AGE–METALLICITY RELATION AND STAR FORMATION HISTORY OF THE GALACTIC DISK

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1. Introduction

In this work, we have determined the age–metallicity relation (AMR) and star formation rate (SFR) for the Galactic disk. The sample was selected from the surveys of chromospheric activity in solar-type stars by the Mount Wilson Group, and includes 730 stars (see details in Rocha-Pinto and Maciel, 1998, hereafter RPM).

2. Results and Discussion

The size of the sample for the building of AMR is 552 stars. We have eliminated from the sample all stars more distant than 80 pc and all very active stars. The metallicities are photometric, and for the active and very active stars they have been corrected to allow for the m_1 deficiency caused by the chromospheric activity (see RPM). We have found very good agreement with other AMRs in the literature. During the lifetime of the disk, the mean [Fe/H] has increased from circa -0.50 dex, 14 Gyr ago, to 0.12 dex today. We find small metallicity dispersion around the mean AMR although this is probably an artifact of our method.

A subsample with 319 stars was used to find kinematical constraints related to age and [Fe/H]. For these stars, we calculated the spatial velocities U, V, W. The velocity dispersion ellipsoid increases steeply with age during the first 3 Gyr, saturating after 6 Gyr in $(\sigma_U, \sigma_V, \sigma_W) = (55 \pm 5, 40 \pm 10, 27 \pm 5)$ km s^{-1}.

The chromospheric age distribution is transformed into star formation history through the application of three corrections: a volume correction, a stellar evolution correction and a scale height correction. Figure 1 shows the results. We have used the same nomenclature introduced by Majewski (1993), namely bursts A, B and

Astrophysics and Space Science is the original source of publication of this article. It is recommended that this article is cited as: *Astrophysics and Space Science* **265:** 245–246, 1999.

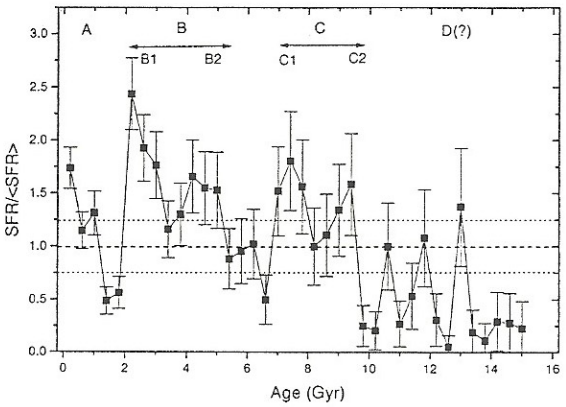

Figure 1. SFR history of the Galactic disc. The dotted lines indicate the 2 σ variations around a constant SFR for a sample of this size.

C. We have run around 3000 simulations to test the statistical significance of the bursts we have found. From the comparison with the results of the simulations, we are able to say that the SFR history we have found for the Milky Way disk is not constant at a confidence level greater than 98%.

We have calculated how this SFR history would be seen at several redshifts, for the case of a flat universe. Our Galaxy does not show enhanced star formation episodes at intermediate redshifts, as is seen in recent determinations of the cosmic SFR. A possible explanation for this difference is that the star formation rate we found is only valid for the disk. The cosmic SFR should reflect mainly the star formation history of the central parts of the galaxies, from where the main part of the ultraviolet light originates.

Acknowledgements

H.J.R-P. and W.J.M. acknowledge support by FAPESP and CNPq; J.S. acknowledges support by NASA; C.F. acknowledges the Finnish Academy.

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