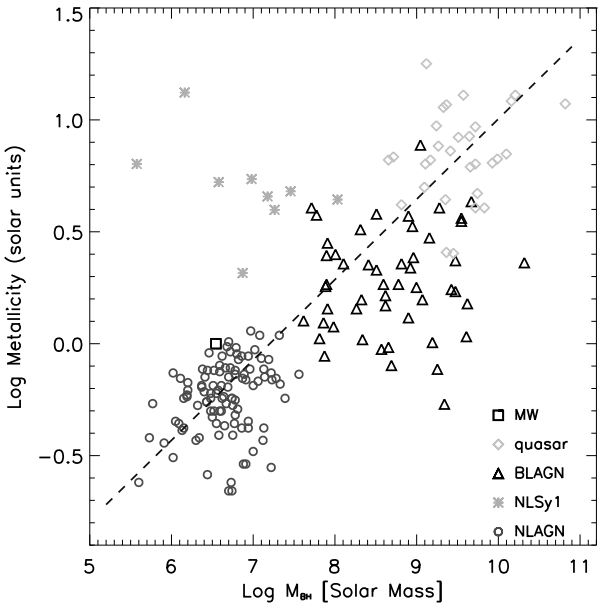

Fig. 20. Metallicities vs. black hole mass. The dashed line is our linear fitted correlation (excluding the NLSy1). The metallicity for the Milky Way is that of the Sun, which is now in better agreement with those of stars in its immediate neighborhood (Asplund et al. 2004). The color figure can be viewed online.

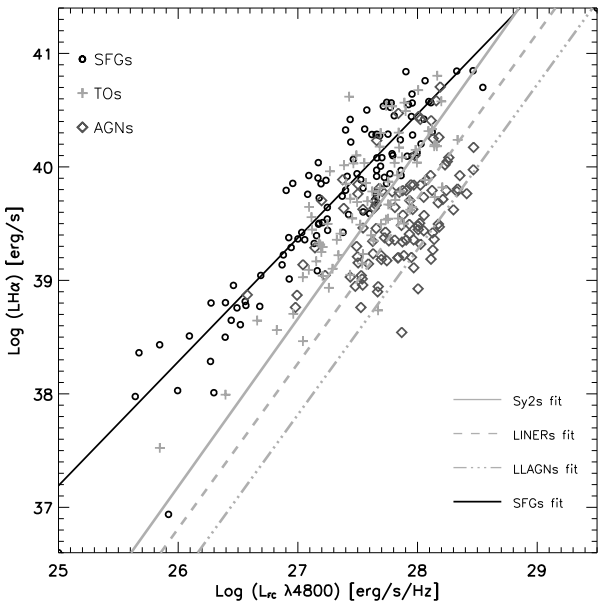

Fig. 21. Relation between ionization luminosity (Hα) and continuum luminosity (at 4800 Å). The different linear relations were determined by Torres-Papaqui et al. (2011) using a sample of 318486 SDSS galaxies. The SFGs follow a linear relation $L_{\mathrm{H}\alpha} \propto L_{4800}^{1.09\pm0.03}$, while the NLAGNs follow a steeper power law relation $L_{\mathrm{H}\alpha} \propto L_{4800}^{1.45\pm0.03}$. The color figure can be viewed online.

In Torres-Papaqui et al. (2011) it was shown that all the different kinds of NLAGNs (Seyfert 2, LINERS and LLAGNs) follow the same power law between the luminosity in Hα and luminosity at 4800 Å (Osterbrock 1989), while the SFGs follow a different, less steep, linear relation. In Figure 21 we verified that this also applies to the isolated NLAGNs of our sample. One can note also the intermediate position of the TOs, consistent with their being a mixture of SFGs and AGNs. This result suggests that we can use the black hole masses in conjunction with the luminosities at 5100 Å to estimate the accretion rates, as was done by Peterson et al. (2005).

In Figure 22, we follow the method of Peterson et al. (2005) to estimate the accretion rates of the NLAGNs of our sample. The SMBHs in the NLAGNs seem to accrete matter at relatively high rates of 0.1 times the Eddington limit. The isolated NLAGNs are consistent with scaled-down versions of quasars and BLAGNs, not powered-down versions: the lower luminosity is a result of smaller-mass black holes, not of lower accretion rates.

In Figure 23 we compare the gas metallicities and accretion rates of the NLAGNs of our sample with those found in quasars and BLAGNs, as determined in Neri-Larios et al. (2011) for the sample studied by Shemmer et al. (2004). Again, the NLAGNs seem to continue the linear correlation found for the quasars and BLAGNs in the lower metallicity regime. A linear fit with a correlation coefficient $r_{\mathrm{Pearson}} = r_{\mathrm{Spearman}} = 0.66$ with both chance probabilities practically equal to zero, suggests the metallicity increases with the accretion rate as:

$$\log([\mathrm{O/H}]) = 0.77 + 0.66 \times \log(L_{\mathrm{Bol}}/L_{\mathrm{Edd}})\,. \quad (7)$$

Although our results are fully consistent with the standard interpretation of NLAGNs as scaled-down versions of quasars and BLAGNs, we must state that there is an unfortunate uncertainty in the black hole masses we have determined. The fact is that there is no consensus in the literature about what is the correct relation to use. For practical reasons, we have used the relation proposed by Häring & Rix (2004) between the bulge mass and the black hole mass. However, in Gültekin et al. (2009) the relation proposed between black hole mass and velocity dispersion of the bulge yields masses which are ten times higher. The problem lies with what Häring & Rix (2004) called the "black hole sphere of influence". These authors argued that the black hole representing only a small fraction of the bulge mass (1% to