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A simple model to explain apparently complicated X-ray spectral variation of NGC5548

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NGC5548 is known to exhibit complicated X-ray spectral variations such that double partial covering layers may have different covering fractions and that one of the fractions correlates with the photon-index of the power-law component (Cappi et al. 2016). It is hard to understand such a correlation between the two parameters that should be physically independent.

Here, we propose a simple model to explain the apparently complicated X-ray spectral variation of NGC5548. In our model, the continuum spectrum from the central region is a cut-off power-law dominant above ~1 keV with a soft excess below ~1 keV (which may be expressed with the disk black body model). The X-ray emission region is fully covered by a highly ionized inner-wind and partially covered by an outer-clumpy absorbing layer, where each clumpy absorber is composed of the cold-core and a warm-layer; thus the "double partial covering" takes place with the same covering fraction.
In addition, we assume a cold outer-disk reflection component accompanying a narrow Fe emission line, and a thermal plasma component from the host galaxy; these components are not affected by the local absorbers.

We conducted extensive spectral study of NGC 5548 using XMM, Suzaku and NuSTAR in 0.3-78 keV in timescales from ~1000 sec to ~16 years. As a result, we found that most of the observed spectral variation over these timescales is explained by only variations of (1) the soft excess spectral component, (2) power-law normalization, and (3) partial covering fraction of the clumpy absorbers. The soft excess component is significantly variable over timescale of years, but rather stable in shorter timescales.
While the power-law normalization is moderately variable by a factor of ~3 in various timescales, the partial covering fraction is significantly variable from 0 (not covered at all) to ~0.98 (almost fully covered). The power-law photon-index, as well as other spectral parameters are hardly variable despite of apparently significant spectral variations.

Our model is consistent with the previous studies, where "Variable Double Partial Covering model"(Iso et al. 2016), explains spectral variations of 20 Seyfert galaxies observed by Suzaku in 2-70 keV, and the "hot-inner and outer-clumpy wind model"(Mizumoto et al. 2019) explains the Fe-K line lags commonly observed in Seyfert galaxies such as 1H0707-495 and Ark 564.
In addition, our model successfully explains wide-band spectral variations of MCG-6-30-15, NGC4593, NGC1365, Swift J2127.4+5654 and MCG-5-23-16 simultaneously observed by XMM-NuSTAR (Ebisawa et al. in this conference).

Topic

Active Galactic Nuclei: accretion physics and evolution across cosmic time

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