CDBS KURUCZ STELLAR ATMOSPHERE ATLAS

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1. INTRODUCTION

An updated version of Kurucz stellar atmospheres models is now in place in the CDBS and will be available to users next November. This update supersedes the previous Buser-Kurucz atlas installed in the CDBS in 1988. The new atlas covers a wider range in metallicities and has a finer grid in effective temperatures, gravities and wavelength.

The format, wavelength coverage, and extension of the atlas is useful for synthetic photometry using SYNPHOT. The atlas can also be used in calculating WFPC2 and NICMOS broad-band photometric transformations.

2. THE 1993 KURUCZ STELLAR ATMOSPHERES ATLAS

The atlas contains about 7600 stellar atmosphere models for a wide range of metallicities, effective temperatures and gravities. These new LTE models have improved opacities and are computed with a finer wavelength and temperature resolution than the previous Buser−Kurucz atlas installed in the CDBS. The microturbulent velocity is 2 km s^{-1}.

The new atlas installed in the CDBS is from the Kurucz database at Goddard Space Flight Center. The original atlas (CD-ROM No. 13) was created on August 22, 1993 and can be obtained from Dr. R. Kurucz.

The atlas includes models of abundances ($\log Z$) relative to solar of +1.0, +0.5, +0.3, +0.2, +0.1, +0.0, −0.1, −0.2, −0.3, −0.5, −1.0, −1.5, −2.0, −2.5,−3.0, −3.5, −4.0, −4.5, and −5.0. The grid of models cover the gravity range from $\log g$= 0.0 to +5.0 in steps of +0.5. The range in effective temperature from 3500 K to 50000 K is covered with an uneven grid (see Table 1a). The model spectra cover the ultraviolet (1000Å) to infrared (10μm) spectral range with non-uniform wavelength spacing (see Table 1b).

3. THE STScI/CDBS VERSION OF THE 1993 KURUCZ ATLAS

The atlas is divided in 19 independent subdirectories, according to metallicity. Within each subdirectory the stellar atmosphere models are given in STDAS multicolumn table format. Each table consist of 12 different columns, the first one containing the wavelength grid and each of the rest containing the spectrum of a star with the same effective temperature but different gravity, ranging from log$g$= 0.0 to +5.0. Columns filled with zeros indicate that the model spectrum for that particular metallicity, effective temperature and gravity combination is not covered by the atlas.

The names of the table files are given as **kszz_ttttt.tab** where **k** , for Kurucz, is the first letter of the atlas; **szz** is the metallicity of the model (zz) with its sign (s); and **ttttt** is the model's effective temperature, using four or five digits depending on the value. For instance, models for an effective temperature of 5000 K with log$Z$= −0.5 and log$Z$= +3.5 are indicated by **ttttt**= 5000, **s**= m, **zz**= 05 and **ttttt**= 5000, **s**= p, **zz**= 35, i.e. km05_5000.tab and kp35_5000.tab.

Within each individual table file, each column is named **gyy** where **yy** corresponds to 10×log$g$. For example, log$g$= +0.5 and log$g$= +4.0 models are located in columns named g05 and g40, respectively. See the appendix for an example of a standard header of a table file.

Physical fluxes of the spectra are given in FLAM surface flux units, i.e. ergs cm^{-2} s^{-1} Å^{-1}. These flux units differ from those in the Kurucz CD-ROM by a factor of $3.336\times10^{-19} \times \lambda^2 \times (4\pi)^{-1}$, i.e. are converted from ergs cm^{-2} s^{-1} Hz^{-1} steradian^{-1} to ergs cm^{-2} s^{-1} Å^{-1}. To convert to observed flux at Earth, multiply by a factor of (R/D)^2 where R is the stellar radius, and D is the distance to Earth.

The names of the files located in each metallicity subdirectory are listed in Tables 3 to 21. The range in gravity covered by the models for the different temperatures is also indicated. A list of solar metallicity stars of different spectral types and luminosity classes together with their closest Kurucz model spectrum is presented in Table 22. The physical parameters, T_{eff} and log$g$, characterizing each star are taken from Schmidt-Kaler's compilation of physical parameters of stars (Schmidt-Kaler 1982, Landolt-Börnstein VI/2b). The U−B and B−V colors of the closest model agree with the characteristic color of each star (see Schmidt-Kaler 1982) to better than 0.06 magnitude.

Since the entire atlas occupies close to 70MB of disk space, many applications could be satisfied by a copy of the solar metallicity spectra, only.

4. THE SPECTRUM OF THE SUN AND VEGA

Vega and the Sun are the primary basic standards for absolute spectrophotometric calibrations at optical and infrared wavelengths, respectively. As an independent part of the atlas, the absolute calibrated spectra of the Sun and Vega are also provided. The physical parameters used by Kurucz in the modeling of the Sun and Vega can be found in Table 2.

The absolute calibration for Vega is obtained by normalizing the surface flux of the Kurucz spectrum at λ5000Å to 4.65 $\times$ 10^{-9} ergs cm^{-2} s^{-1} Å^{-1} (see Colina & Bohlin 1994, *Astron. J.*, **108**, 1931 for details on the selection of this normalization). Vega has a visual magnitude $V_{Johnson}$= +0.035, in the Johnson system (see Colina & Bohlin 1994 for details). This new spectrum is now used by SYNPHOT whenever the vegamag option is required.

As for Vega, the absolute calibration of the Sun's spectrum is obtained by normalizing the surface flux at λ5000Å to an absolute flux of 1.8835 $\times$ 10^{2} ergs cm^{-2} s^{-1} Å^{-1}. This value is obtained by taking the average of Neckel & Labs absolute flux calibrated spectrum of the Sun between λ4985Å and λ5015Å (Neckel & Labs 1984, Solar Physics **90**, 205).

With this normalization, the Johnson visual magnitude of the Sun corresponds to $V_{Johnson}$= −-26.76, assuming Vega has a $V_{Johnson}$ magnitude of +0.035. The V magnitude of the Sun obtained in this way is in excellent agreement with the V magnitude measured by Campins and collaborators, V= −26.762 ± 0.017 (Campins et al. 1985, *Astron. J.*, **90**, 896).

STSDAS table versions of the absolute calibrated model spectra, named sun.tab and vega.tab, can be found in the CDBS directory crgridk93$standards.

5. USE OF KURUCZ ATLAS WITH SYNPHOT

Synphot tasks now permit the use of spectra selected from one of many columns in a single STSDAS table file. One does this by specifying as the "spectrum" parameter the name of the disk file (as before), and appending the name of the column containing the flux in brackets. Thus, to select any model spectrum characterized by a given metallicity, effective temperature, and gravity, specify a "spectrum" of the form: crgridk93$m_directory/kszz_ttttt.tab[gyy], where m_directory is the name of the subdirectory for a given metallicity. For example, to select the spectrum of a star with a metallicity of +0.1, a temperature of 10,000 K, and log gravity of 3.0, the specification would be: crgridk93$kp01/kp01_10000.tab[g30].

Please note that the model spectra in the atlas are in surface flux units. Thus, if the number of counts or the calculated absolute flux is needed, the model spectrum must be renormalized appropriately. One can do this in synphot with the "rn" function.

An enhancement to synphot is planned for the near term that will allow a model spectrum to be selected within a synphot expression, using a special operator. The syntax will be something like "cat(kurucz,t,g,m)" where "t" is the effective temperature, "g" is the log gravity, and "m" is the log metallicity in solar units. The idea is that, instead of having to remember a directory/file naming syntax, a synphot user could specify a spectrum from a specified catalog (the Kurucz atlas, in this case) which most closely matches the specified attributes (in this case, T_{eff}, log g, and log Z) using an expression. The on-line help and the Synphot User's Guide will be updated when this feature is available.

6. WWW ACCESS TO KURUCZ ATLAS

The Kurucz atlas is accessible via the WWW pages of the Observatory Support Branch (http://www.stsci.edu/ftp/cdbs/grid/k93models). STSDAS table files of the model spectra as well as short ASCII explanatory files (READ files) are included for easy access.

Acknowledgements

The author thanks R. Kurucz for making available the models, and W. Landsman for helping with the extraction of the reformated models from the IDL Astronomy Library and UIT database. Also thanks to Ralph Bohlin and Dick Shaw for their useful comments and suggestions.

APPENDIX

Below is an example of a standard header for the table files in the CDBS version of Kurucz atlas. In this example the name of the file is kp00_8000.tab and contains all the models for a star of metallicity log$Z$= 0.0 and effective temperature T_{eff}= 8000 K. Models cover a range of gravities from log$g$= +1.0 (g10 in the header) to log$g$= +5.0 (g50 in the header). Models for gravities log$g$= +0.0 and +0.5 are not available for this particualr metallicity and effective temperature combination, and therefore do not appear listed in the header. Their corresponding columns (g00 and g05) are filled with zeros. The models are in FLAM surface flux units, i.e. ergs cm^{-2} s^{-1} $Å^{-1}$.

Header for table file **kp00_8000.tab**

1 TEFF i 8000
2 LOG_Z d 0.0000000000000000
3 HISTORY t g10
4 HISTORY t g15
5 HISTORY t g20
6 HISTORY t g25
7 HISTORY t g30
8 HISTORY t g35
9 HISTORY t g40
10 HISTORY t g45
11 HISTORY t g50
12 HISTORY t
13 HISTORY t Kurucz model atmospheres (1993)
14 HISTORY t
15 HISTORY t Fluxes tabulated in units of erg s^{-1} $cm^{-2}Å^{-1}$
16 HISTORY t are surface fluxes. To transform to observed
17 HISTORY t fluxes multiply by $(R/D)^2$ where R is the
18 HISTORY t radius of the star and D the distance.
19 HISTORY t Each column in the table represents the
20 HISTORY t spectrum of a star for the same metallicity
21 HISTORY t and effective temperature but different gravity.

TABLE 1a: Grid of temperatures for the models

Temperature Range K	Grid Step K
3000 – 10000	250
10000 – 13000	500
13000 – 35000	1000
35000 – 50000	2500

TABLE 1b: Wavelength coverage for the models

Wavelength Range μm	Grid Step Å
0.10 – 0.29	10
0.29 – 1.00	20
1.00 – 1.60	50
1.60 – 3.20	100
3.20 – 8.35	200
8.35 – 10.0	400

TABLE 2: Sun and Vega models: parameters

Star	log$Z$	T_{eff} K	log$g$	$V_{Johnson}$
SUN	+0.0	5777	+4.44	−26.76
VEGA	−0.5	9550	+3.95	+0.035

TABLE 3: Kurucz stellar atmosphere models for log$Z$= +1.0

File Name	Gravity Range	File Name	Gravity Range
kp10_3500	g00 to g50	kp10_12500	g30 to g50
kp10_3750	g00 to g50	kp10_13000	g30 to g50
kp10_4000	g00 to g50	kp10_14000	g30 to g50
kp10_4250	g00 to g50	kp10_15000	g30 to g50
kp10_4500	g00 to g50	kp10_16000	g30 to g50
kp10_4750	g00 to g50	kp10_17000	g30 to g50
kp10_5000	g00 to g50	kp10_18000	g30 to g50
kp10_5250	g00 to g50	kp10_19000	g30 to g50
kp10_5500	g00 to g50	kp10_20000	g30 to g50
kp10_5750	g00 to g50	kp10_21000	g30 to g50
kp10_6000	g05 to g50	kp10_22000	g35 to g50
kp10_6250	g05 to g50	kp10_23000	g35 to g50
kp10_6500	g05 to g50	kp10_24000	g35 to g50
kp10_6750	g05 to g50	kp10_25000	g35 to g50
kp10_7000	g05 to g50	kp10_26000	g35 to g50
kp10_7250	g05 to g50	kp10_27000	g35 to g50
kp10_7500	g10 to g50	kp10_28000	g40 to g50
kp10_7750	g10 to g50	kp10_29000	g40 to g50
kp10_8000	g10 to g50	kp10_30000	g40 to g50
kp10_8250	g10 to g50	kp10_31000	g40 to g50
kp10_8500	g15 to g50	kp10_32000	g45 to g50
kp10_8750	g15 to g50	kp10_33000	g45 to g50
kp10_9000	g20 to g50	kp10_34000	g45 to g50
kp10_9250	g20 to g50	kp10_35000	g45 to g50
kp10_9500	g20 to g50	kp10_37500	g50
kp10_9750	g20 to g50	kp10_40000	g50
kp10_10000	g20 to g50		
kp10_10500	g25 to g50		
kp10_11000	g25 to g50		
kp10_11500	g30 to g50		
kp10_12000	g30 to g50		

TABLE 4: Kurucz stellar atmosphere models for log$Z$= +0.5

File Name	Gravity Range	File Name	Gravity Range
kp05_3500	g00 to g50	kp05_12500	g25 to g50
kp05_3750	g00 to g50	kp05_13000	g25 to g50
kp05_4000	g00 to g50	kp05_14000	g25 to g50
kp05_4250	g00 to g50	kp05_15000	g25 to g50
kp05_4500	g00 to g50	kp05_16000	g25 to g50
kp05_4750	g00 to g50	kp05_17000	g25 to g50
kp05_5000	g00 to g50	kp05_18000	g30 to g50
kp05_5250	g00 to g50	kp05_19000	g30 to g50
kp05_5500	g00 to g50	kp05_20000	g30 to g50
kp05_5750	g00 to g50	kp05_21000	g30 to g50
kp05_6000	g00 to g50	kp05_22000	g30 to g50
kp05_6250	g05 to g50	kp05_23000	g30 to g50
kp05_6500	g05 to g50	kp05_24000	g30 to g50
kp05_6750	g05 to g50	kp05_25000	g30 to g50
kp05_7000	g05 to g50	kp05_26000	g35 to g50
kp05_7250	g10 to g50	kp05_27000	g35 to g50
kp05_7500	g10 to g50	kp05_28000	g35 to g50
kp05_7750	g10 to g50	kp05_29000	g35 to g50
kp05_8000	g10 to g50	kp05_30000	g40 to g50
kp05_8250	g10 to g50	kp05_31000	g40 to g50
kp05_8500	g15 to g50	kp05_32000	g40 to g50
kp05_8750	g15 to g50	kp05_33000	g40 to g50
kp05_9000	g15 to g50	kp05_34000	g45 to g50
kp05_9250	g20 to g50	kp05_35000	g45 to g50
kp05_9500	g20 to g50	kp05_37500	g45 to g50
kp05_9750	g20 to g50	kp05_40000	g50
kp05_10000	g20 to g50	kp05_42500	g50
kp05_10500	g20 to g50	kp05_45000	g50
kp05_11000	g25 to g50		
kp05_11500	g25 to g50		
kp05_12000	g25 to g50		

TABLE 5: Kurucz stellar atmosphere models for log$Z$= +0.3

File Name	Gravity Range	File Name	Gravity Range
kp03_3500	g00 to g50	kp03_12500	g25 to g50
kp03_3750	g00 to g50	kp03_13000	g25 to g50
kp03_4000	g00 to g50	kp03_14000	g25 to g50
kp03_4250	g00 to g50	kp03_15000	g25 to g50
kp03_4500	g00 to g50	kp03_16000	g25 to g50
kp03_4750	g00 to g50	kp03_17000	g25 to g50
kp03_5000	g00 to g50	kp03_18000	g25 to g50
kp03_5250	g00 to g50	kp03_19000	g30 to g50
kp03_5500	g00 to g50	kp03_20000	g30 to g50
kp03_5750	g00 to g50	kp03_21000	g30 to g50
kp03_6000	g00 to g50	kp03_22000	g30 to g50
kp03_6250	g05 to g50	kp03_23000	g30 to g50
kp03_6500	g05 to g50	kp03_24000	g30 to g50
kp03_6750	g05 to g50	kp03_25000	g30 to g50
kp03_7000	g05 to g50	kp03_26000	g35 to g50
kp03_7250	g05 to g50	kp03_27000	g35 to g50
kp03_7500	g10 to g50	kp03_28000	g35 to g50
kp03_7750	g10 to g50	kp03_29000	g35 to g50
kp03_8000	g10 to g50	kp03_30000	g35 to g50
kp03_8250	g10 to g50	kp03_31000	g40 to g50
kp03_8500	g10 to g50	kp03_32000	g40 to g50
kp03_8750	g15 to g50	kp03_33000	g40 to g50
kp03_9000	g15 to g50	kp03_34000	g40 to g50
kp03_9250	g20 to g50	kp03_35000	g45 to g50
kp03_9500	g20 to g50	kp03_37500	g45 to g50
kp03_9750	g20 to g50	kp03_40000	g45 to g50
kp03_10000	g20 to g50	kp03_42500	g50
kp03_10500	g20 to g50	kp03_45000	g50
kp03_11000	g25 to g50	kp03_47500	g50
kp03_11500	g25 to g50	kp03_50000	g50
kp03_12000	g25 to g50		

TABLE 6: Kurucz stellar atmosphere models for log$Z$= +0.2

File Name	Gravity Range	File Name	Gravity Range
kp02_3500	g00 to g50	kp02_12500	g25 to g50
kp02_3750	g00 to g50	kp02_13000	g25 to g50
kp02_4000	g00 to g50	kp02_14000	g25 to g50
kp02_4250	g00 to g50	kp02_15000	g25 to g50
kp02_4500	g00 to g50	kp02_16000	g25 to g50
kp02_4750	g00 to g50	kp02_17000	g25 to g50
kp02_5000	g00 to g50	kp02_18000	g25 to g50
kp02_5250	g00 to g50	kp02_19000	g25 to g50
kp02_5500	g00 to g50	kp02_20000	g30 to g50
kp02_5750	g00 to g50	kp02_21000	g30 to g50
kp02_6000	g00 to g50	kp02_22000	g30 to g50
kp02_6250	g05 to g50	kp02_23000	g30 to g50
kp02_6500	g05 to g50	kp02_24000	g30 to g50
kp02_6750	g05 to g50	kp02_25000	g30 to g50
kp02_7000	g05 to g50	kp02_26000	g35 to g50
kp02_7250	g05 to g50	kp02_27000	g35 to g50
kp02_7500	g05 to g50	kp02_28000	g35 to g50
kp02_7750	g10 to g50	kp02_29000	g35 to g50
kp02_8000	g10 to g50	kp02_30000	g35 to g50
kp02_8250	g10 to g50	kp02_31000	g40 to g50
kp02_8500	g10 to g50	kp02_32000	g40 to g50
kp02_8750	g15 to g50	kp02_33000	g40 to g50
kp02_9000	g15 to g50	kp02_34000	g40 to g50
kp02_9250	g20 to g50	kp02_35000	g40 to g50
kp02_9500	g20 to g50	kp02_37500	g45 to g50
kp02_9750	g20 to g50	kp02_40000	g45 to g50
kp02_10000	g20 to g50	kp02_42500	g50
kp02_10500	g20 to g50	kp02_45000	g50
kp02_11000	g25 to g50	kp02_47500	g50
kp02_11500	g25 to g50	kp02_50000	g50
kp02_12000	g25 to g50		

TABLE 7: Kurucz stellar atmosphere models for log$Z$= +0.1

File Name	Gravity Range	File Name	Gravity Range
kp01_3500	g00 to g50	kp01_12500	g25 to g50
kp01_3750	g00 to g50	kp01_13000	g25 to g50
kp01_4000	g00 to g50	kp01_14000	g20 to g50
kp01_4250	g00 to g50	kp01_15000	g25 to g50
kp01_4500	g00 to g50	kp01_16000	g25 to g50
kp01_4750	g00 to g50	kp01_17000	g25 to g50
kp01_5000	g00 to g50	kp01_18000	g25 to g50
kp01_5250	g00 to g50	kp01_19000	g25 to g50
kp01_5500	g00 to g50	kp01_20000	g30 to g50
kp01_5750	g00 to g50	kp01_21000	g30 to g50
kp01_6000	g00 to g50	kp01_22000	g30 to g50
kp01_6250	g05 to g50	kp01_23000	g30 to g50
kp01_6500	g05 to g50	kp01_24000	g30 to g50
kp01_6750	g05 to g50	kp01_25000	g30 to g50
kp01_7000	g05 to g50	kp01_26000	g30 to g50
kp01_7250	g05 to g50	kp01_27000	g35 to g50
kp01_7500	g05 to g50	kp01_28000	g35 to g50
kp01_7750	g10 to g50	kp01_29000	g35 to g50
kp01_8000	g10 to g50	kp01_30000	g35 to g50
kp01_8250	g10 to g50	kp01_31000	g35 to g50
kp01_8500	g10 to g50	kp01_32000	g40 to g50
kp01_8750	g15 to g50	kp01_33000	g40 to g50
kp01_9000	g15 to g50	kp01_34000	g40 to g50
kp01_9250	g20 to g50	kp01_35000	g40 to g50
kp01_9500	g20 to g50	kp01_37500	g45 to g50
kp01_9750	g20 to g50	kp01_40000	g45 to g50
kp01_10000	g20 to g50	kp01_42500	g50
kp01_10500	g20 to g50	kp01_45000	g50
kp01_11000	g20 to g50	kp01_47500	g50
kp01_11500	g25 to g50	kp01_50000	g50
kp01_12000	g25 to g50		

TABLE 8: Kurucz stellar atmosphere models for log$Z$= +0.0

File Name	Gravity Range	File Name	Gravity Range
kp00_3500	g00 to g50	kp00_12500	g25 to g50
kp00_3750	g00 to g50	kp00_13000	g25 to g50
kp00_4000	g00 to g50	kp00_14000	g20 to g50
kp00_4250	g00 to g50	kp00_15000	g25 to g50
kp00_4500	g00 to g50	kp00_16000	g25 to g50
kp00_4750	g00 to g50	kp00_17000	g25 to g50
kp00_5000	g00 to g50	kp00_18000	g25 to g50
kp00_5250	g00 to g50	kp00_19000	g25 to g50
kp00_5500	g00 to g50	kp00_20000	g30 to g50
kp00_5750	g00 to g50	kp00_21000	g30 to g50
kp00_6000	g00 to g50	kp00_22000	g30 to g50
kp00_6250	g05 to g50	kp00_23000	g30 to g50
kp00_6500	g05 to g50	kp00_24000	g30 to g50
kp00_6750	g05 to g50	kp00_25000	g30 to g50
kp00_7000	g05 to g50	kp00_26000	g30 to g50
kp00_7250	g05 to g50	kp00_27000	g35 to g50
kp00_7500	g05 to g50	kp00_28000	g35 to g50
kp00_7750	g10 to g50	kp00_29000	g35 to g50
kp00_8000	g10 to g50	kp00_30000	g35 to g50
kp00_8250	g10 to g50	kp00_31000	g35 to g50
kp00_8500	g15 to g50	kp00_32000	g40 to g50
kp00_8750	g15 to g50	kp00_33000	g40 to g50
kp00_9000	g15 to g50	kp00_34000	g40 to g50
kp00_9250	g20 to g50	kp00_35000	g40 to g50
kp00_9500	g20 to g50	kp00_37500	g45 to g50
kp00_9750	g20 to g50	kp00_40000	g45 to g50
kp00_10000	g20 to g50	kp00_42500	g50
kp00_10500	g20 to g50	kp00_45000	g50
kp00_11000	g25 to g50	kp00_47500	g50
kp00_11500	g25 to g50	kp00_50000	g50
kp00_12000	g25 to g50		

TABLE 9: Kurucz stellar atmosphere models for log$Z$= -0.1

File Name	Gravity Range	File Name	Gravity Range
km01_3500	g00 to g50	km01_12500	g25 to g50
km01_3750	g00 to g50	km01_13000	g25 to g50
km01_4000	g00 to g50	km01_14000	g20 to g50
km01_4250	g00 to g50	km01_15000	g25 to g50
km01_4500	g00 to g50	km01_16000	g25 to g50
km01_4750	g00 to g50	km01_17000	g25 to g50
km01_5000	g00 to g50	km01_18000	g25 to g50
km01_5250	g00 to g50	km01_19000	g25 to g50
km01_5500	g00 to g50	km01_20000	g30 to g50
km01_5750	g00 to g50	km01_21000	g30 to g50
km01_6000	g00 to g50	km01_22000	g30 to g50
km01_6250	g05 to g50	km01_23000	g30 to g50
km01_6500	g05 to g50	km01_24000	g30 to g50
km01_6750	g05 to g50	km01_25000	g30 to g50
km01_7000	g05 to g50	km01_26000	g30 to g50
km01_7250	g05 to g50	km01_27000	g35 to g50
km01_7500	g05 to g50	km01_28000	g35 to g50
km01_7750	g10 to g50	km01_29000	g35 to g50
km01_8000	g10 to g50	km01_30000	g35 to g50
km01_8250	g10 to g50	km01_31000	g35 to g50
km01_8500	g10 to g50	km01_32000	g40 to g50
km01_8750	g15 to g50	km01_33000	g40 to g50
km01_9000	g15 to g50	km01_34000	g40 to g50
km01_9250	g20 to g50	km01_35000	g40 to g50
km01_9500	g20 to g50	km01_37500	g45 to g50
km01_9750	g20 to g50	km01_40000	g45 to g50
km01_10000	g20 to g50	km01_42500	g50
km01_10500	g20 to g50	km01_45000	g50
km01_11000	g25 to g50	km01_47500	g50
km01_11500	g25 to g50	km01_50000	g50
km01_12000	g25 to g50		

TABLE 10: Kurucz stellar atmosphere models for log$Z$= -0.2

File Name	Gravity Range	File Name	Gravity Range
km02_3500	g00 to g50	km02_12500	g25 to g50
km02_3750	g00 to g50	km02_13000	g25 to g50
km02_4000	g00 to g50	km02_14000	g20 to g50
km02_4250	g00 to g50	km02_15000	g25 to g50
km02_4500	g00 to g50	km02_16000	g25 to g50
km02_4750	g00 to g50	km02_17000	g25 to g50
km02_5000	g00 to g50	km02_18000	g25 to g50
km02_5250	g00 to g50	km02_19000	g25 to g50
km02_5500	g00 to g50	km02_20000	g30 to g50
km02_5750	g00 to g50	km02_21000	g30 to g50
km02_6000	g00 to g50	km02_22000	g30 to g50
km02_6250	g05 to g50	km02_23000	g30 to g50
km02_6500	g05 to g50	km02_24000	g30 to g50
km02_6750	g05 to g50	km02_25000	g30 to g50
km02_7000	g05 to g50	km02_26000	g30 to g50
km02_7250	g05 to g50	km02_27000	g35 to g50
km02_7500	g05 to g50	km02_28000	g35 to g50
km02_7750	g10 to g50	km02_29000	g35 to g50
km02_8000	g10 to g50	km02_30000	g35 to g50
km02_8250	g10 to g50	km02_31000	g35 to g50
km02_8500	g10 to g50	km02_32000	g40 to g50
km02_8750	g15 to g50	km02_33000	g40 to g50
km02_9000	g15 to g50	km02_34000	g40 to g50
km02_9250	g20 to g50	km02_35000	g40 to g50
km02_9500	g20 to g50	km02_37500	g45 to g50
km02_9750	g20 to g50	km02_40000	g45 to g50
km02_10000	g20 to g50	km02_42500	g50
km02_10500	g20 to g50	km02_45000	g50
km02_11000	g25 to g50	km02_47500	g50
km02_11500	g25 to g50	km02_50000	g50
km02_12000	g25 to g50		

TABLE 11: Kurucz stellar atmosphere models for log$Z$= −0.3

File Name	Gravity Range	File Name	Gravity Range
km03_3500	g00 to g50	km03_12500	g25 to g50
km03_3750	g00 to g50	km03_13000	g25 to g50
km03_4000	g00 to g50	km03_14000	g20 to g50
km03_4250	g00 to g50	km03_15000	g25 to g50
km03_4500	g00 to g50	km03_16000	g25 to g50
km03_4750	g00 to g50	km03_17000	g25 to g50
km03_5000	g00 to g50	km03_18000	g25 to g50
km03_5250	g00 to g50	km03_19000	g25 to g50
km03_5500	g00 to g50	km03_20000	g30 to g50
km03_5750	g00 to g50	km03_21000	g30 to g50
km03_6000	g00 to g50	km03_22000	g30 to g50
km03_6250	g05 to g50	km03_23000	g30 to g50
km03_6500	g05 to g50	km03_24000	g30 to g50
km03_6750	g05 to g50	km03_25000	g30 to g50
km03_7000	g05 to g50	km03_26000	g30 to g50
km03_7250	g05 to g50	km03_27000	g35 to g50
km03_7500	g05 to g50	km03_28000	g35 to g50
km03_7750	g10 to g50	km03_29000	g35 to g50
km03_8000	g10 to g50	km03_30000	g35 to g50
km03_8250	g10 to g50	km03_31000	g35 to g50
km03_8500	g10 to g50	km03_32000	g40 to g50
km03_8750	g15 to g50	km03_33000	g40 to g50
km03_9000	g15 to g50	km03_34000	g40 to g50
km03_9250	g20 to g50	km03_35000	g40 to g50
km03_9500	g20 to g50	km03_37500	g45 to g50
km03_9750	g20 to g50	km03_40000	g45 to g50
km03_10000	g20 to g50	km03_42500	g50
km03_10500	g20 to g50	km03_45000	g50
km03_11000	g25 to g50	km03_47500	g50
km03_11500	g25 to g50	km03_50000	g50
km03_12000	g25 to g50		

TABLE 12: Kurucz stellar atmosphere models for log$Z$= -0.5

File Name	Gravity Range	File Name	Gravity Range
km05_3500	g00 to g50	km05_12500	g25 to g50
km05_3750	g00 to g50	km05_13000	g25 to g50
km05_4000	g00 to g50	km05_14000	g20 to g50
km05_4250	g00 to g50	km05_15000	g25 to g50
km05_4500	g00 to g50	km05_16000	g25 to g50
km05_4750	g00 to g50	km05_17000	g25 to g50
km05_5000	g00 to g50	km05_18000	g25 to g50
km05_5250	g00 to g50	km05_19000	g25 to g50
km05_5500	g00 to g50	km05_20000	g30 to g50
km05_5750	g00 to g50	km05_21000	g30 to g50
km05_6000	g00 to g50	km05_22000	g30 to g50
km05_6250	g05 to g50	km05_23000	g30 to g50
km05_6500	g05 to g50	km05_24000	g30 to g50
km05_6750	g05 to g50	km05_25000	g30 to g50
km05_7000	g05 to g50	km05_26000	g30 to g50
km05_7250	g05 to g50	km05_27000	g35 to g50
km05_7500	g05 to g50	km05_28000	g35 to g50
km05_7750	g10 to g50	km05_29000	g35 to g50
km05_8000	g10 to g50	km05_30000	g35 to g50
km05_8250	g10 to g50	km05_31000	g35 to g50
km05_8500	g10 to g50	km05_32000	g40 to g50
km05_8750	g15 to g50	km05_33000	g40 to g50
km05_9000	g15 to g50	km05_34000	g40 to g50
km05_9250	g20 to g50	km05_35000	g40 to g50
km05_9500	g20 to g50	km05_37500	g45 to g50
km05_9750	g20 to g50	km05_40000	g45 to g50
km05_10000	g20 to g50	km05_42500	g50
km05_10500	g20 to g50	km05_45000	g50
km05_11000	g25 to g50	km05_47500	g50
km05_11500	g25 to g50	km05_50000	g50
km05_12000	g25 to g50		

TABLE 13: Kurucz stellar atmosphere models for log$Z$= −1.0

File Name	Gravity Range	File Name	Gravity Range
km10_3500	g00 to g50	km10_12500	g25 to g50
km10_3750	g00 to g50	km10_13000	g25 to g50
km10_4000	g00 to g50	km10_14000	g20 to g50
km10_4250	g00 to g50	km10_15000	g25 to g50
km10_4500	g00 to g50	km10_16000	g25 to g50
km10_4750	g00 to g50	km10_17000	g25 to g50
km10_5000	g00 to g50	km10_18000	g25 to g50
km10_5250	g00 to g50	km10_19000	g25 to g50
km10_5500	g00 to g50	km10_20000	g30 to g50
km10_5750	g00 to g50	km10_21000	g30 to g50
km10_6000	g00 to g50	km10_22000	g30 to g50
km10_6250	g05 to g50	km10_23000	g30 to g50
km10_6500	g05 to g50	km10_24000	g30 to g50
km10_6750	g05 to g50	km10_25000	g30 to g50
km10_7000	g05 to g50	km10_26000	g30 to g50
km10_7250	g05 to g50	km10_27000	g35 to g50
km10_7500	g05 to g50	km10_28000	g35 to g50
km10_7750	g10 to g50	km10_29000	g35 to g50
km10_8000	g10 to g50	km10_30000	g35 to g50
km10_8250	g10 to g50	km10_31000	g35 to g50
km10_8500	g15 to g50	km10_32000	g40 to g50
km10_8750	g15 to g50	km10_33000	g40 to g50
km10_9000	g15 to g50	km10_34000	g40 to g50
km10_9250	g20 to g50	km10_35000	g40 to g50
km10_9500	g20 to g50	km10_37500	g45 to g50
km10_9750	g20 to g50	km10_40000	g45 to g50
km10_10000	g20 to g50	km10_42500	g50
km10_10500	g20 to g50	km10_45000	g50
km10_11000	g25 to g50	km10_47500	g50
km10_11500	g25 to g50	km10_50000	g50
km10_12000	g25 to g50		

TABLE 14: Kurucz stellar atmosphere models for log$Z$= −1.5

File Name	Gravity Range	File Name	Gravity Range
km15_3500	g00 to g50	km15_12500	g25 to g50
km15_3750	g00 to g50	km15_13000	g25 to g50
km15_4000	g00 to g50	km15_14000	g20 to g50
km15_4250	g00 to g50	km15_15000	g25 to g50
km15_4500	g00 to g50	km15_16000	g25 to g50
km15_4750	g00 to g50	km15_17000	g25 to g50
km15_5000	g00 to g50	km15_18000	g25 to g50
km15_5250	g00 to g50	km15_19000	g25 to g50
km15_5500	g00 to g50	km15_20000	g30 to g50
km15_5750	g00 to g50	km15_21000	g30 to g50
km15_6000	g00 to g50	km15_22000	g30 to g50
km15_6250	g05 to g50	km15_23000	g30 to g50
km15_6500	g05 to g50	km15_24000	g30 to g50
km15_6750	g05 to g50	km15_25000	g30 to g50
km15_7000	g05 to g50	km15_26000	g30 to g50
km15_7250	g05 to g50	km15_27000	g35 to g50
km15_7500	g05 to g50	km15_28000	g35 to g50
km15_7750	g10 to g50	km15_29000	g35 to g50
km15_8000	g10 to g50	km15_30000	g35 to g50
km15_8250	g15 to g50	km15_31000	g35 to g50
km15_8500	g15 to g50	km15_32000	g40 to g50
km15_8750	g20 to g50	km15_33000	g40 to g50
km15_9000	g20 to g50	km15_34000	g40 to g50
km15_9250	g20 to g50	km15_35000	g40 to g50
km15_9500	g20 to g50	km15_37500	g45 to g50
km15_9750	g20 to g50	km15_40000	g45 to g50
km15_10000	g20 to g50	km15_42500	g50
km15_10500	g20 to g50	km15_45000	g50
km15_11000	g25 to g50	km15_47500	g50
km15_11500	g25 to g50	km15_50000	g50
km15_12000	g25 to g50		

TABLE 15: Kurucz stellar atmosphere models for log$Z$= −2.0

File Name	Gravity Range	File Name	Gravity Range
km20_3500	g00 to g50	km20_12500	g25 to g50
km20_3750	g00 to g50	km20_13000	g25 to g50
km20_4000	g00 to g50	km20_14000	g20 to g50
km20_4250	g00 to g50	km20_15000	g25 to g50
km20_4500	g00 to g50	km20_16000	g25 to g50
km20_4750	g00 to g50	km20_17000	g25 to g50
km20_5000	g00 to g50	km20_18000	g25 to g50
km20_5250	g00 to g50	km20_19000	g25 to g50
km20_5500	g00 to g50	km20_20000	g30 to g50
km20_5750	g00 to g50	km20_21000	g30 to g50
km20_6000	g00 to g50	km20_22000	g30 to g50
km20_6250	g05 to g50	km20_23000	g30 to g50
km20_6500	g05 to g50	km20_24000	g30 to g50
km20_6750	g05 to g50	km20_25000	g30 to g50
km20_7000	g05 to g50	km20_26000	g30 to g50
km20_7250	g05 to g50	km20_27000	g35 to g50
km20_7500	g05 to g50	km20_28000	g35 to g50
km20_7750	g10 to g50	km20_29000	g35 to g50
km20_8000	g10 to g50	km20_30000	g40 to g50
km20_8250	g15 to g50	km20_31000	g40 to g50
km20_8500	g15 to g50	km20_32000	g40 to g50
km20_8750	g20 to g50	km20_33000	g45 to g50
km20_9000	g20 to g50	km20_34000	g45 to g50
km20_9250	g20 to g50	km20_35000	g45 to g50
km20_9500	g20 to g50	km20_37500	g45 to g50
km20_9750	g20 to g50	km20_40000	g45 to g50
km20_10000	g20 to g50	km20_42500	g50
km20_10500	g20 to g50	km20_45000	g50
km20_11000	g25 to g50	km20_47500	g50
km20_11500	g25 to g50	km20_50000	g50
km20_12000	g25 to g50		

TABLE 16: Kurucz stellar atmosphere models for log$Z$= -2.5

File Name	Gravity Range	File Name	Gravity Range
km25_3500	g00 to g40	km25_12500	g25 to g50
km25_3750	g00 to g45	km25_13000	g25 to g50
km25_4000	g00 to g45	km25_14000	g20 to g50
km25_4250	g00 to g50	km25_15000	g25 to g50
km25_4500	g00 to g50	km25_16000	g25 to g50
km25_4750	g00 to g50	km25_17000	g25 to g50
km25_5000	g00 to g50	km25_18000	g25 to g50
km25_5250	g00 to g50	km25_19000	g25 to g50
km25_5500	g00 to g50	km25_20000	g30 to g50
km25_5750	g00 to g50	km25_21000	g30 to g50
km25_6000	g00 to g50	km25_22000	g30 to g50
km25_6250	g05 to g50	km25_23000	g30 to g50
km25_6500	g05 to g50	km25_24000	g30 to g50
km25_6750	g05 to g50	km25_25000	g30 to g50
km25_7000	g05 to g50	km25_26000	g30 to g50
km25_7250	g05 to g50	km25_27000	g35 to g50
km25_7500	g05 to g50	km25_28000	g35 to g50
km25_7750	g10 to g50	km25_29000	g35 to g50
km25_8000	g15 to g50	km25_30000	g35 to g50
km25_8250	g15 to g50	km25_31000	g35 to g50
km25_8500	g15 to g50	km25_32000	g40 to g50
km25_8750	g20 to g50	km25_33000	g40 to g50
km25_9000	g20 to g50	km25_34000	g40 to g50
km25_9250	g20 to g50	km25_35000	g40 to g50
km25_9500	g20 to g50	km25_37500	g45 to g50
km25_9750	g20 to g50	km25_40000	g45 to g50
km25_10000	g20 to g50	km25_42500	g50
km25_10500	g20 to g50	km25_45000	g50
km25_11000	g25 to g50	km25_47500	g50
km25_11500	g25 to g50	km25_50000	g50
km25_12000	g25 to g50		

TABLE 17: Kurucz stellar atmosphere models for log$Z$= −3.0

File Name	Gravity Range	File Name	Gravity Range
km30_3500	g00 to g40	km30_12500	g25 to g50
km30_3750	g00 to g40	km30_13000	g25 to g50
km30_4000	g00 to g45	km30_14000	g20 to g50
km30_4250	g00 to g50	km30_15000	g25 to g50
km30_4500	g00 to g50	km30_16000	g25 to g50
km30_4750	g00 to g50	km30_17000	g25 to g50
km30_5000	g00 to g50	km30_18000	g25 to g50
km30_5250	g00 to g50	km30_19000	g25 to g50
km30_5500	g00 to g50	km30_20000	g30 to g50
km30_5750	g00 to g50	km30_21000	g30 to g50
km30_6000	g00 to g50	km30_22000	g30 to g50
km30_6250	g05 to g50	km30_23000	g30 to g50
km30_6500	g05 to g50	km30_24000	g30 to g50
km30_6750	g05 to g50	km30_25000	g30 to g50
km30_7000	g05 to g50	km30_26000	g30 to g50
km30_7250	g05 to g50	km30_27000	g30 to g50
km30_7500	g10 to g50	km30_28000	g35 to g50
km30_7750	g15 to g50	km30_29000	g35 to g50
km30_8000	g15 to g50	km30_30000	g35 to g50
km30_8250	g15 to g50	km30_31000	g35 to g50
km30_8500	g15 to g50	km30_32000	g40 to g50
km30_8750	g20 to g50	km30_33000	g40 to g50
km30_9000	g15 to g50	km30_34000	g40 to g50
km30_9250	g20 to g50	km30_35000	g40 to g50
km30_9500	g20 to g50	km30_37500	g45 to g50
km30_9750	g20 to g50	km30_40000	g45 to g50
km30_10000	g20 to g50	km30_42500	g50
km30_10500	g20 to g50	km30_45000	g50
km30_11000	g25 to g50	km30_47500	g50
km30_11500	g25 to g50	km30_50000	g50
km30_12000	g25 to g50		

TABLE 18: Kurucz stellar atmosphere models for log$Z$= −3.5

File Name	Gravity Range	File Name	Gravity Range
km35_3500	g00 to g35	km35_12500	g25 to g50
km35_3750	g00 to g40	km35_13000	g25 to g50
km35_4000	g00 to g45	km35_14000	g20 to g50
km35_4250	g00 to g45	km35_15000	g25 to g50
km35_4500	g00 to g50	km35_16000	g25 to g50
km35_4750	g00 to g50	km35_17000	g25 to g50
km35_5000	g00 to g50	km35_18000	g25 to g50
km35_5250	g00 to g50	km35_19000	g25 to g50
km35_5500	g00 to g50	km35_20000	g30 to g50
km35_5750	g00 to g50	km35_21000	g30 to g50
km35_6000	g00 to g50	km35_22000	g30 to g50
km35_6250	g05 to g50	km35_23000	g30 to g50
km35_6500	g05 to g50	km35_24000	g30 to g50
km35_6750	g05 to g50	km35_25000	g30 to g50
km35_7000	g05 to g50	km35_26000	g30 to g50
km35_7250	g10 to g50	km35_27000	g35 to g50
km35_7500	g10 to g50	km35_28000	g35 to g50
km35_7750	g15 to g50	km35_29000	g35 to g50
km35_8000	g15 to g50	km35_30000	g35 to g50
km35_8250	g20 to g50	km35_31000	g35 to g50
km35_8500	g15 to g50	km35_32000	g40 to g50
km35_8750	g20 to g50	km35_33000	g40 to g50
km35_9000	g15 to g50	km35_34000	g40 to g50
km35_9250	g20 to g50	km35_35000	g40 to g50
km35_9500	g20 to g50	km35_37500	g45 to g50
km35_9750	g20 to g50	km35_40000	g45 to g50
km35_10000	g20 to g50	km35_42500	g50
km35_10500	g20 to g50	km35_45000	g50
km35_11000	g25 to g50	km35_47500	g50
km35_11500	g25 to g50	km35_50000	g50
km35_12000	g25 to g50		

TABLE 19: Kurucz stellar atmosphere models for log$Z$= −4.0

File Name	Gravity Range	File Name	Gravity Range
km40_3500	g00 to g30	km40_12500	g25 to g50
km40_3750	g00 to g35	km40_13000	g25 to g50
km40_4000	g00 to g40	km40_14000	g20 to g50
km40_4250	g00 to g30	km40_15000	g25 to g50
km40_4500	g00 to g50	km40_16000	g25 to g50
km40_4750	g00 to g50	km40_17000	g25 to g50
km40_5000	g00 to g50	km40_18000	g25 to g50
km40_5250	g00 to g50	km40_19000	g25 to g50
km40_5500	g00 to g50	km40_20000	g30 to g50
km40_5750	g00 to g50	km40_21000	g30 to g50
km40_6000	g00 to g50	km40_22000	g30 to g50
km40_6250	g05 to g50	km40_23000	g30 to g50
km40_6500	g05 to g50	km40_24000	g30 to g50
km40_6750	g05 to g50	km40_25000	g30 to g50
km40_7000	g05 to g50	km40_26000	g30 to g50
km40_7250	g10 to g50	km40_27000	g35 to g50
km40_7500	g10 to g50	km40_28000	g35 to g50
km40_7750	g15 to g50	km40_29000	g35 to g50
km40_8000	g15 to g50	km40_30000	g35 to g50
km40_8250	g20 to g50	km40_31000	g35 to g50
km40_8500	g15 to g50	km40_32000	g40 to g50
km40_8750	g20 to g50	km40_33000	g40 to g50
km40_9000	g15 to g50	km40_34000	g40 to g50
km40_9250	g20 to g50	km40_35000	g40 to g50
km40_9500	g20 to g50	km40_37500	g45 to g50
km40_9750	g20 to g50	km40_40000	g45 to g50
km40_10000	g20 to g50	km40_42500	g50
km40_10500	g20 to g50	km40_45000	g50
km40_11000	g25 to g50	km40_47500	g50
km40_11500	g25 to g50	km40_50000	g50
km40_12000	g25 to g50		

TABLE 20: Kurucz stellar atmosphere models for log$Z$= −4.5

File Name	Gravity Range	File Name	Gravity Range
km45_3500	g00 to g25	km45_12500	g25 to g50
km45_3750	g00 to g35	km45_13000	g25 to g50
km45_4000	g00 to g35	km45_14000	g20 to g50
km45_4250	g00 to g45	km45_15000	g25 to g50
km45_4500	g00 to g50	km45_16000	g25 to g50
km45_4750	g00 to g50	km45_17000	g25 to g50
km45_5000	g00 to g50	km45_18000	g25 to g50
km45_5250	g00 to g50	km45_19000	g25 to g50
km45_5500	g00 to g50	km45_20000	g30 to g50
km45_5750	g00 to g50	km45_21000	g30 to g50
km45_6000	g00 to g50	km45_22000	g30 to g50
km45_6250	g05 to g50	km45_23000	g30 to g50
km45_6500	g05 to g50	km45_24000	g30 to g50
km45_6750	g05 to g50	km45_25000	g30 to g50
km45_7000	g05 to g50	km45_26000	g30 to g50
km45_7250	g10 to g50	km45_27000	g35 to g50
km45_7500	g10 to g50	km45_28000	g35 to g50
km45_7750	g15 to g50	km45_29000	g35 to g50
km45_8000	g15 to g50	km45_30000	g35 to g50
km45_8250	g20 to g50	km45_31000	g35 to g50
km45_8500	g15 to g50	km45_32000	g40 to g50
km45_8750	g20 to g50	km45_33000	g40 to g50
km45_9000	g15 to g50	km45_34000	g40 to g50
km45_9250	g20 to g50	km45_35000	g40 to g50
km45_9500	g20 to g50	km45_37500	g45 to g50
km45_9750	g20 to g50	km45_40000	g45 to g50
km45_10000	g20 to g50	km45_42500	g50
km45_10500	g20 to g50	km45_45000	g50
km45_11000	g25 to g50	km45_47500	g50
km45_11500	g25 to g50	km45_50000	g50
km45_12000	g25 to g50		

TABLE 21: Kurucz stellar atmosphere models for log$Z$= −5.0

File Name	Gravity Range	File Name	Gravity Range
km50_3500	g00 to g30	km50_12500	g25 to g50
km50_3750	g00 to g30	km50_13000	g25 to g50
km50_4000	g00 to g35	km50_14000	g20 to g50
km50_4250	g00 to g40	km50_15000	g25 to g50
km50_4500	g00 to g40	km50_16000	g25 to g50
km50_4750	g00 to g45	km50_17000	g25 to g50
km50_5000	g00 to g50	km50_18000	g25 to g50
km50_5250	g00 to g50	km50_19000	g25 to g50
km50_5500	g00 to g50	km50_20000	g30 to g50
km50_5750	g00 to g50	km50_21000	g30 to g50
km50_6000	g00 to g50	km50_22000	g30 to g50
km50_6250	g05 to g50	km50_23000	g30 to g50
km50_6500	g05 to g50	km50_24000	g30 to g50
km50_6750	g05 to g50	km50_25000	g30 to g50
km50_7000	g05 to g50	km50_26000	g30 to g50
km50_7250	g10 to g50	km50_27000	g35 to g50
km50_7500	g10 to g50	km50_28000	g35 to g50
km50_7750	g15 to g50	km50_29000	g35 to g50
km50_8000	g15 to g50	km50_30000	g35 to g50
km50_8250	g20 to g50	km50_31000	g35 to g50
km50_8500	g15 to g50	km50_32000	g40 to g50
km50_8750	g20 to g50	km50_33000	g40 to g50
km50_9000	g15 to g50	km50_34000	g40 to g50
km50_9250	g20 to g50	km50_35000	g40 to g50
km50_9500	g20 to g50	km50_37500	g45 to g50
km50_9750	g20 to g50	km50_40000	g45 to g50
km50_10000	g20 to g50	km50_42500	g50
km50_10500	g20 to g50	km50_45000	g50
km50_11000	g25 to g50	km50_47500	g50
km50_11500	g25 to g50	km50_50000	g50
km50_12000	g25 to g50		

TABLE 22: Suggested models for specific stellar types

Type	T_{eff}	log$g$	Kurucz model
O3V	52500	+4.14	kp00_50000[g50]
O5V	44500	+4.04	kp00_45000[g50]
O6V	41000	+3.99	kp00_40000[g45]
O8V	35800	+3.94	kp00_35000[g40]
B0V	30000	+3.94	kp00_30000[g40]
B3V	18700	+3.94	kp00_19000[g40]
B5V	15400	+4.04	kp00_15000[g40]
B8V	11900	+4.04	kp00_12000[g40]
A0V	9520	+4.14	kp00_9500[g40]
A5V	8200	+4.29	kp00_8250[g45]
F0V	7200	+4.34	kp00_7250[g45]
F5V	6440	+4.34	kp00_6500[g45]
G0V	6030	+4.39	kp00_6000[g45]
G5V	5770	+4.49	kp00_5750[g45]
K0V	5250	+4.49	kp00_5250[g45]
K5V	4350	+4.54	kp00_4250[g45]
M0V	3850	+4.59	kp00_3750[g45]
M2V	3580	+4.64	kp00_3500[g45]
M5V	3240	+4.94	kp00_3500[g50]
B0III	29000	+3.34	kp00_29000[g35]
B5III	15000	+3.49	kp00_15000[g35]
G0III	5850	+2.94	kp00_5750[g30]
G5III	5150	+2.54	kp00_5250[g25]
K0III	4750	+2.14	kp00_4750[g20]
K5III	3950	+1.74	kp00_4000[g15]
M0III	3800	+1.34	kp00_3750[g15]
O5I	40300	+3.34	kp00_40000[g45]
O6I	39000	+3.24	kp00_40000[g45]
O8I	34200	+3.24	kp00_34000[g40]
BOI	26000	+2.84	kp00_26000[g30]
B5I	13600	+2.44	kp00_14000[g25]
AOI	9730	+2.14	kp00_9750[g20]
A5I	8510	+2.04	kp00_8500[g20]
F0I	7700	+1.74	kp00_7750[g20]
F5I	6900	+1.44	kp00_7000[g15]
G0I	5550	+1.34	kp00_5500[g15]
G5I	4850	+1.14	kp00_4750[g10]
K0I	4420	+0.94	kp00_4500[g10]
K5I	3850	+0.34	kp00_3750[g05]
M0I	3650	+0.14	kp00_3750[g00]
M2I	3450	−0.06	kp00_3500[g00]