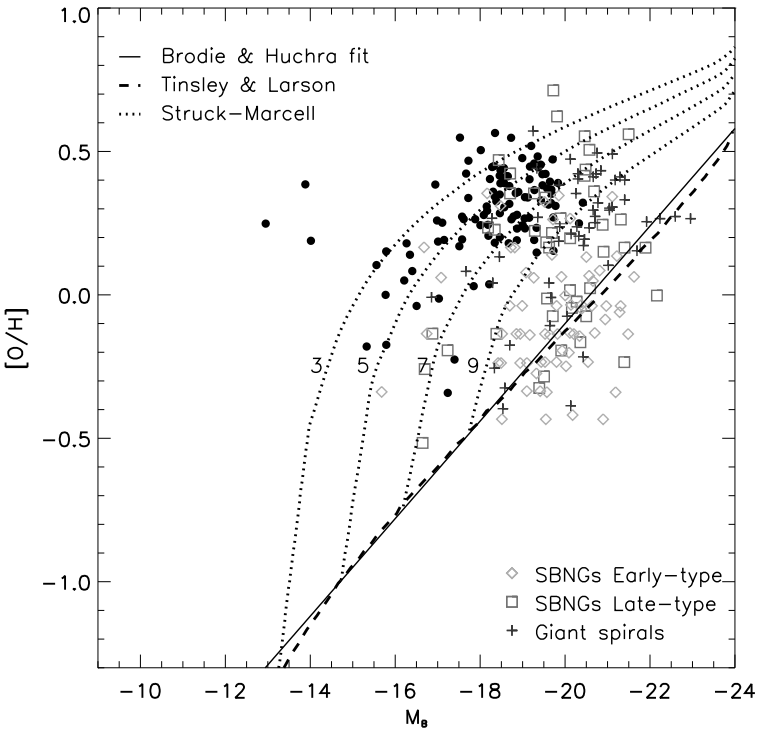

Fig. 13. Gas metallicities vs. absolute B magnitudes for the SFGs (filled dots). The giant spirals sample is taken from Zaritsky et al. (1994) and the SBNGs from (Coziol et al. 1998b). The continuous straight line is the Brodie-Huchra (1991) relation for elliptical galaxies. Also shown are two models of multiple mergers by Tinsley & Larson (1979) and Struck-Marcell (1981). The numbers indicate the approximate number of mergers necessary in the models to reproduce the metallicities. The color figure can be viewed online.

authors, we reproduce some of their results in Figure 14. The models discussed in their study apply exactly to our NELGs. From their study we can see that the line ratio [NII]/Hα is extremely sensitive to the abundance of nitrogen. One possible cause for the increase of nitrogen emission in the AGNs could be an excess of nitrogen (Osterbrock 1970; Storchi-Bergmann & Pastoriza 1989; Storchi-Bergmann 1991; Hamann & Ferland 1993). In the center of galaxies with massive bulges and old stellar populations, we do not expect the nitrogen abundance to follow the normal secondary relation (Zaritsky et al. 1994; Thurston, Edmunds, & Henry 1996; van Zee et al. 1998; Coziol et al. 1999).

In Figure 14 we also observe that, for any value in excess of nitrogen abundance, increasing the ionizing parameter, U, while keeping the metallicity constant causes the ratio [OIII]/Hβ to rise. But, if we increase U too much the ratio [NII]/Hα begins to decrease. In the same figure we observe that when we lower the metallicity while keeping U constant, both line ratios increase, which is consistent with the cooling effect of oxygen. However, if we decrease the metallicity too much, both line ratios eventually decrease. This behavior is consistent with a coupling effect between U and the metallicity (Evans & Dopita 1985): as the metallicity decreases, U increases and vice versa. Therefore, one can arbitrarily change one parameter or the other with almost the same effect.

In Figure 14 the TOs and AGNs trace a continuous sequence where the ratios [NII]/Hα and [OIII]/Hβ increase together. According to the CLOUDY models of Bennert et al. one way to explain this sequence would be to decrease the metallicity gradually while increasing the overabundance of nitrogen. Consistent with this model, we fitted on the TOs and AGNs distributions an empirical relation between the ratio [OIII]/Hβ and [NII]/Hα. We then searched for a calibration that would yield the same range in metallicities for the TOs as obtained using the model of Bennert et al. (2006), from 2.5 to 1 $Z_{\odot}$. As a first approximation we found that the R_3 calibration for the SFGs nearly reproduces these values. Extrapolating this calibration over the AGNs region suggests a decrease in metallicities for these objects from 1 $Z_{\odot}$ to 0.3 $Z_{\odot}$. Based on the models of