

# Default Spectral Fit Parameters for the Chandra Source Catalog

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For the Chandra Source Catalog we need a default set of spectral fit parameters to be used for flux determinations in case where there are too few counts available to make a reliable spectral fit to the data. For the Chandra Source Catalog we need the following: (a) count threshold for spectral fitting; (b) the parameters for an absorbed power law fit; (c) the parameters for an absorbed Blackbody fit.

Using an XMM study (Saxton 2003) which used the XMM1 catalog the following conclusions were arrived at:

**Spectral Fitting Threshold:** An XMM comparison of the detect counts found in EPIC to the input counts used in simulations for these observations found a systematic bias in the number of counts observed below 250 counts (a larger number than expected). This is case of an **Eddington bias** (also referred to as **Malmquist bias**). Thus to avoid problems with this systematic effect it is recommended that a limiting value of at least 250 counts be used for the threshold for spectral fits.

**Power Law Fit:** This same XMM study performed fits to a large number of sources (all over 250 counts) with an absorbed power law. The resultant fit parameters were a spectral index of  $1.80 \pm 0.65$  and a 1 sigma range of the column density of  $N_h = 0.0 - 9.8 \times 10^{20} \text{ cm}^{-2}$ . These values are in keeping with the default values used for the 1XMM catalog of an index of 1.7 and a column density of  $N_h = 3.0 \times 10^{20} \text{ cm}^{-2}$ . Where the values represents the median values of indices and the column density in the study. It is recommend that these 1XMM values be used for as the default fit parameter (for sources below 250 counts) for the Chandra Source Catalog.

**Blackbody Fit:** The XMM studies did not consider a thermal fit to the sources. The source for which this fit will have the most relevance are galactic. Looking at galactic sources we find the following ranges:

- *Normal Stars:* Average of around 1 keV with a range 1-10 keV (Güdel 2004).
- *RS CVn Stars:* Average X-ray spectrum of 1.58 keV with a range of 0.83-4.6 keV (Pasquini, Schmitt, & Pallavicini 1989).
- *Cataclysmic Variables:* Have a soft component of 30-100 eV and a hard component of 1-50 keV (Cordova 1995).

- *X-Ray Binaries (Neutron Stars)*: Typical 1-2 keV disk blackbody spectra (Mitsuda, K. et al. 1984).
- *X-Ray Binaries (Black Holes)*: Typical 1-2 keV spectrum during high state (Miller, Fabian, & Miller 2004, Remillard & McClintock 2006).
- *Super Soft Sources*: A range of 10-200 eV (Kahabka 2006).

Based on these wide range of values for different sources a kT of 1.0 keV is recommended with a column density of  $N_h = 3.0 \times 10^{20} \text{ cm}^{-2}$  to be used as the default values for the Chandra Source Catalog.

To determine some of these parameters we relied on an XMM study (using the 1XMM catalog): [XMM-SOC-CAL-TN-0023](#) “A statistical evaluation of the EPIC flux calibration” (April 2003).

### **References:**

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