NGC 6067: A SPECTROSCOPIC STUDY

J. Alonso, I. Negueruela, A. Marco & R. Dorda

Universidad de Alicante

Universitat d'Alacant
Universidad de Alicante

INTRODUCTION

NGC 6067 is a young open cluster in the Norma Cloud. Its age is around 100 Ma. It hosts a large population of evolved stars: 14 luminous red stars (most of which K Ib supergiants and late-G/early-K giants), 6-8 B giants, two A/F supergiants and two Cepheids (F/G supergiants). All this would imply that NGC 6067 represent one of the best laboratories in the Galaxy to study the evolution of intermediate mass stars. Thackeray et al. (1962, MNRAS 124, 445) performed the first complete study of this cluster but it has been poorly studied since then.

OBSERVATIONS

We obtained high resolution echelle spectra (R=48000) using FEROS (Fiber Extended Range Optical Spectrograph) mounted on the ESO 2,2 m telescope at La Silla Observatory (Chile) in May 2011. Here we present preliminary results based on this spectroscopy and the *UBV* photometry listed in Terndrup & Pinsonneault (2007, ApJ 671, 1640).
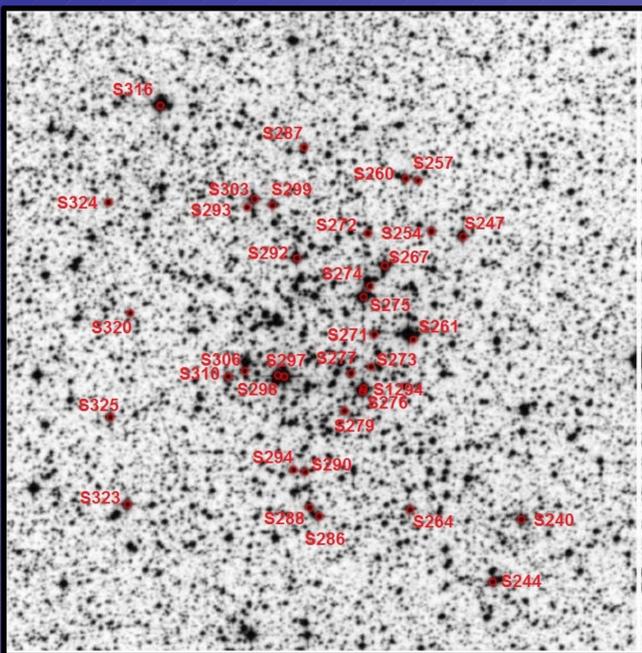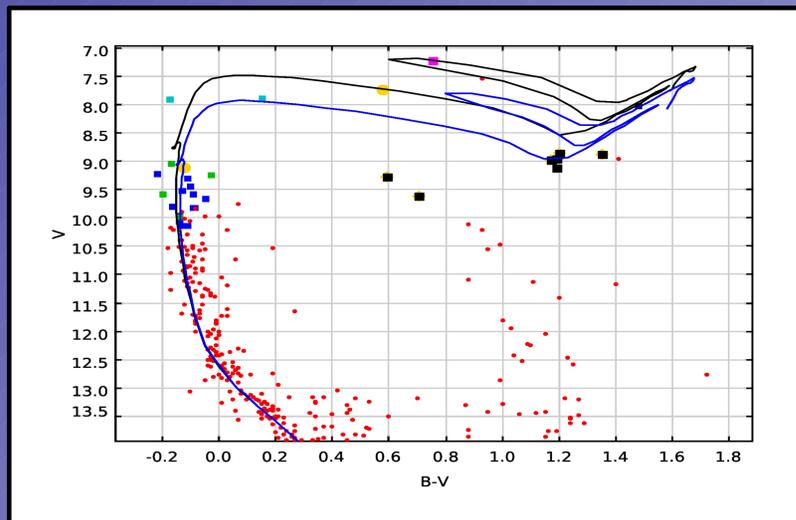

Fig. 1: Finding chart of NGC 6067 (POSS2 + 2MASS)

Fig. 2: CMD for the cluster area. Red circles are the stars observed by Terndrup & Pinsonneault using *UBV* photometry. The remaining stars have been observed in this work: B-type stars appear in dark blue (at the top of MS), Be are green squares, blue giants are shown as light blue squares, binaries stars as yellow circles and red giants as black squares. Cepheid V340 Nor is marked as a pink square.
Two Padova isochrones are drawn. The black one (log τ=7,9) fits the Cepheid better whereas the blue isochrone (log τ =8,0) fits the red giants properly.

CPD NAME	NGC6067	SP. T.
CPD -53 7339	257	B6 IV
CPD -53 7343	260	B6 IV
CPD -53 7361	272	B8 IV shell
CPD -53 7362	273	B7 IV
CPD -53 7370	277	B9 III Si
CPD -53 7372	279	B8 III
CPD -53 7383	285	B7 IV
CPD -53 7385	287	B7 IV
CPD -53 7390	290	B5 shell
CPD -53 7392	291	B9 III Si
CPD -53 7395	293	B7 V
CPD -53 7397	294	B8 IV e
CPD -53 7449	320	B6 V
CPD -53 7456	324	B7 IV

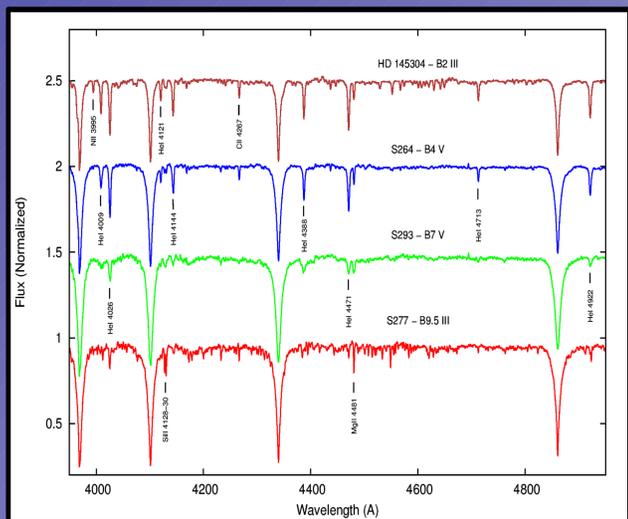*Table:* This is the first spectral classification for some of the brightest blue stars.

Fig 3: Typical spectra (degraded to R=4000) of the blue stars in NGC 6067, covering almost the entire B spectral class. The most important lines are marked (except the Balmer lines, the four deepest). The top of the main sequence is the star S264, with a spectral type B4.
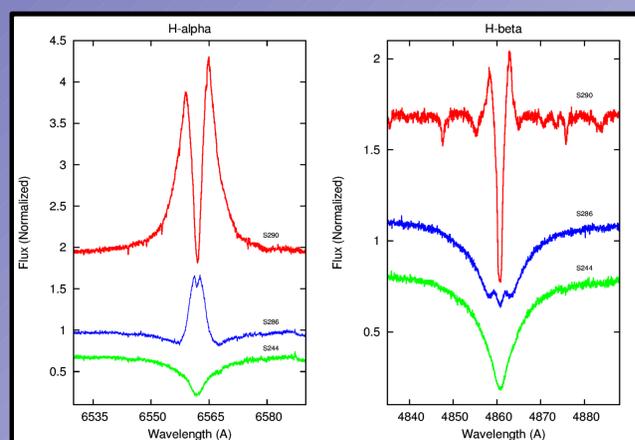

Fig. 4: H-alpha (left) and H-beta (right) line profiles. Star S244 is a non-emission star (B7 III-IV) whereas stars S286 (B7 IIIe) and S290 (B5 shell) show a strong emission in both lines.
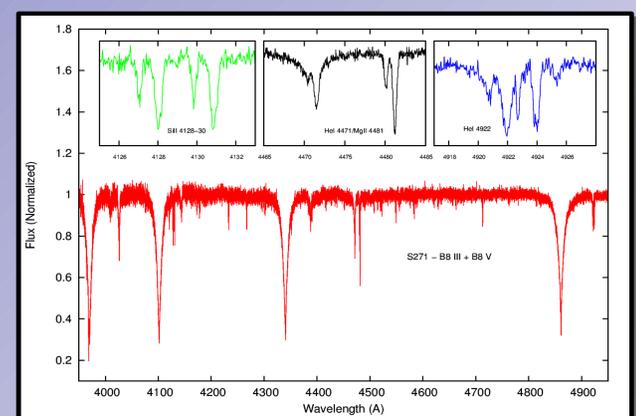

Fig. 5: High resolution spectrum of star S271, a new spectroscopic binary. Three regions are shown in detail. As seen in the inset, specially noted in the SiII region, lines appear doubled so it is possible to observe both companions.

PRELIMINARY RESULTS & FUTURE WORK

Our study is the most complete to date (spectroscopically). We obtained high resolution spectra for half a hundred stars, of which around two dozens have never been observed (In the table is shown a sample of blue stars). We discovered several emission stars (Fig. 4) and, at least, one spectroscopic binary (Fig. 5).
We focused on blue stars, found mostly in the B7-B8 range, to improve some values of the cluster as the distance or extinction The top of the main sequence is at spectral type B4 (S264).
As future work, we will obtain different stellar parameters from these spectra such as radial velocities, chemical abundances ...etc, to confirm or discard the membership of certain stars to the cluster and to test stellar atmosphere models.