# Calibration Issues for X-ray Dust Halos

Randall Smith

# Introduction

Dust scattering creates diffuse X-ray halos of 1'-10' around moderately to heavily absorbed X-ray sources. Accurately measuring the radial profile and energy dependence of these halos is crucial to constraining models of large dust grains.

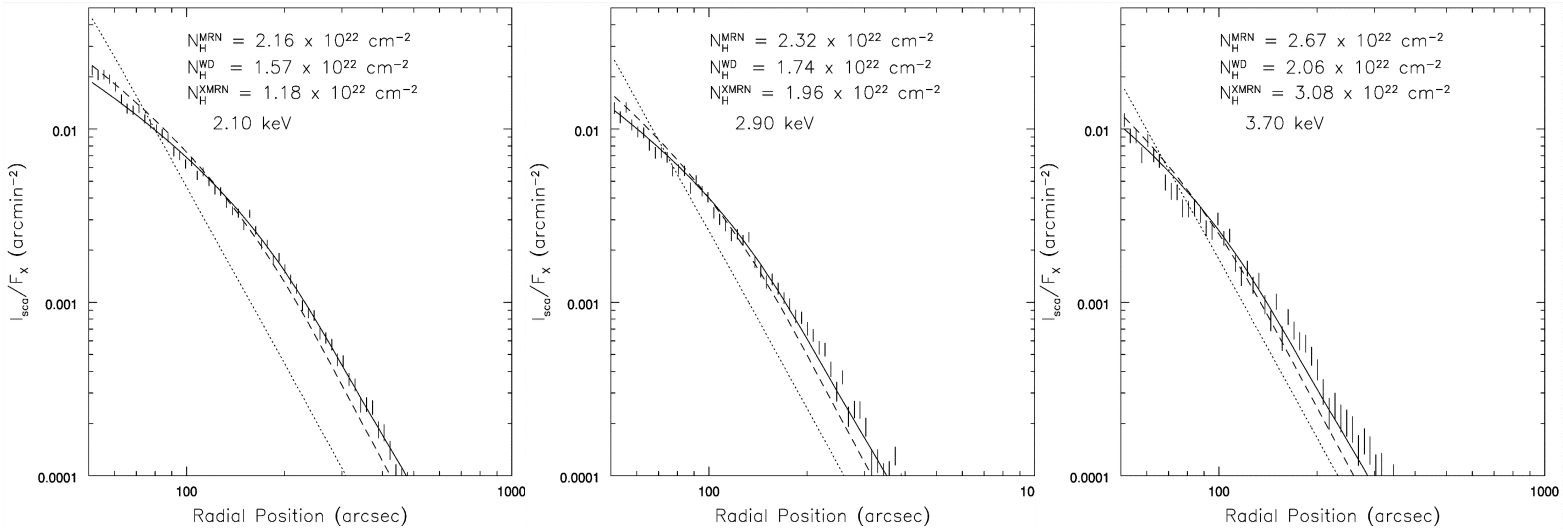
To do this one needs to:

(1) measure Chandra's PSF between 10"-1000" for both on- and off-axis pointing,

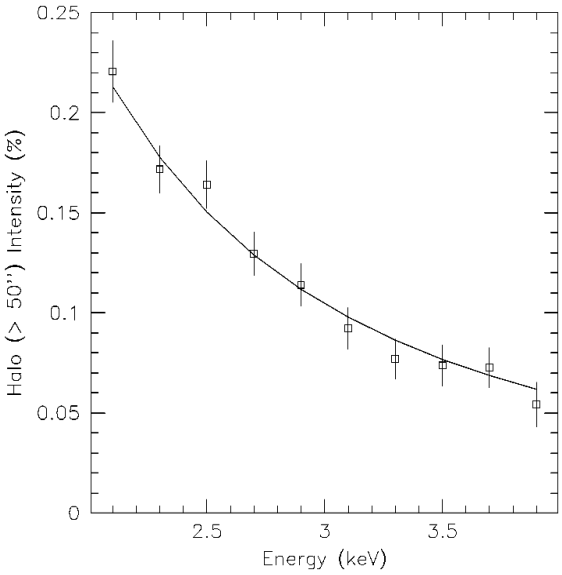
(2) determine the spectrum of highly piled-up sources

(3) use grade ratios to measure pileup.

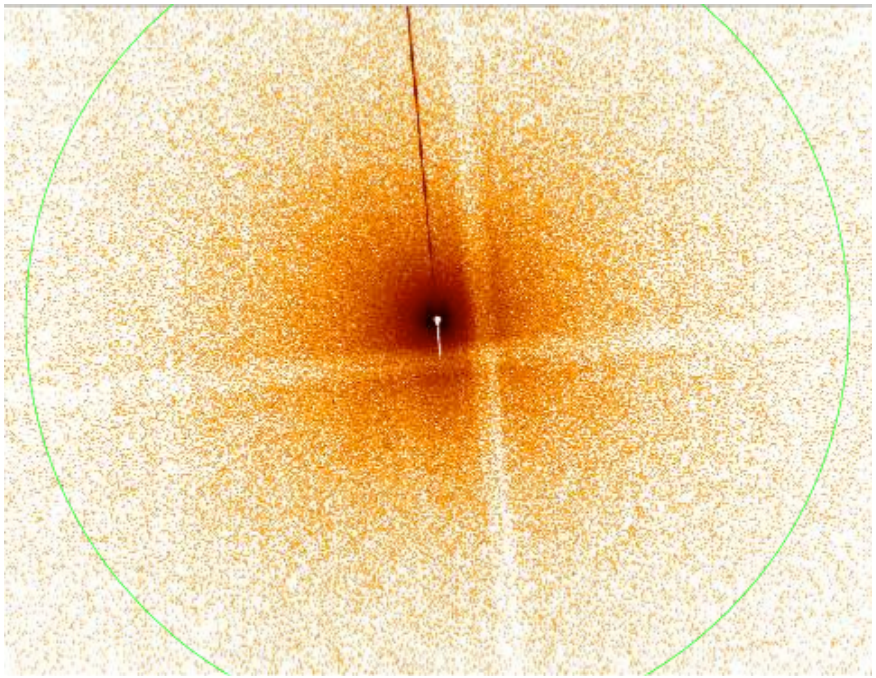
# Halo Results



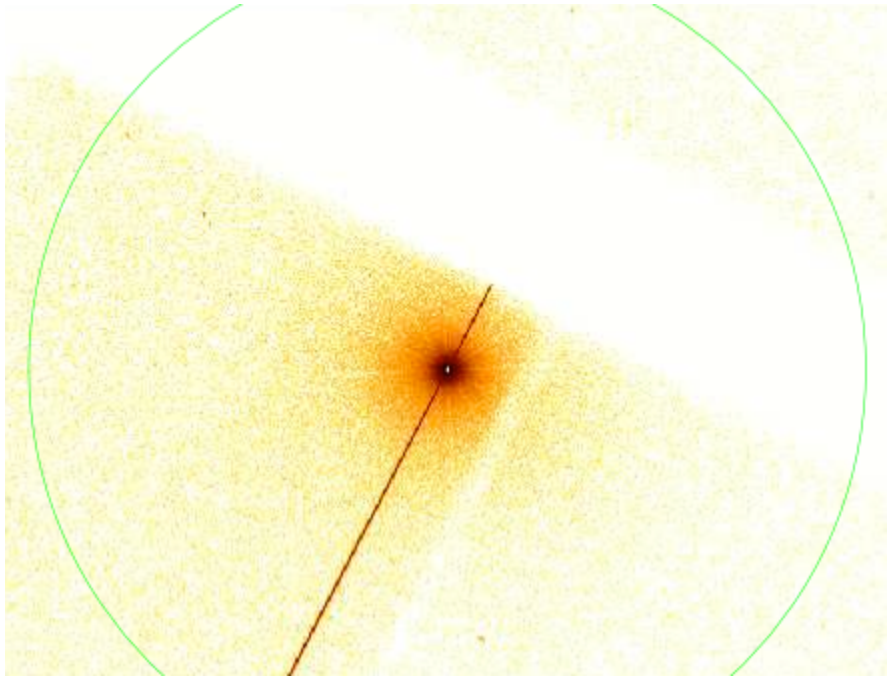

Radial profiles (with PSF subtracted) for GX13+1, plus the total halo intensity fit as a function of energy.



# Chandra PSF



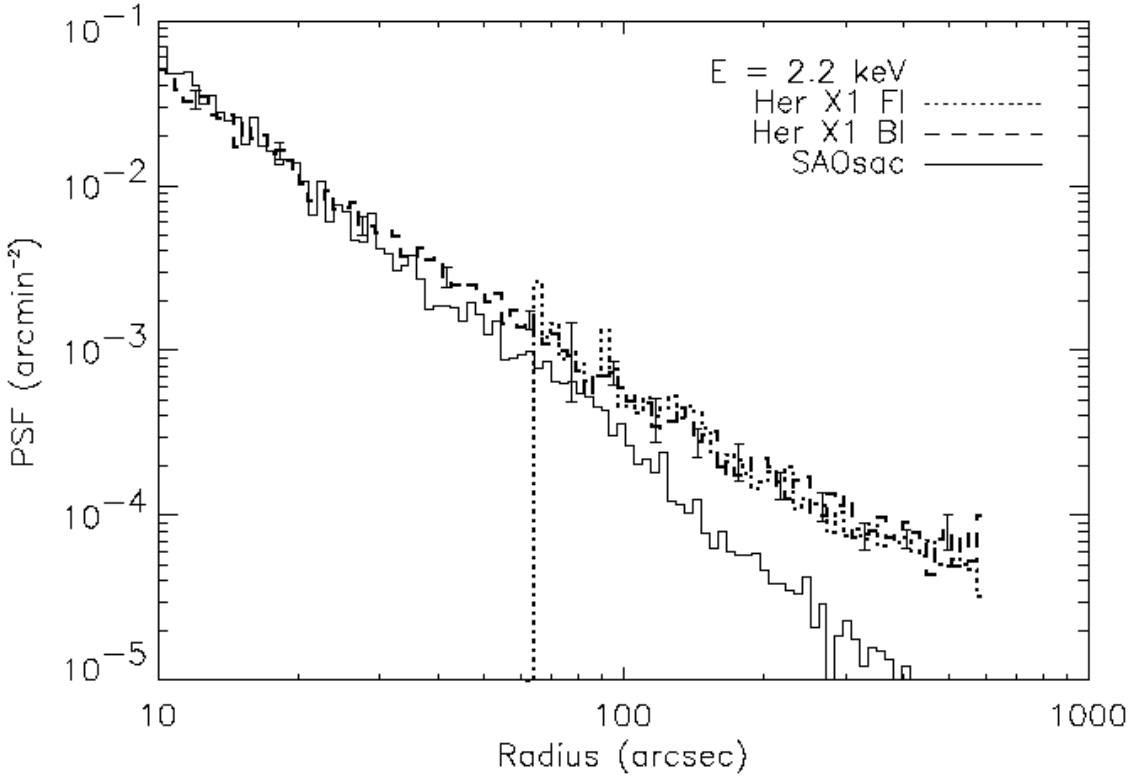
GX13+1



Her X-1

The green circle shows a 6’ radius circle about the source.

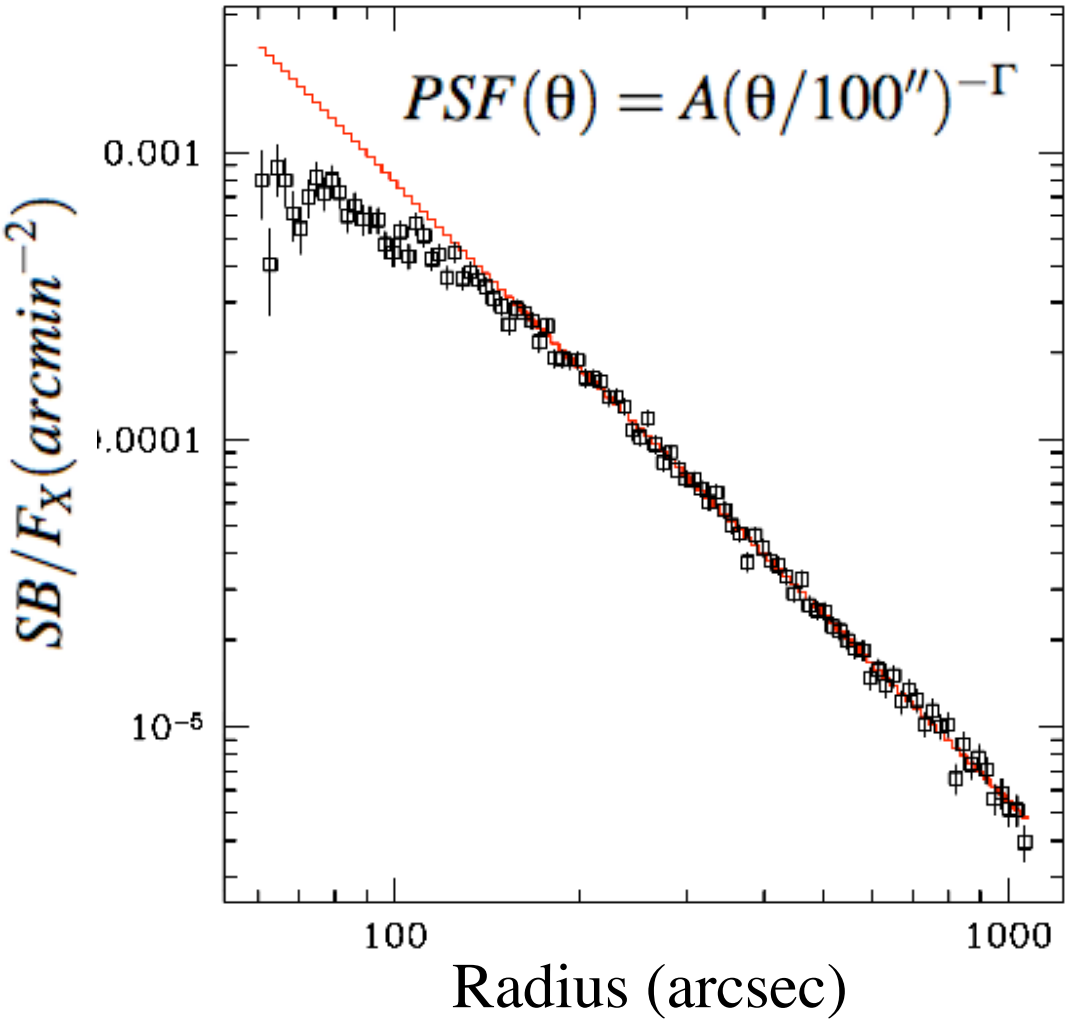
# Chandra PSF




The PSF ( = $SB_{PSF}(\theta,\mathbf{p},E)/S(E)$ ) for Chandra/ACIS for Her X-1 observed onaxis at 2.1-2.3 keV. Her X-1 is an HMXB with an absorbing column of $N_H \sim 10^{20}$ $cm^{-2}$. The lower curve shows the predicted PSF calculated using the Chandra raytrace code ***SAOsac***, which agrees well for $\theta$ < 20" but obviously is inadequate for halo studies. Using the ***SAOsac*** calculated PSF for halo studies leads to overstrong halos with unphysical tails.

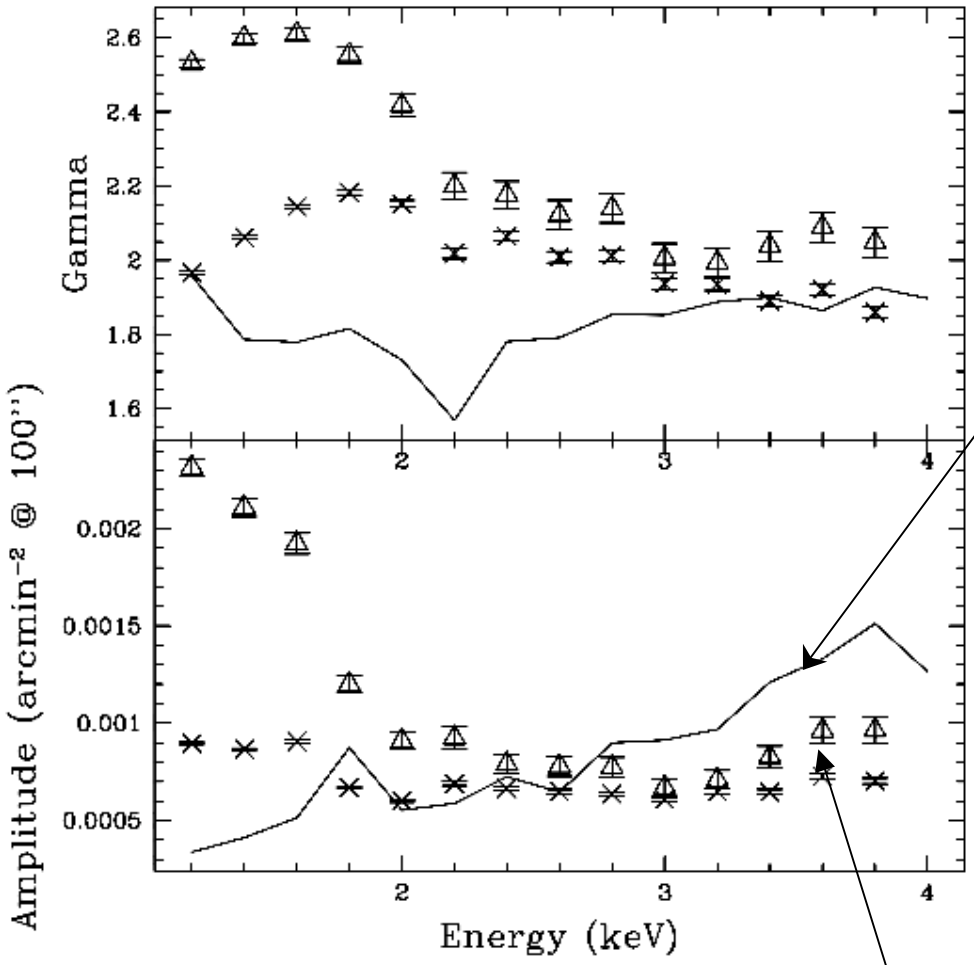
# Chandra PSF

Crab profile (2.2-2.4 keV)



# Chandra PSF

$$PSF(\theta) = A(\theta/100'')^{-\Gamma}$$

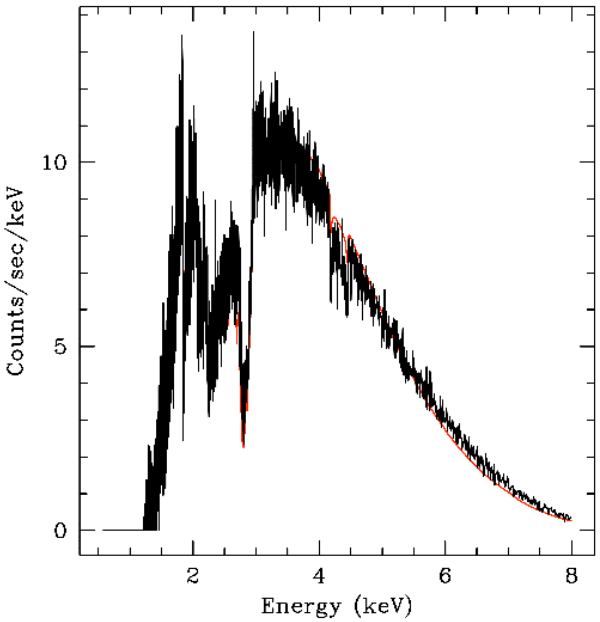



Her X-1
(on-axis)

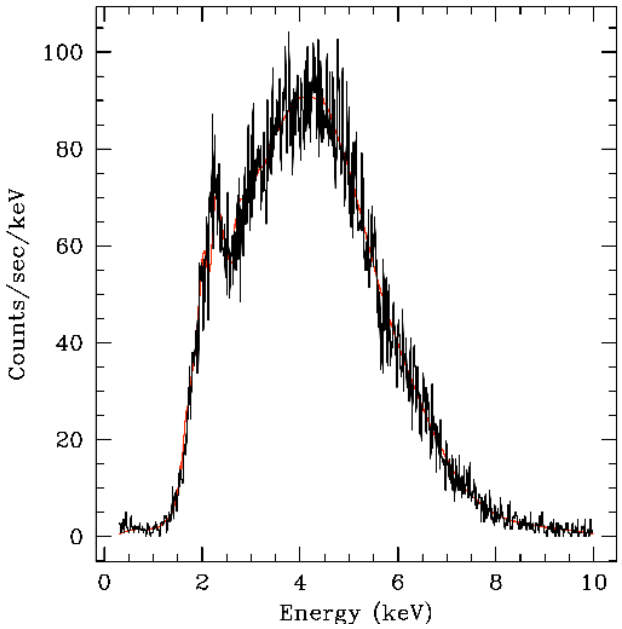
Crab (10' off-axis)

# Calculating Spectral Flux

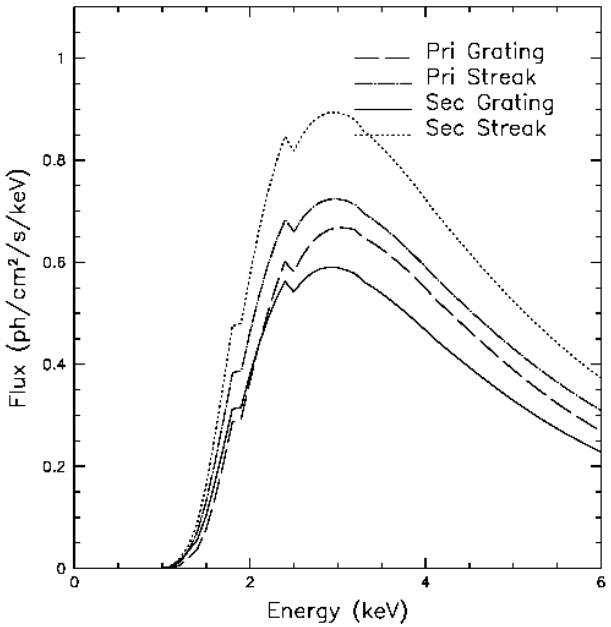
## GX5-1




HETG



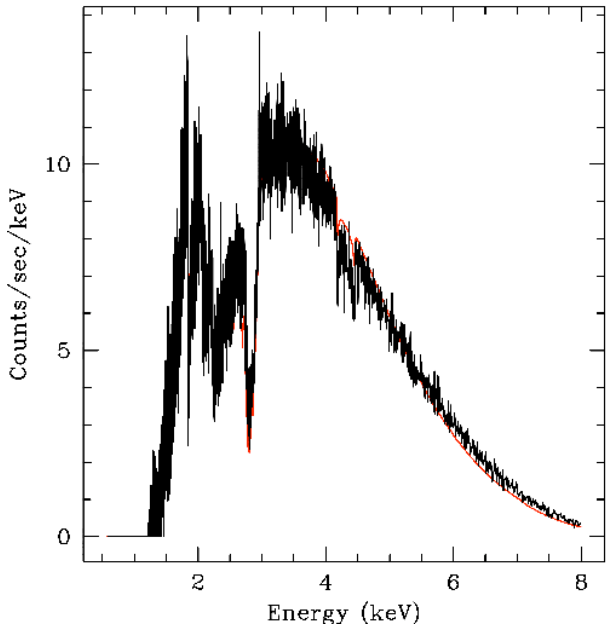

Streak



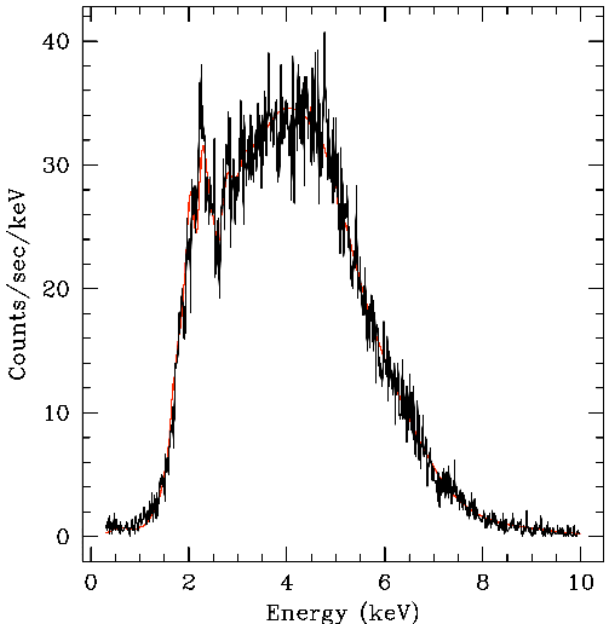

Flux

# Calculating Spectral Flux

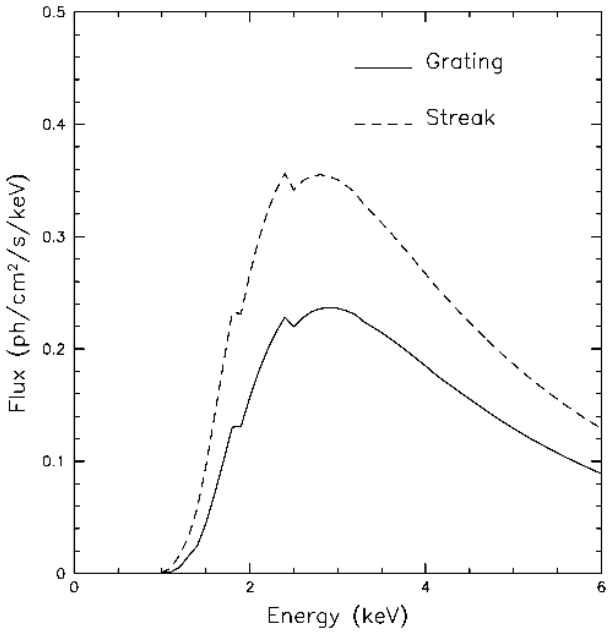
## GX13+1




HETG



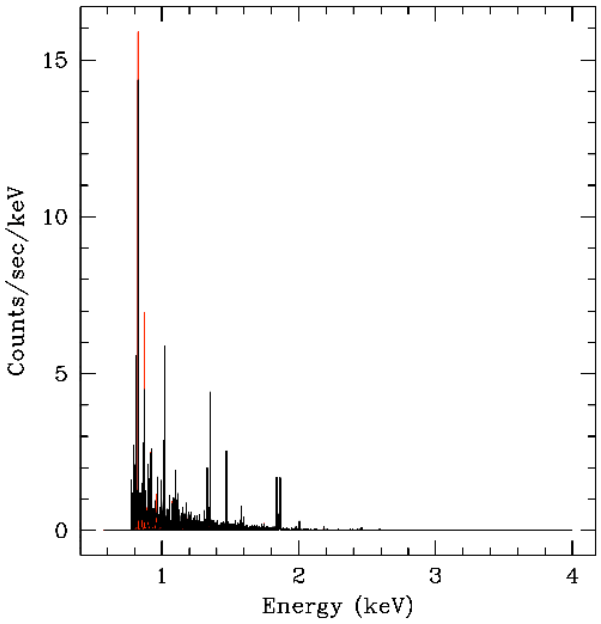

Streak



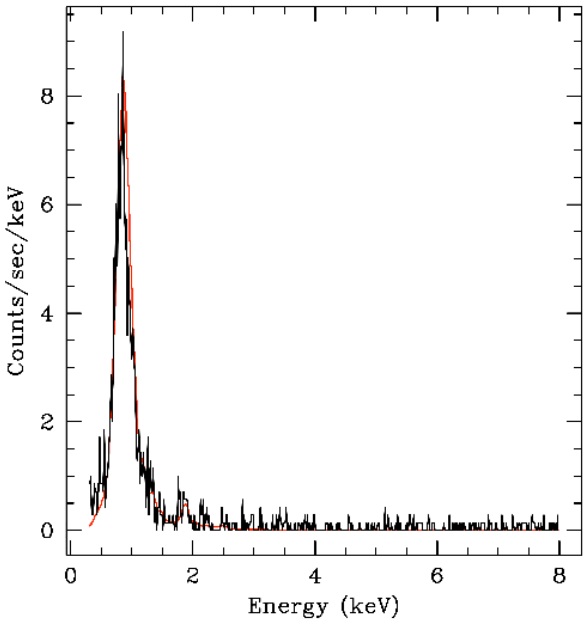

Flux

# Calculating Spectral Flux

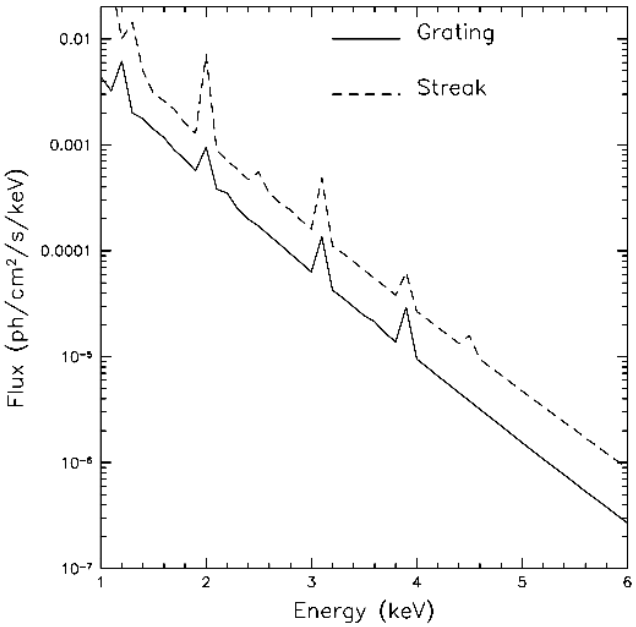
## Capella




HETG




Streak




Flux

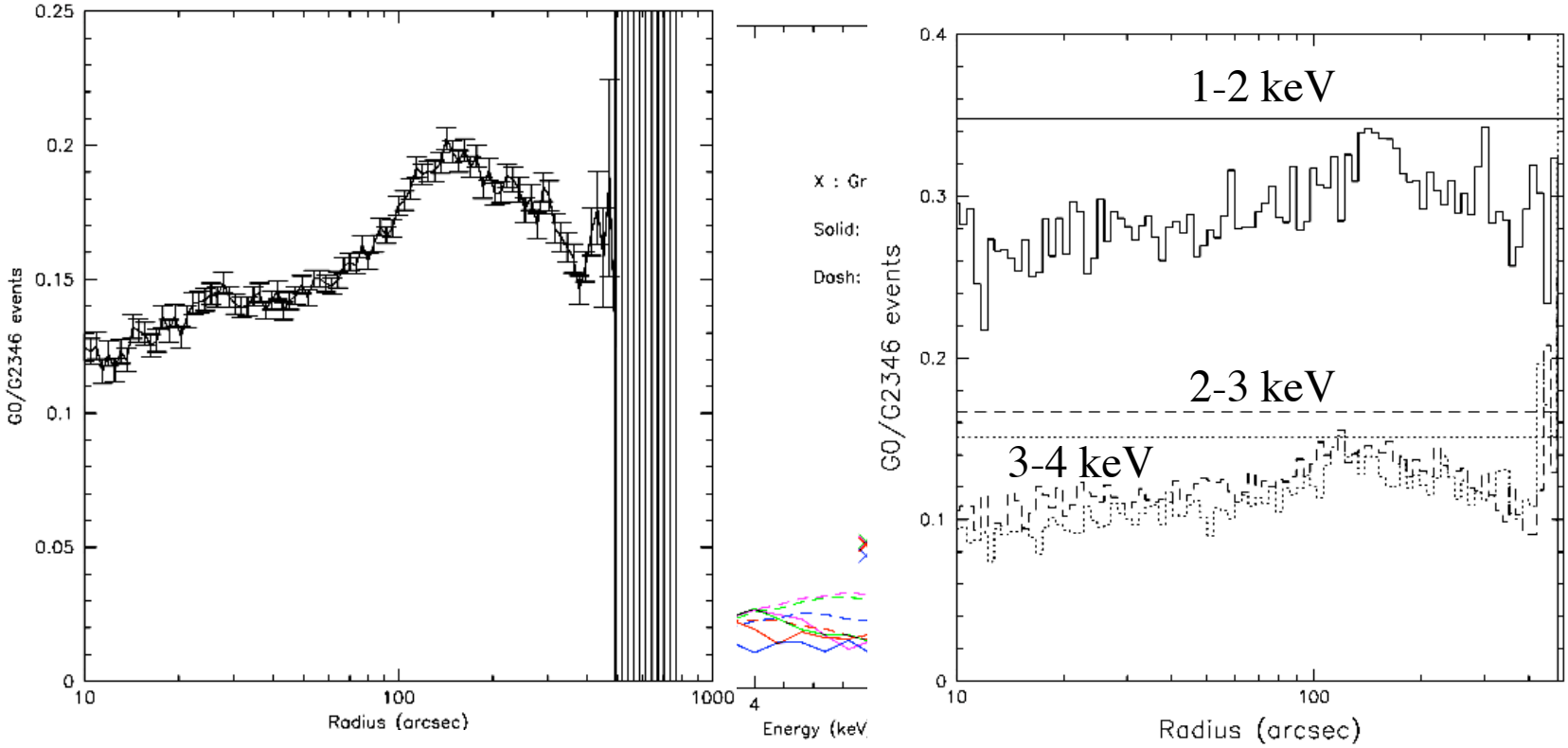
# Conclusions

PSF: The Her-X1 observation shows the PSF from 50-1000'' ; the Crab observation suggests it might not vary greatly even for far off-axis positions. A second (30 ksec) observation off-axis would likely confirm that the variation in the PSF is small.

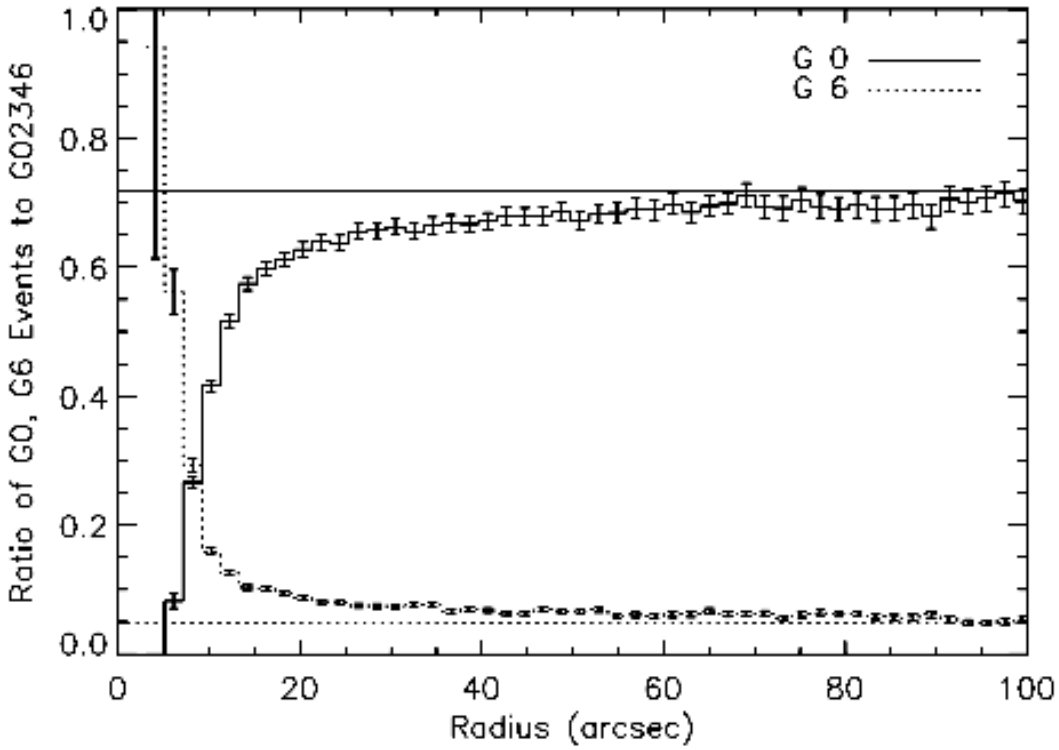
Spectrum: Extracting the flux from the transfer streak has never been formally calibrated. My results show that there could be 25-50% errors in the measured flux.

I would also like to mention that it would be useful to make more information about pileup detection (e.g., expected grade ratios as a function of CCD and energy) available.

# Detecting Pileup



# Detecting Pileup




GX13+1