Drawing a continuum in the orders of echelle spectra that contain hydrogen lines

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1. Introduction

While analyzing the echelle spectrum of a star, a researcher encounters the problem of drawing a continuum. It is especially difficult to find its location for the orders containing hydrogen lines. The main problem that prevents from doing this consists in the fact that the wings of such lines do not reach continuum within the limits of their order. Therefore one could hardly say where exactly it has to be drawn. The problem becomes more complicated if the observed spectrum is not flat-fielded.

The objective of this research is to elaborate a method of automatic location of the continuum in the orders of echelle spectra of normal stars, containing hydrogen lines.

2. Method

The gist of the suggested method is as follows. As it is supposed in the classical method, we draw a quasi-continuum in the observed spectrum, using the locations of the maxima sufficiently distant from the core of the hydrogen line. The same procedure is applied to the synthetic spectrum within the area of research. The spectrum has to be calculated with the fundamental characteristics of the star (T^{eff}, lg*g*), which correspond to its spectral class or appear in the preceding research. In the analyzed order of an echelle spectrum the true continuum will equal the ratio between the theoretical and observed quasi-continua.

Usage of the theoretical spectrum is most controversial. It should be emphasized that the theoretical spectrum is used in this method exceptionally as a recommendation for selection of points with a few blended lines in the observed spectrum in the areas distant from the core of the hydrogen line. These recommendations slightly depend on the selected T^{eff}, lg *g,* and the uncertainty, that related to the selected fundamental characteristics, does not appear to be a critical parameter. In the areas far enough from the core of hydrogen line, continuum is drawn by interpolation.

3. Echelle spectrum of α CMi (Procyon)

It was decided to test the proposed method with the aid of a well-studied spectrum of Procyon. For this purpose an echelle spectrum of *a* CMi was obtained with the 1 m telescope of SAO. For processing of the spectrum the standard system DECH20 (Galazutdinov, 1992) was used. Next, we compared the results of plotting the continuum by the suggested method with plotting the continuum using the classical procedure and with the one employed in Griffin's Atlas of Procyon. Since the atlas is based on photographic spectra, the plot of a continuum for the main lines of the Baimer series was not a problem for the authors. The theoretical spectrum of Procyon was calculated in the STARSP system (Tsymbal, 1996). The results are shown in Figs. 1-5.

A comparison of the spectra in the H_γ region, which were obtained by way of drawing the continuum with the application of the classical and proposed techniques, is presented in Fig. 5. It makes clear the differences between the spectra. A comparison with Griffin's Atlas is given in Fig. 4. One can notice a perfect correlation between the Atlas and the spectrum processed by the proposed method.

A comparison with the Griffin's Atlas in the regions H_β and H_δ is presented in Figs. 6-7. As a conclusion, the suggested method is likely to make it possible to use an extremely significant area of the Balmer jump.

References

Galazutdinov G.A., **1992,** Prepr. SAO RAS, **92, 52**
Tsymbal **V.V., 1996,** ASP Conference Series, **108**

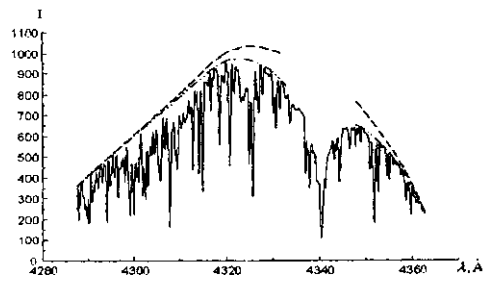

Figure 1: *H_γ line of Procyon: dash-and-dot line — quasi-continuum, dashed line — continuum level for the wings of the hydrogen line, obtained by the proposed method.*

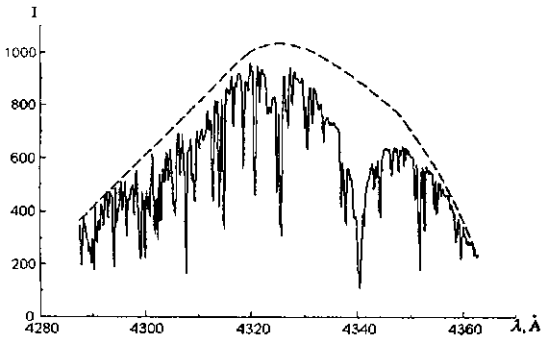

Figure 2: *Continuum in the core of H_γ line of Procyon, obtained by the proposed method.*

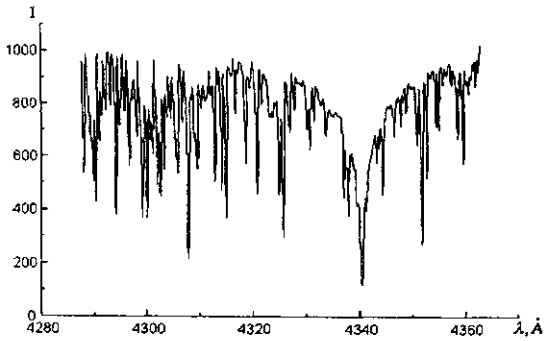

Figure 3: *The spectrum of Procyon near H_γ after processing by the proposed method.*

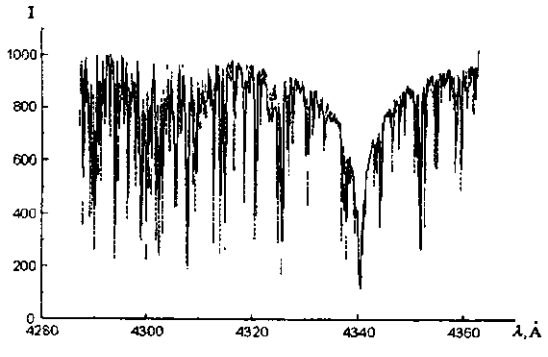

Figure 4: *Comparison of the spectrum near H_γ line after processing by the proposed method (solid line) with that from the Griffin's Atlas of Procyon (dotted line).*

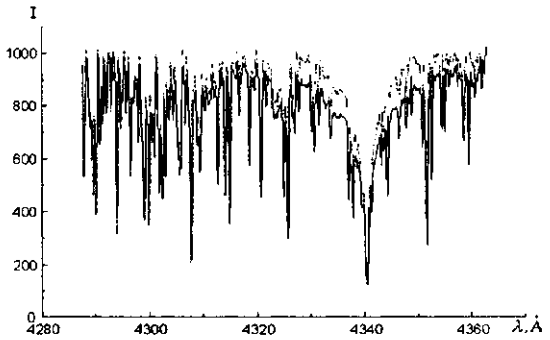

Figure 5: *Comparison of H_γ line normalized to continuum obtained by the proposed method (solid line) and by classical method (dotted line).*

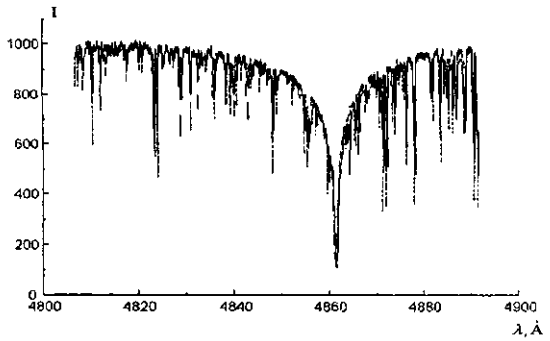

Figure 6: *Comparison of the spectrum near H_β line after processing by the proposed method (solid line) with that from the Griffin's Atlas of Procyon (dotted line).*

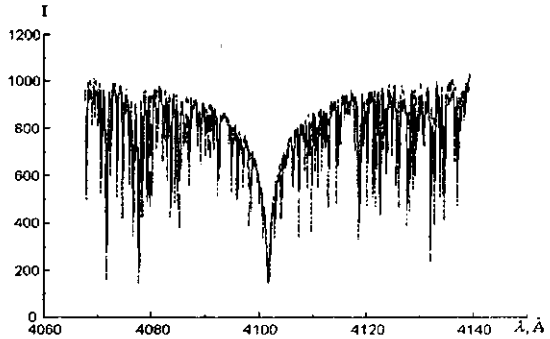

Figure 7: *Comparison of the spectrum near H_δ line after processing by the proposed method (solid line) with that from the Griffin's Atlas of Procyon (dotted line).*