Obscuration and Circumnuclear Medium in Nearby and Distant AGN

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Abstract. Some recent results on the physical and statistical properties of nearby and distant AGN are presented. I first discuss the properties of "elusive" AGNs, i.e. obscured AGNs which do not show a Seyfert-like spectrum in the optical. Then I present preliminary results from a detailed study of the contribution of obscured AGNs and of their host galaxies to the infrared cosmic background. Finally I discuss an observational program aimed at investigating the properties of the most distant quasars, of their circumnuclear medium and the implications for their host galaxies.

1 Introduction

Obscured Active Galactic Nuclei (type 2 AGNs) have been investigated in great detail in the local universe. The recent deep surveys have also found several obscured AGN at high and intermediate redshift, and have shed new light on their evolution [12]. However, there are still some open issues on the physical and statistical properties of obscured AGNs. There is growing evidence for a population of obscured AGNs which do not show the classical AGN signatures in their optical spectra, which might require a revision of the unified model as well as reassessment of the density of AGNs in the local universe. At higher redshift it is now clear that a mixture of obscured and unobscured AGN produce most of the X-ray background, but it is much less clear what is their contribution to the IR background and the possible connection with the evolution of galaxies. At the highest redshift (z$\sim$6) probed so far by quasar surveys, it is not clear what are the properties of the circumnuclear medium and, specifically, if the gas has the requirements to produce obscuration, both in terms of metallicity and dust content. In this paper I shortly summarize some recent work aimed at tackling these issues.

2 Elusive AGNs

A fraction of active galactic nuclei do not show the classical Seyfert-type signatures in their optical spectra, i.e. they are optically "elusive".The closest example of this class of objects is NGC4945. This galaxy hosts a nuclear starburst and its optical spectrum is characterized by faint LINER-like emission lines associated with the starburst superwind. However, its hard X-ray spectrum has revealed the presence of a heavily obscured AGN [11]. Another clear case has been reported by [4], who detected a heavily obscured AGN in the starburst/HII

ESO Symposia: Multiwavelength Mapping of Galaxy Evolution and Formation, pp. 76–81, 2005.

system NGC3690. We specifically define "elusive AGN" as those nuclei which do not show Seyfert-like emission lines in their optical spectra, but where a relatively luminous AGN (i.e. in the Seyfert range) is detected at other wavelengths. Although this class of AGNs clearly exist, it is not clear how common they are, nor it is clear their nature (i.e. why they are optically elusive).

We have started a program aimed at assessing the fraction of elusive AGN in the local universe and to investigate their nature. We are mostly exploiting hard X-ray data from Chandra and XMM, but also near- and mid-IR spectroscopy, to detect obscured AGNs not identified by optical spectroscopy. Preliminary results were reported in [13] and summarized here. There are about 20 elusive AGN identified so far (though not all of them can be used for statistical purposes, see [13]). Once selection effects are taken into account we estimate that elusive AGNs may be as numerous as (or even outnumber) classical, optically identified Seyfert nuclei. The estimated fraction of elusive AGNs as a function of infrared luminosity is shown in Fig.1. Obviously the statistics are still poor and more data are required to secure this result. If confirmed, an important implication would be that the overall fraction of galaxies hosting an AGN in the local universe is significantly higher than estimated previously by optical surveys. This would nicely match the recent results from the hard X-ray surveys [20][12][9], which are finding that the evolution of Seyfert nuclei peaks at much lower redshifts than quasars and probably requiring a high density of Seyferts at z=0. Note that the higher redshift counterparts of elusive AGN may be the so-called XBONGs (X-ray Bright Optically Normal Galaxies) found in the hard X-ray surveys [6].

A most interesting result of the X-ray spectra of elusive AGNs is that they are heavily absorbed and, in particular, most of them are Compton thick, i.e. absorbed by column of gas $N_H > 10^{24}$ cm^{-2}. This suggests that their elusive nature is associated with heavy obscuration. In [13] we suggested that probably in elusive AGNs the nuclear radiation source is obscured in all directions thus preventing UV photons to escape and to produce a Narrow Line Region (NLR).

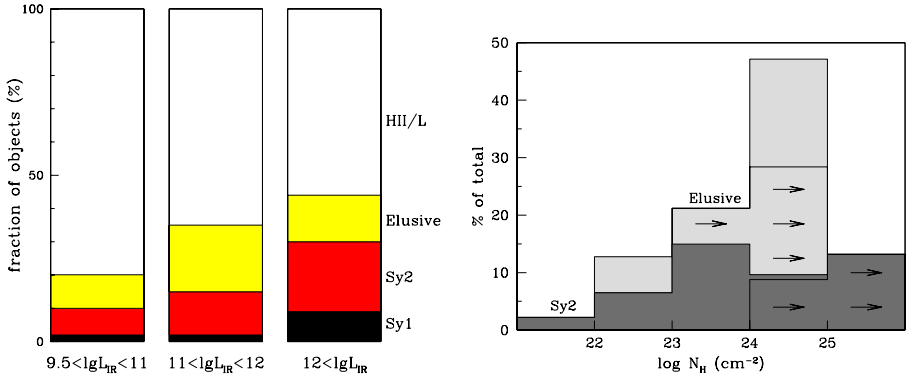

Fig. 1. *Left.* Fraction of elusive AGN and Seyfert nuclei as a function of IR luminosity. *Right.* Cumulative absorbing N_H distribution including elusive AGNs. From [13]