The link among X-ray spectral properties, AGN structure and the host galaxy

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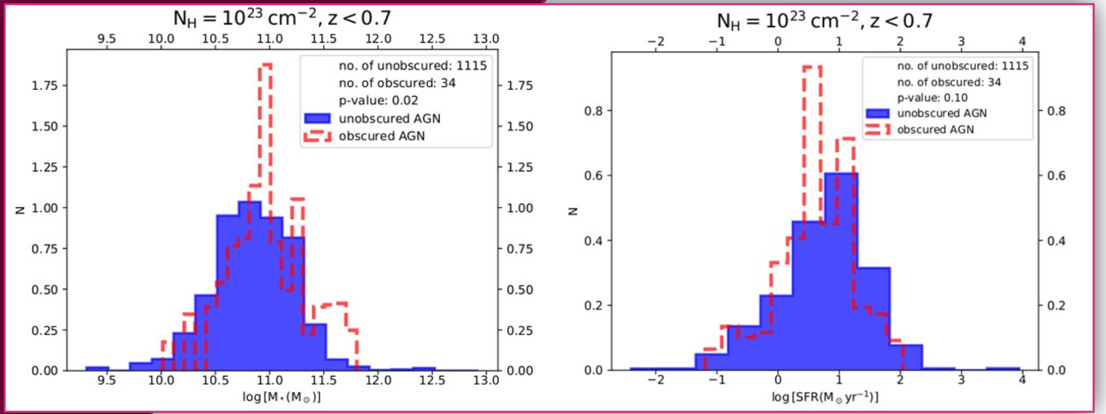

Host galaxy properties (star-formation rate, SFR, stellar mass, M*) of X-ray obscured (red, dashed line histograms) and unobscured AGN (blue shaded histograms). Sources are classified as obscured, when the lower limit of their N_H value is higher than $10^{23}\ cm^{-2}$. We classify AGN as unobscured if the upper limit of their N_H value is below $10^{23}\ cm^{-2}$.

One of the most important questions in Astrophysics revolves around how galaxies form and evolve across cosmic time. In the last two decades, our observations have shown that at the heart of most, if not all, galaxies reside supermassive black holes (SMBHs). These black holes are incredible massive, ranging from hundreds of thousands to billions of times the mass of the Sun. The SMBHs growth through accretion of material that originates either from the host galaxy or the extragalactic environment. When this happens the SMBH becomes active and the galaxy is called an active galactic nuclei (AGN). Recent studies have established a compelling link between the growth of these SMBHs and the evolution of the galaxies they inhabit. Therefore, to truly comprehend how galaxies evolve, it becomes crucial to unveil the true nature and characteristics of these SMBHs.

One important aspect of this pursuit it to decipher why some galaxies have their SMBHs obscured from view while others do not. There are two primary models that seek to explain these distinct manifestations of AGN. According to the unification model, AGN are encircled by a dusty gas torus structure that acts as a shield and absorbs radiation emitted from the SMBH and its surrounding accretion disc. This absorbed radiation is then re-emitted at longer (infrared) wavelengths. In the context of this model, an AGN is classified as obscured or unobscured, depending on the inclination of the line of sight with respect to the symmetry axis of the accretion disk and torus. When the AGN is observed edge-on the source is characterised as obscured, while it is classified as unobscured when the AGN is viewed face-on.

An alternative interpretation of the AGN obscuration arises from the class of the evolutionary models. These models propose that different AGN types result from observing SMBHs and their host galaxies at various developmental phases. The main idea of these models is that obscured AGN are observed at an early stage, when the energy output from the accretion disk around the SMBH is relatively weak and incapable of expelling the gas that surrounds it. As material accumulates onto the SMBH over time, its energetic output becomes more powerful and eventually pushes away the obscuring material, revealing an unobscured AGN.

A popular method to study the two AGN populations and shed light on the many different aspects of the AGN-galaxy interplay is to compare the properties of galaxies that host the two types of AGN. In the context of the XMM2ATHENA project, we conducted an analysis involving about 35,000 AGN detected across various wavelengths of the electromagnetic spectrum, spanning from X-rays to optical and infrared. Our goal was to compare the rate at which galaxies hosting the two AGN populations form stars (star-formation rate, SFR) and the total mass of their stellar populations (M*). Our results revealed significant trends. Galaxies that host obscured SMBHs, tend to be more massive than their unobscured counterparts. They also form stars at a lower rate in comparison to galaxies that host unobscured AGN. The Figure presents the distributions of the two host galaxy properties for the different AGN classes. The existence of these significant differences provide support for the evolutionary theory of obscured AGN.

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