BHSPEC

BHSPEC is a spectral fitting model which has been implemented as a additive table model for the *Xspec* Spectral Fitting Package. It consists of a large grid of tabulated artificial spectra which are used to fit data via interpolation. Currently, the model is comprised of multiple files which cover different regions of parameter space. The models can be invoked in Xspec using the atable{*filename*} command.

Our method for generating the artificial spectra is described in detail in Davis et al. (2005, ApJ, 621, 372) and Davis & Hubeny (2006, ApJS, 164, 530). The spectra are based on fully relativistic accretion disk models similar to the KERRBB model already implemented in *Xspec*. The main difference between KERRBB and BHSPEC is the treatment of the emission at disk surface. KERRBB utilizes a color-corrected blackbody prescription with either isotropic emission or an analytic limb darkening profile. BHSPEC uses stellar atmospheres-like calculations of disk annuli to self-consistently calculate the vertical structure and radiative transfer. These annuli spectra are tabulated in the parameters of interest (equivalent to effective temperature, gravity and surface density) and used to reconstruct the spectra at any radius in the disk via interpolation.

The BHSPEC model is parameterized as follows:

par1 $\log M/M_\odot$, the mass of the black hole in units of solar masses. See fig. 1.

par2 $\log L/L_{\rm Edd}$, the luminosity of the accretion disk as a fraction of the Eddington luminosity for completely ionized H ($L_{\rm Edd} = 1.3 \times 10^{38}(M/M_\odot)$ erg/s). Here $L = \eta \dot{M} c^2$ where η is determined by the position of the last stable circular orbit in the Kerr spacetime. See fig. 2.

par3 $\cos i$, the cosine of the inclination of the accretion disk relative to the plane of the sky. See fig. 3

par4 a_*, the dimensionless spin of the black hole. See fig. 4.

par5 $\log \alpha$, the dimensionless variable in the Shakura & Sunyaev (1973) prescription for the midplane accretion stress $\tau_{r\phi} = \alpha P$, where P is the total pressure at the disk midplane. Currently the model is tabulated for only two values of α: 0.1 and 0.01. For files which include this parameter, we recommend keeping it fixed at $\log \alpha$=-1 or -2, the values for which the spectra were tabulated. (Note that some of the table files may not include α as a parameter, but instead assume a particular value of α.)

K the model normalization. K is related to the source distance D via K= $(10{\rm kpc}/D)^2$

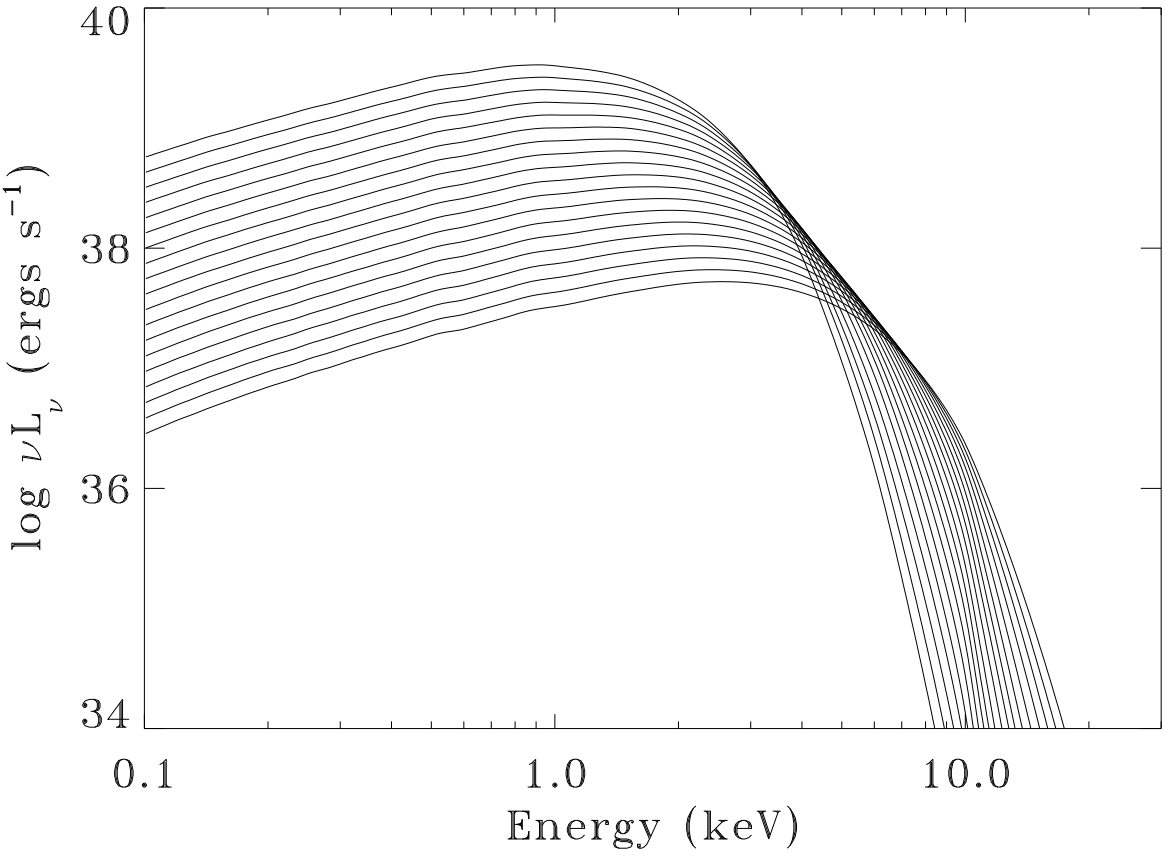

Figure 1: The variation in the BHSPEC model SED with mass for $\log L/L_{\rm Edd} = -0.5$, $a_* = 0$, $\cos i = 0.5$, and $\log \alpha = -2$. We plot $\log M/M_\odot$ from 0.477 ($3M_\odot$) to 2.477 ($300M_\odot$) in steps of 0.1. This corresponds to the range and resolution of the mass parameter tabulated in the table model.

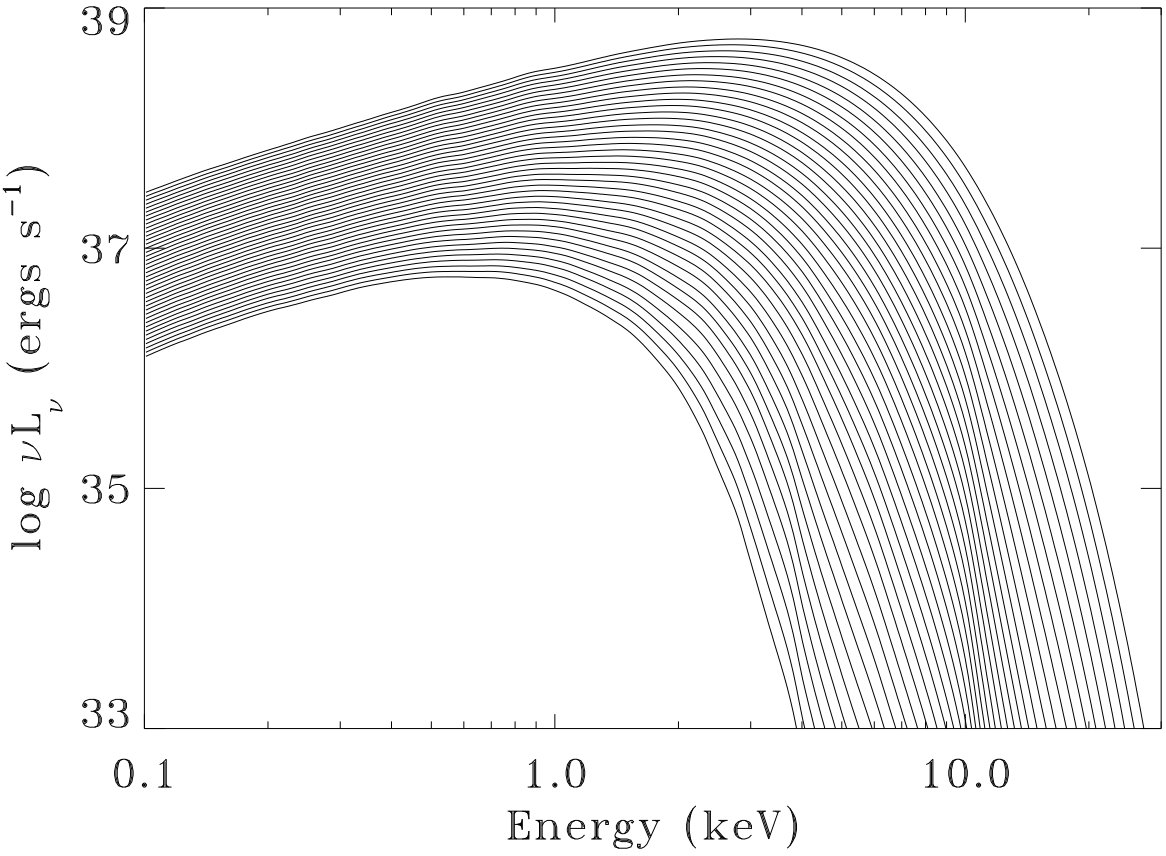

Figure 2: The variation in the BHSPEC model SED with luminosity for $\log M/M_\odot = 1$, $a_* = 0$, $\cos i = 0.5$, and $\log \alpha = -2$. We plot $\log L/L_{\rm Edd}$ from -2 to 0 in steps of 0.05. This corresponds to the range and resolution of the luminosity parameter tabulated in the table model.

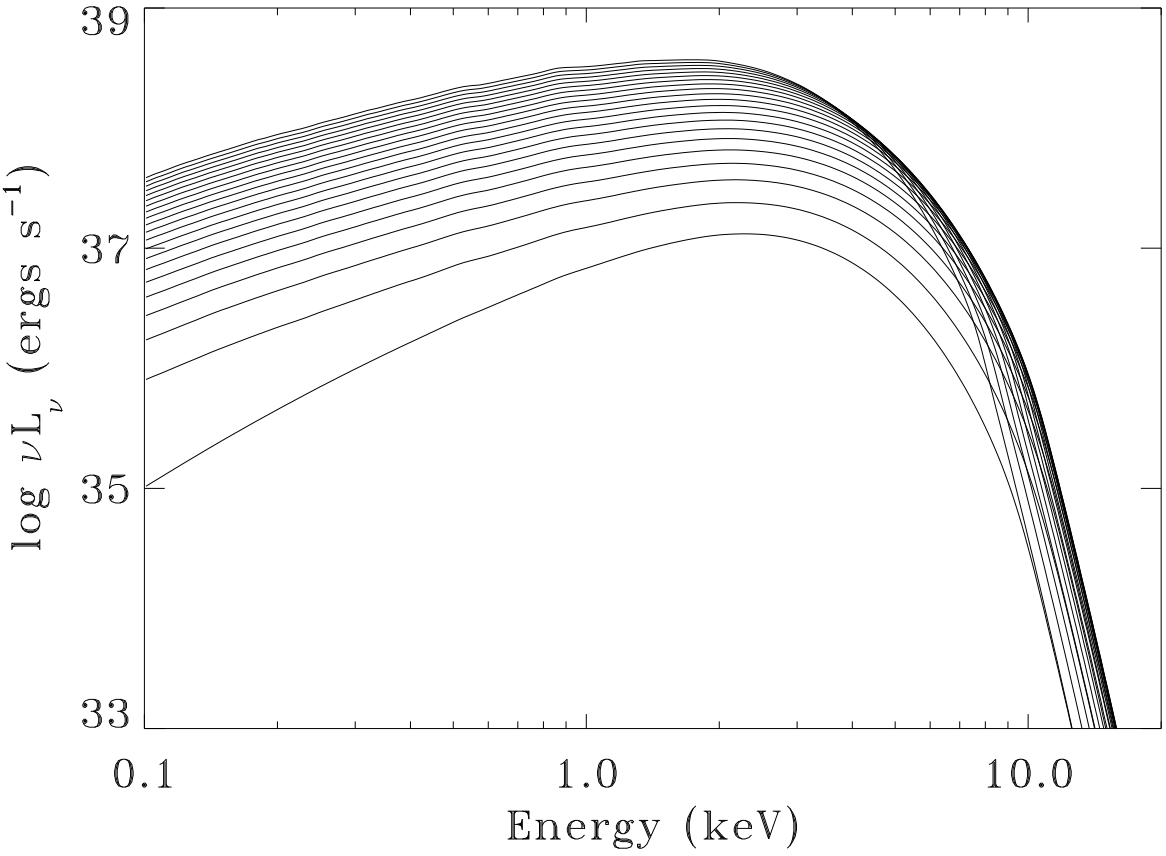

Figure 3: The variation in the BHSPEC model SED with inclination for $\log M/M_\odot = 1$, $\log L/L_{\rm Edd} = -0.5$, $a_* = 0$, and $\log \alpha = -2$. We plot $\cos i$ from 0 to 1 in steps of 0.05. This corresponds to the range and resolution of the inclination parameter tabulated in the table model.

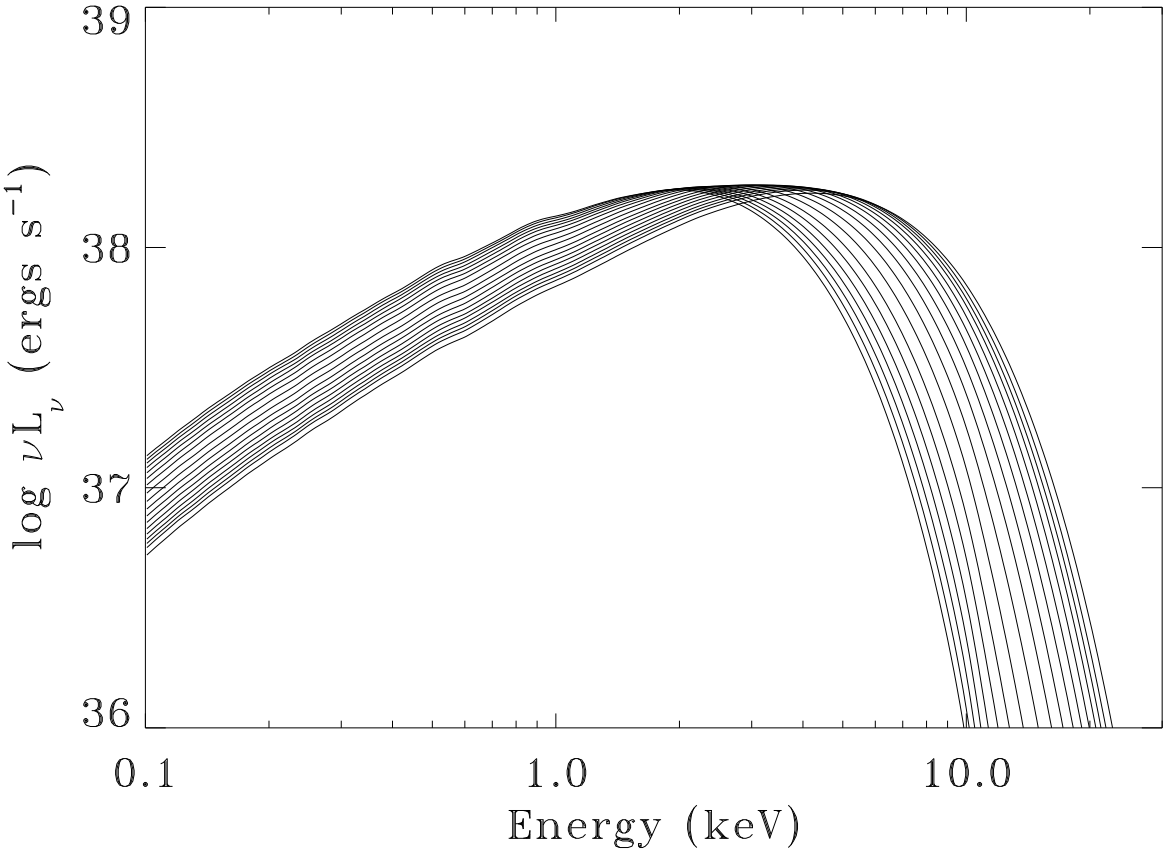

Figure 4: The variation in the BHSPEC model SED with spin for $\log M/M_\odot = 1$, $\log L/L_{\rm Edd} = -0.5$, $\cos i = 0.5$, and $\log \alpha = -2$. We plot $a_* = \{0,\ 0.1,\ 0.2,\ 0.3,\ 0.4,\ 0.5,\ 0.6,\ 0.7,\ 0.78,\ 0.838,\ 0.881,\ 0.913,\ 0.936,\ 0.953,\ 0.966,\ 0.975,\ 0.981,\ 0.99\}$. This corresponds to the range and resolution of the spin parameter tabulated in the table model.