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SOLAR ORIGINS: PLACE AND CHEMICAL COMPOSITION

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RESUMEN

Discutimos un modelo de evolución química con rendimientos dependientes de Z que reproduce los gradientes de O/H, C/H y C/O del disco Galáctico y la historia química de la vecindad solar. El modelo ajusta las abundancias de H, He, C y O derivadas a partir de líneas de recombinación en la región H II M17 (incluyendo la fracción de átomos de C y O embebida en polvo); las abundancias protosolares de H, He, C, O y Fe; y las relaciones C/O-O/H, C/Fe-Fe/H y O/Fe-Fe/H derivadas de estrellas de la vecindad solar. El ajuste del modelo con las abundancias protosolares al tiempo de formación del Sol implica que el Sol se originó en un medio químicamente bien mezclado a una distancia galactocéntrica de 7.6 ± 0.8 kpc.

ABSTRACT

We discuss a chemical evolution model with Z-dependent yields that reproduces the O/H, C/H, and C/O gradients of the Galactic disk and the chemical history of the solar vicinity. The model fits the H, He, C, and O abundances derived from recombination lines of the H II region M17 (including the fraction of C and O atoms embedded in dust); the protosolar H, He, C, O, and Fe abundances; and the C/O-O/H, C/Fe-Fe/H, and O/Fe-Fe/H relations derived from stars of the solar vicinity. The agreement of the model with the protosolar abundances at the Sun-formation time implies that the Sun originated from a well mixed ISM at a galactocentric distance of 7.6 ± 0.8 kpc.

Key Words: galaxies: chemical evolution — H II regions (M17, Orion nebula) — ISM: abundances — Sun: abundances

1. INTRODUCTION

The comparison of detailed Galactic chemical evolution models, GCE models, with accurate abundance determinations of stars and gaseous nebulae provides a powerful tool to test the GCE models and the accuracy of observational abundance determinations of stars of different ages and of H II regions located at different galactocentric distances.

To find a robust model for the Galaxy we decided to use as main observational constraint the slope and absolute value of the O/H gradient. This model has been tested with other observational constraints of high quality. A full discussion of this problem on the GCE has been presented elsewhere (Carigi & Peimbert 2011).

2. DISCUSSION

GCE models can be constrained by chemical gradients obtained by different methods used in the literature. Those Galactic disk gradients in general show similar slopes but a considerable spread in the absolute O/H ratios. A comparison of many of the different methods used has been made by Kewley & Ellison (2008). They find that the O/H differences derived by different methods for a given H II region can be as large as 0.7 dex. Most of the differences among the various calibrations are due to the temperature distribution inside the nebulae. The recombination lines (RL) method, that is almost independent of the electron temperature, produces gaseous O and C abundances higher by about 0.15 to 0.35 dex than the forbidden lines (FL) method, that is strongly dependent on the electron temperature. It is possible to increase the FL abundances under the assumption of temperature inhomogeneities to reach agreement with the RL values (Peimbert & Peimbert 2011).

In this work we use H, He, C, and O abundances of H II regions at different galactocentric distances based only on the RL method. Since the recombinatio line ratios among these four elements are practically independent of the electron temperature their relative abundances are very reliable.

Moreover, these abundances were corrected under the assumption that 35% of the O atoms and 25% of the C atoms are trapped in dust grains (Peimbert & Peimbert 2010), increasing the O/H and C/H values by 0.12 and 0.10 dex, respectively. In order to constrain the chemical history of the interstellar medium, we considered stellar abundances of different ages.

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