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A NEW DETERMINATION OF THE PRIMORDIAL HELIUM ABUNDANCE

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We analyze the observations of 45 oxygen poor extragalactic H II regions obtained by Izotov et al. Based on this analysis we select the 12 best observed objects. We determine their He/H ratio taking into account the optical depth in the He I 3889 Å line, the density structure, and the temperature structure. Using these values we determine the primordial helium abundance. This determination is in very good agreement with that derived by Peimbert, Peimbert, & Ruiz (2000, hereinafter Paper I) on the other hand it is considerably smaller than that derived by Izotov et al. from the same sample of objects. The main difference is due to the treatment of the temperature structure of these objects.

We consider that the best observations of O-poor extragalactic H II regions are those by Izotov et al. (1994, 1997, 1998, 1999). We decided to compute Y, for the best 12 objects of Izotov et al. sample.

We have found, from models and observations of giant extragalactic H II regions, that $T_e(\text{He II})$ is from 6% to 12% smaller than $T_e(\text{O III})$.

We derive the He^+/H^+ value for each object with a maximum likelihood method using as input parameters $T_e(\text{He II})$, and the well observed He line intensities, usually 3889, 4471, 4921, 5876, 6678, and 7065, and in some cases also 3819, 4026, 4387, and 7281 (see Paper I).

Figure 1 shows the Y vs O/H for the objects of our sample, from these objects and assuming that $\Delta Z(\text{O})/\Delta Y = 3.5$ we have derived a new Y_p value of 0.2371 ± 0.0015.

The Y_p values derived by us are significantly smaller than the values derived by Izotov et al. (1998) and Izotov & Thuan (1999) from their sample that amount to $Y_p = 0.2443 \pm 0.0015$ and $Y_p = 0.2452 \pm 0.0015$, respectively.

The main difference between their results and ours is the treatment of the electron temperature. While Izotov et al. use $T_e(\text{O III})$ to derive Y, we use a $T_e(\text{He II})$ 9% $\pm$ 3% lower than $T_e(\text{O III})$. This produces differences of up to $\Delta Y_p = -0.01$.

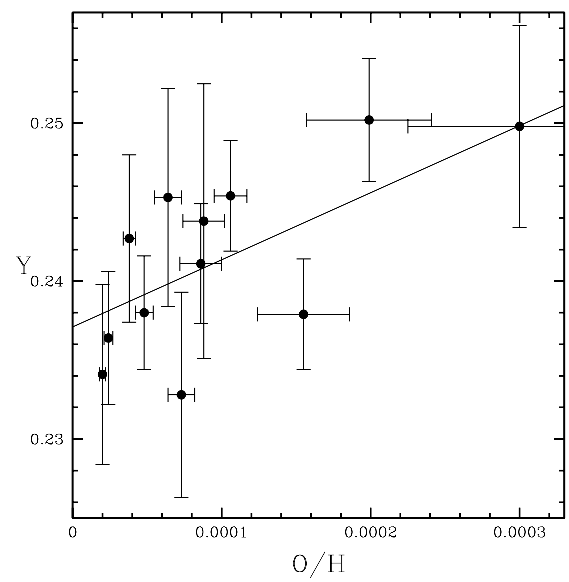

Fig. 1. Y versus O/H diagram for the twelve objects. The line corresponds to a slope $\Delta Z(\text{O})/\Delta Y = 3.5$.

The Y_p value derived by us is in contradiction with the D_p determinations and with the results on Ω_b derived by MAP and BOOMERANG. On the other hand, it is in good agreement with the Li_p, the CBI, and the baryon budget determinations. The differences in the estimated Ω_b values by different methods need to be sorted out, if real non standard BBN models might be needed to explain the observations.

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