S12a Ionization structure of the warm absorber of NGC 5548

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Over half of all Seyfert 1 galaxies present evidence of a photoionized gas, warm absorber. The warm absorber is usually blue-shifted at velocities of an order of several hundreds km s^{-1}, indicating an outgoing material from the black hole, thus is important for understanding the AGN feedback as well as the physics of gas accretion.

We re-analyzed 340 ks Chandra LETG data of a Seyfert 1 galaxy NGC 5548 using the radiation transfer code with the latest atomic data (`CLOUDY` vc10; Ferland 2002) and the software package optimized for high-resolution X-ray spectroscopy (`SPEX` v2.04; Kaastra et al. 1996). Following the previous work (Steenbrugge et al. 2005), we fitted the spectrum with a power-law plus black body continuum with absorption models. We found that at least four distinct absorbers with different ionization degrees are required to explain the absorption features. We derived the ionization parameter ξ, the column density and outflowing velocity for each component.

Based on the latest atomic codes, we plotted the results on the temperature versus ξ for constant pressure $\Xi = L/(4\pi c r^2 P) \propto \xi/T$ (L and r are the luminosity of and the distance from the ionization source, P and T are the gas pressure and temperature at LTE). We found that all ionization components are in a stable branch against isobaric thermal perturbations. The lowest ionized component ($\log\xi = 1.14$) is not in a pressure equilibrium with the others. The other three high ionized components ($\log\xi = 1.99, 2.34, 3.07$) are close to be in the pressure equilibrium. Such a condition is similar to the one found in Mrk 509 (Kaastra et al. 2011). We discuss the ionization structure of the warm absorber of NGC 5548 in comparison to that of Mrk 509.