THE X-RAY SPECTRUM AND VARIABILITY OF NGC 4151

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We report investigation of the iron Kα line in a long (100 ks) *ASCA* observation of NGC 4151. This observation offers unprecedented good statistics; however, the situation is complicated by the fact that the absorption in NGC 4151 is complex and therefore it is difficult to deconvolve a broad iron line from the power law strongly curved by the absorption. Preliminary spectral fitting with a dual absorber model, using updated abundances and response matrices, and also allowing for iron overabundance, revealed significant spectral residuals around 5 keV which could be modeled with a broad Gaussian. This profile resembles the line characteristic of emission from a relativistic accretion disk; however, that model fit the spectra poorly. Since the energy of the narrow core is nearly 6.4 keV, the orientation of the accretion disk should be nearly face-on, because if the inclination were higher, the blue horn should be shifted to higher energies. If the orientation is face-on, there should be no emission blueward of 6.4 keV; however, a small blue wing as well as a long red wing are present in the residuals.

Atomic physics requires that an iron Kβ line should be produced with about 13.5% of the Kα line flux at 7.06 keV. If we include an additional Gaussian to model the Kβ line with energy, width and flux scaled appropriately to the Kα line parameters, the model fit becomes as good as the broad+narrow line description with no change in number of free parameters. The disk line then models the red wing and, with $\sim$ 100 eV equivalent width, contributes only a small fraction of the total line emission.

The Kβ interpretation of the blue wing implicitly assumes that the narrow core of the line near 6.4 keV is intrinsically narrow and therefore arises

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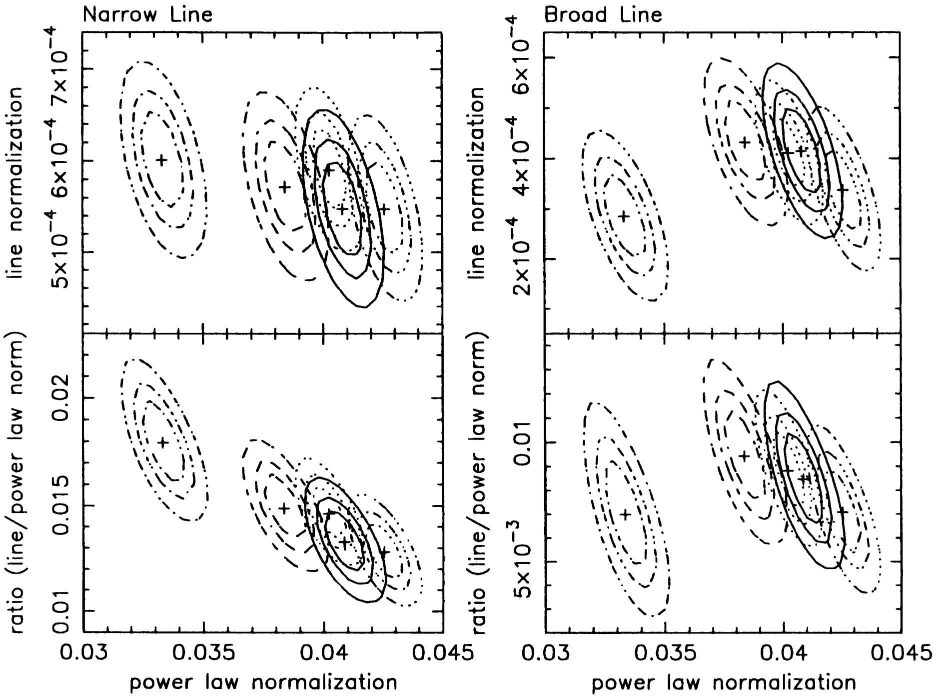

Figure 1. χ^2 contours from fits to five time-sliced spectra from the long *ASCA* observation of NGC 4151. The left and right sides show the results for the narrow Kα (including the Kβ line scaled to 13.5% of the flux of the Kα line), and broad disk line respectively. The upper and lower panels shows the line flux, and the ratio of the line to power law flux, respectively.

in regions where the velocity of the emitting material is relatively small, such as the broad-line emission clouds, the molecular torus, or the material responsible for the continuum absorption. Therefore, the line flux should vary less than the continuum flux on short time scales. During the observation, variability in total flux with amplitude about 40% was observed. The light curve was divided into 5 time slices corresponding roughly to the slow changes in flux observed. We fit the time-sliced spectra with the complex line model described above and found indeed that the flux of the narrow line component, composed of the Kα and Kβ lines, did not vary significantly. However, the ratio of the line flux to the power law flux did vary (Figure 1). Since the photon index was fixed to best fit value, this ratio approximates the equivalent width. Neither the flux nor the equivalent width of the broad component varied significantly. Detection of such variability was hampered because the equivalent width is low, and also because observed continuum spectral variability attributed to changes in the absorption column required us to allow the absorption columns to vary independently while fitting each time-sliced spectrum.