

memory of the initial stellar angular momentum vanishing, considering q as a memory parameter ($q = 1$ corresponding to no memory). In fact, these stars retain the memory of their initial angular momentum until an age > 100 Myr (e.g., Bouvier et al. 1997, A&A, 326, 1023). de Freitas & De Medeiros (2013, MNRAS, 433, 1789) shown that the rotation-age relationship can be reproduced using a model from NF. In this model the index q_K is derived from the Kawalers parameterization, where $q_K = 1$ indicates the saturated magnetic field regime, and the unsaturated one is given by $q_K = 1 + 4aN/3$. The parameters a and N are related to the dynamo and magnetic field geometry, respectively. We used the de Freitas & De Medeiros' model to derive an empirical relationship between q , a and N as the equation $q \approx q_0(1 - \Delta t/q_K)$, where $\Delta t = t - t_0$ is the age range, and q_0 is the index q for the cluster with age t_0 . This equation constitutes a bridge between q and the theory of magnetic braking of stellar rotation.

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ZINC ABUNDANCES IN GALACTIC BULGE STARS

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Zinc is overabundant in metal-poor stars (Cayrel et al. 2004), being partially produced by neutron addition. It decreases with increasing metallicity, similarly to alpha-elements. In order to trace its abundance, the derivation of Zn abundance in different stellar populations, and varying metallicities, helps understanding its nucleosynthesis processes.

Zn is also the main element of reference to derive the metallicity from absorption lines in quasars (QSOs), which allows to compare their evolution as a function of redshift and metallicity in metal-poor stars.

In the present work, we derive Zn abundances for a sample of 56 bulge field stars, observed at high resolution with the FLAMES-UVES spectrograph. The mean wavelength coverage is 4800-6800 Å, at a resolution $R \sim 45000$. The atmospheric parameters effective temperature, gravity and metallicity were derived in Zoccali et al. (2008) and Hill et al. (2011). Recently we have analysed the manganese abundances of this sample (Barbuy et al. 2013).

To compute the Zn abundances we use spectrum synthesis, for the lines ZnI 4810.53 and 6362.34 Å.

The analysis of our data shows that the abundance of [Zn/Fe] decreases with increasing metallicity, in agreement with the data obtained from the literature. The details of Zn behaviour for the metal-rich bulge stars of the present work are under analysis.

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A STUDY OF ROTATIONAL VELOCITY DISTRIBUTION OF BE STARS

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Classical Be stars are rapid rotators of spectral type late O to early A and luminosity class V-III, which exhibit Balmer emission lines and often a near infrared excess originating in an equatorially concentrated circumstellar envelope, both produced by sporadic mass ejection episodes. The causes of the abnormal mass loss (the so-called Be phenomenon) are as yet unknown. In spite of their high $v \sin i$, rapid rotation alone cannot explain the ejection episodes as most Be stars do not rotate at their critical rotation rates. In this work we present the distribution of $v \sin i$ of 261 Be's stars from BeSS (Be Star Spectra) database. We used two techniques, the Fourier method and the FWHM (Full Width at Half Maximum) method. For the analysis we made use of three absorption lines of Helium (4026Å, 4388Å and 4471Å). Stars with projected rotational velocities up to 300 km s^{-1} agree with the ones already published in the literature. 84 of our stars do not have the values of rotational velocity published. The majority of our sample are B1/B2 spectral type, whose have the greatest velocities.

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MORE FITTING $V \sin I$ DISTRIBUTION FOR EVOLVED FIELD STARS

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We use 1536 $V \sin i$ measurements of evolved field stars in order to determine the q parameter from

the named q -Maxwellian model (Soares *et al.* 2006, *Physica A*, 364, 413), a power-law type distribution function that adjusts the distribution of the projected rotational velocity. Then we compare the different distributions of $V \sin i$ obtained for different $B - V$ intervals with the distribution model using the Kolmogorov-Smirnov statistical test to find the best fit.

Results revealed that, as overall trend, low $B - V$ tends to exhibit $q > 1$ values while $q < 1$ for high $B - V$ for all classes of stars under study. Specifically, this point indicates rotation distributions with long tails due to the percentage of stars with relatively high speed for low $B - V$, and tailless distributions for stars of high $B - V$. Furthermore, it is a general behavior that binaries present q values slightly higher than singles indicating that their rotation distributions are wider than the single ones. As another broad trend, binaries tend to have $q < 1$ values later than their fellow-colors. In addition, there exists an inversion point in $B - V$, from which $q > 1$ regime switches to $q < 1$ regime, that is higher the more evolved is the luminosity class.

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SN 2009N: ANOTHER SUPERNOVA BETWEEN THE NORMAL AND SUBLUMINOUS TYPE II-P

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We collected ultraviolet, optical, and near-infrared photometry together with optical and near-infrared spectra of SN 2009N. The optical spectra had narrow features with low velocities, typical of subluminal SNe II-P. The bolometric luminosity during the plateau phase was in between those of the subluminal and normal SNe II-P.

The NIR spectra of SN 2009N contain features typical of SNe II-P, with the exception of the appearance of a feature at $\sim 1.055 \mu\text{m} + 48$ days after the explosion. Via spectral modeling we found that this line is probably due to high-velocity He I $\lambda 10830$. The presence of this line, together with a HV component of H α , can be an indicator of weak interaction of the ejecta with circumstellar material.

We estimated the distance to SN 2009N using multiple versions of both the expanding photosphere method and the standardized candle method as $D =$

21.6 ± 1.1 Mpc ($\mu = 31.67 \pm 0.11$). The produced nickel mass was estimated to be $0.020 \pm 0.004 M_{\odot}$. We determined the physical properties of the progenitor at the explosion via hydrodynamical modeling. The total explosion energy (~ 0.48 foe) is in between the values typical of subluminal and normal SNe II-P. The pre-supernova mass ($\sim 13 - 13.5 M_{\odot}$) is consistent with that of red supergiant stars, while the relatively small estimated radius at the time of the explosion ($R_{\text{ini}} \approx 287 R_{\odot}$) can point to a yellow supergiant star.

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REVISITING TW HYDRAE IN LIGHT OF NEW ASTROMETRIC DATA

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Our efforts in the present work focused mainly on refining and improving the previous description and understanding of the stellar association TW Hydrae (TWA) including a very detailed membership analysis and its dynamical and evolutionary age. To achieve our objectives in a fully reliable way we take advantage of our own astrometric measurements (Ducourant et al. 2013) performed with NTT/EFOSC2 - ESO (La Silla - Chile) spread over three years (2007 - 2010) and of those published in the literature. A very detailed membership analysis based on the convergent point strategy as developed by our team (Galli et al. 2012, 2013) allowed us to define a consistent kinematic group containing 31 stars among the 44 proposed as TWA member in the literature. Assuming that our sample of stars may be contaminated by non-members and to get rid of the particular influence of each star we applied a Jackknife resampling technique generating 2000 random lists of 13 stars taken from our 16 stars and calculated for each the epoch of convergence when the radius is minimum. The mean of the epochs obtained and the dispersion about the mean give a dynamical age of 7.5 ± 0.7 Myr for the association that is in good agreement with the previous traceback age (De La Reza et al. 2006). We also estimated age for TWA moving group members from pre-main sequence evolutionary models (Siess et al. 2000) and find a mean age of 7.4 ± 1.2 Myr. These results