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A near-IR stellar spectral library in the H band using the Mt. Abu telescope

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Abstract. We present an H band near-infrared (NIR) spectral library of 135 solar type stars covering spectral types O5–M3 and luminosity classes I–V as per MK classification. The observations were carried out with 1.2 meter Gurushikhar Infrared Telescope (GIRT), at Mt. Abu, India using a NICMOS3 HgCdTe 256×256 NIR array based spectrometer. The spectra have a moderate resolution of 1000 (about 16 Å) at the H band and have been continuum shape corrected to their respective effective temperatures. A detailed paper describing all the aspects of this spectral library has been published in Ranade et. al. (2004).

The complete H-Band library is available online at:

http://vo.iucaa.ernet.in/∼voi/NIR_Header.html

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1. Introduction

Near-infrared astronomy has seen a very rapid growth in the past few decades. This growth has also initiated efforts by various groups to observe stars in the NIR region, i.e., J, H and K bands and make photometric and spectroscopic measurements. A comprehensive set of reference spectra in these bands has special importance in stellar population synthesis studies of galaxies, clusters and AGN's and for the purpose of synthesizing the integrated light spectrum of these objects. Large-area photometric sky surveys such as

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2MASS (2 Micron All-Sky Survey, Skrutskie et al. 1997) and DENIS (Deep Near-Infrared Survey, Epchtein 1997) have produced large target lists that require spectroscopic follow-ups.

Modern spectral classification tools like Artificial Neural Networks (ANN) have recently made use of such spectral libraries in the optical region (Valdes et al. 2004). The features of the most prominent near-infrared stellar spectral libraries available in the literature have been summarized recently by Ivanov et al. (2004). They have also presented H and K-Band spectra of 218 red stars spanning a range of [Fe/H] $\sim$ -2.2 to $\sim$ +0.3. We present here a spectral library of 135 stars in the H band at a moderate resolution of 16 Å covering a larger range in T_{eff} as compared to Ivanov et al. (2004) thus complementing the existing NIR libraries. For 119 of the stars, the wavelength coverage is from 1.52 μm to 1.78 μm and for 16 stars the coverage is from 1.55 μm to 1.73 μm.

Section 2 describes the observations and related issues. In section §3, we describe the basis of selection of the stars for this library and in section §4 we describe the spectral library.

2. Observations

The library of 135 stars has a substantial coverage of H-R diagram from O5-M3 spectral class and supergiants to dwarfs(I to V). This database has been compiled through six different observing runs (January -April 2003). All the observations have been done from the 1.2 meter Gurushikhar Infrared Telescope (GIRT) of Mt.Abu Infrared Observatory, India ($24^0 39' 10.9''$N, $72^0 46' 45.9''$E at an altitude of 1680 meters). The H band long slit spectra were taken from the NIR Imager/Spectrometer equipped with a 256×256 HgCdTe NICMOS3 array. The slit width corresponds to 2 arc-seconds for the f/13 Cassegrain focus with the slit covering most of 240 arc-seconds field of view and oriented along North-South direction in the sky. The reflection grating has 149 lines per mm and is blazed for H band center wavelength of 1.65 μm in the first order and combined with the slit width of 76 μm gives a moderate resolution of 1000. Other observational details are published in Ranade et. al. (2004).

3. Selection of stars

While building a spectral library, it is very important that one includes various spectral types so that we have a homogeneous and comprehensive coverage of all possible spectro-luminosity classes. Given the limitation of instruments' saturation etc., we have limited the exposure times to about few minutes in each of the bands and this limitation allows us to go no fainter than visible magnitude 7 in brightness. The histogram in Fig. 1 represents the number of stars that could be covered with these limitations in terms of spectral types (top panel) and Luminosity classes (bottom panel) in addition to the other

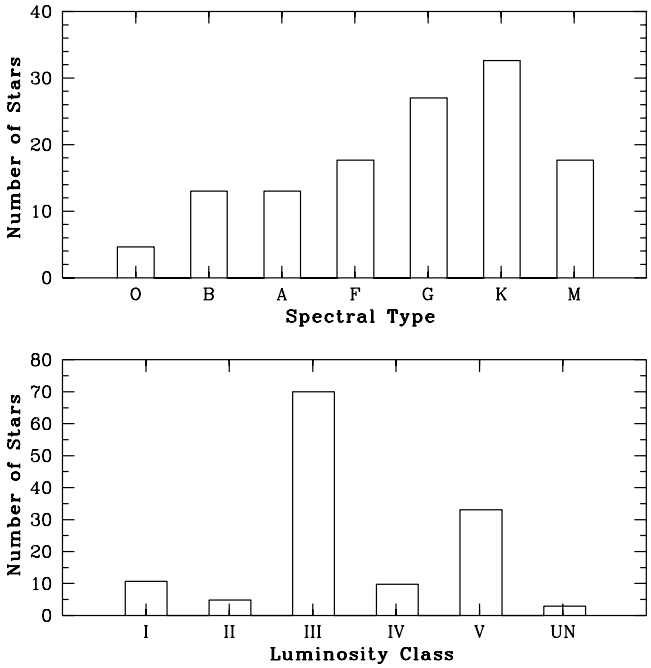

Figure 1. Distribution of stars in the database by spectral type and Luminosity class

limitations like availability at the observatory latitude, weather restrictions etc. It may be noted that we have covered the HR diagram in effective temperature and luminosity parameters reasonably well, although we do not have enough stars for luminosity class II and main spectral type O. Fig. 2 shows the plot of log g vs. T_{eff} for the GIRT stars. The general trend is quite similar to that of Ivanov et al. (2004) except for the larger coverage in effective temperature in our case.

4. Spectral library

The NIR H band spectral library of 135 stars is available in the format of reduced ASCII tables with wavelength versus flux at a spectral resolution of 1000 at 5 Å binning. The main goal of this paper is to make this library available for variety of investigators working in the NIR region. Thus, the complete library can be downloaded from the website:

http://vo.iucaa.ernet.in/∼voi/NIR_Header.html

The essential information of each star in the database is also available in Ranade et. al. (2004). Fig. 3 shows a series of six dwarf stars with spectral types from O to K to illustrate the basic features of the spectra with changing temperature.

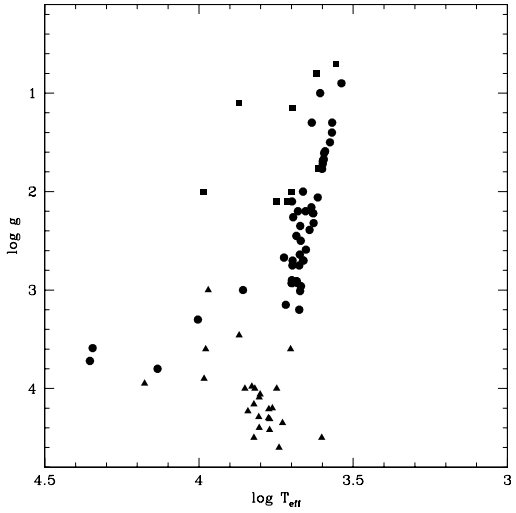

Figure 2. Distribution in the GIRT library: supergiants (I & II) with squares, giants (III) with filled circles and dwarfs (IV & V) with triangles on surface gravity log g vs. effective temperature T_{eff} plane.

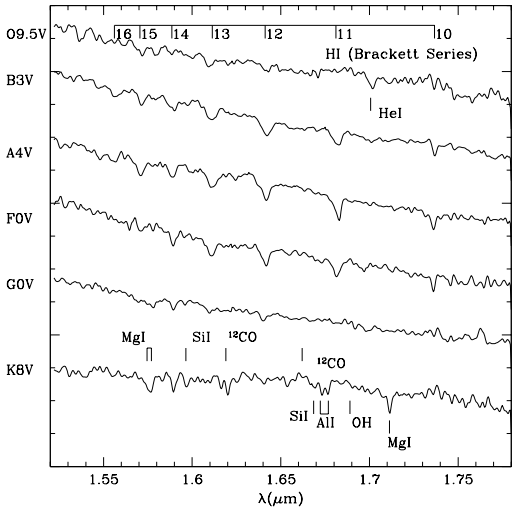

Figure 3. Spectra of six dwarf stars, covering a large range of MK spectral type, are plotted to illustrate the basic dependence of spectral features. The stars plotted, top to bottom, are HR6175, HR1239, HR4357, HR4090, HR4375 and HD88230. The spectral types are listed on the vertical axis. Also shown are some of the prominent absorption features like HI Brackett series and other species seen in the late type spectra.

In conclusion we may mention that this library of 135 stellar spectra in the NIR H band has been carefully checked for its consistency with earlier published libraries and provides a larger database with extended spectro-luminosity coverage for usage in stellar population synthesis work and other applications as well as complimenting large optical libraries.

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