TABLE 2

ABUNDANCE GRADIENTS NORMALIZED TO R_0[a]

Galaxy	R_0(kpc)[b]	12+log(O/H)	12+log(C/H)	log(C/O)
M101	28.95	$-0.492 \times (r/R_0)+8.84$	$-1.32 \times (r/R_0)+8.99$	$-0.65 \times (r/R_0)+0.03$
M33	6.83	$-0.492 \times (r/R_0)+9.00$	$-0.72 \times (r/R_0)+8.93$	$-0.22 \times (r/R_0)-0.10$
MW	11.25	$-0.495 \times (r/R_0)+9.16$	$-1.16 \times (r/R_0)+9.50$	$-0.65 \times (r/R_0)+0.34$

[a] R_0 = galactic photometric radius to 25 mag per square second.

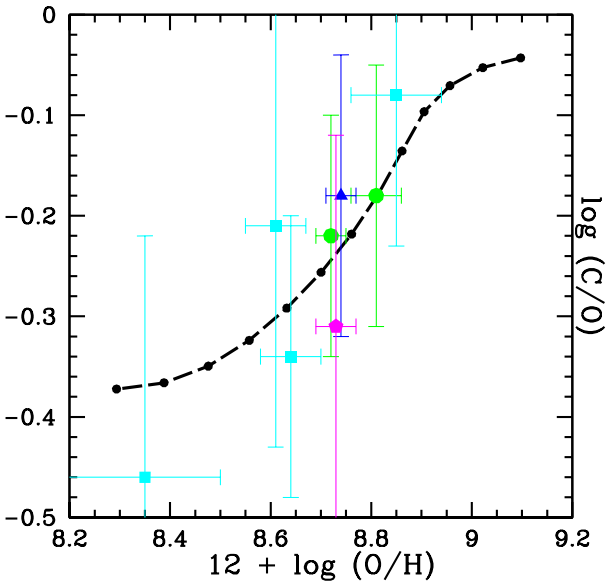

Fig. 8. C/O-O/H values at 13 Gyr predicted by IWY model (long-dashed lines). Small black circles: model predictions at different Galactocentric distances, from 4 kpc (right) to 16 kpc (left). Observed abundances ratios of extragalactic H II regions in spiral galaxies: cyan squares: M101, big green circles: M33, blue triangle: M31, and magenta pentagon: NGC 2403. The color figure can be viewed online.

It should be clear that Figure 8 does not correspond to models of the four spiral galaxies, and that the r values correspond to our galaxy and not to the other galaxies.

In Table 2 we present some galactic information for M33, M101, and the Milky Way, the only galaxies with determinations of chemical gradients based on recombination lines. Specifically, we show the galactic photometric radius to 25 mag per square second (R_0) and the chemical gradients normalized to R_0 corrected for dust depletion (Esteban et al. 2002, 2005, 2009). The MW R_0 was taken from de Vaucouleurs & Pence (1978).

In Figure 9 we show the O/H, C/O, and C/O values as a function of r normalized to R_0 for the eight extragalactic and the eight Galactic H II regions presented in Figures 8 and 7, respectively. Moreover we display the chemical gradients shown in Table 2.

From Figure 9, it can be noted that: (i) the O/H slope for the three galaxies is the same within the errors, which suggests that for a given galaxy the O/H gradient normalized to R_0 is a more meaningful representation than the standard gradient; (ii) the O/H gradients extend from $r/R_0 \sim 0.2$ to $r/R_0 \sim 1.0$; (iii) the O/H ratio at a given r/R_0 differs by a constant among M33, M101 and the MW; and (iv) for 12+log(O/H)$\sim$8.8 the slopes of the C/H and C/O gradients become steeper.

The parallel behavior of the O/H gradients when they are plotted relative to r/R_0 is remarkable, suggesting that the main mechanisms involved in the formation and evolution of spiral galaxies are similar.

The slope of the O/H gradients is similar, but the O/H absolute value at a given r/R_0 is different for each galaxy. In particular the MW shows an O/H ratio 0.24 dex higher than the average of M33 and M101 at a given r/R_0. Considering that the MW is an Sbc galaxy and M33 and M101 are Scd galaxies, this result probably implies that the earlier the type of a galaxy the higher the O/H value at a given r/R_0. This result might be due to the fact that the earlier the bulk of star formation occurs, the fainter the stellar luminosity at a given O/H value and consequently the higher the O/H value at a given R_0 value. More high accuracy determinations of O gradients in spiral galaxies are needed to test this result.

From Figures 8 and 9 it follows that we need: (i) to increase the r/R_0 coverage, mainly for smaller galactocentric distances, with abundance determinations of high accuracy; (ii) to increase the sample by including spiral galaxies of different types; and (iii) to make specific models for each galaxy. All this is