Elemental abundance analysis of φ Herculis and o Pegasi with coadded spectra

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Abstract. Coadded high dispersion photographic spectra of φ Herculis and o Pegasi were analysed for the purpose of testing of methods and codes we use in abundance analyses of stellar spectra. Effective temperatures and surface gravities were derived comparing the observed and computed hydrogen profiles. Elemental abundances using the SYNSPEC code were computed. Some new line-identifications are suggested and differences in abundances relative to the published values are discussed. The reliability of the SYNSPEC code in the analyses of stellar atmospheres is demonstrated.

Key words: stars - chemically peculiar - abundances

1. Introduction

In late 1987 the Workshop on Elemental Abundance Analysis was held in Lausanne to give a partial answer to the question why different investigators obtain such a range of abundances for the same star.

Before the workshop, records of coadded spectra of φ Her and o Pegasi were distributed to expected participants by T. Lanz. Coaddings were prepared by Ch. Cowley with 0.24 nm/mm IIaO DAO photographic spectrograms.

The projects of the workshop were as follow:

- (1) to measure equivalent widths of 100 selected lines in each spectrum
- (2) to compute model atmospheres of the effective temperatures and surface gravities given and for solar chemical composition
- (3) to compute abundances from twenty selected lines with gf-values given and classical damping constants

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Unfortunately, at that time, the authors of this paper were not able to participate in the workshop projects except for the first one, i.e. measuring the equivalent widths of selected lines. Later on, however, we implemented the SYNSPEC code (Hubený, 1987) enabling detailed line profiles and/or continuum fluxes to be computed, as well as the code TLUSTY (Hubený, 1988) for computing model atmospheres.

In this paper we demonstrate the ability of the SYNSPEC code and our methods of measuring spectral lines and of analysing abundances.

2. Equivalent widths measurements

The equivalent widths measurements are one of the first possible sources of discrepancies in the abundances derived by different authors. The situation is critical when the strength of line corresponds to the flat portion of the curve of growth. A hundred lines in both spectra were selected and recommended by S. Adelman for measurement in frame of the Project (1). We measured a set of 30 equivalent widths in the following ways:

- numerical integration
- fitting the profile with the Gaussian
- measuring by planimeter (φ Her)
- $W_\lambda - R_c$ - relation (o Peg)
- triangle approximation

The lines to be measured were selected to cover satisfactorily the range of equivalent widths rather than that of wavelengths. The comparison showed that numerical integration and fitting the data with a Gaussian are the best methods to determine the equivalent widths. Consequently, we chose the numerical integration to demonstrate the quality of our measurements on all 100 selected lines of o Peg. The fit is admirably close except for the strongest line, λ407.771 , which seems to be overestimated in our measurements. We obtained the following fit (in pm) with the values adopted by Adelman and Lanz (1988) (lower ADP):

$$ADP = (0.991 \pm 0.005) W_\lambda + (0.124 \pm 0.025) \quad (1)$$

3. Model atmospheres

The effective temperatures and surface gravities were determined by comparing the observed profiles of H_γ with the theoretical ones after Kurucz (1978). The method of least squares was used in the comparisons. Prior to calculating of the least squares the theoretical profiles were

– widened to the projected rotational velocity

– renormalized to unity at the off center distance $\Delta\lambda = 5.0$ nm

– corrected for 4% of the light scattered in the spectrograph

Table 1. summarizes the residual fluxes as measured by different authors. In the case of φ Her, our profile is a little wider in the central part of the profile up to 0.8 nm. The values $T_{\rm eff}$=11 500 K and log g = 1.75 (SI) were determined as the best fit for φ Her and $T_{\rm eff}$=10 500 K and log g=1.8 (SI) for o Peg. The comparison of the atmospheric parameters are summarized in the tables 2 and 3.

Table 1. H_γ residual observed fluxes for φ Her and o Peg (Adelman, Lanz 1988)

	φ Her							
	[pm]							
Author	0.2	0.4	0.6	0.8	1.0	1.6	2.0	3.0
Adelman	0.488	0.611	0.715	0.779	0.833	0.935	0.967	0.985
Savanov	0.488	0.612	0.712	0.785	0.837	0.935	0.962	
Smith	0.494	0.617	0.717	0.791	0.846	0.938	0.968	0.994
Takada-Hidai	0.487	0.614	0.712	0.785	0.841		0.967	0.993
this paper	0.473	0.605	0.708	0.785	0.841	0.968	0.968	0.993

	o Peg							
	[pm]							
Author	0.2	0.4	0.6	0.8	1.0	1.6	2.0	3.0
Adelman	0.414	0.508	0.594	0.668	0.736	0.871	0.918	0.974
Castelli	0.414	0.506	0.587	0.660	0.728	0.871	0.905	0.968
Kocer	0.409	0.505	0.589	0.666	0.733	0.866	0.918	
Sadakane	0.414	0.510	0.598	0.679	0.739	0.875	0.924	0.978
Smith	0.416	0.512	0.599	0.676	0.742	0.877	0.924	0.980
Vant'Veer	0.410	0.508	0.592	0.670	0.734	0.866	0.916	0.972
this paper	0.409	0.510	0.588	0.663	0.732	0.863	0.913	0.967

Table 2. Atmospheric parameters comparisons

	φ Her		o Peg	
	$T_{\rm eff}$	log g	$T_{\rm eff}$	log g
Pre-workshop Adelman, Lanz (1988)	11450±230	1.66±0.16	9500± 80	1.53±0.04
Workshop Adelman, Lanz (1988)	11570±170	1.77±0.16	9540±120	1.55±0.06
Postworkshop Adelman (1988a)	11325	1.70		
Our	11500	1.75	10500	1.8

There is a significant difference between our and the other autors' determination of the effective temperature for o Peg. This difference lies in the theory used for the hydrogen line profile computation. While Kurucz (1978) used the Griem theory, the other authors used the Vidal-Cooper-Smith theory. It is worth noting that both our and the other author's measured profiles fit the same theoretical Kurucz's model best.

Table 3. Preworkshop comparisons for φ Her and o Peg (Adelman, Lanz 1988)

φ Her			
Author	T_{eff}	log g	v_{turb}
Adelman	11325	1.55	0.2
Savanov-Boyarchuk	11600	1.75	0.5
Cowley	11500	1.50	0.0
Didelon	11500	1.60	–
Lanz	11700	1.90	0.95
Ryabchikova-Piskunov	11000	3.50	0.0
Takada-Hidai	11500	1.80	1.4
average	11450±230	1.66±0.16	0.5±0.6
this paper	11500	1.75	1.0

Table 3 (cont.)

o Peg			
Author	T_{eff}	$\log g$	v_{turb}
Adelman	9600	1.60	1.3
Castelli-Hack	9590	1.55	1.9
Cowley	9500	1.50	2.0
Kocer et al.	9500	1.50	1.5
Sadakane	9500	1.50	2.0
Smith and Dworetsky	9500	1.50	1.3
Vant' Veer et al.	9350	1.50	1.8
average	9500± 80	1.53±0.04	1.7±0.3
this paper	10500	1.80	2.0

4. Abundance analysis

Detailed profiles and equivalent widths of selected lines of elements were computed by the SYNSPEC code and compared with the observed to determine the abundances. In the computations we used the sources of oscillator strengths recommended in the workshop. The damping constants were taken from Kurucz and Peytremann (1975). The partition functions for the elements up to atomic number 30 from Traving et al.(1966) were taken while for the rest elements from Irwin (1981). The microturbulent velocity was estimated from lines of Ti II, Fe II and Y II for φ Her and from lines of Fe I, Fe II and Ti II for o Peg in a way that the assumption that the abundance of the element does not depend on the strength of the line used was fulfilled. The fourth column of Table 3 lists our and the pre-workshop results of this procedure. We accepted the value $\xi_{\rm turb} = 1.0\,{\rm km\,s^{-1}}$ for φ Her and $\xi_{\rm turb} = 2.0\,{\rm km\,s^{-1}}$ for o Peg. Our resulting values slightly differ from the preworkshop values. This might be the consequence of actual depth-dependence of the microturbulent velocity which follows from the different values of $\xi_{\rm turb}$ we arrived at when analysing the groups of weak and strong lines separately. The derived abundances are given in Tab.7 with the solar data for comparison (Grevesse 1984) and with the data obtained by Adelman (1988a, 1988b). Table 4 gives the "preworkshop" abundances.

4.1. Comparison of abundances computed for 20 selected lines

The purpose of Project (3) was to test the codes for computing theoretical line strengths as a possible source of the systematic discrepancies between the results by different authors. Fig. 1 displays the result for φ Her and o Peg. Three of the values, for lines Fe I λ 384.044 and 384.105 nm and Fe II λ 435.176 nm occur far

from the zero level for φ Her. This probably is due to their positions near the centers of H_9 and H_γ and consequently to the uncertainity in the equivalent width measurement which seems to be a common effect in the analyses of all authors (Adelman, Lanz 1988). There is a systematic shift of our zero point relative to the accepted values amounting to 0.011 dex as well as a small dispersion of the points. Fig. 1 also shows the comparison for *o* Peg. The systematic shift amounts to 0.008 dex. In contrast to φ Her, we obtained a considerably large dispersion for *o* Peg, essentially for lines of the equivalent widths ≥ 8 pm. However, these equivalent widths display a trend of increasing dispersion in all the workshop results.

Table 4. Preworkshop results of abundances for φ Her and *o* Peg (Adelman, Lanz 1988)

φ Her			
Author	Species		
	Fe II	Ti II	Si II
Adelman	7.43	5.61	7.34
Boyarchuk	7.56	5.43	6.73
Cowley	7.52	-	-
Lanz	7.72	6.00	7.31
Ryabchikova	7.44	5.70	7.47
Takada-Hidai	7.60	5.80	7.58
average	7.54±.1	5.71±.21	7.29±.29
this paper	7.67	6.18	*7.35

o Peg			
Author	Species		
	Fe II	Ti II	Si II
Adelman	7.78	5.16	7.61
Castelli, Hack	7.82	5.36	7.86
Cowley	7.62	-	-
Kocer et al.	7.63	5.20	7.68
Sadakane	7.70	5.21	7.79
Smith, Dworetsky	7.91	5.30	7.87
Van't Veer et al.	7.62	5.33	-
average	7.73±.11	5.26±.08	7.76±.1
this paper	7.69	5.31	*7.61

* classical damping constants

4.2. Abundances of special computational interest

4.2.1. Helium

There is a significant spread in the values of the helium abundance derived by different authors. We used lines λ 402.6 and 447.1 nm to derive the helium abundance in φ Her and λ 447.1 for o Peg. We computed the detailed line profiles and equivalent widths with the damping constants according to Dimitrijevic and Sahal-Brechot (1984). The ordinary Voigt profile was used for line λ 402.6 nm and that after Barnard et al.(1974) for line λ 447.1 nm. Two computational methods were applied to the He lines for φ Her:

- helium was considered a simple atom
- helium was considered explicitly, i. e. two explicit levels of He I with the lowest level and averaged level with principal quantum number 2, two explicit levels of He II (with the principal quantum number 1 and 2) and one explicit level of He III.

The results are summarized in Table 5.

Table 5. Helium abundance for φ Her and o Peg (Adelman, Lanz 1988)

φ Her				
Author	Line	Eq.w. [pm]	He/H abundance	
			simple atom	explicit atom
Adelman	4471	11.2	0.020	-
	4026	19.5	0.028	-
Takada-	4471	15.2	0.038	-
Hidai	4026	26.2	0.054	-
this paper	4471	10.7	0.011	0.011
	4026	24.0	0.069	0.063

o Peg				
Author	Line	Eq. w. [pm]	He/H abundance	
			simple atom	explicit atom
Adelman	4471	3.6	0.055	-
	4026	3.7	0.055	-
this paper	4471	4.5	0.041	-
	4026	-	-	-

4.2.2. Silicon

The lines of the first and the third multiplet were used to derive silicon abundance. In determining the silicon abundance one often meets a situation when remarkably different values are obtained from these multiplets. The source of this can lie in the values of the damping constants used in Stark theory. This is fairly demonstrated in our computations listed in Table 6. The discrepancy disappears when the damping constant after Griem (1974) or Lanz et al. (1988) are used instead of that after Kurucz and Peytremann (1975).

Table 6. Silicon abundance

φ Her			
Line	Abundances		
	KP	Griem	Lanz et al.
4130	$6.16 \cdot 10^{-6}$	$1.76 \cdot 10^{-5}$	$1.86 \cdot 10^{-5}$
3856	$3.31 \cdot 10^{-5}$	$1.86 \cdot 10^{-5}$	$2.60 \cdot 10^{-5}$

o Peg			
Line	Abundances		
	KP	Griem	Lanz et al.
4130	$1.62 \cdot 10^{-5}$	$6.68 \cdot 10^{-5}$	$6.54 \cdot 10^{-5}$
3856	$9.77 \cdot 10^{-5}$	$9.12 \cdot 10^{-5}$	$9.31 \cdot 10^{-5}$

5. Discussion

5.1. Model atmosphere parameters

5.1.1. φ Herculis

Our comparison of the measured and theoretical profiles of H_γ resulted in the values of $T_{\rm eff}$ and log g close to those of the preworkshop as well as workshop analyses. Our value 11 500 K is practically identical with the value derived in the preworkshop work, 11 450 ±230 K, as well as the one adopted in the workshop, 11 570±170 K. The difference of 175 K between Adelman's postworkshop and our value is not too significant either. Our value of log g is well inside the error interval of the other ones.

5.1.2. o Pegasi

We reached the best fit of the observed and theoretical H_γ profiles for $T_{\rm eff}$= 10 500 K. This means a difference of 1000 K relative to the values estimated both in the preworkshop and workshop analyses. Our measured profile does not differ from the profiles measured by the other authors. However, besides the different theory for the H_γ profile they applied additional criteria such as narrow-band photometry, ionization equilibrium, energy distribution in the optical and UV region. The value of log g also differs more than could be considered as "good" agreement. In spite of these discrepancies, for the sake of testing of our computational codes for synthetic spectrum, we accepted the model parameters adopted in the workshop.

Table 7. Comparison of abundances for φ Her and o Peg

φ Her							
log N ,log $N(H) = 12$							
species	this paper	n	Adelman (1988a)	n	Grevesse (1984)	[1]G	[2]A
He I	10.60	2	10.38	2	(11.00)	-0.40	0.22
C II	8.63±0.03	2	8.42	7	8.69	-0.06	0.21
MgII	7.63±0.22	4	7.20	8	7.58	0.05	0.43
Si II	7.35±0.21	5	7.36	5	7.55	-0.20	-0.01
S II	7.33±0.32	2	7.09	13	7.21	0.22	0.24
Ca II	5.53	1	6.64	1	6.46	-0.93	-1.11
Sc II	4.68±0.08	4	4.52	13	3.10	1.58	0.16
Ti II	5.87±0.24	11	5.63	64	5.02	0.85	0.24
Cr II	7.41±0.26	9	6.50	60	5.67	1.74	0.91
Mn II	7.96±0.73	10	6.92	86	5.45	2.51	1.04
Fe II	7.67±0.17	11	7.41	126	7.67	0	0.26
Ni II	6.06±0.34	2	5.74	6	6.25	-0.19	0.32
Ga II	5.54	1	6.00	2	-	-	-0.46
Ba II	2.30	1	<3.94	1	2.13	0.17	-1.64
Sr II	4.20	1	3.66	2	2.90	1.30	0.54
Y II	5.26±0.07	7	5.28	27	2.24	3.02	-0.02
Zr II	4.84±0.08	7	4.68	25	2.56	2.28	0.16

[1] this paper - Grevesse (1984)
[2] this paper - Adelman (1988a)

Table 7 (cont.)

o Peg							
log N ,log N(H) = 12							
species	this paper	n	Adelman (1988b)	n	Grevesse (1984)	[1]G	[2]A
He I	10.62	1	10.74	2	(11.00)	-0.38	-0.12
Mg II	7.71±0.15	4	7.48	7	7.58	0.13	0.23
Si II	7.61±0.32	4	7.61	5	7.55	0.06	0
S II	8.74	1	7.93	5	7.21	1.53	0.81
Ca I	6.38±0.18	2	6.50	8	6.36	0.02	-0.12
Ti II	5.31±0.18	11	5.16	54	5.02	0.29	0.15
Cr II	6.37±0.14	9	6.19	29	5.67	0.70	0.18
Cr I	5.85	1	5.87	4	5.67	0.18	-0.02
Mn II	6.15	1	5.37	6	5.45	0.70	0.78
Mn I	5.65±0.10	2	5.64	6	5.45	0.20	0.01
Fe II	7.69±0.18	7	7.78	100	7.67	0.02	-0.09
Ni II	7.34±0.13	4	6.15	4	6.25	1.09	1.19
Ni I	6.73±0.14	2	6.81	6	6.25	0.48	-0.08
Ba II	2.82	1	<3.63	1	2.13	0.69	-0.81
Sr II	4.13±0.33	2	3.87	3	2.90	1.23	0.26
Y II	3.04±0.01	2	2.91	11	2.24	0.80	0.13
Zr II	3.62±0.19	10	3.58	27	2.56	1.06	0.04
V II	4.79±0.17	5	4.77	21	4.00	0.79	0.02
Al II	6.80	1	6.57	1	6.47	0.33	0.23

[1] this paper - Grevesse (1984) [2] this paper - Adelman (1988b)

5.2. Abundance differences

5.2.1. φ Herculis

Table 7 lists our results of abundance determination together with Adelman's (1988a, 1988b). Differences occur mainly for Mg, Ca, Cr, Mn, Ga, Ba and Sr. In Table 8 we give a list of the equivalent widths and abundances derived from the individual lines used for these elements. As for Mg, Ca, Ba and Sr the differences most probably result from the differences in equivalent widths. Differences in the equivalent widths of the lines used as well as different sources of *gf*-values are the probable reasons for the difference in the results for Cr and Mn. In spite of the same source of *gf*-values and although practically equal equivalent widths were used, our abundance of gallium is substantially lower.

5.2.2. *o* Pegasi

The summary of the results given in Table 7 indicates different abundances mainly for S, Mn II, Ni II and Ba. Table 8 brings the results for the individual lines of these elements. As regards Mn II nothing can be said as different lines were used in our and Adelman's anlysis. Different *gf* -sources and values of

equivalent widths for S and Ni II may cause the different results. The difference between equivalent widths is the cause of the lower abundance for Ba.

5.3. Identification of some unidentified features

Although the digitized data of the coadded DAO spectrograms of φ Her were analyzed in great detail by Guthrie (1988), there are still some domains in the spectrum of unclear identification indicated with a question mark in Guthrie's contribution. The domains are at the following wavelengths: λ 391.427, λ 394.738,λ 425.570 and λ 455.402 nm. After we had derived the final abundances we computed the segments of synthetic spectra of these domains and attempted to explain the spectral features.

- λ 391.427 nm: In this feature the four following lines occur in a blend:Ti II λ 391.4189, V II λ 391.4326, Zr II λ 391.434 and Fe II λ 391.4503 nm in the ratio of their strengths being 21:3:36:40.

- λ 394.738 nm: This feature is in Guthrie's identification assigned to Fe I (mult. 361,426), with uncertainity. Our synthetic spectrum suggests the following identification: Fe I λ 394.6994, O I λ 394.7295, O I λ 394.7481 and O I λ 394.7586 nm, the relative strengths being 3:44:32:21. The Fe I λ 394.7382 nm line is evidently very weak and invisible.

- λ 455.402 nm: This spectral feature is in fact a blend of two lines Zr II λ 455.3970 and Ba II λ 455.4029 nm, the former being stronger. The line of Ba blends with the Zr line by approximately 6% of its strength. From this we derived the abundance of barium to be log [Ba/H]= 2.3.

- λ 425.552 nm: This feature consists of lines Ga II λ 425.552 and Cr II λ 455.502 nm. From Table 8, where the abundances of the individual lines are listed, indicates that the "deblending" of the feature in a slightly different way could easily lead to a higher abundance of gallium, because the abundance of chromium from this line is too high.

Table 8. Comparison of individual abundances.

φ Her					
	this paper			Adelman (1988a)	
line	W [pm]	Abnd.		W [pm]	Abnd.
448.111	28.6	1.07E-04	Mg	26.4	1.91E-05
385.039	0.8	1.80E-06		1.2	1.74E-05
439.057	4.7	3.31E-05		4.0	1.66E-05

Table 8 (cont.)

442.800	1.3	2.29E-05		1.0	1.12E-05
total	35.4			32.6	
425.552	1.0	3.47E-07	Ga	1.1	1.00E-06
404.710	6.0	1.58E-08	Sr	3.9	3.55E-09
455.403	0.3	1.99E-10	Ba	3.1	8.71E-09
393.366	28.5	3.39E-07	Ca	32.6	4.40E-06
463.409	6.5	1.65E-05	Cr	6.0	2.30E-06
458.831	7.6	1.04E-05		7.2	2.20E-06
455.866	9.5	1.05E-05		8.8	4.40E-06
455.502	5.2	1.91E-05		-	-
453.961	2.6	1.48E-05		-	-
386.653	2.1	8.04E-06		-	-
386.602	0.9	2.69E-06		0.9	3.90E-06
414.580	4.3	1.19E-05		4.1	4.30E-06
400.330	3.4	4.36E-06		3.1	2.50E-06
total	33.2			30.1	
414.046	0.7	1.16E-05	Mn	0.9	8.5E-06
420.538	4.5	5.25E-05		4.0	8.3E-06
420.638	6.3	1.26E-04		-	-
423.919	2.2	2.07E-05		2.1	1.29E-05
425.172	4.1	2.21E-05		4.0	7.80E-06
425.919	5.7	7.85E-05		5.3	2.40E-05
427.860*	1.7	3.76E-03		-	-
429.223	4.8	5.37E-04		-	-
436.523	2.6	3.02E-05		2.0	6.20E-06
399.518*	0.9	3.13E-03		*0.9	6.80E-06
424.424*	2.3	1.38E-05		2.0	1.70E-05
424.044	1.6	1.07E-05		1.4	1.23E-05
total	23.7			21.7	

o Peg

	this paper			Adelman (1988a)	
line	W [pm]	Abnd.		W [pm]	Abnd.
425.919	1.5	1.58E-06	Mn	-	-
414.510	1.7	5.50E-04	S	1.3	1.62E-04
384.958	7.2	1.55E-05		-	-
401.548	6.1	3.16E-05	Ni	5.4	1.12E-06
419.207	3.0	2.40E-05		2.5	1.02E-06
436.210	3.8	1.91E-05		3.8	1.41E-06
total	12.9			11.7	
total	10.4			9.1	
445.403	5.7	6.60E-10	Ba	7.9	>4.26E-09

* excluded

As regards o Pegasi, there are some uncertainities indicated by a question mark in the Adelman et al. (1984) identification list. We added four other domains of unclear identifications which had arised in the abundance analysis process. The synthetic spectra were computed after the abundances had been determined. Our identifications are given in Table 9 together with the relative strenths of the lines concerned in the fourth column.

Table 9. Identification problems of o Peg.

Domain [nm]	Ions	Wavelength [nm]	Percentual Strength Ratio
389.566	Mg I	389.557	42:54:4
	Fe I	389.566	
	Fe I	389.542	
390.055	Fe I	390.050	18:12
	Ti II	390.050	
392.064	Fe II	392.063	77:3:20
	C II	392.068	
	Fe I	392.083	
392.922	Fe I	392.910	37:4:41:6:2:9:1
	Ti II	392.914	
	Fe I	392.920	
	La II	392.922	
	Co I	392.925	
	Fe II	392.925	
	Mn II	392.927	
394.483	Fe II	394.487	4:83:13
	Fe I	394.489	
	Fe I	394.497	
394.909	La II	394.910	38:12:50
	Ni II	394.910	
	Fe I	394.914	
397.852	Ni I	397.838	24:49:27
	Fe I	397.845	
	Fe II	397.871	
400.491	Fe I	400.481	50:49:1
	Fe I	400.497	
	Fe I	400.497	
400.724	Fe I	400.724	
415.195	Fe I	415.194	44:4:7:45
	Ce II	415.197	
	La II	415.197	
	Fe I	415.216	

Table 9 (cont.)

417.187	Fe I	417.189	4:20:57:1:18
	Cr II	417.191	
	Ti II	417.191	
	Ga I	417.206	
	Fe I	417.212	
417.760	Y II	417.754	47:4:49
	Fe I	417.759	
	Fe II	417.769	
420.896	Zr II	420.898	96:3:1
	Cr II	420.905	
	Cr I	420.917	
421.551	Sr II	421.551	87:1:12
	Fe I	421.543	
	Cr II	421.574	
423.655	Ni I	423.636	20:72:1:7
	Cr II	423.638	
	Fe I	423.677	
	V II	423.681	
437.445	Sc II	437.446	92:8
	Fe I	437.449	
440.927	Ti II	440.914	15:85
	Ti II	440.926	
446.571	Cr II	446.580	98:2
	Ti II	446.582	
447.156	He I	~447.150	
	Fe I	447.159	
	Mo II	447.166	
412.874	Fe II	412.875	
429.224	Fe I	429.228	36:24:40
	Ni I	429.234	
	Mn II	429.244	
450.931	Fe I	450.930	10:90
	Ni II	450.927	
459.606	Fe I	459.606	93:7
	Fe II	459.615	

6. Conclusions

In this work a "postworkshop" analysis of coadded spectra of one Ap and one Am star was carried out to compare our methods of elemental abundance deter-

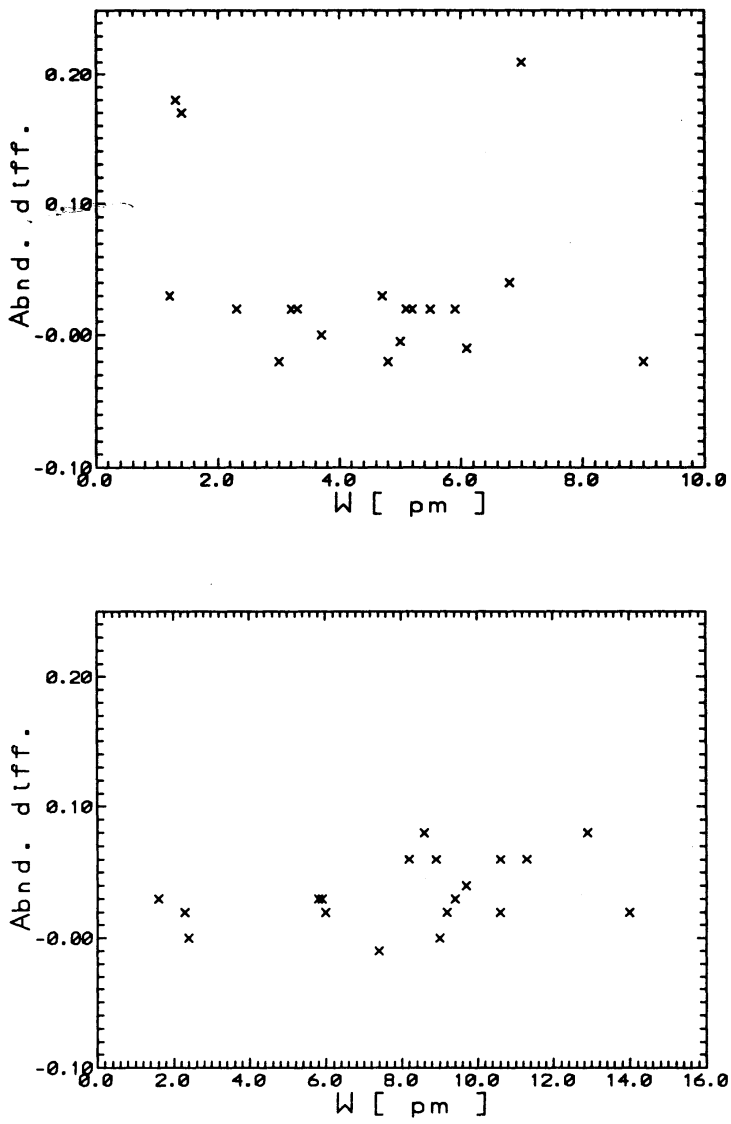

Figure 1. Plot of the abundance difference as a function of equivalent width, see Adelman, Lanz (1988), top φ Her, bottom o Peg

mination with internationally recommended methods. In frame of Project # 1 we tested five methods of measuring equivalent widths on 30 selected spectral lines in both spectra. Numerical integration and fitting the profile with a Gaussian were found to be the most convenient methods. In Project # 2 we derived the atmospheric parameters $T_{\rm eff}$ and log g using published LTE line blanketed model atmospheres (Kurucz 1978). From lines of neutral and singly ionized Ti, Fe and Y we determined the microturbulent velocities in the atmospheres of

both stars. The differences between our and the workshop results for some of the species show that one has to be very careful in measuring equivalent widths when confined to small number of analyzed lines. The differences in our results arose mainly from the equivalent widths and sources of atomic parameters used. Unclear identifications were checked by computing the synthetic spectra with the new abundances derived. Our results obtained in a frame of Project # 3 are in good agreement with those obtained at the workshop. This analysis proved the SYNSPEC code to be reliable in elemental abundance analyses of stellar atmospheres.

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