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XMM-Newton observations of the ultraluminous X-ray source NGC 1313 X-1: a super-Eddington accreting black hole

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Abstract

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Ultraluminous X-ray sources (ULXs) are non-nuclear, extra-galactic X-ray point sources with X-ray luminosity ($L_{\rm X}$) in excess of the Eddington limit for a 10 $M_{\odot}$ black hole ($L_{\rm X} > 10^{39}$ erg s^{-1}). It is thought that the majority of ULXs are accreting black holes. However, due to their extreme brightness, the mass of black holes powering ULXs is still the topic of active debate. In this work, we study the high quality X-ray spectra of the nearby ULX NGC 1313 X-1 using the observational data from *XMM-Newton* observatory. A range of physical models is used to model the ULX spectra and to interpret the results physically. The modeling results indicate that the spectra consist of two components. We argue that the spectra could be explained well using a super-Eddington accretion model in which a stellar-remnant black hole is accreting material above the Eddington rate. Indeed, the high energy component of the spectra could be explained well using the super-Eddington slim accretion disc model. Moreover, assuming that the low energy spectral component is the X-ray emission from the putative outflowing wind, the wind radius could be calculated. Alternatively, using the model of accretion disc around Kerr black hole to fit with the high energy component, the mass of black hole powering the ULX could be constrained to $\sim$10 $M_{\odot}$, supporting that the ULX is powering by the stellar-remnant black hole. Finally, we demonstrate that the ULX spectral variability could be explained successfully in the context of the super-Eddington accretion model.

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