THE IDENTIFICATION OF ABSORPTION LINES OF DYSPROSIUM IN THE SOLAR SPECTRUM.

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ABSTRACT. 12 additional absorption lines of Dy II were identified on the basis of calculations of synthetic spectrum and it's comparison with the spectral atlas of solar flux.

Key words: atomic data – line identification – Sun: abundances – Sun: photosphere

The information contained in the data on the abundances of r–, s–processes elements can help to check the elements creation theory.

The identification of absorption lines of these elements in the Solar spectrum is necessary for deriving the abundances. The work of Moore et al. (1966) contain 39 unblended and 17 blended lines of Dy II in the solar spectrum from 2935 to 8770 Å. More than 6000 lines in the solar spectrum are marked as unidentified lines in the mentioned paper. Moore et al. (1966) note, that further laboratory work on the lanthanon group of rare earths may add to line identifications in spectra of elements to be present.

The meteoritic abundance of dysprosium is $\lg A(Dy)$=1.15±0.01 in the usual logarithmic scale, where $\lg A(Dy)=\lg(N_{\rm Dy}/N_{\rm H})+12.00$ (Grevesse and Noels, 1993). The abundance of dysprosium in the Solar photosphere is $\lg A(Dy)$=1.1±0.15 (Anders and Grevesse, 1989). Recently Grevesse et al. (1993) and Biemont and Lowe (1993) derived abundance of disprosium in the solar photosphere: $\lg A(Dy)$=1.14±0.08 (20 lines) and $\lg A(Dy)$=1.20±0.06 (16 lines) respectively. Grevesse et al. (1993) identified 2 lines of Dy II (λ 3914.868 Å and λ 4011.294 Å) and used 18 lines identified by Moore et al. (1966). Biemont and Lowe (1993) identified 2 lines of Dy II (λ 4011.288 Å and λ 4041.975 Å). The rest of lines used by these authors were identified by Moore et al. (1966).

The aim of this paper is a search for additional absorption lines of disprosium in the Solar spectrum.

For a more complete investigation of abundances of heavy elements the synthetic spectra were calculated for Sun within the wavelength range of 2990 – 7470 Å with interval of 0.01 Å.

Theoretical spectrum was calculated using Tsymbal (1992), Pavlenko (1994) and last version of Gadun and Sheminova (1988) programs. These programs are based on Kurucz's ATLAS6 program.

The used line list include one of the versions of Kurucz's computations for iron group elements (1991) and files NBSDATA, NLTELINES, BELLLIGHT, BELLHEAVY (Kurucz, 1992, 1993). Molecular lines have not been considered.

This synthetic spectrum was used only for identification: from calculations the unblended and faintly blended absorption lines of disprosium were selected. Each line selected from the computed list was investigated in the observed spectrum. Spectral atlas of solar flux was used (Kurucz et al., 1984).

12 additional absorption lines of Dy II were identified on the basis of calculations of synthetic spectra and their comparison with the spectral atlases of Sun.

Selected lines of dysprosium were analyzed by the method of spectrum synthesis or model atmospheres.

The method of spectrum synthesis was used

Table 1. Lines of dysprosium in the Solar spectrum

	Moore et al.(1966)					
λ (Å)	λ (Å)	Ident.	W (mÅ)	W (mÅ)	$\lg gf$	$\lg A$
3171.466	.466	no id.	12.0		−0.02	1.29
3305.400	.414	no id.	7.0		0.53	1.26
3305.512	.512	no id.	8.0		0.60	1.27
3539.369	.361	Fe I	3.0		−0.57	1.24
3544.347	.347	no id.	2.5		0.00	0.88
3620.161	.156	no id.	6.5	3.0	0.39	0.99
3629.416				6.7	0.63	1.08
3782.871				1.3	−1.03	1.13
3957.790	.797	no id.	4.5	4.7	0.08	1.12
3991.316	.314	no id.	9.0	6.0	0.08	1.40
4091.757				1.2	−0.22	1.31
4124.627	.630	no id.	5.5	2.7	−0.44	1.14

for first five lines in the wavelength region 2960 – 3600 Å. The unidentified lines were replaced by artificial lines of Fe I. Synthetic spectra were broadened by Gaussian type macroturbulence with velocity 1.6 km/s and rotation (2 km/s).

The rest of lines were analyzed by the model atmospheres method. The equivalent widths of these lines were determined using the methodic of decomposition of the spectrum into gaussians (Kassatella, 1976).

Holweger and Muller (1974) solar model were used for determination of dysprosium abundance in the Sun atmosphere. Microturbulent velocity (0.9 km/s) were derived by Gopka and Yushchenko (1994). For model atmosphere method calculations we used Kurucz's program WIDTH9.

One of the most important problems for obtaining the abundance of dysprosium in the solar atmosphere is oscillator strengths. In this paper we use Kurucz's (1992,1993) oscillator strengths from file BELLHEAVY.

Table 1 contains the identifications of disprosium lines in the solar spectrum. The wavelengths are given in the first column, last figures of wavelengths, identifications and equivalent widths from Moore et al. (1966) are given in the next three columns. Equivalent widths derived from Solar flux atlas (Kurucz et al., 1984), oscillator strengths and logarithmic abundances are given in the last three columns.

Twelve additional lines of disprosium are identified in the Solar spectrum. These lines will be used for determination of dysprosium abundance in the Solar photosphere.

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THE ABUNDANCES OF SOME HEAVY ELEMENTS IN THE ATMOSPHERE OF γ TAURI

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ABSTRACT. Comparison of synthetic spectrum of the γ Tauri photosphere and high quality spectral atlases of this star permit us to identify absorption lines of rubidium, indium, disprosium, erbium, osmium in the observed spectra. The abundances of these elements in the atmosphere of γ Tauri with respect to their abundances in the solar atmosphere were determined by the method of spectrum synthesis.

Key words: $r-$, $s-$processes elements – stellar abundances

The investigations of abundances of $r-$, $s-$processes elements in the atmospheres of stars of different types are important for solving a number of astrophysical problems. The present study is aimed at the determination of the abundance of some heavy elements in the photosphere of γ Tauri.

γ Tauri is a member of Hyades cluster. This is the nearest cluster to the Sun. In time it is only one-tenth. the age of the Sun so its overall chemical abundance will provide evidence of any general enrichment that the Galaxy may have received in heavy elements since the birth of the Sun (Griffin and Holweger, 1989). A high resolution spectral atlases of this star were published by Gratton et al. (1975) and Appelquist et al. (1983). The wavelength regions of these atlases are 3985–4812 Å and 5186–8693 Å, respectively.

The synthetic spectra were calculated for K0 III type star and for solar type star within the wavelength range of spectral atlases of γ Tauri with interval of 0.01 Å. Tsymbal (1992) and Gadun and Sheminova (1988) programs were used. The used line list consists of one of the versions of Kurucz's computations for iron group elements (1991) and files BELLLIGHT, BELLHEAVY, NBSDATA, NLTELINES (Kurucz, 1992, 1993).

We used the following parameters of the atmosphere models: $T_{\rm eff}$=5000 K, $\lg g$=2.7, $v_{\rm micro}$=1.6 km/s for γ Tauri, $T_{\rm eff}$=5777 K, $\lg g$=4.4377, $v_{\rm micro}$=0.9 km/s for Sun. Kurucz (1992) grid of atmosphere models were used. The synthetic spectrum of K0 III type star in the wide spectral region was used only for iden-