Constrains for T_{eff} and log *g* of A-type star from line-index

Wen Hou, A-Li Luo,Yue Wu, Xiao Kong

The National Astronomical observatories, Chinese Academy of Science

Abstract

We attempt to use the feature of spectra such as line index to constrain parameters of A -type stars. Four line indices are chosen for fitting functions of the effective temperature and log *g*. The lines include Hα, Hγ, Ca II K-line and Fe II/Ti II λ4172-4179 blends, which are sensitive to T_{eff} or log *g* or both. We use KURUCZ model spectra with resolution R~2000 as experimental data. Calculating the EW of the lines mentioned above, polynomial fitting is carried out to find the relationship between line indices and both T_{eff} and log *g*. Then we selected about 4000 A-type spectra with high signal to noise from the LAMOST pilot survey, whose T_{eff} and log *g* are measured by ULYSS. The comparison and comment of these two methods are put forward at the last section.

Introduction

A lot of research has been done for the determination of stellar atmospheric parameters through low resolution spectra. Up to now, the most accurate measurements of stellar atmosphere parameters from low resolutions spectra are focused on the effective temperature range that is 4000~7500K(F、G、K type). For stars with higher temperatures (such as A-type), the measurement error is quilt large. Big data samples of low resolution spectroscopy give us opportunities for study of parameters of A-type stars. From statistic view, we employ the relationship between line indices and parameters, obtained from model spectra, to real spectra from LAMOST pilot survey. A data set with 4000 high quality LAMOST A type stellar spectra are selected and the parameters of them are determined by ULYSS software. The work of this presentation is going to study the correctness of those derived parameters by checking if the parameter satisfy the relationship, and the error estimation is our next work.

Data

The data includes model spectra and LAMOST spectra. We select 144 synthesis spectra from KURUCZ. The resolution is reduced to R~2000. The effective temperature range is from 7500K to 12000K with step of 250K and the range of log *g* is from 0.5dex to 5.0dex with step of 0.5dex. The element abundance is fixed at -0.5dex. We also select about 4000 high quality observed spectra classified as A-type star in LAMOST database with S/N > 10. All of the LAMOST spectra have been processed by ULYSS to calculate parameters including atmospheric parameters.

Method

Polynomial fitting

We get four 3D images from the polynomial fitting. In order to see more intuitively the relationship among them, the projection maps are shown in the following.

EW_Hα vs T_{eff} and log *g*

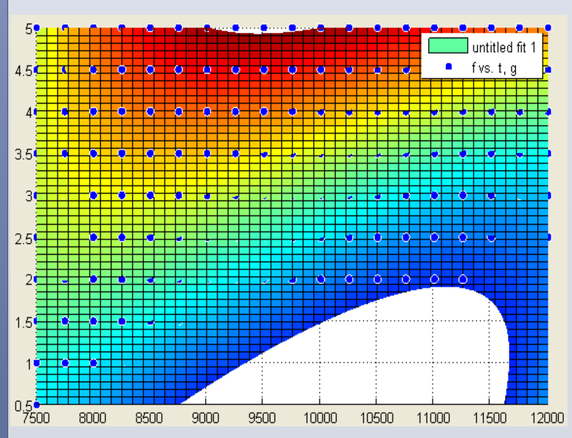


fig1

EW_Hγ vs T_{eff} and log *g*

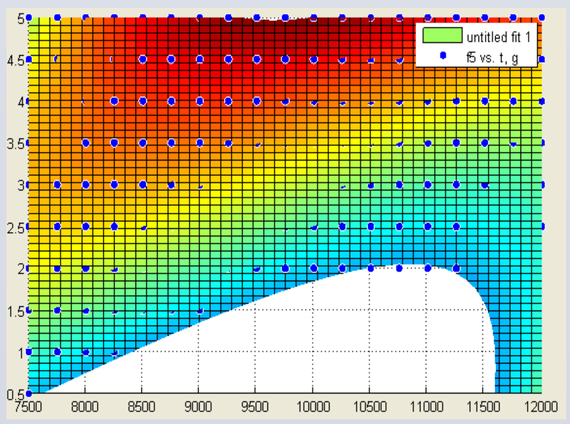


fig2

$$fig1: z = -96.5 + 0.04176x - 26.5y - 5.407\times10^{-6}x^2 + 0.006803xy - 1.791y^2 + 2.202\times10^{-10}x^3 - 3.981\times10^{-7}x^2y + 0.0002046xy^2$$

$$fig2: z = -105.2 + 0.05246x - 44.24y - 7.709\times10^{-6}x^2 + 0.01291xy - 4.874y^2 + 3.444\times10^{-10}x^3 - 7.938\times10^{-7}x^2y + 0.0004876xy^2$$

Z: equal width of line x: the effective temperature y: log *g*

EW_cak/Hε vs T_{eff} and log *g*

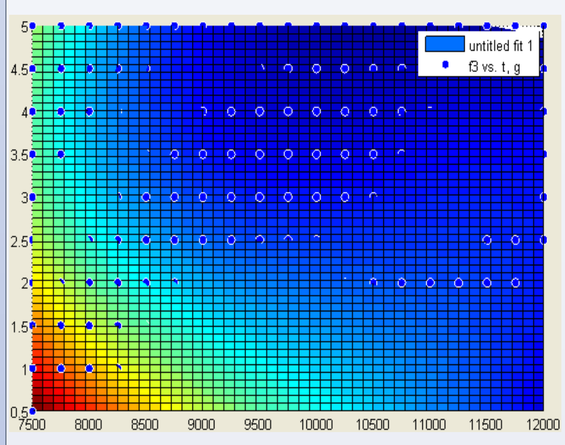


fig3

EW_Fe+Ti vs T_{eff} and log *g*

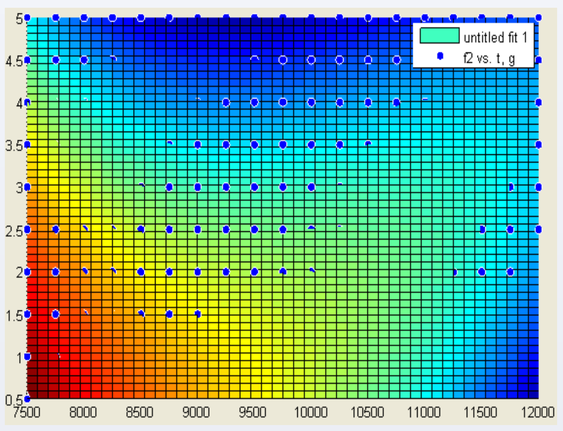


fig4

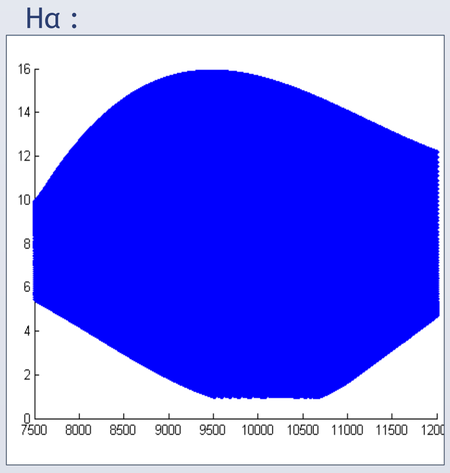
$$fig3: z = 15.14 - 0.003644x - 0.6766y + 3.371\times10^{-7}x^2 + 2.039\times10^{-5}xy + 0.1394y^2 - 1.085\times10^{-11}x^3 + 3.528\times10^{-9}x^2y - 1.297\times10^{-5}xy^2$$

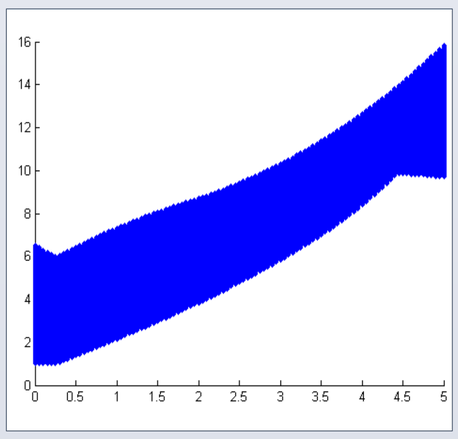
$$fig4: z = 9.408 - 0.001737x + 0.1403y + 1.092\times10^{-7}x^2 - 0.0002709xy + 0.2776y^2 - 1.567\times10^{-12}x^3 + 6.307\times10^{-8}x^2y - 0.000109xy^2 + 0.04952y^3 - 3.513\times10^{-12}x^3y + 7.217\times10^{-9}x^2y^2 - 3.771\times10^{-6}xy^3 - 0.000844y^4$$

The range of T_{eff} and log *g* corresponding to equal width

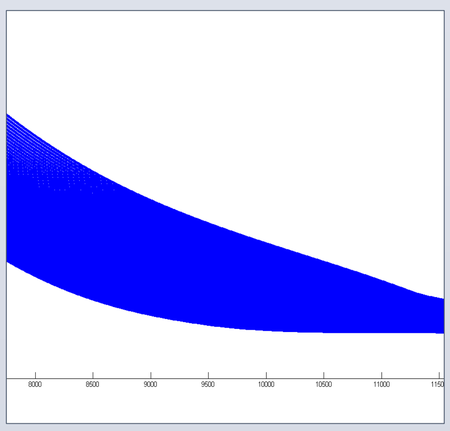
We give four figures in which the horizontal axis is equal width and the vertical is T_{eff} or log *g*. From the figure, we can get the range of parameters corresponding to each equal width.

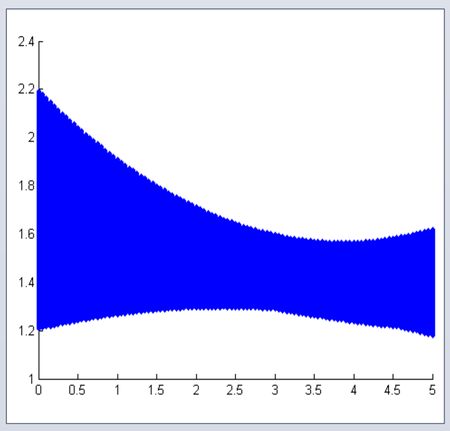
Hα :





Ca II K/Hε :





The following work

Currently, we fit the relationship between independent one spectral line and parameters of A type star , and get the range of T_{eff} and log *g* corresponding to each value of equal width given metallicity. It's our first step of the work. In the following, we will use overlaps of these relationships to get more precisely relationship, then experiment with LAMOST spectra and their derived parameters by checking if they satisfy the relationship. Moreover, errors and confidence of parameters derived from low resolution spectera.

Reference

1. Christopher J. Evans, & and Ian D. Howarth, 2003, Mon. Not. R. Astron. Soc, 345, 1223-1235
2. Richard O. Gray & Christopher J. Corbally, 2009, Stellar Spectral Classification, 160-165