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Dissecting AGN Spectral Energy Distributions: Obscuration and Host Contribution

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Abstract. The X-ray-infrared spectral energy distributions (SEDs) of a sample of X-ray selected AGN at z=0.2–3 are modeled with a nuclear and host component in order to determine the importance of host type, nuclear obscuration, and AGN intrinsic SED in sources of different type and luminosity. Overall, there is a good correspondence between optical obscuration and X-ray absorption. The AGN is X-ray absorbed in type 2 AGN and unabsorbed in type 1 AGN, as expected. We find two types of intrinsic AGN SEDs with different X-ray/mid-infrared luminosity ratios independently of the AGN luminosity and obscuration.

1. Goal, sample and SED types

AGN SEDs are determined by the AGN luminosity, the amount of obscuration affecting the nuclear region, and the type and luminosity of the host galaxy. Here, we investigate whether also the intrinsic AGN SED can vary and play a role in dictating the AGN type, and whether its shape is related to the AGN luminosity and obscuration. For this study, we selected a sample of AGN detected in the hard X-ray band in the XMM-*Newton* Deep Medium survey (XMDS; Chiappetti et al. 2005), and in the *Chandra*/SWIRE survey (Polletta et al. 2006). The sample contains 348 AGN with multi-wavelength data from infrared to X-rays. Spectroscopic redshifts are available for 46% of the sample, and photometric redshifts for the rest (Polletta et al. 2007). Each AGN optical-IR SED is classified on the basis of its best-fit template in one of the following four types: AGN1 (corresponding to type 1 AGN templates), AGN2 (corresponding to templates of obscured luminous AGN), Sey1.8 (corresponding to the median template of intermediate Seyfert galaxies), and SFG (corresponding to galaxy templates, from early spirals to starburst galaxies). On average, the AGN1 and Sey1.8 types exhibit soft X-ray spectra, implying little or no absorption, while AGN2, and SFGs show hard X-ray spectra, indicating absorption (see Fig. 3).

2. AGN intrinsic SED

In Fig. 3, we show the median SEDs of each type divided in two luminosity groups, one with $<L_{2-10\,keV}> = 10^{43.9}$ ergs s^{-1} (low-L_X), and another with $<L_{2-10\,keV}> = 10^{44.4}$ ergs s^{-1} (high-L_X). For each median SED we estimate the host galaxy contribution assuming a spiral (Sc) template and requiring that the SEDs resulting from the difference between total and host luminosities satisfies $L_\nu(3\,\mu m)/L_\nu(1.6\,\mu m) = 2.8$ (equivalent to $L_\nu \propto \lambda^{1.65}$). This luminosity ratio roughly corresponds to what is expected for pure and unobscured nuclear emission. A higher flux ratio would increase the host galaxy contribution and imply

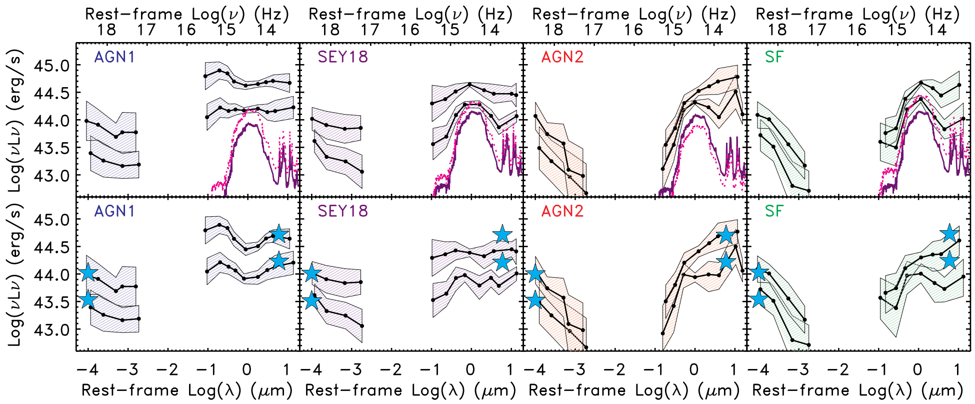

Figure 3. *Top panels:* Median SEDs regrouped by type (from left to right: AGN1, Sey18, AGN2, and SFG) and X-ray luminosity (top shaded area: $<L_{2-10\,keV}>=10^{44.4}$ ergs s^{-1}; bottom shaded area: $<L_{2-10\,keV}>=10^{43.9}$ ergs s^{-1}). The dotted (magenta) and solid (purple) lines represent the estimated host galaxy contribution to the high and low luminosity groups, respectively. *Bottom panels:* same as in the top panels, but after subtracting the host contribution. The cyan stars represent L(6μm)/L(12 keV) = 5 and are normalized at the 12 keV luminosity. Note that they are higher than observed at 6 μm for Sey1.8 and SFGs.

AGN obscuration in the near-IR. The estimated host contribution is subtracted from the total flux and the difference yields the intrinsic AGN SED of each type and luminosity group. We find that the AGN intrinsic SEDs do not vary significantly within the same type as a function of luminosity, but they differ among the 4 types. The difference does not depend on the luminosity and can be only in part explained by effects of obscuration. The AGN intrinsic SEDs become redder in the optical and harder in X-rays going from AGN1, to Sey1.8, AGN2, and SFGs. In order to minimize obscuration effects, we consider luminosities where those effects are negligible, i.e. at 6 μm, and 12 keV in the rest-frame (see cyan stars in Fig. 3). A ratio L(6μm)/L(12 keV) equal to 5 well describes the ratio observed in AGN1 and AGN2, but it is higher than the ratio observed in Sey1.8 and SFGs. Note that such a difference would be even more pronounced in case the host galaxy contribution was underestimated. Hence, the intrinsic AGN SEDs of Sey1.8 and SFGs differ from those of AGN1 and AGN2. It appears that Sey1.8 and SFGs are more efficient X-ray emitters or less efficient mid-IR emitters than AGN1 and AGN2. Finally, SFGs seem to be the obscured counterparts of Sey1.8, and AGN2 the obscured counterparts of AGN1.

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