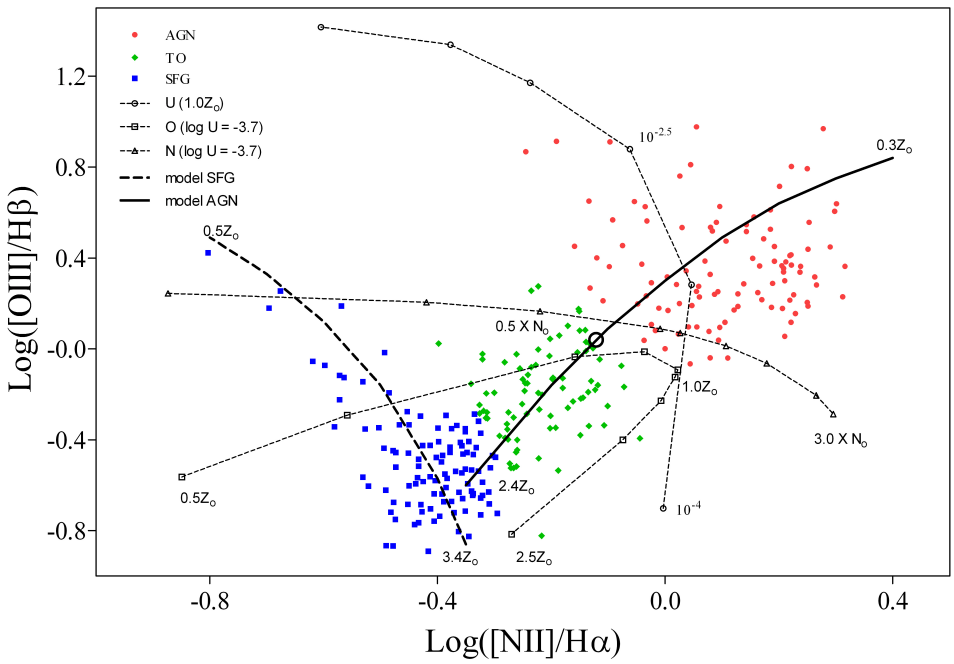

Fig. 14. Diagnostic diagram with three curves obtained by Bennert et al. (2006) using CLOUDY: U, varying the ionizing parameter at constant solar metallicity; O, varying the metallicity keeping U constant; N, varying the nitrogen abundance. Also shown is our calibration using R_3. The bold circle on this curve corresponds to 1.0 $Z_\odot$. The color figure can be viewed online.

Bennert et al. (2006), the ionizing parameter would increase from $10^{-3.5}$ to $10^{-2.5}$, which seems in good agreement with the values found by Baskin & Laor (2005), and the abundance of nitrogen would not exceed 2 times the solar value, which is a lower excess than suggested originally by Osterbrock (1970), but still fully consistent with what is observed in the bulges of normal galaxies (Thurston et al. 1996; van Zee et al. 1998; Coziol et al. 1999).

Our model suggests that there is an inversion in the metallicity-nitrogen abundance relation in the AGNs compared to that in the SFGs: in the SFGs, the nitrogen abundance increases with the metallicity, while in the TOs and AGNs the nitrogen abundance increases as the metallicity decreases (consistent with an excess in nitrogen abundance). For the TOs and AGNs the relation is:

$$[\mathrm{O/H}] = -0.52 + (\log([\mathrm{NII}]/\mathrm{H}\alpha) - 0.6)^2 . \quad (3)$$

For the SFGs the relation is:

$$[\mathrm{O/H}] = -[0.99 + 0.61/(\log([\mathrm{NII}]/\mathrm{H}\alpha) - 0.05)] . \quad (4)$$

To test our calibration, we searched the literature for NLAGNs for which the metallicity of the gas was previously estimated using CLOUDY, and could also be evaluated by our method (with reported spectrophotometry in the optical). We found very few examples, and all are Sy2 located in the upper part of our diagram in Figure 15, where we expect our calibration to yield the most discrepant results. The values obtained are compiled in Table 7.

TABLE 7

GAS METALLICITIES OF AGNS FROM THE LITERATURE, COMPARED TO THOSE OBTAINED USING OUR CALIBRATION

ID	$Z/Z_\odot$ (lit.)	$Z/Z_\odot$ (ours)	Literature sources
Mrk 78	0.30	0.30	(1)(2)
NGC 3393	0.10	0.21	(3)
NGC 1068	0.30	0.16	(4)
NGC 4507	0.50	0.27	(4)
NGC 5135	0.2-0.5	0.43	(4)
NGC 5506	0.50	0.23	(4)
Mrk 1388	0.70	0.23	(4)

(1)Ramos Almeida et al. 2006, (2) Ulrich 1971, (3) Cooke et al. 2000, (4) Nagao et al. 2006.