

**MEMORANDUM**

Date: March 15, 2007  
 From: Nancy R. Adams-Wolk  
 To: ACIS Operations Team, MIT ACIS Team  
 Subject: ObsId 8224 Cygnus X-2 failure simulations  
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**Abstract**

There are four cycle 8 observations of Cygnus X-2 with the X-ray source on the S3 CCD. This memo summarizes the simulations completed to estimate damage from these observations.

**1 Introduction**

The Chandra proposal 08910231 consists of several observations with both the ACIS and HRC detectors to observe the halo around Cygnus X-2. The ACIS component of this proposal contains four observations, of 6 ks each, with Cyg X-2 on the S3 CCD. Figure 1 displays the setup for the first of the four observations.

To estimate the X-ray dose that ACIS-S would receive from Cyg X-2, I completed 4 simulations with `xspec` and MARX. Cyg X-2 is low mass X-ray binary which is known as a Z source. This Z is the shape on an X-ray color-color diagram as the source changes between different spectral states. (Piraino *et al.*, 2002). I modeled a low flux and a high flux state. For both states, I used an `xspec` model of `phabs*(diskbb+compTT)`. See the `xspec` manual for a detailed explanation of these models. I then followed the parameters in Piraino *et al.*, for both the low and high flux states.

Model Component	Parameter	Value	Unit
phabs	nH	0.220000	10e22
diskbb	Tin	1.10000	keV
diskbb	norm	1.00000	
compTT	Redshift	0.00000	
compTT	T0	1.30000	keV
compTT	kT	3.00000	keV
compTT	taup	8.10000	
compTT	approx	0.500000	
compTT	norm	2.25000	

Table 1: Cyg X-2 Low flux state model: `phabs*(diskbb+compTT)`

**2 The Simulations**

Originally, I planned for the low state of the source, but it was reported by the observer that the source was in a high flux state. Both states were then modeled.

I created the models in `xspec` and then converted the models for MARX use via `xspec2marx`. I used `MARX v3.0` for the simulations. For all simulations, the actual parameters for the observation were placed into MARX and dither was switched between on and off. All simulations were run for 6000s.

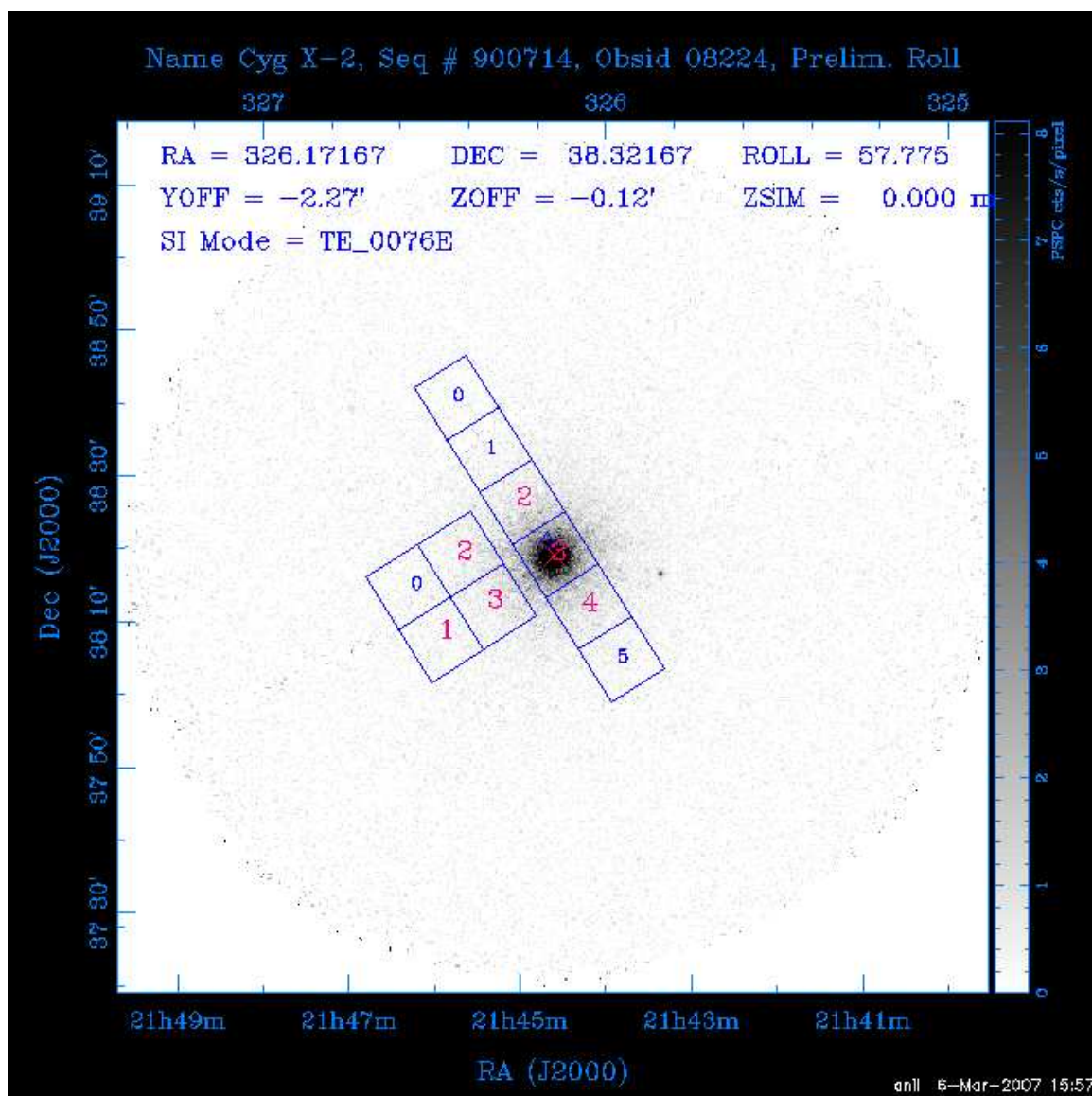


Figure 1: ObsId 8224-Over the ROSAT PSPC image. The pointing parameters and offsets are labeled on the plot.

Model Component	Parameter	Value	Unit
phabs	nH	0.170000	10e22
bbbody	kT	0.500000	keV
bbbody	norm	0.500000	
compTT	Redshift	0.00000	
compTT	T0	1.06500	keV
compTT	kT	2.75000	keV
compTT	taup	9.90000	
compTT	approx	0.500000	
compTT	norm	1.00000	

Table 2: Cyg X-2 High flux state model:phabs\*(diskbb+compTT)

### 3 Maximum Dose

Once the simulations were completed, I used *marx2fits* to create a fits image from the MARX data. The FITS files were copied to only include the aim point ccd (*dmcopy*), then converted to an image from the event list (*dmcopy*) and finally a statistical summary of the image was performed to find the maximum counts in a pixel (*dmstat*).

To determine the damage to ACIS, I used the total budgeted dose of radiation for the mission, the Mission Dose (MD). This is described in Butt's memo as 625 krad as the MD for BI CCDS with a 100:1 cts/pix:rad/pix ratio.

Simulation	Source Flux	Dither	Max Counts	Dose krad	%MD
1	Low	ON	14859	0.148	0.024%
2	Low	OFF	644638	6.446	1.03%
3	High	ON	38031	0.380	0.0608%
4	High	OFF	1620897	16.209	2.59%

Table 3: ObsId 7501 Simulation Results for the maximum counts in a pixel for the 6ks observation.

### 4 Summary

The observation 8224 is safe as planned. These observations are short and a real time communication is not expected to be requested during the observations. The command loads will need to be carefully examined to confirm that dither is enabled before and during these observations.

### 5 References

1. S. Virani, "MARX Simulations of the AO4 Crab Nebula/Saturn-Titan Conjunction Proposals", CXC Memo, 27, June 2002
2. Y. Butt, "Operational Limits for X-ray Photon Dose On ACIS", CXC Memo, 3 May 2002
3. Piraino, S., Santangelo, A. and Kaaret, P., "X-Ray Spectral and Timing Observations of Cygnus X-2", ApJ, 2002, v567, 1091.