

Does black-hole growth depend on the cosmic environment?

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Abstract

It is well known that environment affects galaxy evolution, which is broadly related to supermassive black hole (SMBH) growth. We investigate whether SMBH evolution also depends on host-galaxy local (sub-Mpc) and global ($\approx 1\text{--}10$ Mpc) environment. We construct the surface-density field (local environment) and cosmic web (global environment) in the Cosmic Evolution Survey (COSMOS) field at $z = 0.3\text{--}3.0$. The environments in COSMOS range from the field to clusters ($M_{\text{halo}} \lesssim 10^{14} M_{\odot}$), covering the environments where ≈ 99 per cent of galaxies in the Universe reside. We measure sample-averaged SMBH accretion rate ($\text{BHAR}^{\text{---}}$) from X-ray observations, and study its dependence on overdensity and cosmic-web environment at different redshifts while controlling for galaxy stellar mass (M_{\star}). Our results show that $\text{BHAR}^{\text{---}}$ does not significantly depend on overdensity or cosmic-web environment once M_{\star} is controlled, indicating that environment-related physical mechanisms (e.g. tidal interaction and ram-pressure stripping) might not significantly affect SMBH growth. We find that $\text{BHAR}^{\text{---}}$ is strongly related to host-galaxy M_{\star} , regardless of environment.

Keywords

Galaxies: active, Galaxies: evolution, Galaxies: nuclei, Large-scale structure of Universe, X-rays: galaxies