Bull. Astr. Soc. India (2007) **35**, 87–109

A near-infrared stellar spectral library: II. K-band spectra

Arvind C. Ranade[1], Harinder P. Singh[2], Ranjan Gupta[3*] and N. M. Ashok[4]
[1] *Vigyan Prasar, A-50, Institutional Area, Sector-62, NOIDA 201 307, India*
[2] *Department of Physics & Astrophysics, University of Delhi, Delhi 110 007, India*
[3] *IUCAA, Post Bag 4,Ganeshkhind, Pune 411 007, India*
[4] *Physical Research Laboratory, Navrangpura, Ahmedabad 380009, India*

Received 7 May 2007; accepted 26 May 2007

Abstract. This paper is the second in the series of papers on near-infrared (NIR) stellar spectral library produced by reducing the observations carried out with 1.2 meter Gurushikhar Infrared Telescope (GIRT), at Mt. Abu, India using a NICMOS3 HgCdTe 256×256 NIR array based spectrometer. In paper I (Ranade et al. 2004), H-band spectra of 135 stars at a resolution of ~ 16Å were presented. The K-band library being released now consists of 114 stars covering spectral types O7–M7 and luminosity classes I–V. The spectra have a moderate resolution of ~ 22Å in the K band and have been continuum shape corrected to their respective effective temperatures. We hope to release the remaining J-band spectra soon. The complete H and K-Band library is available online at: http://vo.iucaa.ernet.in/~voi/NIR_Header.html

Keywords : astronomical databases: atlases – techniques: spectroscopic – instrumentation: spectrographs – methods: observational – infrared: stars

1. Introduction

In the last few years, several population synthesis models have completely renewed the interest for population analysis. Models by Vazdekis et al. (1999), Bruzual & Charlot (2003) and le Borgne et al. (2004, PEGASE.HR) gained in details with a higher spectral

*e-mail:rag@iucaa.ernet.in

Table 1. Observations log at GIRT.

Dates of Observations	Programme Stars	Standard Stars
20-24 Jan 03	18	1
07-12 Feb 03	40	3
02-04 Mar 03	13	2
17-20 Mar 03	28	1
04-07 Apr 03	26	9
27-30 Apr 03	20	18

resolution. The physics of the models has improved substantially, with the implementation of new evolutionary tracks, in particular with enhanced Mg/Fe (Thomas & Maraston 2003). However, the most remarkable progress concerns the quality of the stellar libraries.

A decade ago, the stellar spectral libraries, even in the visible region, were lacking in spectral resolution, wavelength coverage and/or coverage of the parameter space. The best library at that time was the Jones library (1999) with a resolution R=3000 but with a restricted wavelength coverage, and a poor knowledge of the atmospheric parameters of the stars. In the last few years a new generation of libraries has been published; ELODIE: with 1500 stars at R=10000 in the range 390 to 680 nm (Prugniel & Soubiran 2001; last version in Prugniel et al. 2007); STELIB: which has a small number of stars and low resolution but covers all the visible range (Le Borgne et al. 2003); INDO-US (Valdes et al. 2004) which has both a large wavelength coverage with a good spectral resolution, R=5000 and MILES: which has a good coverage in wavelength and atmospheric parameters but still insufficient resolution (Sanchez-Blazquez et al. 2006).

But the situation is not the same in case of near-infrared. Several authors have compiled small libraries in K band region (Johnson & Meńdez 1970 ; Kleinman & Hall 1986; Lançon & Rocca-Volmerange 1992; Ali et al. 1995; Hanson et al. 1996; Wallace & Hinkle 1997). Most of these libraries are at medium resolution (500-3000). The most recent is by Ivanov et al. (2004) which contains 218 late type stars spanning a range of [Fe/H] $\sim$ -2.2 to $\sim$ +0.3 but is not flux calibrated. In this paper, we present a spectral library of 114 star in K-band at moderate resolution of 22 Å covering larger range in T_{eff} as compared to Ivanov et al. (2004).

In this paper, 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 data reduction and calibration procedure. Lastly, in section §5 we show examples of some K band spectra and their comparison with the existing database of Wallace et al. (1997).

Table 2. Standard star list with observational parameters*.

HD (1)	α(J2000.0) (2)	δ(J2000.0) (3)	Type (4)	V_{mag} (5)	T_{eff} (°K) (6)
HD71155	08 25 39.63	-03 54 23.13	A0V	3.90	9520
HD87901	10 08 22.31	+11 58 01.95	B7V	1.35	13000
HD28319	04 28 39.74	+15 52 15.17	A7III	3.41	8150
HD47105	06 37 42.70	+16 23 57.31	A0IV	1.90	9520
HD71155	08 25 39.63	-03 54 23.13	A0V	3.90	9520
HD47105	06 37 42.70	+16 23 57.31	A0IV	1.90	9520
HD139006	15 34 41.27	+26 42 52.90	A0V	2.21	9520
HD65456	07 57 40.11	-30 20 04.46	A2Vvar	4.79	8970
HD97633	11 14 14.41	+15 25 46.45	A2V	3.32	8970
HD155125	17 10 22.69	-15 43 29.68	A2.5Va	2.43	8845
HD94601	10 55 36.82	+24 44 59.3	A1V	4.50	9230
HD60179	07 34 35.9	+31 53 18	A1V	1.58	9230
HD106591	12 15 25.56	+57 01 57.42	A3V	3.30	8720
HD153808	17 00 17.37	+30 55 35.06	A0V	3.91	9520
HD103287	11 53 49.85	+53 41 41.14	A0Ve	2.43	9520
HD130109	14 46 14.92	+01 53 34.39	A0V	3.72	9520
HD85235	09 52 06.36	+54 03 51.56	A3IV	4.56	8720
HD141003	15 46 11.26	+15 25 18.57	A2IV	3.66	8970
HD79469	09 14 21.86	+02 18 51.41	B9.5V	3.88	10010
HD118098	13 34 41.60	-00 35 44.95	A3V	3.40	8720
HD82621	09 34 49.43	+52 03 05.32	A2V	4.48	8970
HD141003	15 46 11.26	+15 25 18.57	A2IV	3.66	8970
HD87737	10 07 19.95	+16 45 45.59	A0Ib	3.51	9730
HD141003	15 46 11.26	+15 25 18.57	A2IV	3.66	8970

* (2)-(5) From SIMBAD database,(6) From Lang (1992)

2. Observations

The database of 114 stars selected in this library were observed in six different runs from January-April 2003. The details of the log is shown in Table 1 in which the first column gives observing date and month, column 2 gives the total number of programme stars observed in each run, last column gives the total number of standard stars observed in each run. All the observations have been done from the 1.2 meter Gurushikhar Infrared Telescope (GIRT) of Mt.Abu Infrared Observatory, India (24°39′ 10.9″N, 72°46′45.9″E at an altitude of 1680 meters). The K 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 arcseconds for the f/13 Cassegrain focus with the slit covering most of 240 arcseconds 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

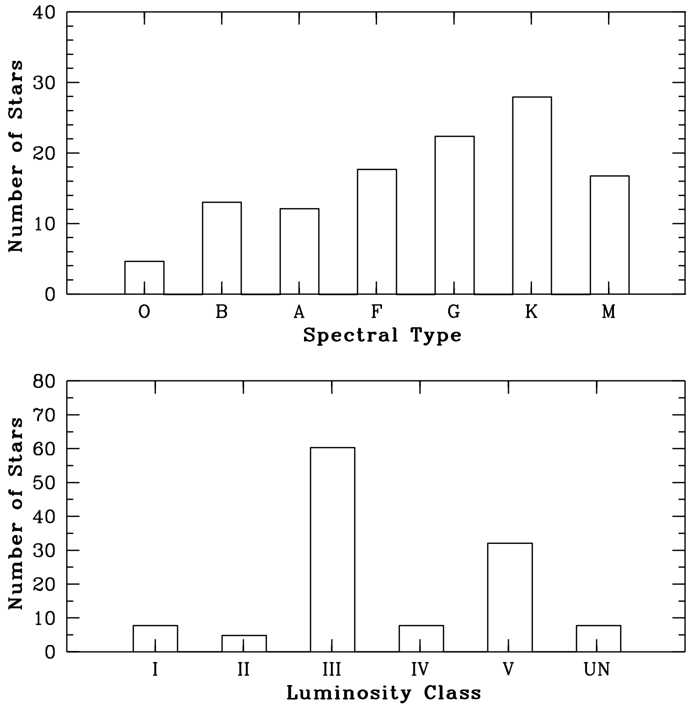

Figure 1. Distribution of stars in the database by spectral type and luminosity class.

1.65 μm in the first order and combined with the slit width of 76 μm gives a moderate resolution of 1000. The exposure time for individual spectrum ranged from 1 sec to 120 sec depending on the K magnitude of the programme star resulting in S/N ratio of 50 or better. Two sets of spectra were obtained at two dithered positions on the array, the typical separation was about 20 arcsec. As the 256 elements of NICMOS3 array in the dispersion axis do not cover the entire K band, the spectra have been obtained for two grating settings, denoted as K1 and K2 region. By combining K1 and K2 region, single K band spectra have been computed. The details of procedure to acquire the data from the Mt. Abu observatory is discussed in paper I.

For a majority of the programme stars, we have observed a nearby main-sequence A type star at nearly same air-mass to minimize the effects of atmospheric extinction. To optimize the observing efficiency, a single standard star has been observed whenever some of the programme stars happened to be in the nearby region of the sky. For the early February and late April 2003 observing runs, late B type standards have been observed. The list of standard stars that have been observed are given in Table 2. In this table the standard star identifier is given in column (1) with right ascension and declination for J2000.0 in columns (2) and (3) respectively. Columns (4), (5) and (6) contain the spectro-luminosity class, observed V magnitude and T_{eff} respectively.

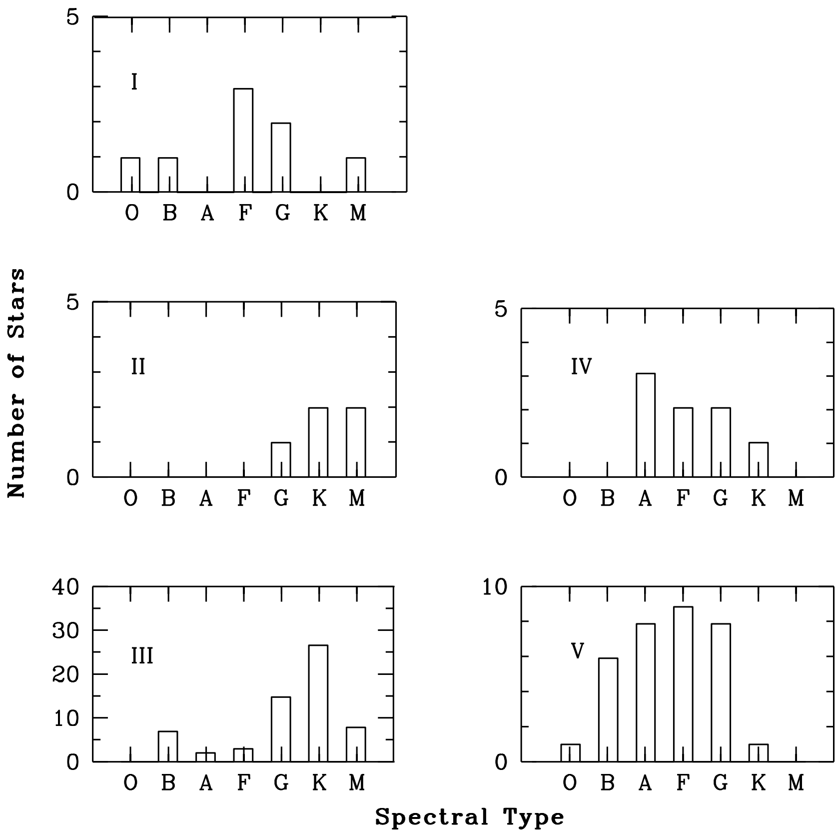

Figure 2. Distribution of stars in the database by spectral type per luminosity class.

The wavelength calibration has been performed using OH airglow lines. Hence, in case of brighter stars when the individual integration time was less than 120 sec, a separate sky frame was taken with 120 sec exposure time by drifting the star in RA axis by typically about 10 arcseconds. This enabled the OH airglow lines to register with reasonably large counts.

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. To optimise the observing efficiency stars upto a magnitude of ~ 7 were selected for the present programme. The histogram in Fig. 1 represents the total number of stars covered in terms of spectral types (top panel) and luminosity classes (bottom panel). The details of number of stars covered in terms of spectral types per

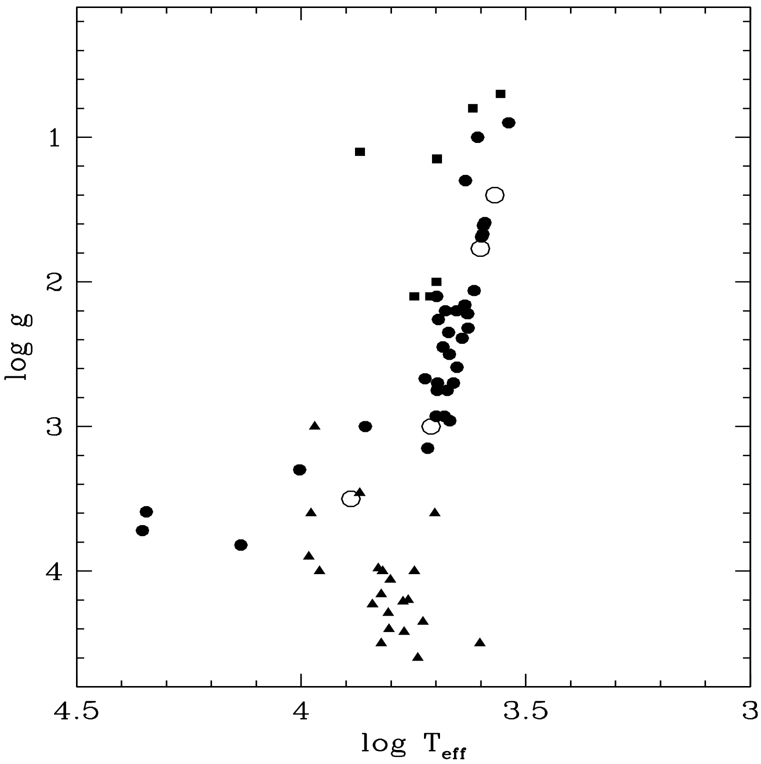

Figure 3. Distribution in the GIRT library: supergiants (I & II) with filled squares, giants (III) with filled circles, dwarfs (IV & V) with filled triangles and unknown luminosity class with open circles on surface gravity log g vs. effective temperature T_{eff} plane.

luminosity class is illustrated by the histogram in Fig. 2. 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. The details of programme stars along with the NIR magnitudes in J,H,K,L & M are listed in Table 3. In this table, the first column contains the programme star ID, columns (2) to (6) list the J,H,K,L, & M magnitudes respectively. The references from which they have been taken are listed in column 7.

The detailed criteria for the selection of stars with their references are discussed in paper I. We have covered a reasonable region of parameter space in temperature, gravity and metallicity. Fig. 3 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. Figs 4 and 5 shows the plot of [Fe/H] vs. T_{eff} and log g respectively for the GIRT sample.

Table 3. NIR magnitudes of programme stars.

HD (1)	J_{mag} (2)	H_{mag} (3)	K_{mag} (4)	L_{mag} (5)	M_{mag} (6)	Reference (7)
HD007927						1997ApJ....111...445 (Wallace)
HD008538		2.30				1998ApJ....508...397 (Meyer)
HD023475						1997ApJ....111...445 (Wallace)
HD025204	3.66	3.67	3.66	3.65	3.71	1983A&AS....51...489 (Koornneef)
HD026846	2.97	2.39	2.27	2.19		1983A&AS....51...489 (Koornneef)
HD030652	2.37	2.15	2.08	2.09		1983A&AS....51...489 (Koornneef)
HD030836		4.10				1998ApJ....508...397 (Meyer)
HD035468	2.17	2.28	2.32	2.34	2.36	1983A&AS....51...489 (Koornneef)
HD035497	1.96	2.02	2.02	2.03	2.11	1983A&AS....51...489 (Koornneef)
HD036673	2.05	1.92	1.86	1.81		1983A&AS....51...489 (Koornneef)
HD037128		2.40				1998ApJ....508...397 (Meyer)
HD037742	2.21	2.27	2.32	2.31		1983A&AS....51...489 (Koornneef)
HD038393	2.70	2.47	2.41	2.38		1983A&AS....51...489 (Koornneef)
HD038858	4.82	4.50	4.44			1991A&AS....91...409 (Bouchet)
HD040136	3.10	2.94	2.90	2.87		1983A&AS....51...489 (Koornneef)
HD043232	1.84	1.19	1.02	0.94		1983A&AS....51...489 (Koornneef)
HD047839		5.50				1998ApJ....508...397 (Meyer)
HD048329						1997ApJ....111...445 (Wallace)
HD049331						1997ApJ....111...445 (Wallace)
HD054605	0.77	0.51	0.41	0.32	0.28	1983A&AS....51...489 (Koornneef)
HD054810	3.18	2.64	2.53	2.47		1983A&AS....51...489 (Koornneef)
HD056537						1997ApJ....111...445 (Wallace)
HD058715	1.83	1.07	0.90	0.77		1983A&AS....51...489 (Koornneef)
HD060414	1.25	0.38	0.09	-0.09	0.17	1983A&AS....51...489 (Koornneef)
HD061935	2.28	1.77	1.62	1.57		1983A&AS....51...489 (Koornneef)
HD062576	1.74	0.96	0.75	0.63		1983A&AS....51...489 (Koornneef)
HD062721						1997ApJ....111...445 (Wallace)
HD063700	1.52	1.03	0.89	0.81		1983A&AS....51...489 (Koornneef)
HD065810	4.40	4.33	4.32	4.31		1990MNRAS....242...1 (Carter)
HD067228	4.13	3.91	3.83	3.79	3.92	1983A&AS....51...489 (Koornneef)
HD068312						1997ApJ....111...445 (Wallace)
HD070272						1997ApJ....111...445 (Wallace)
HD071369						1997ApJ....111...445 (Wallace)
HD072094	2.45	1.64	1.43	1.26	1.57	1994A&AS....105...311 (Fluks)
HD074918	2.80	2.33	2.23	2.17		1983A&AS....51...489 (Koornneef)
HD076943						2004ApJS...152..251 (INDO-US)
HD077912						2004ApJS...152..251 (INDO-US)
HD085444	2.59	2.13	2.02	1.97		1983A&AS....51...489 (Koornneef)
HD085951	2.01	1.22	1.01	0.85	1.18	1994A&AS....105...311 (Fluks)
HD086663	1.54	0.72	0.50	0.34	0.66	1994A&AS....105...311 (Fluks)
HD088230						2004ApJS...152..251 (INDO-US)
HD088284	1.99	1.51	1.40	1.34		1983A&AS....51...489 (Koornneef)
HD089010	4.78	4.47	4.40	4.36	4.42	1983A&AS....51...489 (Koornneef)
HD089025		2.8				1998ApJ....508...397 (Meyer)
HD089021		3.3				1998ApJ....508...397 (Meyer)

Table 3. Continued.

HD (1)	J_{mag} (2)	H_{mag} (3)	K_{mag} (4)	L_{mag} (5)	M_{mag} (6)	Reference (7)
HD089449						2004ApJS...152..251 (INDO-US)
HD089490						2004ApJS...152..251 (INDO-US)
HD089758						1997ApJ....111...445 (Wallace)
HD090254	2.45	1.59	1.36	1.20	1.48	1994A&AS....105...311 (Fluks)
HD090277						2004ApJS...152..251 (INDO-US)
HD090432	1.31	0.56	0.38	0.26		1983A&AS....51...489 (Koornneef)
HD090610	1.81	1.07	0.91	0.77	1.00	1994A&AS....105...311 (Fluks)
HD092125						1997ApJ....111...445 (Wallace)
HD092588						2004ApJS...152..251 (INDO-US)
HD093813	1.07	0.42	0.27	0.17		1983A&AS....51...489 (Koornneef)
HD094264						2004ApJS...152..251 (INDO-US)
HD094481						1997ApJ....111...445 (Wallace)
HD095418						1997ApJ....111...445 (Wallace)
HD097603	2.32	2.27	2.27	2.29		1983A&AS....51...489 (Koornneef)
HD097778						1997ApJ....111...445 (Wallace)
HD098430	1.68	1.07	0.94	0.86		1983A&AS....51...489 (Koornneef)
HD099028						2004ApJS...152..251 (INDO-US)
HD099167						2004ApJS...152..251 (INDO-US)
HD100407	2.01	1.58	1.44	1.40	1.50	1983A&AS....51...489 (Koornneef)
HD100920						2004ApJS...152..251 (INDO-US)
HD101501		3.8				1998ApJ....508...397 (Meyer)
HD102647		2.0				1998ApJ....508...397 (Meyer)
HD105707	0.94	0.31	0.14	0.03		1983A&AS....51...489 (Koornneef)
HD106625	2.79	2.83	2.82	2.76		1983A&AS....51...489 (Koornneef)
HD107259	3.81	3.78	3.77	3.76		1990MNRAS....242...1 (Carter)
HD107328	2.95	2.32	2.19	2.09		1983A&AS....51...489 (Koornneef)
HD108767	3.06	3.08	3.06	3.03		1983A&AS....51...489 (Koornneef)
HD109358						2004ApJS...152..251 (INDO-US)
HD109379	1.24	0.81	0.70	0.64		1983A&AS....51...489 (Koornneef)
HD109387						2004ApJS...152..251 (INDO-US)
HD110379	2.07	1.90	1.86	1.84		1983A&AS....51...489 (Koornneef)
HD111812	3.73	3.46	3.36	3.29	3.34	1983A&AS....51...489 (Koornneef)
HD113139		4.1				1998ApJ....508...397 (Meyer)
HD113226						1997ApJ....111...445 (Wallace)
HD113847						2004ApJS...152..251 (INDO-US)
HD113996						2004ApJS...152..251 (INDO-US)
HD114330						1997ApJ....111...445 (Wallace)
HD114961						2004ApJS...152..251 (INDO-US)
HD115604		3.9				1998ApJ....508...397 (Meyer)
HD115892	2.73	2.74	2.73	2.70		1983A&AS....51...489 (Koornneef)
HD116656				–		1997ApJ....111...445 (Wallace)
HD116658	1.53	1.64	1.68	1.72	1.76	1983A&AS....51...489 (Koornneef)
HD116870	2.62	1.81	1.61	1.47	1.73	1994A&AS....105...311 (Fluks)
HD120315		2.4				1998ApJ....508...397 (Meyer)
HD120323	-0.51	-1.39	-1.66	-1.84	-1.4 0	1983A&AS....51...489 (Koornneef)
HD123139	0.42	-0.09	-0.21	-0.31	-0.2 1	1983A&AS....51...489 (Koornneef)
HD123299		3.5				1998ApJ....508...397 (Meyer)
HD123657						2004ApJS...152..251 (INDO-US)
HD123934						2004ApJS...152..251 (INDO-US)

Table 3. Continued.

HD (1)	J_{mag} (2)	H_{mag} (3)	K_{mag} (4)	L_{mag} (5)	M_{mag} (6)	Reference (7)
HD124294	1.89	1.18	1.03	0.94		1983A&AS....51...489 (Koornneef)
HD126661						2004ApJS...152..251 (INDO-US)
HD127665						2004ApJS...152..251 (INDO-US)
HD129116	4.38	4.46	4.52	4.56		1990MNRAS....242...1 (Carter)
HD129502	3.12	2.94	2.89	2.83		1983A&AS....51...489 (Koornneef)
HD130025						2004ApJS...152..251 (INDO-US)
HD130819	4.40	4.21	4.16	4.13	4.13	1983A&AS....51...489 (Koornneef)
HD130841	2.52	2.45	2.42	2.40		1983A&AS....51...489 (Koornneef)
HD131156						2004ApJS...152..251 (INDO-US)
HD134083						2004ApJS...152..251 (INDO-US)
HD135722						2004ApJS...152..251 (INDO-US)
HD135742	2.80	2.83	2.86	2.84		1983A&AS....51...489 (Koornneef)
HD136512						2004ApJS...152..251 (INDO-US)
HD141004	3.36	3.05	2.99			1991A&AS....91...409 (Bouchet)
HD141714						2004ApJS...152..251 (INDO-US)
HD141850	2.05	1.23	0.69	-0.08	-0.10	1994A&AS....105...311 (Fluks)
HD145328						2004ApJS...152..251 (INDO-US)
HD147165	2.49	2.44	2.42	2.42	2.43	1983A&AS....51...489 (Koornneef)
HD148513						1990MNRAS....242...1 (Carter)
HD161239						1997ApJ....111...445 (Wallace)

4. Data reduction and calibration

The near infrared spectral data reduction is similar to that of optical data reduction with minor differences. The presence of strong telluric emission lines and varying atmospheric transmission due to changing water vapour content necessitates observation of standard star spectra at similar airmass soon after the programme star observation. The whole process of near infrared long slit spectra reduction can be separated into a few major steps, viz., (i) pre-processing (ii) spectrum extraction (iii) wavelength calibration (iv) atmospheric transmission and instrument response determination using standard star data (v) continuum fitting and (vi) radial velocity correction. We have used standard tasks available in software package IRAF [1] for data reduction. As discussed in §2 we have two sets of frames at two different locations of the detector. The availability of these two sets of spectra is utilized to remove the dark counts and the large sky background at near infrared wavelengths. This is accomplished by taking the difference of spectra obtained at two different locations on the detector. As there is no autoguider on the telescope, the frames with maximum counts in two positions are selected for data reduction. We thus have two difference frames for extraction of the spectrum. The details of each

[1] IRAF is distributed by National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

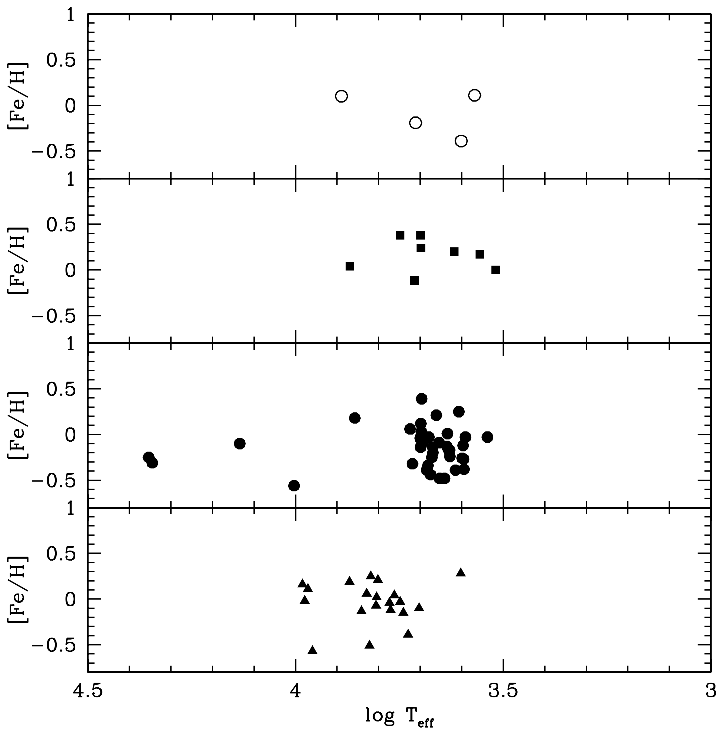

Figure 4. Distribution in the GIRT library: unknown luminosity class with open circles, supergiants (I & II) with filled squares, giants (III) with filled circles and dwarfs (IV & V) with filled triangles (*from top to bottom*) on metallicity [Fe/H] vs. effective temperature T_{eff} plane.

task and its significance in the data reduction is discussed in paper I. As discussed in §2 registering atmospheric OH airglow lines in the frame is important which helps for wavelength calibration of the stellar spectra. The list of registered OH airglow lines are given in Table 4. The IRAF task *identify* is used for this purpose. The IRAF task *refspec* is used to specify the appropriate wavelength calibrated spectrum for the stellar spectra extracted through *apall* task. The IRAF task *dispcor* was used to set the wavelength calibration for the stellar spectra.

The effects like atmospheric transmission effects and the instrument effects (filter transmission and wavelength dependence of detector quantum efficiency) can be be removed by taking the ratio of the programme star spectrum with that of a standard star spectrum observed under similar conditions and subsequently multiplying with a model synthetic spectrum for the standard star. We have selected bright A and late B type with $T_{eff} \approx 10000$ K because at this temperature only neutral hydrogen lines will be present and no metallic lines will survive in the NIR spectral region. Table 2 lists standard stars

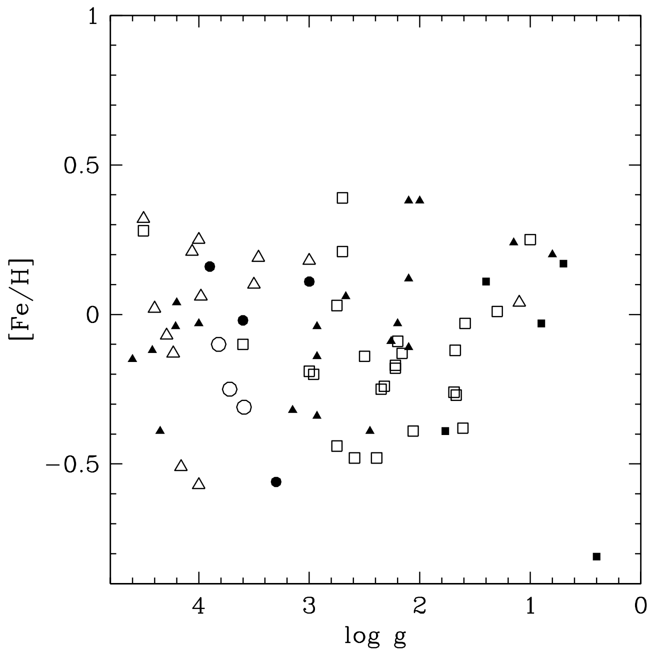

Figure 5. Distribution in the GIRT library: Stars of spectral types B (open circles), A (filled circles) F (open triangles), G (filled triangles), K (open squares) and M (filled squares) are shown in metallicity [Fe/H] vs. surface gravity log g plane.

Table 4. Line list of atmospheric OH airglow emissions used for wavelength calibrations in K-band.

Sr. Number	Wavelength in Å
1	20008.2
2	20275.9
3	20412.7
4	20563.6
5	20729.0
6	20909.6
7	21507.3
8	21802.2
9	21956.0
10	22125.5
11	22312.7
12	22516.7

Table 5. Observational parameters (from SIMBAD) of programme stars.

HD (1)	HR (2)	α(J2000.0) (3)	δ(J2000.0) (4)	V_{mag} (5)	Standard Star (6)	NIR Coverage μm) (7)
HD007927	HR382	01 20 04.91	+58 13 53.79	5.01	HR3314	2.04-2.26
HD008538	HR403	01 25 48.95	+60 14 07.01	2.68	HR3314	2.03-2.21
HD023475	HR1155	03 49 31.28	+65 31 33.50	4.47	HR2421	2.05-2.17
HD025204	HR1239	04 00 40.81	+12 29 25.24	3.40	HR2421	2.05-2.19
HD026846	HR1318	04 14 23.68	-10 15 22.61	4.90	HR2421	2.05-2.17
HD030652	HR1543	04 49 50.41	+06 57 40.59	3.19	HR3314	2.03-2.20
HD030836	HR1552	04 51 12.36	+05 36 18.37	4.47	HR2421	2.05-2.19
HD035468	HR1790	05 25 07.86	+06 20 58.92	1.62	HR3314	2.05-2.22
HD03549-	HR1791	05 26 17.51	+28 36 26.82	1.68	HR3314	2.03-2.21
HD036673	HR1865	05 32 43.81	-17 49 20.23	2.59	HR2421	2.04-2.18
HD037128	HR1903	05 36 12.81	-01 12 06.91	1.70	HR3314	2.09-2.20
HD037742	HR1948	05 40 45.53	-01 56 33.50	1.70	HR3314	2.08-2.24
HD038393	HR1983	05 44 27.79	-22 26 54.17	3.60	HR2421	2.08-2.23
HD038858	HR2007	05 48 34.94	-04 05 40.73	5.97	HR2421	2.03-2.15
HD040136	HR2085	05 56 24.29	-14 10 03.72	3.71	HR1412	2.05-2.19
HD043232	HR2227	06 14 51.33	-06 14 29.19	3.98	HR3314	2.08-2.19
HD047839	HR2456	06 40 58.66	+09 53 44.71	4.66	HR3314	2.08-2.25
HD048329	HR2473	06 43 55.92	+25 07 52.04	3.01	HR2421	2.05-2.19
HD049331	HR2508	06 47 37.22	-08 59 54.60	5.10	HR3982	2.05-2.19
HD054605	HR2693	07 08 23.48	-26 23 35.51	1.84	HR5793	2.04-2.19
HD054810	HR2701	07 10 13.68	-04 14 13.58	4.92	HR3314	2.06-2.20
HD056537	HR2763	07 18 05.57	+16 32 25.37	3.58	HR2421	2.04-2.18
HD058715	HR2845	07 27 09.04	+08 17 21.53	2.88	HR2421	2.04-2.23
HD060414	HR2902	07 33 47.96	-14 31 26.01	4.97	HR1412	2.05-2.18
HD061935	HR2970	07 41 14.83	-09 33 04.07	3.93	HR2421	2.05-2.17
HD062576	HR2993	07 43 32.38	-28 24 39.18	4.62	HR2891	2.03-2.19
HD062721	HR3003	07 46 07.44	+18 30 36.15	4.88	HR2421	2.03-2.19
HD063700	HR3045	07 49 17.65	-24 51 35.22	3.33	HR3113	2.05-2.19
HD065810	HR3131	07 59 52.05	-18 23 57.22	4.61	HR5793	2.04-2.20
HD067228	HR3176	08 07 45.85	+21 34 54.53	5.30	HR2421	2.05-2.18
HD068312	HR3212	08 11 33.00	-07 46 21.14	5.35	HR5793	2.03-2.20
HD070272	HR3275	08 22 50.10	+43 11 17.27	4.25	HR3982	2.05-2.17
HD071369	HR3323	08 30 15.87	+60 43 05.40	3.37	HR2421	2.05-2.18
HD072094	HR3357	08 31 35.70	+18 05 40.00	5.33	HR5793	2.05-2.19
HD074918	HR3484	08 46 22.53	-13 32 51.79	4.32	HR3314	2.04-2.21
HD076943	HR3579	09 00 38.40	+41 46 58.00	3.90	HR2891	2.03-2.18
HD077912	HR3612	09 06 31.80	+38 27 08.00	4.50	HR3894	2.05-2.21
HD085444	HR3903	09 51 28.69	-14 50 47.77	4.11	HR2421	2.05-2.18
HD085951	HR3923	09 54 52.20	-19 00 34.00	4.93	HR5793	2.05-2.20
HD086663	HR3950	10 00 12.80	+08 02 39.00	4.64	HR3799	2.03-2.22
HD088230		10 11 22.14	+49 27 15.25	6.61	HR3665	2.05-2.20
HD088284	HR3994	10 10 35.27	-12 21 14.69	3.61	HR5793	2.05-2.21
HD089010	HR4030	10 16 32.28	+23 30 11.14	5.90	HR5793	2.05-2.18
HD089025	HR4031	10 16 41.41	+23 25 02.31	3.44	HR2421	2.03-2.19
HD089021	HR4033	10 17 05.79	+42 54 51.71	3.44	HR2421	2.05-2.18
HD089449	HR4054	10 19 44.10	+19 28 15.00	4.70	HR4259	2.05-2.20

Table 5. Continued.

HD (1)	HR (2)	α(J2000.0) (3)	δ(J2000.0) (4)	V_{mag} (5)	Standard Star (6)	NIR coverage (μ m) (7)
HD089490	HR4059	10 19 32.20	-05 06 21.00	6.30	HR4359	2.05-2.18
HD089758	HR4069	10 22 19.74	+41 29 58.25	3.06	HR2421	2.03-2.18
HD090254	HR4088	10 25 15.20	+08 47 25.00	5.59	HR3799	2.03-2.20
HD090277	HR4090	10 25 59.90	+33 47 46.00	4.70	HR4554	2.03-2.19
HD090432	HR4094	10 26 05.42	-16 50 10.64	3.83	HR1412	2.03-2.20
HD090610	HR4104	10 27 09.10	-31 04 04.00	4.27	HR4660	2.05-2.21
HD092125	HR4166	10 38 43.21	+31 58 34.45	4.68	HR5793	2.03-2.21
HD092588	HR4182	10 41 24.62	-01 44 23.50	6.26	HR4359	2.04-2.20
HD093813	HR4232	10 49 37.48	-16 11 37.13	3.11	HR5793	2.04-2.20
HD094264	HR4247	10 53 18.33	+34 13 07.30	3.03	HR4554	2.04-2.18
HD094481	HR4255	10 54 17.77	-13 45 28.92	5.66	HR5793	2.03-2.17
HD095418	HR4295	11 01 50.47	+56 22 56.73	2.34	HR5793	2.04-2.20
HD097603	HR4357	11 14 06.50	+20 31 25.38	2.56	HR5793	2.03-2.18
HD097778	HR4362	11 15 12.22	+23 05 43.80	4.58	HR2421	2.04-2.20
HD098430	HR4382	11 19 20.44	-14 46 42.74	3.50	HR5793	2.04-2.19
HD099028	HR4399	11 23 55.50	+10 31 45.00	3.90	HR4259	2.05-2.19
HD099167	HR4402	11 24 36.62	-10 51 34.90	4.83	HR4357	2.04-2.19
HD100407	HR4450	11 33 00.11	-31 51 27.45	3.54	HR5793	2.05-2.20
HD100920	HR4471	11 36 57.02	-00 49 26.00	4.30	HR4554	2.04-2.18
HD101501	HR4496	11 41 03.01	+34 12 05.88	5.32	HR2421	2.04-2.18
HD102647	HR4534	11 49 03.57	+14 34 19.41	2.14	HR2421	2.04-2.18
HD105707	HR4630	12 10 07.48	-22 37 11.15	3.01	HR5793	2.05-2.18
HD106625	HR4662	12 15 48.37	-17 32 30.94	2.59	HR2421	2.05-2.19
HD107259	HR4689	12 19 54.35	-00 40 00.49	3.89	HR5793	2.05-2.19
HD107328	HR4695	12 20 20.98	+03 18 45.26	2.06	HR2421	2.07-2.19
HD108767	HR4757	12 29 51.85	-16 30 55.55	2.95	HR2421	2.05-2.19
HD109358	HR4785	12 33 47.64	+41 21 12.00	4.26	HR4660	2.05-2.19
HD109379	HR4786	12 34 23.23	-23 23 48.33	2.65	HR5793	2.04-2.19
HD109387	HR4787	12 33 29.00	+69 47 18.00	3.80	HR4554	2.05-2.18
HD110379	HR4825	12 41 39.60	-01 26 57.90	3.65	HR3314	2.04-2.19
HD111812	HR4883	12 51 41.92	+27 32 26.56	4.93	HR3982	2.04-2.18
HD113139	HR4931	13 00 43.59	+56 21 58.81	4.93	HR2421	2.03-2.18
HD113226	HR4932	13 02 10.59	+10 57 32.94	2.83	HR3982	2.03-2.17
HD113847	HR4945	13 05 52.30	+45 16 07.00	5.60	HR4660	2.05-2.20
HD113996	HR4954	13 07 10.70	+27 37 29.00	4.80	HR5867	2.05-2.19
HD114330	HR4963	13 09 56.99	-05 32 20.43	4.38	HR5793	2.05-2.20
HD114961		13 14 04.45	-02 48 24.70	7.02	HR5867	2.05-2.19
HD115604	HR5017	13 17 32.54	+40 34 21.38	4.72	HR3314	2.04-2.19
HD115892	HR5028	13 20 35.81	-36 42 44.26	2.70	HR2421	2.05-2.18
HD116656	HR5054	13 23 55.54	+54 55 31.30	2.70	HR2421	2.05-2.20
HD116658	HR5056	13 25 11.57	-11 09 40.75	1.04	HR2421	2.05-2.18
HD116870	HR5064	13 26 43.16	-12 42 27.59	5.27	HR5793	2.05-2.22
HD120315	HR5191	13 47 32.43	+49 18 47.75	1.86	HR2421	2.05-2.19
HD120323	HR5192	13 49 26.72	-34 27 02.79	4.19	HR5793	2.05-2.18
HD123139	HR5288	14 06 40.94	-36 22 11.83	2.06	HR5893	2.05-2.18
HD123299	HR5291	14 04 23.34	+64 22 33.06	3.65	HR2421	2.05-2.18
HD123657	HR5299	14 07 55.65	+43 51 17.30	5.27	HR5511	2.03-2.18

Table 5. Continued.

HD (1)	HR (2)	α(J2000.0) (3)	δ(J2000.0) (4)	V_{mag} (5)	Standard Star (6)	NIR coverage (μ m) (7)
HD123934	HR5301	14 10 50.50	-16 18 07.00	4.90	HR4259	2.05-2.18
HD124294	HR5315	14 12 53.74	-10 16 25.32	4.19	HR2421	2.05-2.19
HD126661	HR5405	14 26 27.36	+19 13 36.83	5.39	HR3314	2.05-2.19
HD127665	HR5429	14 31 50.13	+30 22 11.00	3.58	HR6324	2.05-2.19
HD129116	HR5471	14 41 57.59	-37 47 36.59	3.98	HR5793	2.05-2.20
HD129502	HR5487	14 43 03.62	-05 39 29.54	3.90	HR5793	2.05-2.18
HD130025	HR5507	14 45 20.70	+18 53 05.00	6.59	HR5107	2.06-2.20
HD130819	HR5530	14 50 41.18	-15 59 50.05	5.15	HR5793	2.05-2.20
HD130841	HR5531	14 50 52.71	-16 02 30.40	2.75	HR5793	2.05-2.20
HD131156	HR5544	14 51 23.30	+19 06 04.00	4.50	HR6324	2.05-2.18
HD134083	HR5634	15 07 17.34	+24 52 17.00	4.93	HR5867	2.05-2.19
HD135722	HR5681	15 15 29.77	+33 18 58.70	3.47	HR6324	2.05-2.19
HD135742	HR5685	15 17 00.41	-09 22 58.50	2.60	HR3314	2.05-2.19
HD136512	HR5709	15 20 08.94	+29 37 00.00	5.51	HR5511	2.05-2.18
HD141004	HR5868	15 46 26.61	+07 21 11.06	4.43	HR6378	2.05-2.19
HD141714	HR5889	15 49 35.88	+26 04 09.00	4.63	HR5511	2.05-2.19
HD141850	HR5894	15 50 41.70	+15 08 01.00	7.10	HR6324	2.05-2.19
HD145328	HR6018	16 08 58.45	+36 29 10.30	4.76	HR5107	2.05-2.19
HD147165	HR6084	16 21 11.31	-25 35 34.06	2.91	HR6324	2.05-2.19
HD148513	HR6136	16 28 33.98	+00 39 54.00	5.90	HR6378	2.05-2.19
HD161239	HR6608	17 43 21.56	+24 19 40.15	5.74	HR5867	2.04-2.20

used for the purpose of taking ratios. The stellar absorption feature due to hydrogen namely the Brackett gamma line was removed before taking the ratio. The programme star flux is divided by the corresponding standard star flux and in this process the modulation due to telluric features, atmospheric extinction and instrumental effects cancels out. The resultant function from this division is multiplied with a corresponding blackbody flux distribution at the temperature corresponding to the standard star. It may be noted that unlike many of the spectral libraries published earlier the spectra presented here have been continuum shape corrected to their respective effective temperatures.

As mentioned in Section 2, majority of the spectra were obtained at two positions (K1 and K2) of the grating to cover the entire K band region. While doing the data reduction it was observed that registration of OH airglow lines at higher wavelength (K2 region) is quite poor and difficult to use for wavelength calibration. The slightly different placement of the grating in K2 setting resulted in non-uniform coverage of longer wavelengths for each star. Hence most of the data in this library spans the earlier part of the K band with slightly different wavelength coverage corresponding to the K1 setting. The detail of the wavelength coverage for each star is given in table 5. In Table 5, the first and second column contain the star ID, Columns (3) and (4) contain the right ascension (J2000.0) and declination (J2000.0) respectively Column (5) gives the apparent V magnitude. The column (6) gives the corresponding standard star ID used for data reduction while last column gives the available GIRT spectral region for the same star.

Table 6. Physical parameters of programme stars.

HD (1)	Spectral Type (2)	Luminosity Class (3)	T_{eff} (°K) (4)	log_{10} (g) (5)	(Fe/H) (6)	Reference (7)
HD007927	F0	Ia				
HD008538	A5	III	8090			1995A&AS...110..553 (Sokolov)
HD023475	M2	IIab				
HD025204	B3	V				
HD026846	K3	III	4582	2.70	0.21	1997A&AS...124..299C (Cayrel)
HD030652	F6	V	6380	4.40	0.02	2004ApJS...152..251 (INDO-US)
HD030836	B2	III	22120	3.59	-0.31	1997A&AS...124..299C (Cayrel)
HD035468	B2	III	22570	3.72	-0.25	2004ApJS...152..251 (INDO-US)
HD035497	B7	III	13622	3.80	-0.10	2004ApJS...152..251 (INDO-US)
HD036673	F0	Ib	7400	1.10	0.04	2004ApJS...152..251 (INDO-US)
HD037128	B0	Iab				
HD037742	O9	Iab				
HD038393	F7	V	6398	4.29	-0.07	1997A&AS...124..299C (Cayrel)
HD038858	G4	V				
HD040136	F1	V	6939	4.23	-0.13	2004ApJS...152..251 (INDO-US)
HD043232	K1.5	III	4270	2.22	-0.18	2004ApJS...152..251 (INDO-US)
HD047839	O7	Ve				
HD048329	G8	Ib	4150	0.80	0.20	2004ApJS...152..251 (INDO-US)
HD049331	M1	Iab	3600	0.70	0.17	1997A&AS...124..299C (Cayrel)
HD054605	F8	Iab				
HD054810	K0	III	4697	2.35	-0.25	2004ApJS...151..387 (Ivanov)
HD056537	A3	V				
HD058715	B8	Ve	11710			1995A&AS...110..553 (Sokolov)
HD060414	M2	III				
HD061935	G9	III	4776	2.20	-0.03	2004ApJS...151..387 (Ivanov)
HD062576	K3	III	4308	1.30	0.01	1997A&AS...124..299C (Cayrel)
HD062721	K4	III	3940	1.67	-0.27	1997A&AS...124..299C (Cayrel)
HD063700	G6	Ia	4990	1.15	0.24	1997A&AS...124..299C (Cayrel)
HD065810	A1	V				
HD067228	G1	IV	5779	4.20	0.04	2004ApJS...152..251 (INDO-US)
HD068312	G6	III				
HD070272	K4.5	III	3900	1.59	-0.03	1997A&AS...124..299C (Cayrel)
HD071369	G5	III	5300	2.67	0.06	2004ApJS...152..251 (INDO-US)
HD072094	K5	III				
HD074918	G8	III	4950	2.26	-0.09	1997A&AS...124..299C (Cayrel)
HD076943	F3	V	6590	4.00	0.25	2004ApJS...152..251 (INDO-US)
HD077912	G7	Ib-II	5000	2.00	0.38	2004ApJS...152..251 (INDO-US)
HD085444	G6	III	5000	2.93	-0.14	2004ApJS...152..251 (INDO-US)
HD085951	k5	III				
HD086663	M2	III				
HD088230	K8	V	4000	4.50	0.28	1997A&AS...124..299C (Cayrel)
HD088284	K0	III	4971	2.70	0.39	2004ApJS...151..387 (Ivanov)
HD089010	G1.5	IV	5600	4.00	-0.03	2004ApJS...152..251 (INDO-US)
HD089025	F0	III				
HD089021	A1	IV				
HD089449	F6	IV	6333	4.06	0.21	2004ApJS...152..251 (INDO-US)
HD089490	K0					
HD089758	M0	III				

Table 6. Continued.

HD (1)	Spectral Type (2)	Luminosity Class (3)	T_{eff} (°K) (4)	$\log_{10}$ (g) (5)	(Fe/H) (6)	Reference (7)
HD090254	M3	III	3706	1.40	0.11	1997A&AS...124..299C (Cayrel)
HD090277	F0	V	7412	3.46	0.19	2004ApJS...152..251 (INDO-US)
HD090432	K4	III	3950	1.68	-0.12	1997A&AS...124..299C (Cayrel)
HD090610	K4	III	3990	1.77	-0.39	1997A&AS...124..299C (Cayrel)
HD092125	G2.5	IIa	5600	2.10	0.38	2004ApJS...152..251 (INDO-US)
HD092588	K1	IV	5044	3.60	-0.10	2004ApJS...152..251 (INDO-US)
HD093813	K0	III	4250	2.32	-0.24	2004ApJS...152..251 (INDO-US)
HD094264	K0	III	4670	2.96	-0.20	2004ApJS...152..251 (INDO-US)
HD094481	K0	II+..				
HD095418	A1	V	9620	3.90	0.16	2004ApJS...152..251 (INDO-US)
HD097603	A4	V	8080			1995A&AS...110..553 (Sokolov)
HD097778	M3	IIb	3300		0.00	2004ApJS...151..387 (Ivanov)
HD098430	K0	III	4500	2.59	-0.48	2004ApJS...152..251 (INDO-US)
HD099028	F1	IV	6739	3.98	0.06	2004ApJS...152..251 (INDO-US)
HD099167	K5	III	3930	1.61	-0.38	2004ApJS...152..251 (INDO-US)
HD100407	G7	III	5010	2.93	-0.04	1997A&AS...124..299C (Cayrel)
HD100920	G8.5	III	4800	2.93	-0.34	2004ApJS...152..251 (INDO-US)
HD101501	G8	V	5360	4.35	-0.39	2004ApJS...151..387 (Ivanov)
HD102647	A3	V	8720			1995A&AS...110..553 (Sokolov)
HD105707	K2	III	4320	2.16	-0.13	1997A&AS...124..299C (Cayrel)
HD106625	B8	III				
HD107259	A2	IV	9333	3.00	0.11	2004ApJS...152..251 (INDO-US)
HD107328	K0	IIIb	4380	2.39	-0.48	2004ApJS...152..251 (INDO-US)
HD108767	B9.5	V	10350			1995A&AS...110..553 (Sokolov)
HD109358	G0	V	5903	4.42	-0.12	2004ApJS...151..387 (Ivanov)
HD109379	G5	II	5170	2.10	-0.11	1997A&AS...124..299C (Cayrel)
HD109387	B6	IIIpe				
HD110379	F0	V	7099	4.00	-0.57	1997A&AS...124..299C (Cayrel)
HD111812	G0	IIIp			0.01	2004ApJS...152..251 (INDO-US)
HD113139	F2	V				
HD113226	G8	III	4994	2.10	0.12	2004ApJS...151..387 (Ivanov)
HD113847	K1	III	4510	2.20	-0.09	2004ApJS...152..251 (INDO-US)
HD113996	K5	III	3970	1.69	-0.26	2004ApJS...151..387 (Ivanov)
HD114330	A1	Vs+..	9509	3.60	-0.02	2004ApJS...152..251 (INDO-US)
HD114961	M7	III	3014	0.40	-0.81	2004ApJS...152..251 (INDO-US)
HD115604	F3	III	7200	3.00	0.18	2004ApJS...152..251 (INDO-US)
HD115892	A2	V	9030			1995A&AS...110..553 (Sokolov)
HD116656	A2	V	5793			2004ApJS...152..251 (INDO-US)
HD116658	B1	III				
HD116870	K5	III				
HD120315	B3	V	17200			1995A&AS...110..553 (Sokolov)
HD120323	M4.5	III				
HD123139	K0	IIIb	4980	2.75	0.03	1997A&AS...124..299C (Cayrel)
HD123299	A0	III	10080	3.30	-0.56	2004ApJS...152..251 (INDO-US)
HD123657	M4.5	III	3452	0.90	-0.03	2004ApJS...152..251 (INDO-US)
HD123934	M2	IIIa				
HD124294	K2.5	IIIb	4120	2.06	-0.39	1997A&AS...124..299C (Cayrel)
HD126661	F0m		7754	3.50	0.10	2004ApJS...152..251 (INDO-US)

Table 6. Continued.

HD (1)	Spectral Type (2)	Luminosity Class (3)	T_{eff} (°K) (4)	$\log_{10}$ (g) (5)	(Fe/H) (6)	Reference (7)
HD127665	K3	III	4260	2.22	-0.17	2004ApJS...152..251 (INDO-US)
HD129116	B3	V				
HD129502	F2	III	6820			1995A&AS...110..553 (Sokolov)
HD130025	K0		5140	3.00	-0.19	2004ApJS...152..251 (INDO-US)
HD130819	F3	V	6632	4.16	-0.51	1997A&AS...124..299C (Cayrel)
HD130841	A3	IV				
HD131156	G7	Ve	5500	4.60	-0.15	2004ApJS...152..251 (INDO-US)
HD134083	F5	V	6632	4.50	0.32	2004ApJS...152..251 (INDO-US)
HD135722	G8	III	4834	2.45	-0.39	2004ApJS...151..387 (Ivanov)
HD135742	B8	V	13250			1995A&AS...110..553 (Sokolov)
HD136512	K0	III	4730	2.75	-0.44	2004ApJS...152..251 (INDO-US)
HD141004	G6	V	5937	4.21	-0.04	2004ApJS...152..251 (INDO-US)
HD141714	G5	III	5230	3.15	-0.32	2004ApJS...152..251 (INDO-US)
HD141850	M7	III				
HD145328	K1	III	4678	2.50	-0.14	2004ApJS...151..387 (Ivanov)
HD147165	B1	III				
HD148513	K4	III	4046	1.00	0.25	2004ApJS...151..387 (Ivanov)
HD161239	G2	IIIb				

5. Spectral library

The NIR K band spectral library of 114 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 summarized in Tables 3 and 5 as observational parameters and in Table 6 as physical parameters. The contents of Table 3 has been mentioned in section §3 and content of table 5 has been mentioned in section §4. Table 6 contains the star ID in the first column. Columns (2), (3) and (4) give the main spectral type, luminosity class and effective temperature respectively. Columns (5) and (6) give the log g and [Fe/H] values respectively. The last column gives the references from which the physical parameters have been obtained.

Fig. 6 shows spectra of six supergiant stars, covering a large range of MK spectral type, and thus illustrates the basic dependence of spectral features. Fig. 7 shows spectra of five giant stars again covering different spectral types. Similarly Fig. 8 shows a series of six dwarf stars. All of these plots illustrate the change in basic features with the temperature, gravity and metallicity. We also attempt to show the quality of spectra by

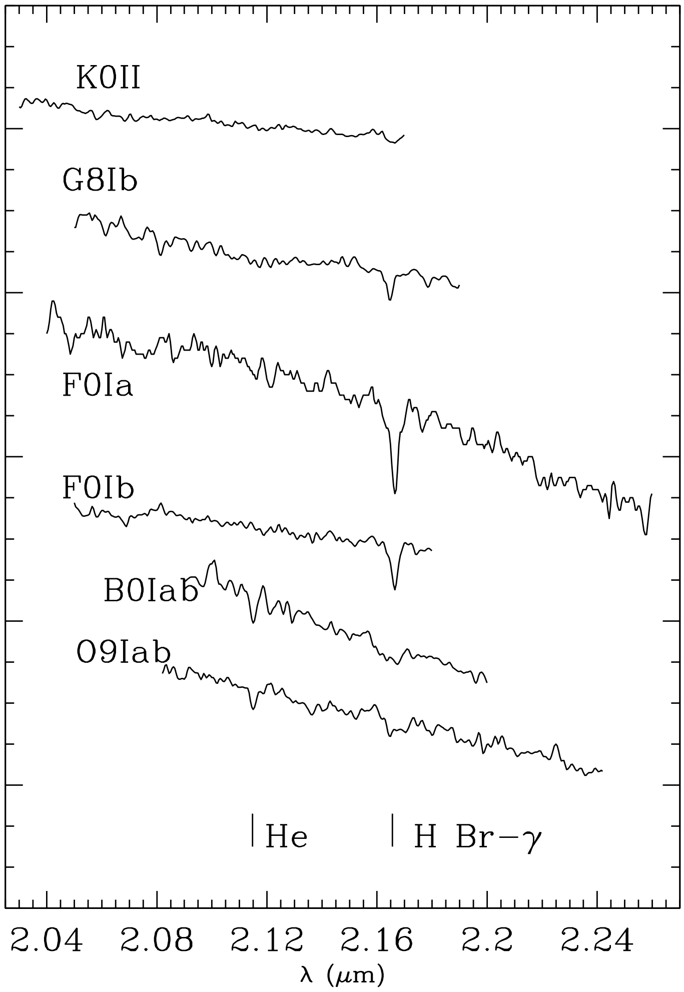

Figure 6. Spectra of six supergiant stars, covering a large range of MK spectral type, are plotted to illustrate the basic dependence of spectral features. The stars plotted, top to bottom, are HR4255, HR2473, HR382, HR1865, HR1903 and HD1948. The spectral types are listed on the spectra.

comparing some selected spectra with the already published K band library by Wallace et al. (1997).

Following paragraphs describe the procedure that we have followed for comparing the GIRT and Wallace data.

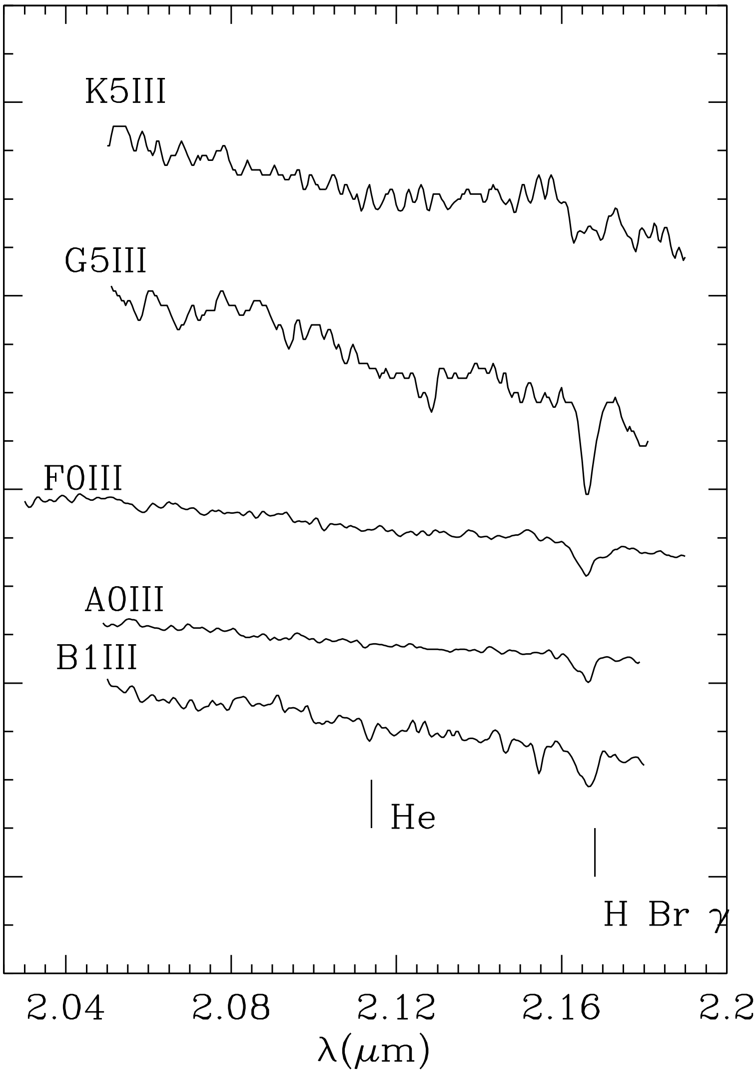

Figure 7. Spectra of five giant stars, covering a large range of MK spectral type, are plotted to illustrate the basic dependence of spectral features. The stars plotted, top to bottom, are HR4954, HR3323, HR4031, HR5291 and HR5056. The spectral types are listed on the spectra.

The block diagram in Fig. 9 depicts the steps carried out on both libraries. There are two steps to be performed on Wallace et al. (1997).

(i) conversion of wave number vs. relative flux to wavelength vs. relative flux

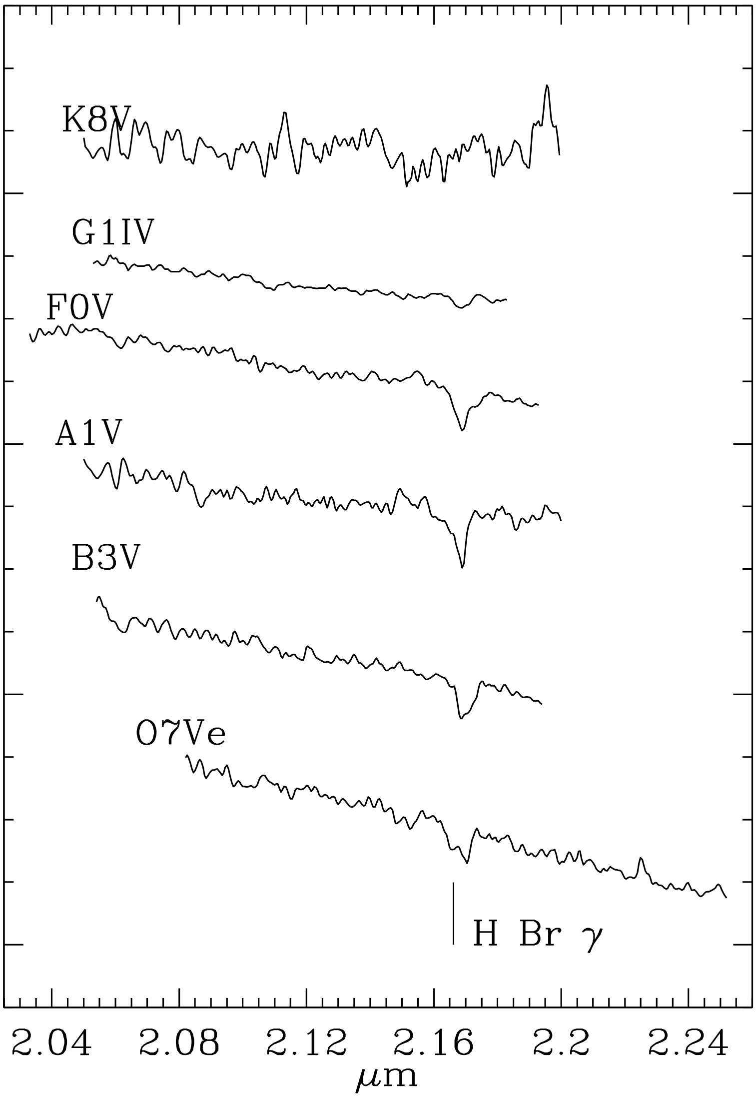

Figure 8. Spectra of six dwarf stars, covering a large range of MK spectral type, are plotted to illustrate the basic dependence of spectral features. The stars plotted, top to bottom, are HD88230, HR3176, HR4090, HR4963, HR5191 and HD2456. The spectral types are listed on the spectra.

(ii) fitting a continuum to respective T_{eff} of each star and spline fitting for binning at 5 Å steps

These steps were performed by writing a common algorithm which could run uni-

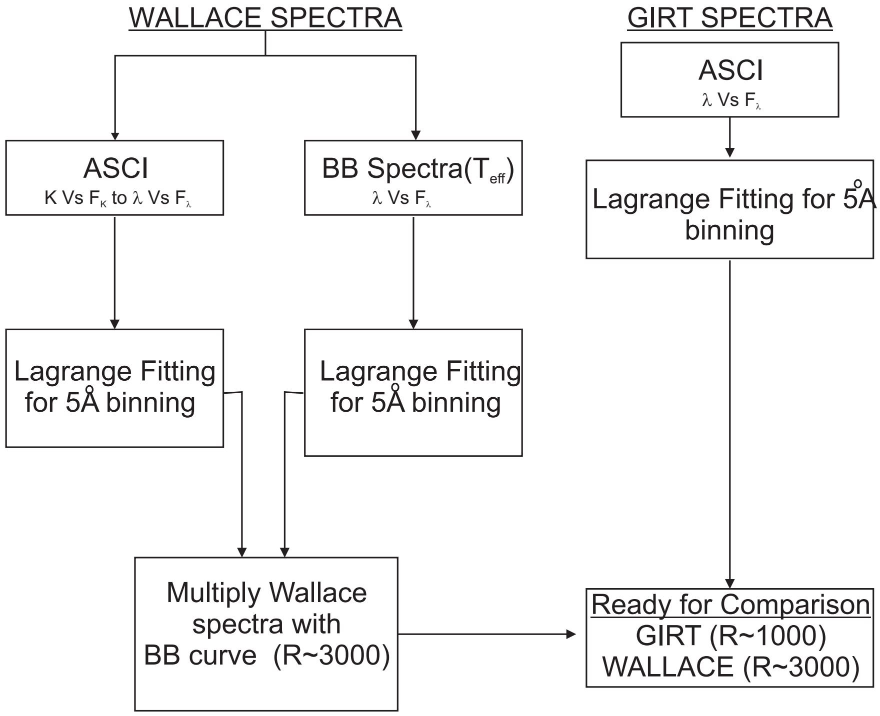

Figure 9. Block diagram illustrating the steps involved in comparison of GIRT and Wallace et al. (1997) libraries

formly on Wallace et al. (1997) library. The T_{eff} values were taken from 'Astronomical Hand Book' by K. R. Lang and the black body spectra was generated by IRAF *mk1dspec* task for K band region.

Fig. 10 shows a sample of some of the common stars in GIRT and Wallace et al. library with good matching of the spectral features as evident from the correlation coefficient r values. This plot covers most of the main spectral types. It may be noted that the resolution of both the spectra is not same viz. GIRT $\sim$ 1000 and Wallace $\sim$ 3000.

In conclusion, we may mention that this library of 114 stellar spectra in the NIR K 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. However it is very important to have large spectral range to cover the entire spectra in K band region, we would like to mention that we will carry out similar observations to overcome spectral feature identification problem either through using lamp spectra or choosing the right time of the year when OH lines can be registered in sky frame.

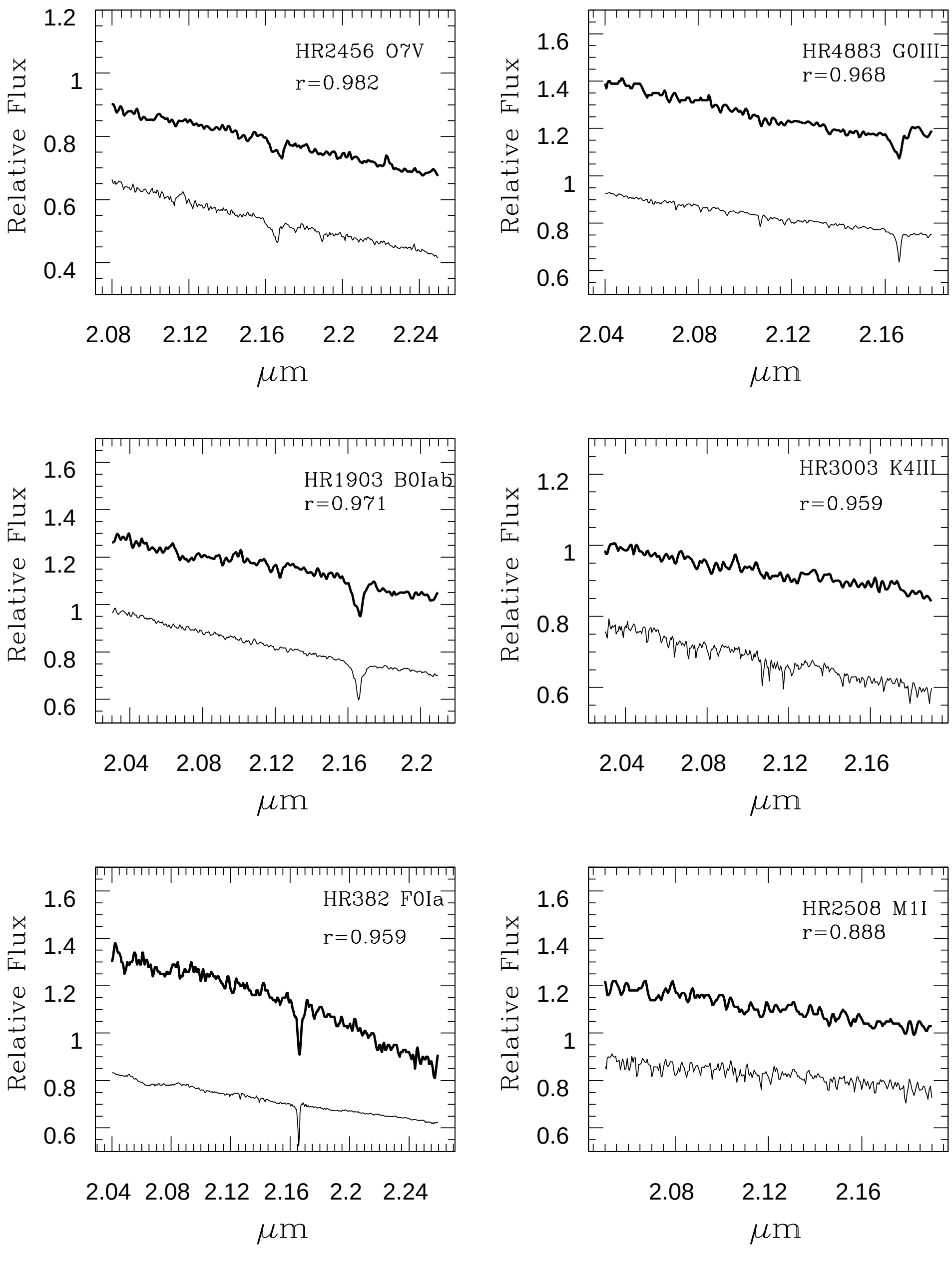

Figure 10. Spectra of a selection of common spectra from Wallace et al. 1997 (*thin* lines) and GIRT (*thick* lines) libraries. Please note that the two spectra in each panel have been offset purposely for sake of clarity and the flux values are relative.

Acknowledgements

The research was partly funded by a grant from ISRO RESPOND. The research work at the Physical Research Laboratory is funded by the Department of Space, Government of India. This paper has made use of the SIMBAD database, operated at CDS, Strasbourg, France.

References

Blum, R. D., Ramond, T. M., Conti, P. S., Figer, D. F., & Sellgren, K., 1997, AJ, 113, 1855
Bouchet, P., Manfroid, J., & Schmider, F.-X., 1991, A&AS, 91, 409
Bruzual, G. & Charlot, S., 2003, MNRAS, 344, 1000
Carter, B. S., 1990, MNRAS, 242, 1
Fluks, M. A., Plez, B., The, P. S., Winter, D. de, Westerlund, B. E., & Steenman, H. C., 1994, A&AS, 105, 311
Ivanov, V. D., Reike, M. J., Englebracht, C. W., Alonso-Herrero, A., Reike, G. H., & Luhman, K. L., 2004, ApJS, 151, 397
Johnson, H. J., & Mer'ndez, M. E., 1970, AJ, 75, 785
Jones, L. A., 1999, Phd Thesis, University of North Carolina
Kleinman, S. G., & Hall, D. N. B., 1986, ApJS, 62, 501
Koornneef, J., 1983, A&AS, 51, 489
Lançon, A., & Rocca-Volmerange, B., 1992, A&AS, 96, 593
Lang, K. R., 1992, Astrophysical Data: Planets & Stars, Springer-Verlag, New York
Le Borgne, D., & Rocca-Volmerange, B., et al., 2004, A&A, 425, 881
Le Borgne, J. F., Bruzual, G., & Pello, R. et al., 2003, A&A, 402, 433
Meyer, M. R., Edwards, S., Hinkle, K. H., & Strom, S. E., 1998, ApJ, 508, 397
Prugniel, Ph., Soubiran, C., 2001, A&A, 369, 1048
Prugniel, Ph., Soubiran, C., Koleva, M., & Le Borgne, D., 2007, Astro-ph, 3658
Ranade, A., Gupta, R., Ashok, N. M., & Singh, H. P., 2004, BASI, 32, 311 (Paper I)
Sańchez-Blaźquez, P., & Gorgas, J. et al., 2006, A&A, 457, 809
Thomas, D., & Maraston, C., 2003, A&A, 401, 429
Valdes, F., Gupta, R., Rose, J. A., Singh, H. P., & Bell, D. J., 2004, ApJS, 152, 251
Vazdekis, A., & Arimoto, N., 1999, ApJ, 525, 144
Wallace, L., & Hinkle, K., 1997, ApJS, 111, 445
Wallace, L., Meyer, M. R., Hinkle, K., & Edwards, S., 2000, ApJ, 535, 325