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Interstellar spectral features and telluric absorption lines

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In good quality spectra of stars the weak interstellar absorption lines may be substantially contaminated by telluric lines. Many telluric lines may also simulate interstellar absorptions. To avoid undesirable telluric effects during searches for interstellar absorptions, especially for diffuse interstellar bands (DIBs), we looked for all accessible catalogued telluric absorption lines in our spectra which contain DIBs. We investigated the echelle spectra of two stars, oPer and βTau, to revise the list of DIBs in oPer direction known from literature. We found that many telluric features simulate interstellar absorptions. We present the example parts of spectra to visualize this problem.

Key words: ISM: lines and bands

INTRODUCTION

The diffuse interstellar bands (DIBs) [3] were first discovered in the optical spectra of reddened stars in 1919 [2] and they still represent a long-standing spectroscopic problem in astronomy. Since that time various molecules have been proposed as the carriers of DIBs (e. g. polycyclic organic hydrocarbons, fullerenes, carbon chains, carbon nanotubes, etc.) but among ∼500 recently proposed DIBs e.g. [4] only few of them have carrier candidates. Nowadays the problem of DIB's carriers can be partially solved by searching of "spectroscopic families" [5], subsets of DIBs with the same carriers. Finding unquestionable spectroscopic families is not an easy task but it can bring identifications of some DIBs. In search for spectroscopic families the most important thing is to have the list of DIBs as complete and correct as possible. Many DIBs proposed e. g. in [1, 4] have their origin rather in Earth's atmosphere than in interstellar medium (ISM). Because of this fact it is of great importance to have good quality spectra of stars to state for sure that the observed absorption lines correspond to DIBs and not to telluric lines. The spectra of oPer and βTau which we obtained are the best scientific data to check if all of currently proposed DIBs are correctly classified.

DATA

For our analysis we used high quality echelle spectra obtained with the 2-m Bernard Lyot Telescope coupled with NARVAL spectropolarimeter at Pic du Midi Observatory (France). Observations were done in March 2010 for two stars: oPer – target star (March 12, 13) and βTau – comparison star (March 13). Resolving power of our spectra is 67,000 and S/N is greater than 1000. Forty echelle spectra rows cover the whole optical range, from 3,700 to 10,480 Å. The observed stars have been properly selected. The target star oPer (HD 3180) is a bright star with V-band magnitude of 3.8^m. It is short period spectroscopic binary of B1 III spectral type. Interstellar reddening for oPer was evaluated as $E(B-V) = 0.30^m$. βTau (HD 35497) is non-reddened B7 III star of $V = 1.68^m$. Its rotation speed is $v \sin i = 82$ km/s that is almost the same as for oPer (88 km/s). The telluric line spectrum was generated using HITRAN database[1]. We used spectra only for those compounds which were available in database and had absorption lines in the optical range (H_2O, O_2, CO_2 and OH).

RESULTS AND CONCLUSIONS

Figures 1, 2 show different parts of oPer, βTau and telluric (H_2O) spectra. They well illustrate coexistence of interstellar and telluric absorption lines in the spectrum of oPer. Very often telluric lines affect the DIBs, that is clearly seen in the case of strong, broad 5780 DIB (Figure 1). We can also see that not all telluric features, that means those structures which are seen as well in oPer as in βTau, are present in HITRAN data base. Furthermore, many

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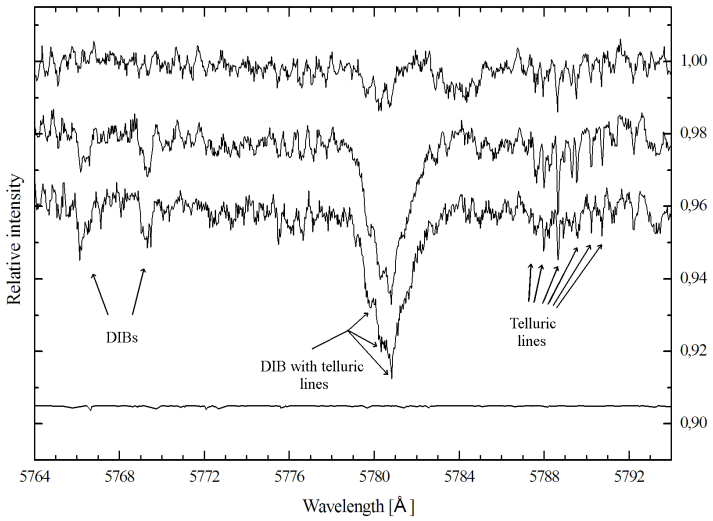

Fig. 1: The selected parts of βTau and oPer spectra. From top to bottom: βTau with airmass am = 1.1 (March 13), oPer with am = 1.67 (13 March), oPer with am = 1.25 (12 March) and telluric spectrum of H_2O from HITRAN database. In presented wavebands we can recognize the DIBs (present only in oPer spectra) and absorption telluric lines (present in βTau as well as in oPer spectrum).

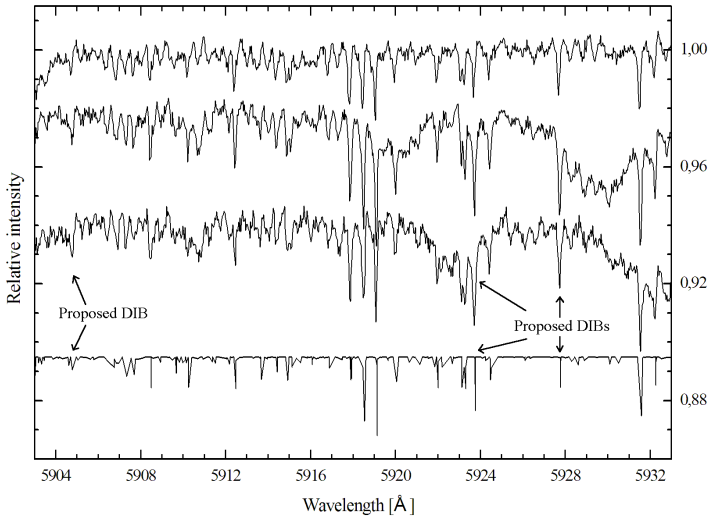

Fig. 2: The other part of βTau and oPer spectra (like in Figure 1). Here we can see examples of proposed (by other authors) DIBs with positions clearly overlapping with positions of telluric H_2O lines.

proposed DIBs, in Figure 2 we can see only three of them, are telluric in their origin. Although complete results of our analysis, achieved partially also by our collaborators (Michele Auriere, Christine Joblin and Giacomo Mulas), will be published soon, the examples exposed here show clearly that it is necessary to verify currently proposed lists of DIBs. Good atlas of telluric lines would be very helpful to verify new discovered weak and uncertain DIBs.

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