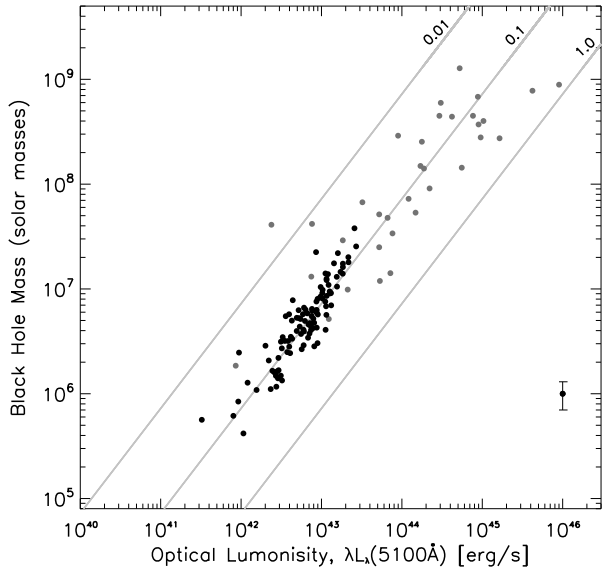

Fig. 22. Black hole mass as a function of continuum luminosity at 5100 Å for the NLAGNs compared to the BLAGNs studies in Peterson et al. (2005). The typical uncertainty for the NLAGNs is indicated by the red dot with error bars. The color figure can be viewed online.

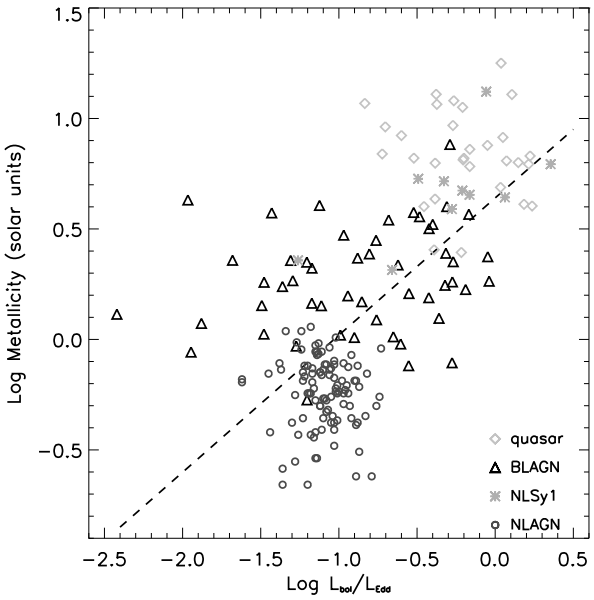

Fig. 23. Relation between metallicity and accretion rate. The NLAGNs are compared to the quasars and BLAGNs as studied by (Shemmer et al. 2004). The linear relation was fitted for all the galaxies (including the NLSy1). The color figure can be viewed online.

0.1%) cannot be responsible for the full value of the velocity dispersion, which explains why they apply a correction and obtain ten times smaller black hole mass values. In Gültekin et al. (2009), this correction is simply rejected as non valid, without further arguments.

If we adopt the relation of Gültekin et al. (2009), then the SMBH in the NLAGNs would be ten times more massive. In Figure 20, the relation between metallicity and black hole mass would be slightly steeper and the NLAGNs would differ significantly from the Milky Way. In Figure 22 the NLAGNs would not be scaled-down versions of BLAGNs but rather powered-down versions, that is, the SMBH of the NLAGNs would have masses comparable to those found in the BLAGNs but they would now be accreting at only 0.01 times the Eddington limit. Finally in Figure 23 the NLAGNs would fall farther to the left, but would still be in good agreement with the metallicity vs. accretion rate relation suggested by Shemmer et al. (2004).

5. SUMMARY AND CONCLUSION

We have constructed a sample of galaxies that have formed in low galactic density environments and have evolved in relative isolation. All these galaxies show a spiral disk and some kind of nuclear activity. Using a standard diagnostic diagram we have established that as many as 64% of these galaxies are classified as NLAGNs or TOs.

We have established a strong connection between the AGN phenomenon and the mass of the bulge, but have also found a strong correlation with the morphological type of the galaxies. This suggests that the AGN phenomenon is a "normal" occurrence related to the formation process of massive bulges in early-type spiral galaxies.

Consistent with this interpretation, our analysis suggests the AGNs and TOs have experienced during their formation higher astration rates than the SFGs–transforming their gas into stars more efficiently (Sandage 1986). Evidences favoring higher astration rates in AGNs than in SFGs are: (1) their older stellar populations; (2) their lower oxygen abundance and a possible excess of nitrogen. We also found the NLAGNs to have higher binding energies than the SFGs, suggesting they host a SMBH in their center.

Our results are in good agreement with the standard interpretation of NLAGNs, either as scaled-down (lower BH mass but same accretion rates) or powered-down (same BH mass but lower accretion rates) versions of quasars and BLAGNs. The NLAGNs also seem to follow the same relation between the BH mass, the accretion rate and the gas metallicity as the quasars and BLAGNs.