From Lithium to Uranium: Elemental Tracers of Early Cosmic Evolution
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The Metal Enrichment History of the Stellar System ω Centauri

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Abstract. We present results of an extensive spectroscopic survey of Subgiant stars in the stellar system ω Centauri. Using infrared CaII triplet lines we derived metallicities and radial velocities for more than 250 stars belonging to different stellar populations of the system. A small age spread (<2 Gyr) among the stellar populations of ω Cen has been estimated regardless of any choice of helium abundance. These results impose severe constraints on the time-scale of the enrichment process of this stellar system, excluding the possibility of an extended star formation period. The radial velocities analysis of the entire sample demonstrates that only the metal-intermediate populations ($-1.4 < [Fe/H] < -1.0$) are kinematically cooler than the others.

Keywords. Methods: data analysis, techniques: radial velocities, techniques: spectroscopic, stars: abundances, stars: kinematics, stars: Population II, globular cluster: individual (ω Centauri)

1. Chemical Inhomogeneities in ω Centauri

As part of the Ital-FLAMES GTO we performed an extensive survey of a large sample of sub-giant stars belonging to different sub-populations of ω Cen. Using the Fibre Large Array Multi Element Spectrograph (FLAMES) mounted at UT2 of the ESO-VLT at Cerro Paranal (Chile) we obtained a series of high quality (S/N $\sim$ 50) low-resolution (R $\sim$ 6,500) spectra in the infrared spectral range 8200-9400 Å where CaII triplet lines are measurable. In particular: *(i)* 170 SGB stars have been selected from the BVI catalog by Pancino *et al.* (2000) in an external region ($\sim$10' away from the cluster centre) and *(ii)* 110 SGB stars, selected from the ACS@HST photometry by Ferraro *et al.* (2004), along four well separated branches. The metallicity distribution function confirms the metallicity spread observed in previous analysis performed on giant stars. SGB-a stars appear to have a metallicity higher than the bulk population, representing the extreme metal-rich extension of the stellar content of ω Cen. In order to assess the relative age of each population we fit the observed branches with theoretical isochrones having appropriate metallicities and various helium content: [Fe/H] ~ -1.8 for the metal poor population, [Fe/H] ~ -1.3 and [Fe/H] ~ -1.0 for the two main metal-intermediate populations and [Fe/H] ~ -0.6 for the SGB-a. This comparison suggest: (a) a differential helium abundance allows a better fit of the observed SGB morphology but does not significantly affect the relative ages (b) the ages derived for the different populations are all compatible within 2 Gyr (see Fig. 1). This result imposes firm constraints on the chemical

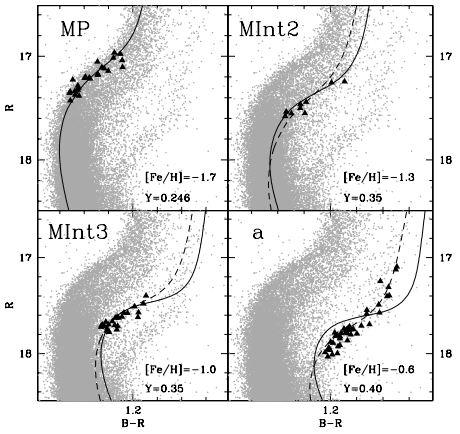

Figure 1. Isochrone fitting of the four observed SGBs of ω Cen in the *ACS sample*. The spectroscopic target stars are marked on the CMD as triangles. Theoretical isochrones with Y=0.246 (solid lines) and with different helium abundances (dashed lines) are overplotted.

evolution of this system. Moreover, from accurate radial velocity determinations we observed a clear trend in the velocity dispersion distribution as a function of metallicity. SGB-a stars do not follow this trend: they show a significantly larger velocity dispersion and seem to be dynamically warm.

References

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