ARCS: the Asiago Red Clump Spectroscopic Survey

M. Valentini,[1,2] R. Barbon,[1] U. Munari,[2] M. Fiorucci[2] and A. Siviero[2]

[1] *Osservatorio Astrofisico - Università di Padova, Via dell'Osservatorio 8, I-36012 Asiago, Italy*

[2] *INAF - Osservatorio Astronomico di Padova, sede di Asiago, Via dell'Osservatorio 8, I-36012 Asiago, Italy*

Abstract.   The Asiago Red Clump Spectroscopic survey derives from high resolution optical spectra accurate multi-epoch radial velocities and atmospheric parameters ($T_{\rm eff}$, $\log g$, [M/H], $V_{\rm rot} \sin i$, [α/Fe], ξ) for a well selected sample of $\sim$500 equatorial Red Clump stars belonging to the solar neighborhood. These results coupled with astrometric and photometric external data are used in investigation of galactic structure and dynamics.

Target selection for ARCS (http://www.oapd.inaf.it/ARCS) aims to isolate the purest RC (red clump) sample and to ensure that accurate astrometric and photometric external data exist to support our spectroscopy. Among them are: (*i*) accurate spectral classification between G8III and K2III, (*ii*) Hipparcos $\pi(\pm\sigma_\pi)$ parallax compatible with M_{V_T} of RC stars, (*iii*) accurate Tycho-2 proper motions, (*iv*) no hint of binarity or variability, (*v*) 2MASS, DENIS, UBVRI, uvby photometry available, (*vi*) not already observed in other spectroscopic surveys, (*vii*) within 6° of the celestial equator and at high galactic latitude ($|b| \geq 25°$), (*viii*) $6.8 \leq V_T \leq 8.1$ mag. About 500 stars matched these criteria.

Spectra are obtained with the Asiago 1.82m + Echelle at 20,000 resolving power, high S/N and wavelength coverage from 3900 to 7300 Å. The extraction and calibration of spectra is carried out in IRAF and put special emphasis on scattered light removal. So far 203 of the $\sim$500 target stars have been observed at two widely separated epochs (typically 45 days apart). Coupled with the 0.5 km/s accuracy of measured radial velocities, re-observation prunes the sample from most - if not all - binary stars. Radial velocities are obtained via cross-correlation against synthetic templates. Cross-correlation of a synthetic telluric spectrum against telluric absorptions in reddest Echelle orders allows to control the zero point of the wavelength scale at the 0.3 km/sec level. Measurement of $T_{\rm eff}$, $\log g$, [M/H], $V_{\rm rot} \sin i$, [α/Fe], ξ is performed via χ^2 fitting to the synthetic spectral library of Munari et al. (2005), cf. Fig 1 and 2.

To derive reliable space velocities the distance must be known to appropriate accuracy. The M_{V_T}, M_K and optical-IR photometric colors have been calibrated as function of atmospheric parameters, in particular the metallicity, against ARCS stars with an Hipparcos parallax more accurate than 10%. This is used to refine the Hipparcos parallax of more distant targets. Reddening is not an issue at the high galactic latitude of ARCS survey, nevertheless absorption by interstellar lines of NaI D and CaII H & K are used to measure E(B-V) adopting Munari & Zwitter (1997).
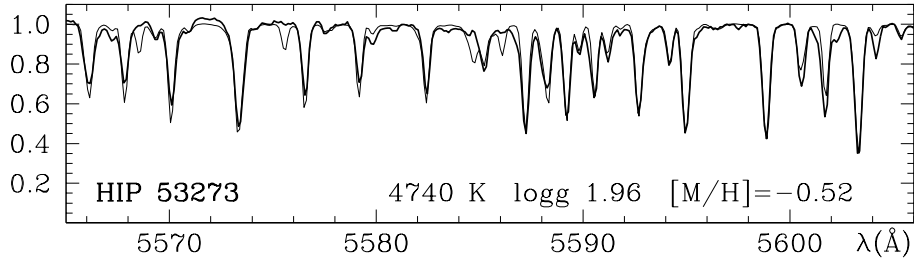
Figure 1.   Example of χ^2 fitting of a single Echelle order against the Munari et al. (2005) synthetic spectral library. Similar results for other 22 Echelle orders are averaged into final results (and error) for the given ARCS target.
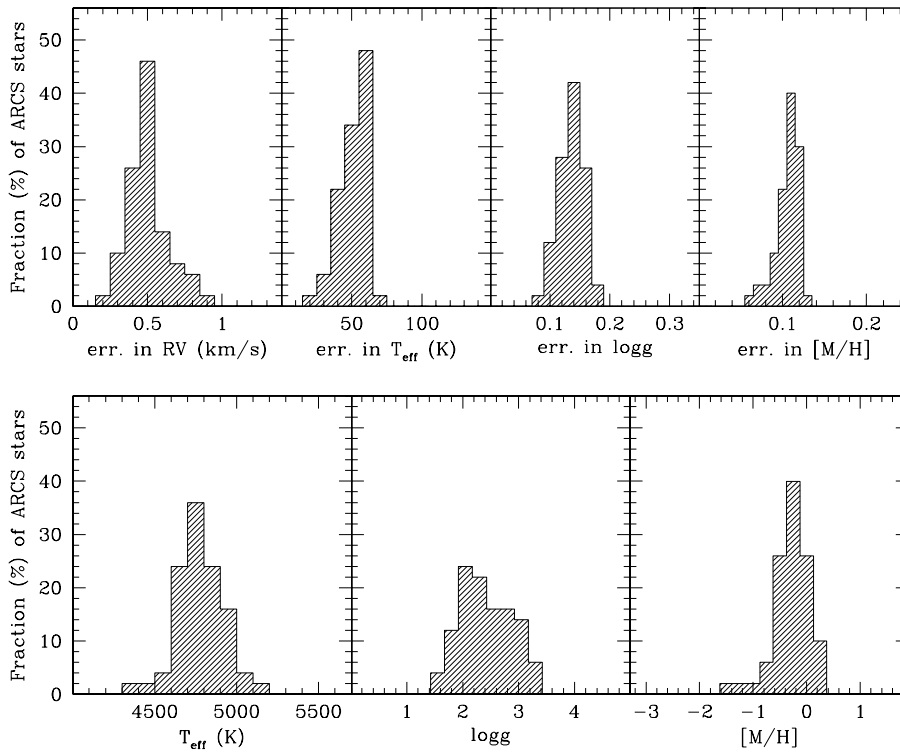

Figure 2.   *Top row*: distribution of errors in the determination of radial velocities, temperature, gravity and metallicity as derived from the comparison of the χ^2 results on three independent and consecutive ARCS re-observations of the same star. *Bottom row*: distribution of temperature, gravity and metallicity derived for ARCS stars.

References

Munari, U., Zwitter, T. 1997, A&A, 318, 269
Munari, U., et al. 2005, A&A, 442, 1127