum

- Simulated background spectrum based on GEANT-4
- Simulated data converted to PHA file



Spectral Models

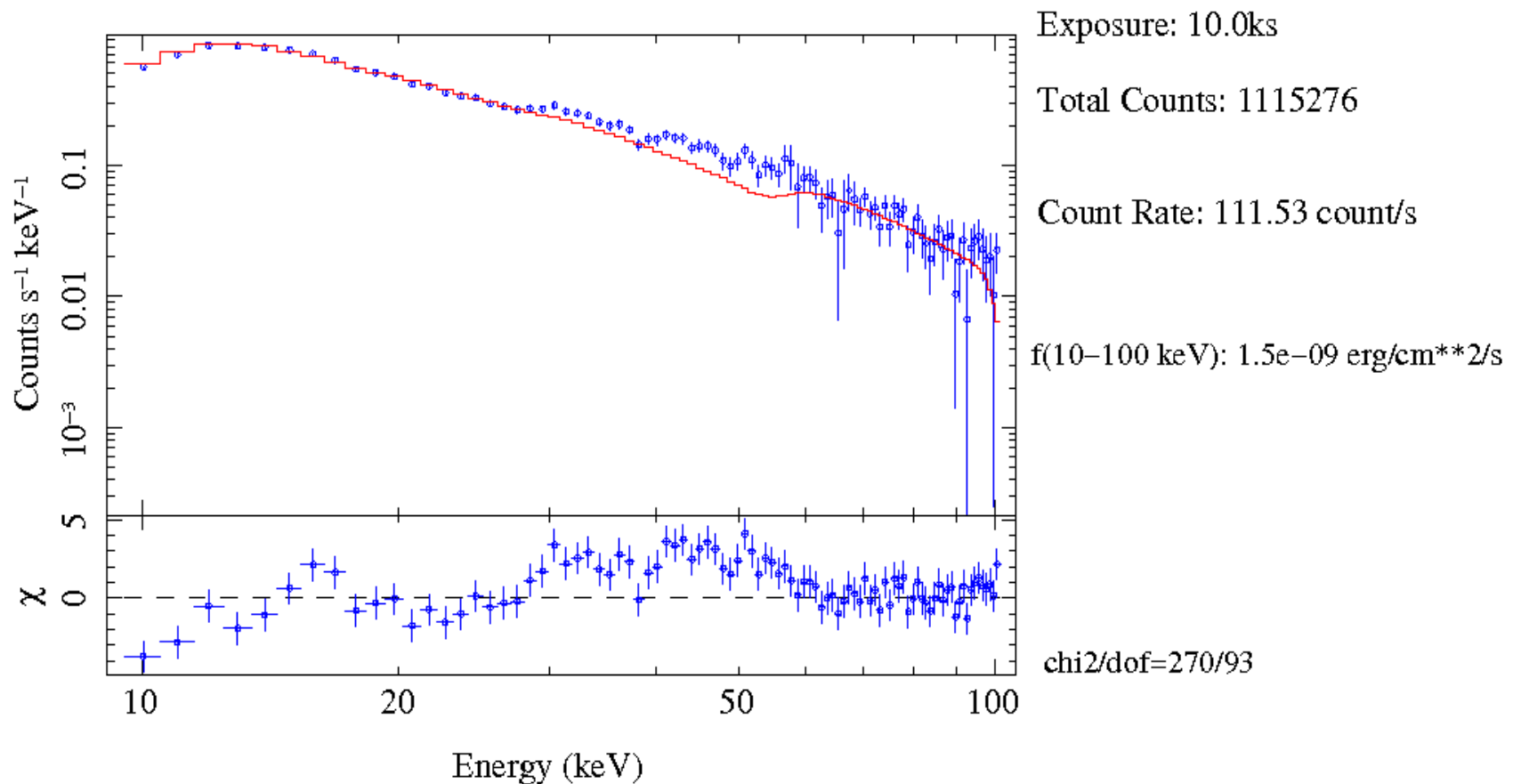
- A large number of spectral models in XSPEC/ISIS/Sherpa
- Local models can be implemented
- An example of local models implemented in ISIS to test the sensitivity of CZTI
 - Pulsar with hollow mounds
 - Pulsar with filled mounds
 - (Theoretical spectra from simulations by Dipankar etal.)
 - Simulated data converted to four ISIS local models :
pulsar_hollow & pulsar_filled (line+continuum and continuum)

ISIS local model & Simulation

ASTROSAT CZTI Simulation

Target : Pulsar Hollow

Model : data based on pulsar_hollow, fitted with pulsar_filled

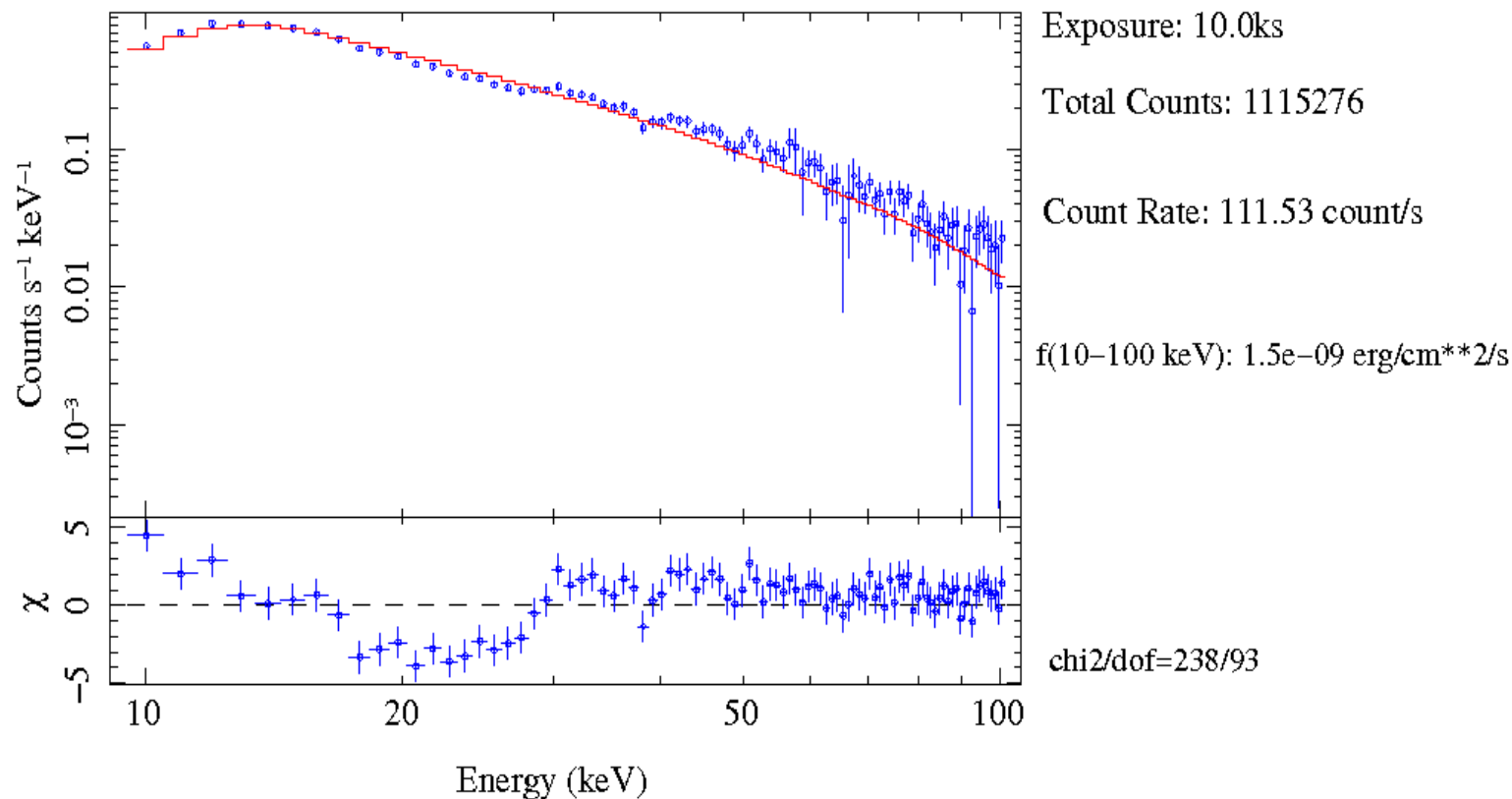


ISIS local model & Simulation

ASTROSAT CZTI Simulation

Target : Pulsar Hollow

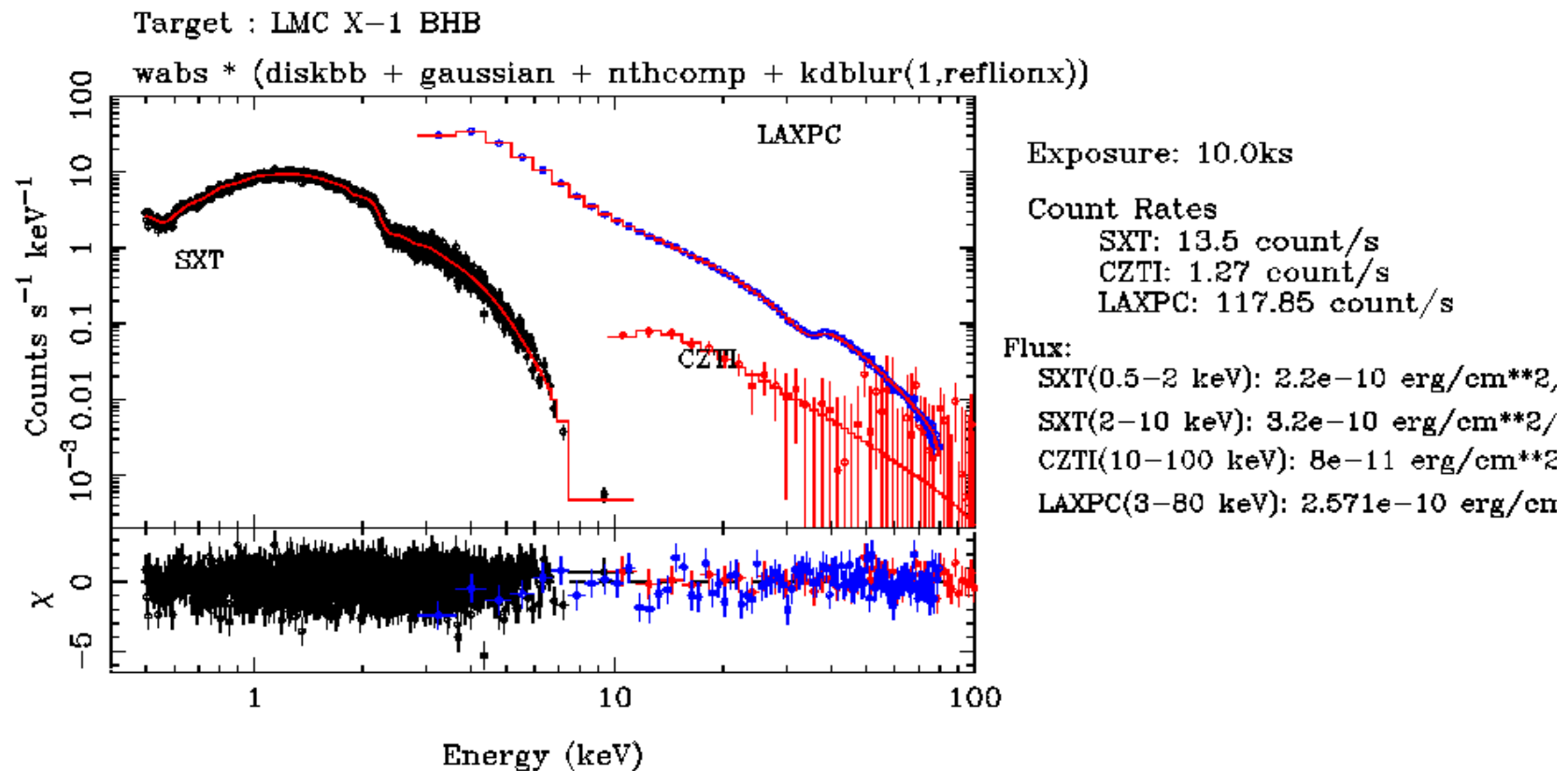
Model : data based on pulsar_hollow, fitted with pulsar_hollow_cont model



Towards a Multiwavelength Simulator

- ISIS Tool - SXT, CZTI, LAXPC implemented, UVIT to be done.
- Define multiwavelength spectral model and provide exposure time

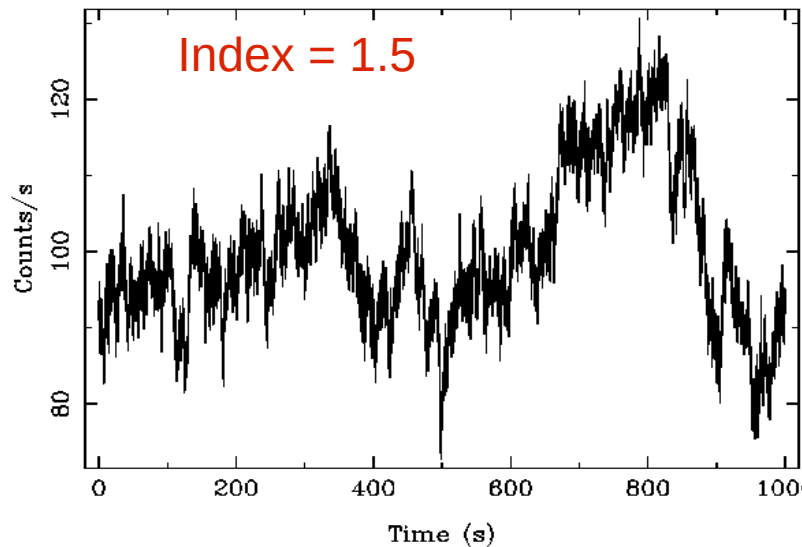
ASTROSAT Simulation



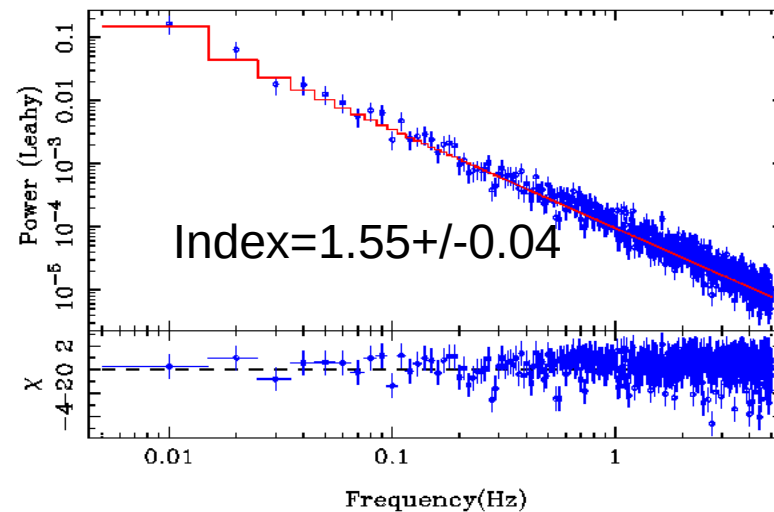
Temporal Simulation

- Count rate estimates from PIMSS or ISIS/XSPEC etc.
- Defining PSD & Lightcurve simulation - ISIS/IDL
- PSD fitting - ISIS or XSPEC

ISIS simulation of a lightcurve based on PL psd



PSD of simulated lightcurve and ISIS fit



A PSD break or a QPO can be simulated and accuracy can be checked for a given exposure

Thank You

Calibration Tools

- RMF generation

- XSPEC local model to fit calibration spectra of radio-active sources

- $XCZT = G(i) + B(i) + S(i) + D(i)$

1. Gaussian function $G(i) = H_g \times \exp\{-(i - E_{peak})^2 / 2\sigma^2\}$

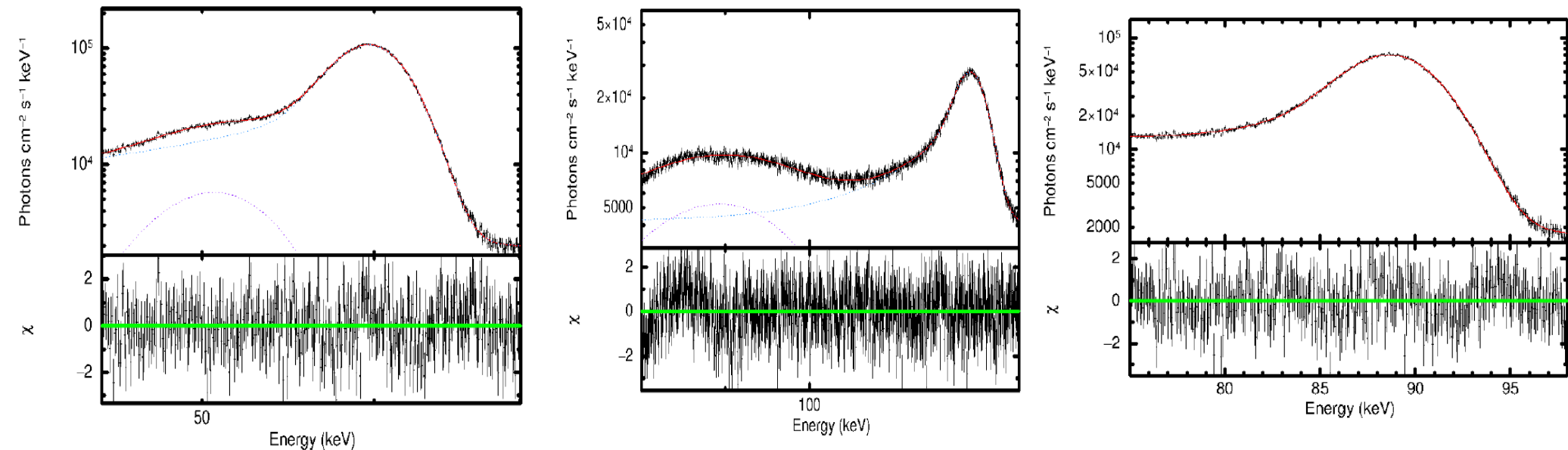
2. Background $B(i) = A + B \times i$

3. Step function $S(i) = H_s H_g \times \text{erfc}\{(i - E_{peak}) / \sigma\sqrt{2}\}$

4. Exponential tail

$$D(i) = H_t H_g \times \exp\{(i - E_{peak}) / T_s \sigma\} \times \text{erfc}\{(i - E_{peak}) / \sigma\sqrt{2}\} + 1 / T_s \sqrt{(2)}$$

Fit to Calibration Spectra



Tools Needed for Response Generation

1. Functional form for energy dependence of best-fit pars
2. Create 2D matrix in energy and channel space
3. Create OGIP standard RMF file

In progress..