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# Signature of a Seyfert-like Component in Blazar 3C 273 and Its Reflection-based Explanation

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## Abstract

We present the results of blazar 3C 273 from simultaneous observations obtained using the XMM-Newton and NuSTAR satellites during the period 2015–2019 in five epochs. When the spectra are modeled with a power law, significant residuals arise below ∼2 keV and in the energy range of 30–78 keV in NuSTAR data. Residuals in the lower energy band represent soft X-ray excess, while at higher energies it likely represents a Compton reflection hump, which might be a weak component arising from dense and cold material. A faint iron line is present in XMM-Newton observations. We interpret such features as being attributed to the coronal emission plus those produced through reflection from an accretion disk. We model the spectral energy distributions (SEDs) with the single-zone inverse Compton (IC) jet model based on synchrotron self-Compton and external Compton phenomena. It is found that a one-zone synchrotron+IC model explains the SEDs quite well, but the jet component alone fails to fit the multiband X-ray emission for the low flux state of this object in 2018 and 2019, which arises owing to spectral flattening at low-energy X-rays, indicating that an additional Seyfert-like thermal component must be present at X-rays. This is further supported by a big blue bump present in the optical/UV band in all SEDs. Finally, we analyzed all the epochs using the relxill model to incorporate relativistic reflection and to model those residuals of soft excess and Compton hump in the X-ray bands.

*Unified Astronomy Thesaurus concepts:* Active galaxies (17); X-ray active galactic nuclei (2035)

## 1. Introduction

3C 273 is the nearest high-luminosity quasar, with a redshift of $z = 0.158$, and is classified as radio-loud. It is categorized as a flat-spectrum radio quasar and exhibits many characteristics typical of blazars, including variability in flux across all wavelengths, from radio to gamma-ray energies, as well as variable polarization from the radio to the X-ray spectrum (i.e., T. J.-L. Courvoisier 1998; S. Soldi et al. 2008). The quasar features a relativistic jet that demonstrates superluminal motion (S. G. Jorstad et al. 2001, 2005). The emissions detected from radio to optical wavelengths are attributed to synchrotron radiation produced by the jet (A. A. Abdo et al. 2010). Additionally, the presence of a prominent feature known as the big blue bump (BBB) in the optical/UV spectrum can be accounted for by two independently varying components; the more rapidly varying component is believed to arise from the reprocessing of photons in an accretion disk, while the slowly varying component may be associated with jet emissions (S. Paltani et al. 1998).

In the low-energy X-ray band (<2 keV), this source exhibits a soft X-ray excess (SE; P. Pietrini & G. Torricelli-Ciamponi 2008). This phenomenon may be attributed to the blue tail of the multicolor blackbody components or due to the Comptonization of UV photons (K. L. Page et al. 2004). Alternatively, it could arise from significant smearing of reflected emissions arising from the accretion disk very close to the supermassive black hole (SMBH; J. Crummy et al. 2006). The Comptonization process is favored owing to the observed correlated variations between SE and optical/UV emissions (R. Walter & T. J.-L. Courvoisier 1992; K. L. Page et al. 2004); however, later M. Chernyakova et al. (2007) could not find any substantial correlation between these bands. Using simultaneous observations conducted with XMM-Newton, N. Kalita et al. (2017) discovered a strong correlation between UV and X-ray emissions during the low state of 3C 273. In contrast, during the flaring state, the relationship between optical/UV and X-ray emissions exhibits different behavior.

In previous studies, a faint Fe K$\alpha$ line has been detected around 6.4 keV in the X-ray spectrum of this source (M. J. L. Turner et al. 1990; J. Kataoka et al. 2002; P. Grandi & G. G. C. Palumbo 2004; K. K. Madsen et al. 2015; N. Kalita et al. 2017). Based on these characteristics, it has been inferred that the emission of this blazar in X-ray bands results from a mixture of thermal processes (specifically, the component originating from the inner accretion disk/corona or possibly accompanied by disk reflection) and nonthermal processes are associated with the jet emission.

Previous X-ray observations of this source between 2 and 10 keV were well fitted with a power law having a spectral index of ∼1.5 (M. J. L. Turner et al. 1985; M. Chernyakova et al. 2007). NuSTAR observations of K. K. Madsen et al. (2015)