

## CHAPTER 9

### Summary and Conclusions

Photometric time-series observations for the open cluster NGC 2126 were obtained during 22 nights in the years 2004, 2013 and 2015 using the 1-m telescope at the Mount Lemmon Optical Astronomy Observatory (LOAO), Arizona and 0.5 and 2.4-m telescopes at the Thai National Observatory (TNO), Thailand. In this present study, the calibrated  $B$  and  $V$  photometry of stars in the FOV down to  $V \approx 17$  mag are presented. These data were used to determine the basic parameters of the cluster including the cluster extinction, age, metallicity and distance from the colour-magnitude diagram (CMD). The physical parameters of the cluster NGC 2126 is obtained through theoretical isochrone fitting;  $\log(\text{age}) = 9.1 \pm 0.1$  yr, metallicity of 0.019, extinction  $E(B - V) = 0.27 \pm 0.01$  mag and distance modulus of  $(m - M)_0 = 10.80 \pm 0.05$  mag. And the physical parameters of the cluster NGC 1528:  $\log(t)$  of  $8.50 \pm 0.05$  yr and a metallicity of 0.019.  $E(B - V) = 0.25 \pm 0.01$  mag and  $(m - M)_0 = 9.85 \pm 0.05$  mag.

Eleven new and known variable stars in the field of the cluster NGC 2126 were detected. Eight of them are pulsating stars, two of them are Algol-type eclipsing binaries and one is an eclipsing binary with a pulsating component. The identification of six previous known variables from Gáspár et al. (2003) and three known variables from Liu et al. (2009) are confirmed. Two new multi-periodic  $\delta$  Scuti variables N1 and N2 located in the area of  $\delta$  Scuti instability strip are discovered and identified. V1 and V2 show long-period variations with the period of about 0.8 d. From absolute magnitude, the spectral classes and the pulsation periods both stars can be interpreted as  $\gamma$  Dor stars. The light variation of the stars V5, ZV1 and ZV2 show multi-periodic variations. From their pulsation periods, spectral classes and the locations on the CMD, It is concluded that they are multi-periodic  $\delta$  Scuti stars.

The interesting target, V551 Aur, in the cluster was studied in detail. The new value of the orbital period of V551 Aur  $1.1731744 \pm 0.0000002$  days is obtained. The light curve was analyzed using the Wilson-Devinney technique in order to obtain a new set of the system's parameters. According to our analysis, the solution shows that V551 Aur is a detached binary system with  $q = 0.769$  and  $i = 73.01^\circ$ . From the period analysis of the residuals, The presence of pulsations with a main frequency of 7.71315 c/d and a semi amplitude of 18.70 mmag is confirmed. The results show that  $f_2$  is the first harmonic of  $f_1$ . The ratio between the orbital and pulsation periods with the value of 9.049 may indicate the existence of a kind of resonance or a possible causal relation to tidal effects suggesting that the 9th harmonic of the orbital period is excited by the tidal forces.

By excluding the high proper motion stars with  $|\mu| > 30$  mas/yr, the average proper motion of the cluster:  $\mu_\alpha \cos \delta = 0.67 \pm 0.20$  mas/yr and  $\mu_\delta = -1.66 \pm 0.23$  mas/yr are found. These values are near to zero, therefore the cluster members are not easily distinguishable in proper motion from the background stars. The accurate values of high proper motion star LHS 1809 as  $\mu_\alpha \cos \delta = 115.7$  mas/yr and  $\mu_\delta = -823.7$  mas/yr are determined. Spectroscopic data for all the variables in the cluster are needed to analyze their variability behavior in detail and obtain more information for individual stars. Though rather faint (it would require a medium-sized telescope), it would be worthwhile to collect high-resolution spectra of all the candidate variable stars in the cluster to determine their fundamental atmospheric properties with a good accuracy. This additional information and the radial velocity data would then help to confirm or not their membership to the cluster.

CCD times of the light minimum in  $B$  and  $V$  bands of AO Ser were obtained during 13 nights using the telescope at Beersel Hills Observatory and spectroscopic data using HERMES high-resolution spectrograph. Our new light and radial velocity curves of AO Ser were simultaneously analyzed using the Wilson-Devinney technique. A semi-detached configuration of the system is confirmed and an accurate mass ratio from the binary radial velocity orbit and absolute physical parameters, effective temperatures, radii and a surface gravity of components are determined. We can interpret the stellar type of

secondary component as K2 III. The new accurate parameters will be used for spectroscopic modelling and analyses of pulsation line-profile variations in the primary component caused by non-radial pulsations.



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