# Classification Spectra and determination of stellar fundamental parameters

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## Abstract

In the time of large space based mission like Corot and Kepler the increasing need for accurate fundamental parameters of all the observed targets for further analysis and interpretation is obvious. This leads to a huge competition for time on large telescopes for the needed spectroscopic follow up programs. We present an approach to use easier classification spectra and show the possibilities and limitations of a fully automated tool for the determination of temperature, surface gravity and metallicity.

By fitting synthetic spectra to the temperature and gravity sensitive parts of the observations we derive the physical parameters of the observed stars. Our pipeline works for stars in the temperature range of 5000 to 20000 K. At this time temperatures, surface gravities and metallicity of approximately 14000 stars are available for the IRa1, LRa1 and LRa2 of CoRoT which will be published in a catalogue.

## Observation

During the ground based follow up of the CoRoT runs IRa1, LRa1 and LRa2 several thousand AAOmega classification spectra (Guenther et al. 2012) with a resolution of R=1400 were obtained at the AAT (Anglo Australian Telescope) which is located at the Siding Spring Observatory in Coonabarabran in Australia. The AAOmega facility allows the simultaneous observation of about 390 classification spectra via a fiber-fed spectrograph in one exposure.

Furthermore narrow band Strömgren photometry acquired for the IRa1 of CoRoT at the Isaac Newton Group of Telescopes, La Palma was available.

Broad band 2MASS Johnson colors extracted from the headers of the CoRoT light curves were also used .

## Temperature Estimation

To calculate the temperatures from the photometric indices we used the calibrations of Ramirez et al. 2005 for the Johnson photometry and Napiwotzki et al. 1993 for the Strömgren photometry.

Using model atmospheres computed by LLmodels (Shulyak et al. 2004) and synthetic spectra calculated with SynthV (Tsymbal et al. 1996) for fitting the observed Hβ line it was possible to derive the effective temperatures of the stars (Kaiser et al. 2012) from AAO spectra.

The last set of effective temperatures was estimated using Hα line fitting of medium resolution HARPS spectra performed by hand with Rotate (Kochukhov 2007).

## Temperature Comparison

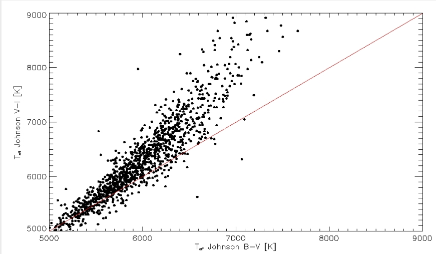


Fig. 1. Comparison of $T_{eff}$ derived from Johnson photometry for the temperature indicators B-V and V-I.

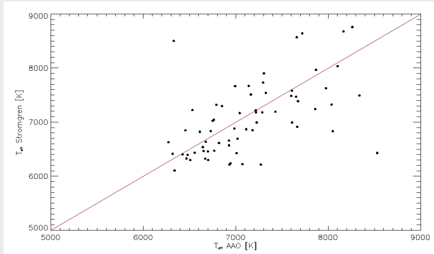


Fig. 2. Comparison of $T_{eff}$ derived from Strömgren photometry and AAO spectroscopy.

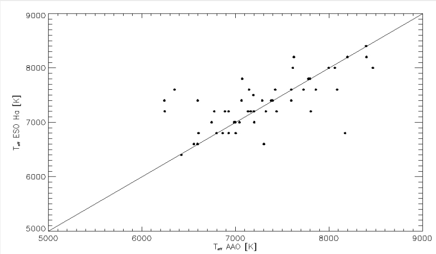


Fig. 3. Comparison of $T_{eff}$ derived from AAO spectroscopy and high resolution ESO Flames spectroscopy.

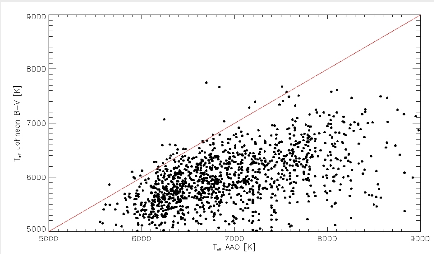


Fig. 4. Comparison of $T_{eff}$ derived by Johnson B-V photometry and AAO spectroscopy.

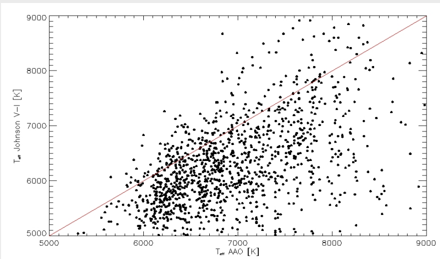


Fig. 5. Comparison of $T_{eff}$ derived from Johnson V-I photometry and AAO spectroscopy.

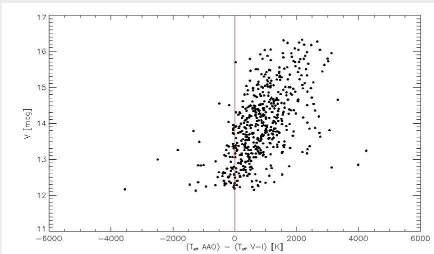


Fig. 6. Difference of the temperatures derived from AAO spectra to those derived from the Johnson V-I index in relation to the V magnitude of the observed stars.

## Discussion & Conclusion

Figure 1 shows the effective temperatures estimated from Johnson B-V versus V-I colors. For the hotter stars a clear trend is visible. These stars have an up to 1000K offset resulting a uncertainty of one entire MK class. This effect is caused by the different interstellar reddening effects especially for our faint CoRoT targets.

Figure 2 shows the situation for effective temperatures estimated using narrow band Strömgren photometry and spectroscopic line fitting. As the Strömgren calibrations used iterative dereddening algorithms the trend observed by broad band estimates is not visible.

Figure 3 shows the effective temperatures derived from medium resolution ESO Flames spectra and from low resolution AAO spectra. Again there is no visible trend, indicating that the resolution of the AAO spectra is sufficient for estimating the temperature.

Figure 4 shows the effective temperatures derived from Johnson B-V colors and from low resolution spectra. The effect of reddening is strongly visible and is in many cases more than an entire spectral class.

Figure 5 shows the effective temperatures derived from Johnson V-I colors and from low resolution spectra. The effect of reddening is still clearly visible although is, as expected, not as strong as for the B-V photometry.

Figure 6 illustrates the effect of reddening with apparent magnitude of the stars. Fainter stars have in general more reddening and thus a bigger error in the effective temperature estimation from broad band colors.

The accuracy of fundamental parameters derived by low-resolution spectroscopy is superior to those of photometric indices. For narrow band photometry it is comparable but the estimate of the surface gravity and the metallicity is not possible in a satisfying way (Kaiser et al. 2012).

Low resolution spectroscopy solves therefore two challenges of modern day ground based follow up observation . It can be done for multiple objects simultaneously on medium size telescopes and it provides fundamental parameters that do not suffer from interstellar reddening effects.

## References

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