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RESEARCH

Long-term X-ray variability of the NLS1 Ark 564

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Abstract

We present a systematic spectral study of the X-ray emission from the Narrow-Line Seyfert 1 (NLS1) galaxy Ark 564 using *Swift*/XRT observations spanning sixteen years. The source exhibits significant variability in both the soft and hard X-ray bands, along with a strong positive correlation between them, indicating a closely coupled emission mechanism within the accretion flow-corona system. A simple absorbed power-law model is statistically insufficient to describe the spectra, confirming the presence of an additional soft component. To investigate the origin of the soft excess, we performed multi-model spectral fitting. Incorporating a warm Comptonization component yields a statistically improved fit, supporting the scenario in which the soft excess arises from Comptonization in a warm, optically thick corona. We also applied a relativistic reflection model to representative observations; however, given the moderate spectral resolution and limited high-energy coverage of *Swift*/XRT, the current data do not allow us to robustly determine whether reflection provides a superior or physically preferred description. Our results indicate that warm Comptonization offers a consistent explanation for the observed soft excess in Ark 564 within the limitations of the available data, while deeper broadband observations are required to definitively distinguish between competing models and comprehensively characterise the long-term X-ray spectral variability of the source.

Keywords Active galaxies · Ark 564 · NLS1 galaxies · X-rays

1 Introduction

An Active Galactic Nucleus (AGN) is a very bright and compact region found at the centre of a galaxy, often emitting more light than all the stars in the galaxy combined (Antonucci 1993; Netzer 2015). AGN derive their energy from accretion onto a central supermassive black hole (SMBH) (Shakura and Sunyaev 1973; Peterson 1997), wherein the accretion disk emits thermal optical/UV photons that are subsequently Compton up-scattered to X-ray energies by hot electrons in a corona located close to the SMBH (Haardt and Maraschi 1993; Turner et al. 2001).

Seyfert galaxies are a class of active galaxies whose host systems typically exhibit spiral morphology (Osterbrock and Ferland 2006; Peterson 1997; Khachikian and Weedman 1974). They are known for pronounced X-ray variability

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