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What Can We Learn about Compton-thin AGN Tori from Their X-Ray Spectra?[1]

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We have developed a Monte Carlo code for simulation of X-ray spectra of active galactic nuclei (AGN) based on a model of a clumpy obscuring torus. Using this code, we investigate the diagnostic power of X-ray spectroscopy of obscured AGN with respect to the physical properties and orientation of the torus, namely: the average column density, $\langle N_{\rm H}\rangle$, the line-of-sight column density, $N_{\rm H}$, the abundance of iron, $A_{\rm Fe}$, the clumpiness (i.e. the average number of gas clouds along the line of sight), $\langle N\rangle$, and the viewing angle, α. In this first paper of a series, we consider the Compton-thin case, where both $\langle N_{\rm H}\rangle$ and $N_{\rm H}$ do not exceed $10^{24}\,{\rm cm}^{-2}$. To enable quantitative comparison of the simulated spectra, we introduce five measurable spectral characteristics: the low-energy hardness ratio (ratio of the continuum fluxes in the 7–11 keV and 2–7 keV energy bands), the high-energy hardness ratio (ratio of the continuum fluxes in the 10–100 keV and 2–10 keV energy bands), the depth of the iron K absorption edge, the equivalent width of the Fe Kα line, and the fraction of the Fe Kα flux contained in the Compton shoulder. We demonstrate that by means of X-ray spectroscopy it is possible to tightly constrain $\langle N_{\rm H}\rangle$, $N_{\rm H}$ and $A_{\rm Fe}$ in the Compton-thin regime, while there is degeneracy between clumpiness and viewing direction.

Keywords: supermassive black holes — active galaxy nuclei — X-ray spectroscopy.

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