

# X-Ray Spectral Analyses of AGNs from the 7Ms Chandra Deep Field-South Survey The Distribution, Variability, and Evolutions of AGN Obscuration

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## Abstract

We present a detailed spectral analysis of the brightest active galactic nuclei (AGNs) identified in the 7Ms Chandra Deep Field-South (CDF-S) survey over a time span of 16 years. Using a model of an intrinsically absorbed power-law plus reflection, with possible soft excess and narrow Fe K $\alpha$  line, we perform a systematic X-ray spectral analysis, both on the total 7Ms exposure and in four different periods with lengths of 2–21 months. With this approach, we not only present the power-law slopes, column densities  $N_{\rm H}$ , observed fluxes, and absorption-corrected 2–10 keV luminosities LX for our sample of AGNs, but also identify significant spectral variabilities among them on timescales of years. We find that the  $N_{\rm H}$  variabilities can be ascribed to two different types of mechanisms, either flux-driven or flux-independent. We also find that the correlation between the narrow Fe line EW and  $N_{\rm H}$  can be well explained by the continuum suppression with increasing  $N_{\rm H}$ . Accounting for the sample incompleteness and bias, we measure the intrinsic distribution of  $N_{\rm H}$  for the CDF-S AGN population and present reselected subsamples that are complete with respect to  $N_{\rm H}$ . The  $N_{\rm H}$ -complete subsamples enable us to decouple the dependences of  $N_{\rm H}$  on LX and on redshift. Combining our data with those from C-COSMOS, we confirm the anticorrelation between the average  $N_{\rm H}$  and LX of AGN, and find a significant increase of the AGN-obscured fraction with redshift at any luminosity. The obscured fraction can be described as  $f_{\rm obscured} \approx 0.42 (1+z)^{0.60}$ .

## Keywords

catalogs, galaxies: active, galaxies: evolution, surveys, X-rays: galaxies.