Erken B-türü β Cephei değişen yıldızı Gamma Pegasi'nin YTD (Yerel Termodinamik Denge) ve YTDO (Yerel Termodinamik Denge Olmayan) CNO bolluk sonuçları:

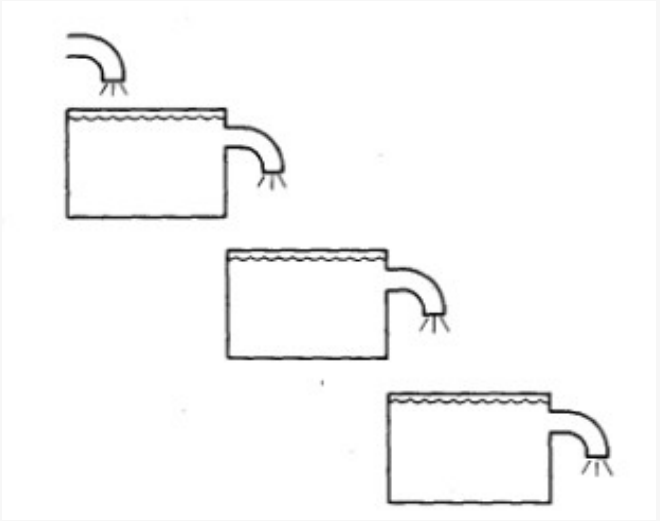
Taner Tanrıverdi[1]

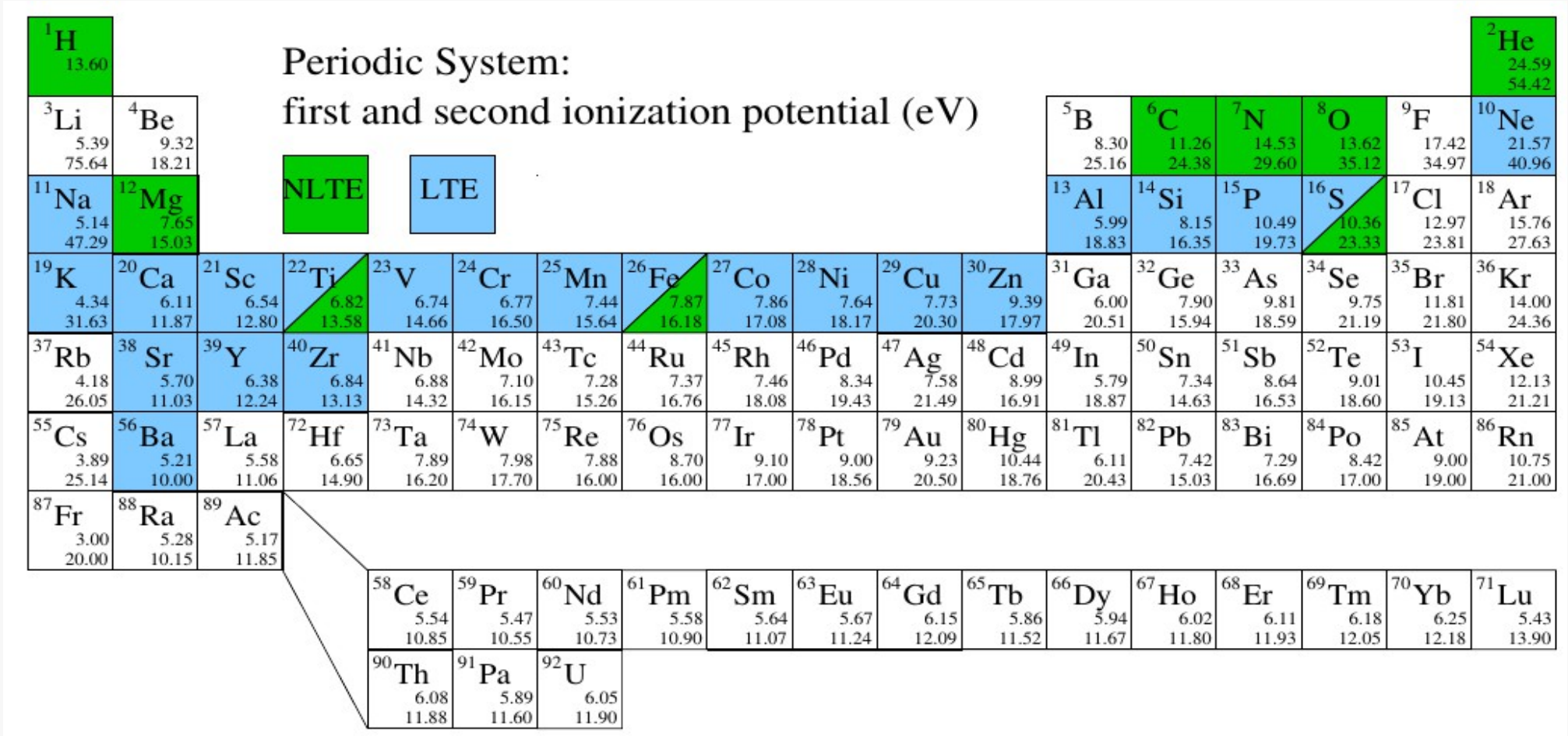
Ömer Halisdemir Üniversitesi, Fen Edebiyat Fakültesi, Fizik Bölümü, Niğde, Türkiye, 51240

ULUSAL ASTRONOMİ KONGRESİ,5-9 EYLÜL 2016, ATATÜRK ÜNİVERSİTESİ, ERZURUM

YTD (Yerel Termodinamik Denge)

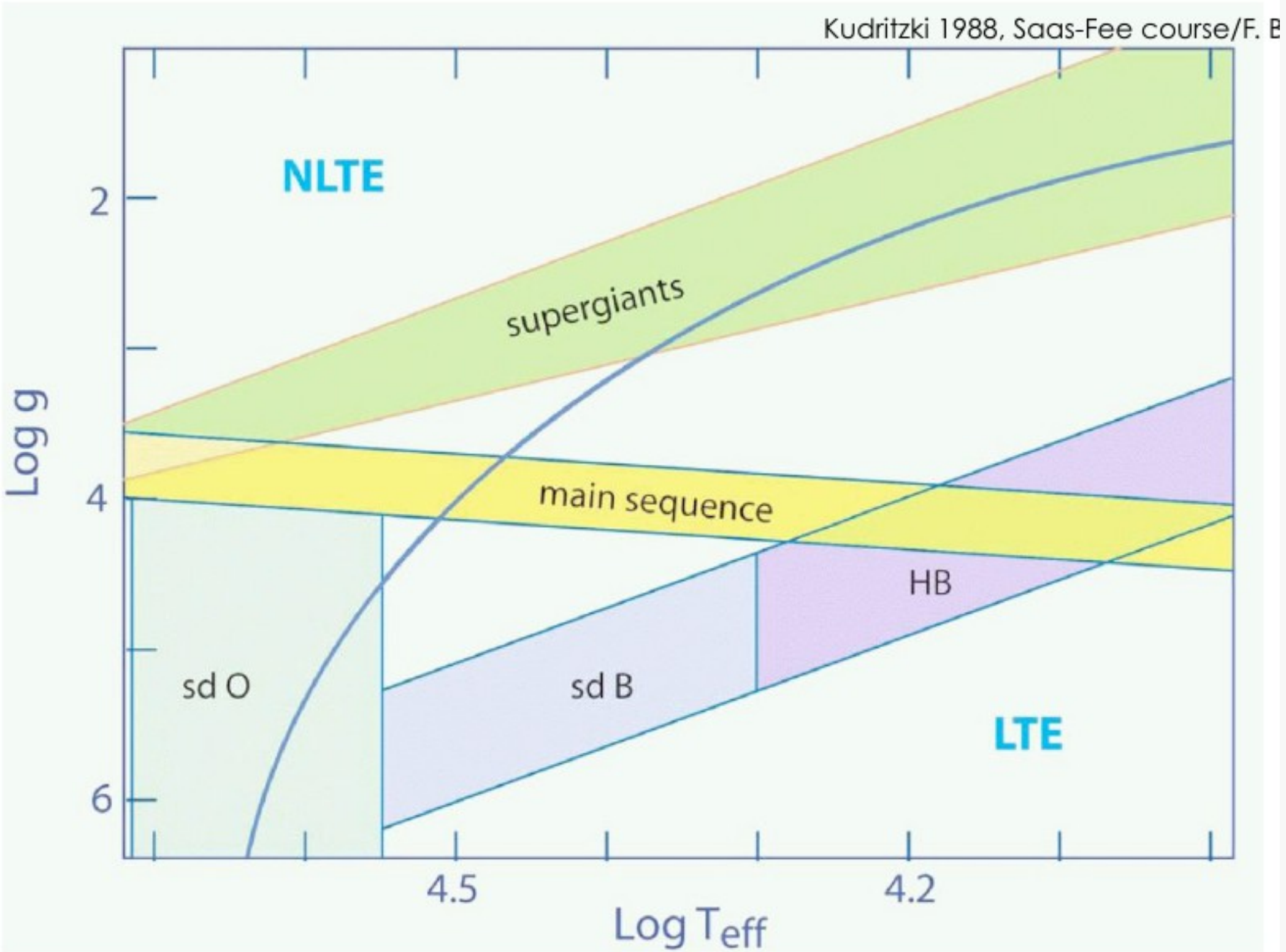
-
  - Hidrostatik denge
  - Radyatif Denge
  - Termodinamik Denge
  - Yük Dengesi




Periodic System:
first and second ionization potential (eV)
NLTE
LTE
1H 13.60
2He 24.59 54.42
3Li 5.39 75.64
4Be 9.32 18.21
5B 8.30 25.16
6C 11.26 24.38
7N 14.53 29.60
8O 13.62 35.12
9F 17.42 34.97
10Ne 21.57 40.96
11Na 5.14 47.29
12Mg 7.65 15.03
13Al 5.99 18.83
14Si 8.15 16.35
15P 10.49 19.73
16S 10.36 23.33
17Cl 12.97 23.81
18Ar 15.76 27.63
19K 4.34 31.63
20Ca 6.11 11.87
21Sc 6.54 12.80
22Ti 6.82 13.58
23V 6.74 14.66
24Cr 6.77 16.50
25Mn 7.44 15.64
26Fe 7.87 16.18
27Co 7.86 17.08
28Ni 7.64 18.17
29Cu 7.73 20.30
30Zn 9.39 17.97
31Ga 6.00 20.51
32Ge 7.90 15.94
33As 9.81 18.59
34Se 9.75 21.19
35Br 11.81 21.80
36Kr 14.00 24.36
37Rb 4.18 26.05
38Sr 5.70 11.03
39Y 6.38 12.24
40Zr 6.84 13.13
41Nb 6.88 14.32
42Mo 7.10 16.15
43Tc 7.28 15.26
44Ru 7.37 16.76
45Rh 7.46 18.08
46Pd 8.34 19.43
47Ag 7.58 21.49
48Cd 8.99 16.91
49In 5.79 18.87
50Sn 7.34 14.63
51Sb 8.64 16.53
52Te 9.01 18.60
53I 10.45 19.13
54Xe 12.13 21.21
55Cs 3.89 25.14
56Ba 5.21 10.00
57La 5.58 11.06
72Hf 6.65 14.90
73Ta 7.89 16.20
74W 7.98 17.70
75Re 7.88 16.00
76Os 8.70 16.00
77Ir 9.10 17.00
78Pt 9.00 18.56
79Au 9.23 20.50
80Hg 10.44 18.76
81Tl 6.11 20.43
82Pb 7.42 15.03
83Bi 7.29 16.69
84Po 8.42 17.00
85At 9.00 19.00
86Rn 10.75 21.00
87Fr 3.00 20.00
88Ra 5.28 10.15
89Ac 5.17 11.85
58Ce 5.54 10.85
59Pr 5.47 10.55
60Nd 5.53 10.73
61Pm 5.58 10.90
62Sm 5.64 11.07
63Eu 5.67 11.24
64Gd 6.15 12.09
65Tb 5.86 11.52
66Dy 5.94 11.67
67Ho 6.02 11.80
68Er 6.11 11.93
69Tm 6.18 12.05
70Yb 6.25 12.18
71Lu 5.43 13.90
90Th 6.08 11.88
91Pa 5.89 11.60
92U 6.05 11.90

Atmosfer Modelleri

- LTE
  - ATLAS9
  - MARCS
- NLTE
  - DETAIL
  - ATA
  - TLUSTY


Kudritzki 1988, Saas-Fee course/F. B
NLTE
supergiants
main sequence
HB
sd O
sd B
LTE
2
4
6
Log g
4.5
4.2
Log T_eff

- Erken Tür ve Süperdevler
    - NLTE
- >=A8 tayf türü
    - Baınç Tersinirliği(Pressuure Inv.)
    -
- Soğuk Yıldızlar
    - F,G,K yıldızları

Model Atmosfer Programı

- **TLUSTY**
  - 27500 K<=Teff <=55000 K
  - 3.0 <=log g<= 4.75
  - Düzlem paralel

ELODIE

- 4100-6800 A
- R~42000 ve 10000
- S/N~300

HD886

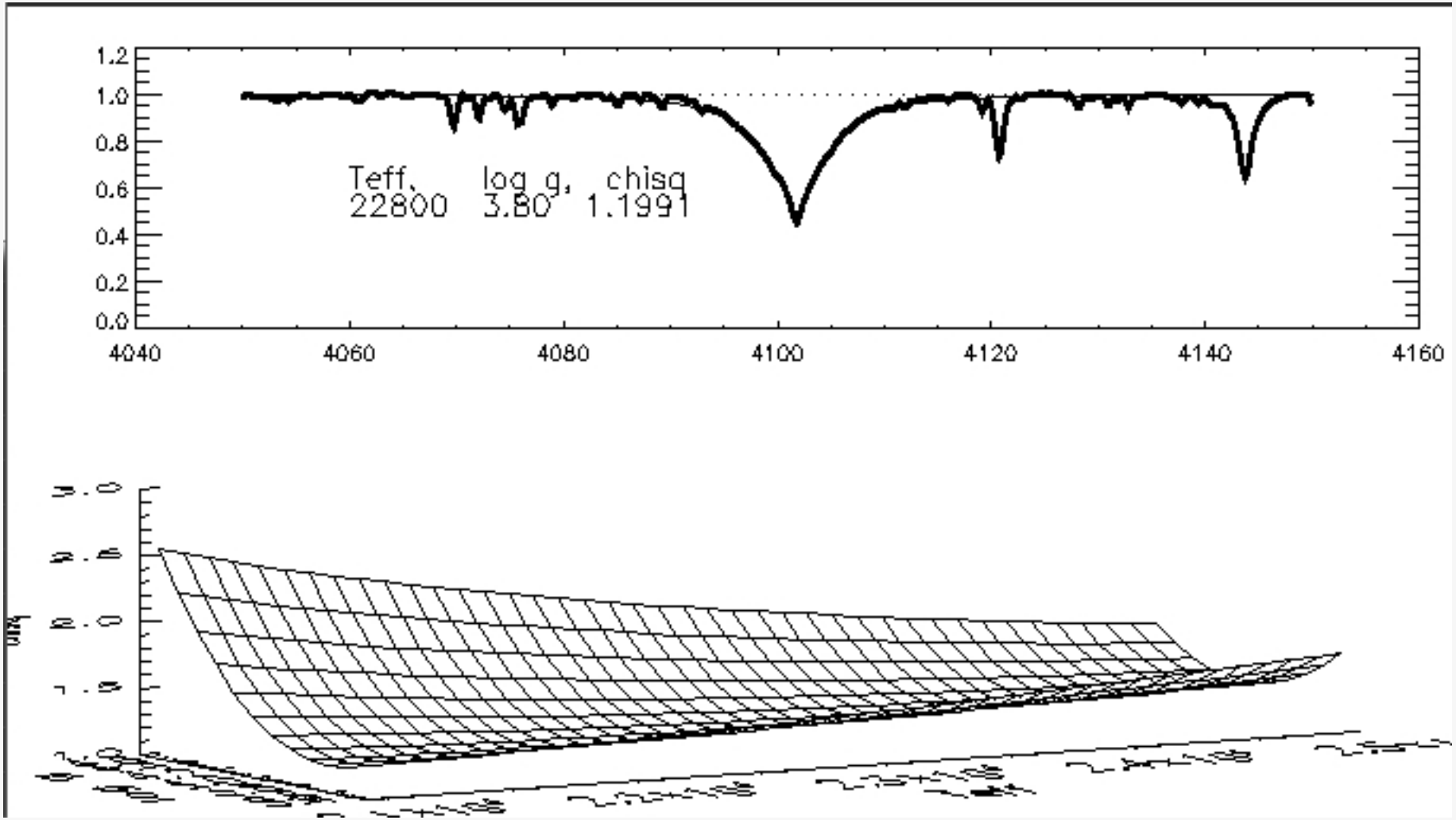
- B2 IV tayf türü
- Beta Cep değişen
  - Galaktik
  - l~109, b~-46
- Nieva&Przybilla,2014,A&A,566,7
- Gies&Lambert,1992,ApJ,387,673

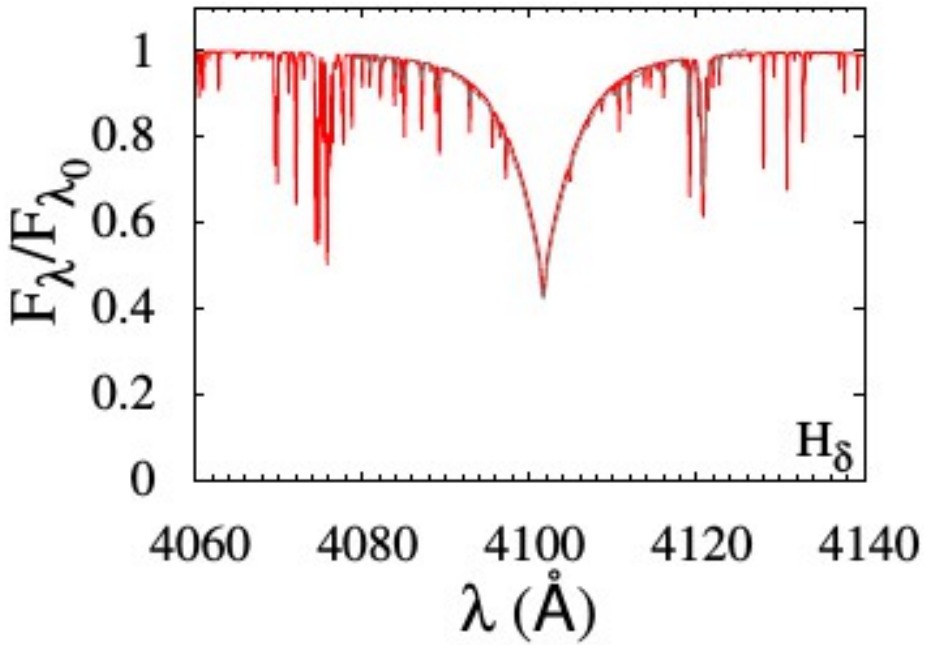
Teff,logg belirleme

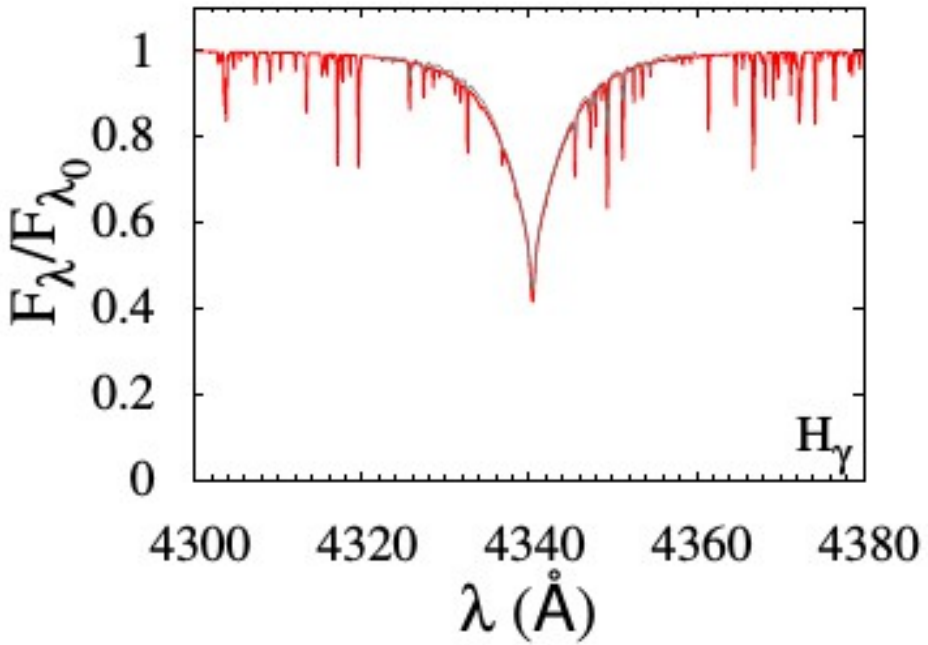
- Fotometrik Kalibrasyon+
- Balmer Seri çizgileri+
- İyonizasyon Dengesi-
- Eksitaston potansiyeli-
- SED (Spectral Energy Dist.)-

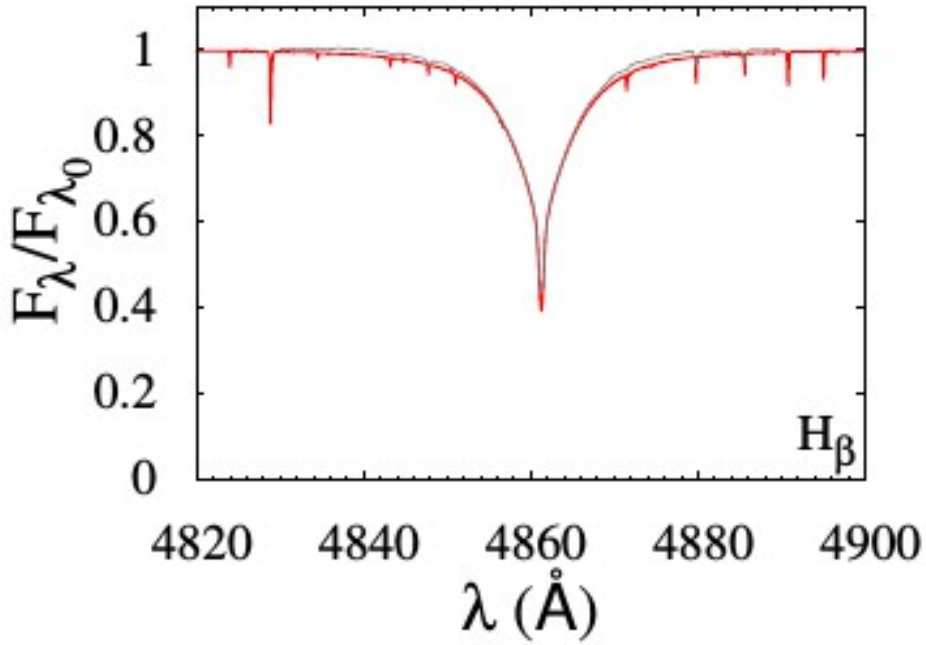
Method

- **IRAF, *splot,continuum* task**
  - Normalizasyon
  - Gauss,Fit, EW
- Atomik veriler, **VALD**
- **SYNPLOT, Tlusty**
  - Teff
  - Logg
  - Vsini
  - Microtürbülans Hızı
  - CNO bolluk


Teff, log g, chisq
22800 3.80 1.1991
1.2
1.0
0.8
0.6
0.4
0.2
0.0
4040
4060
4080
4100
4120
4140
4160


1
0.8
0.6
0.4
0.2
0
F_λ/F_{λ_0}
H_δ
4060
4080
4100
4120
4140
λ (Å)


1
0.8
0.6
0.4
0.2
0
F_λ/F_{λ_0}
H_γ
4300
4320
4340
4360
4380
λ (Å)

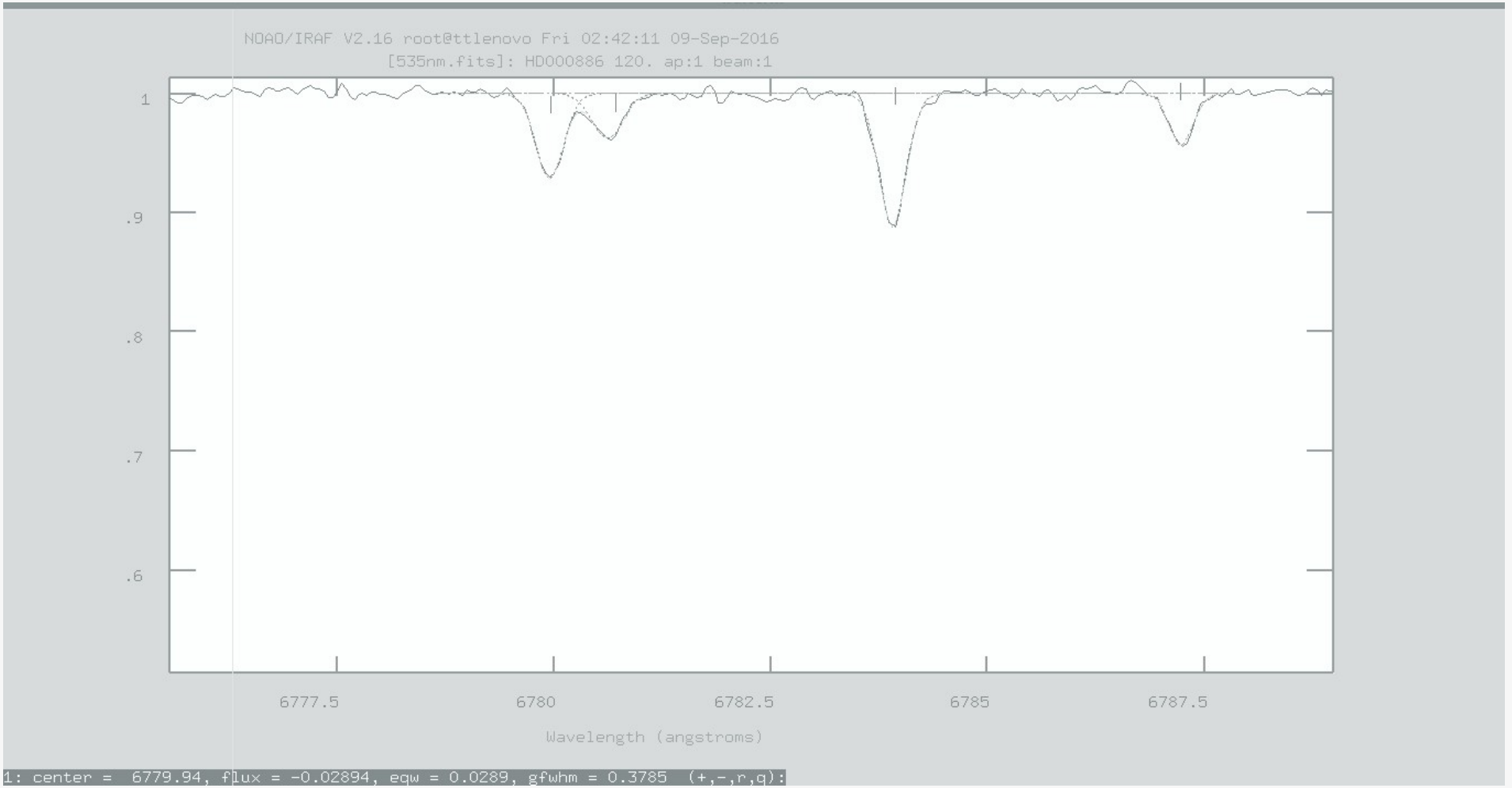

1
0.8
0.6
0.4
0.2
0
F_λ/F_{λ_0}
H_β
4820
4840
4860
4880
4900
λ (Å)

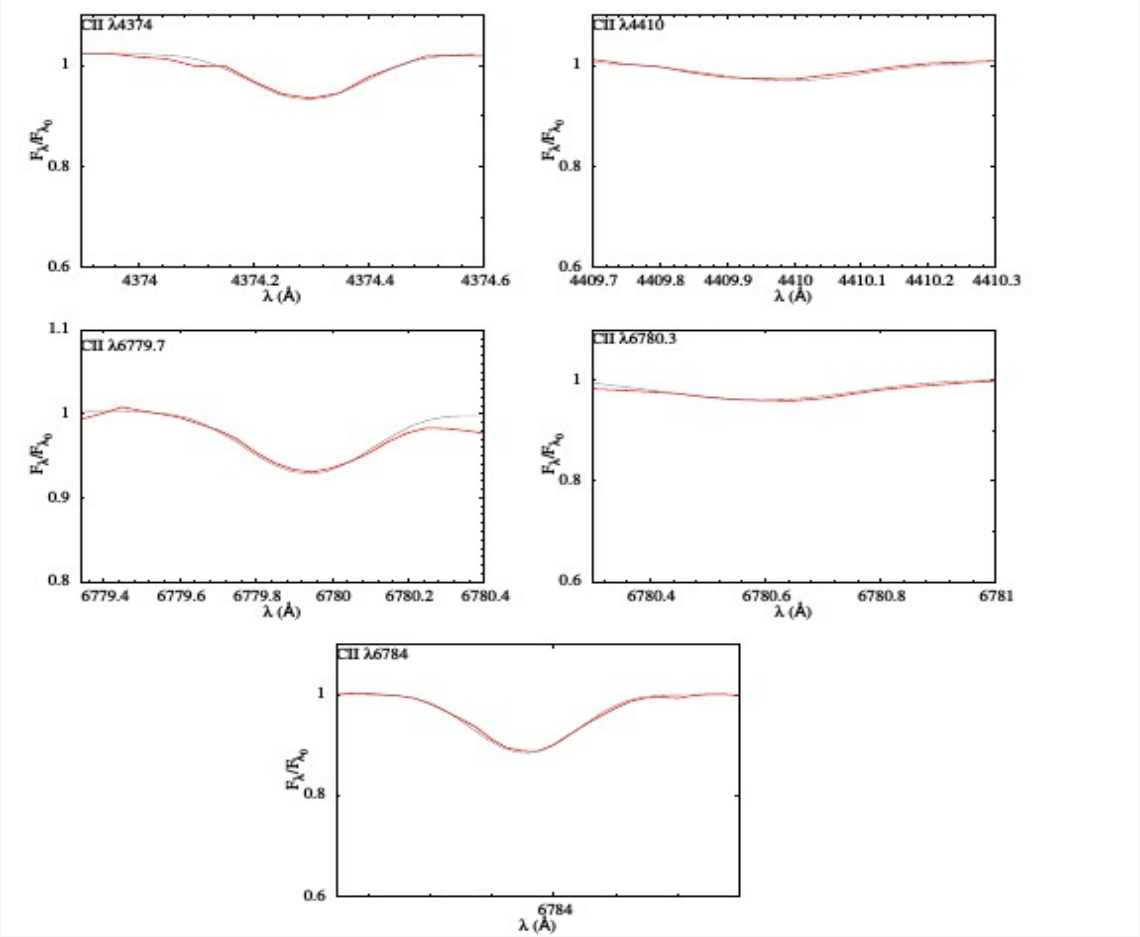
$T_{\rm eff}$ (K)	log g (cgs)	Kaynak
22000	4.00	Nieva (2013)
20700	3.81	Koleva & Vazdekis (2011)
20454	3.79	Prugniel P. (2011)
22670	4.02	Gies & Lambert (1992)
21913	3.70	Peters (1976)
20160	...	Snijders (1969)

λ (Å)	$T_{\rm eff}$ (K)	log g (cgs)	χ^2
4100	22050	4.10	0.0322
4300	22650	3.90	0.0414
4800	23350	3.90	0.0241
ort.	∼22700	∼ 3.97	
sd.	∼900	∼ 0.10	

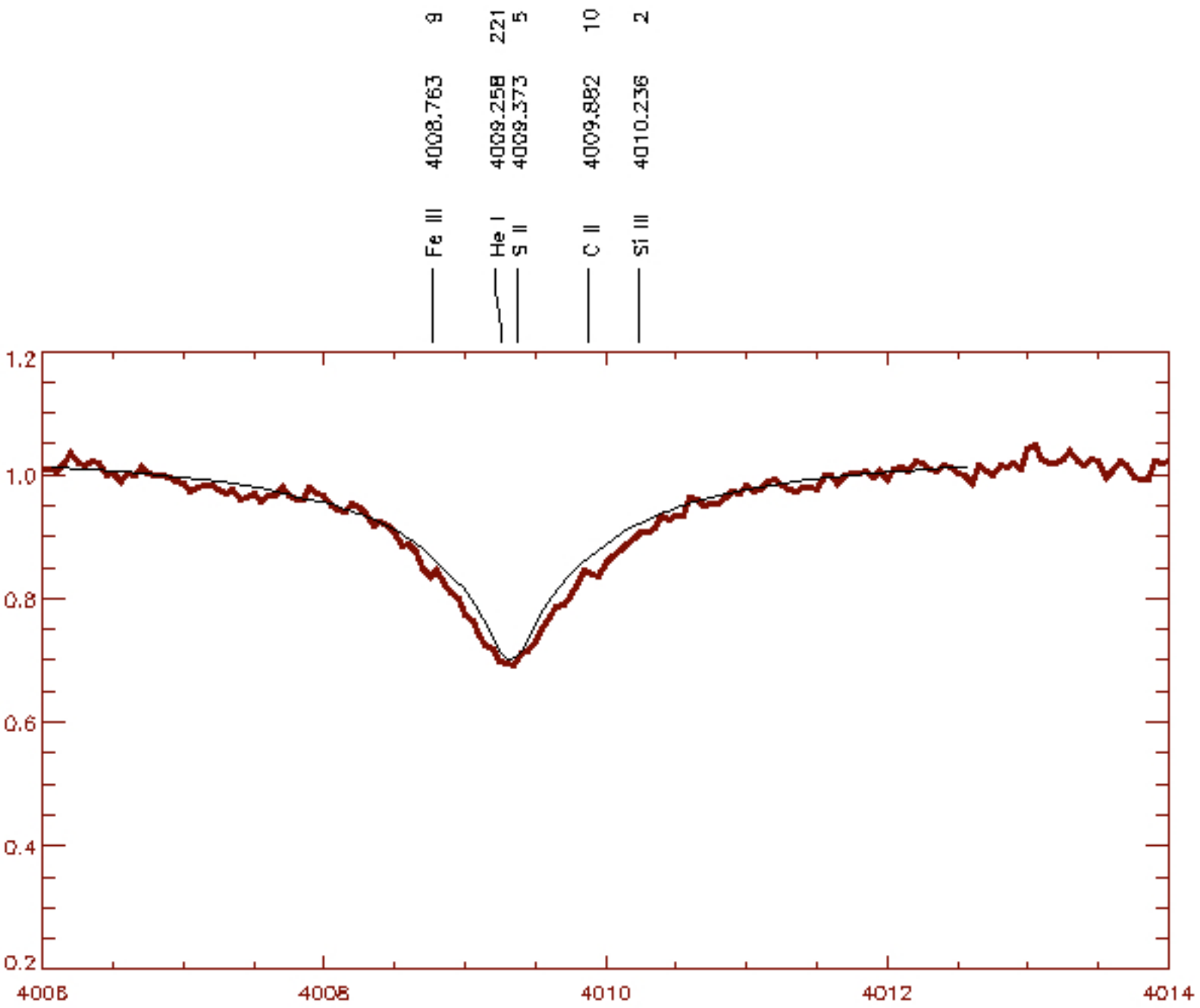
	$T_{\rm eff}$ (K)	log g (cgs)
Q	20454	3.79
[u-b]	20700	3.81
[c1]	22670	4.02
ort.	23000	4.00
sd.	1000	0.10

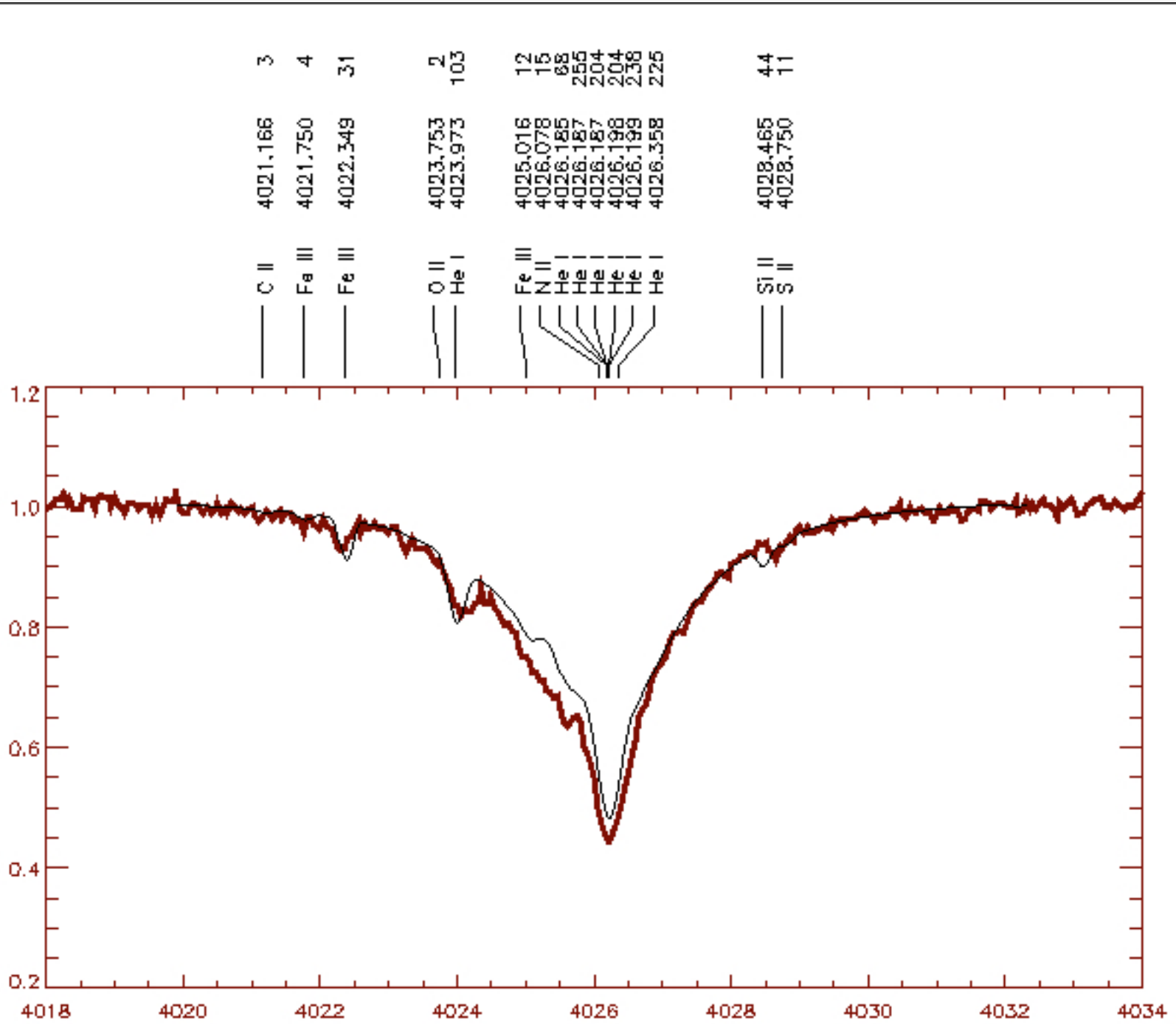
λ (Å)	He/H
4009	0.12
4026	0.12
4388	0.15
4471	0.11
4713	0.09
Average	**0.12**
Std.Dev.	0.02

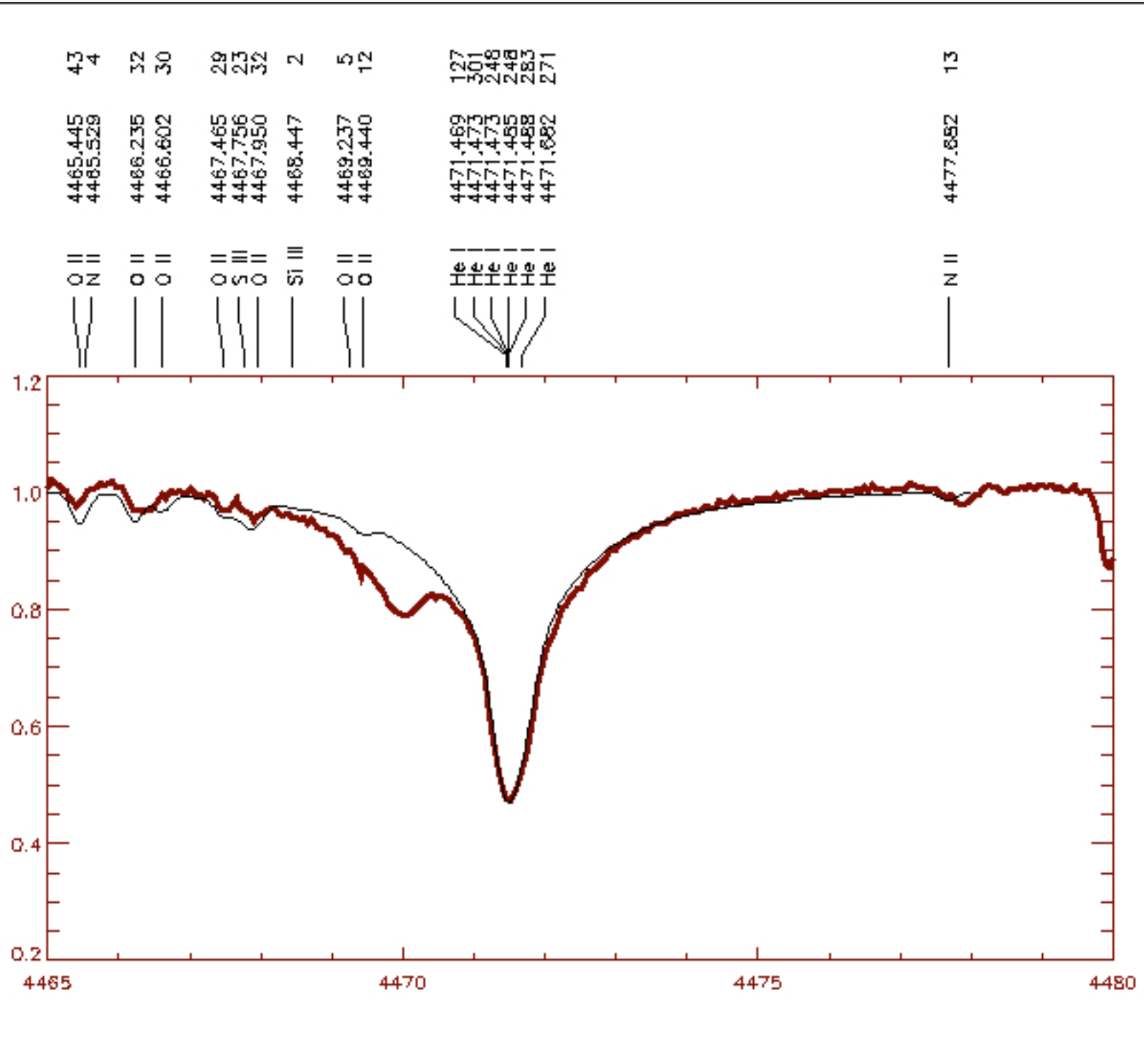

NOAO/IRAF V2.16 root@ttlenovo Fri 02:42:11 09-Sep-2016
[535nm.fits]: HD000886 120. ap:1 beam:1
1
.9
.8
.7
.6
6777.5
6780
6782.5
6785
6787.5
Wavelength (angstroms)
1: center = 6779.94, flux = -0.02894, eqw = 0.0289, gfwhm = 0.3785 (+,-,r,q):

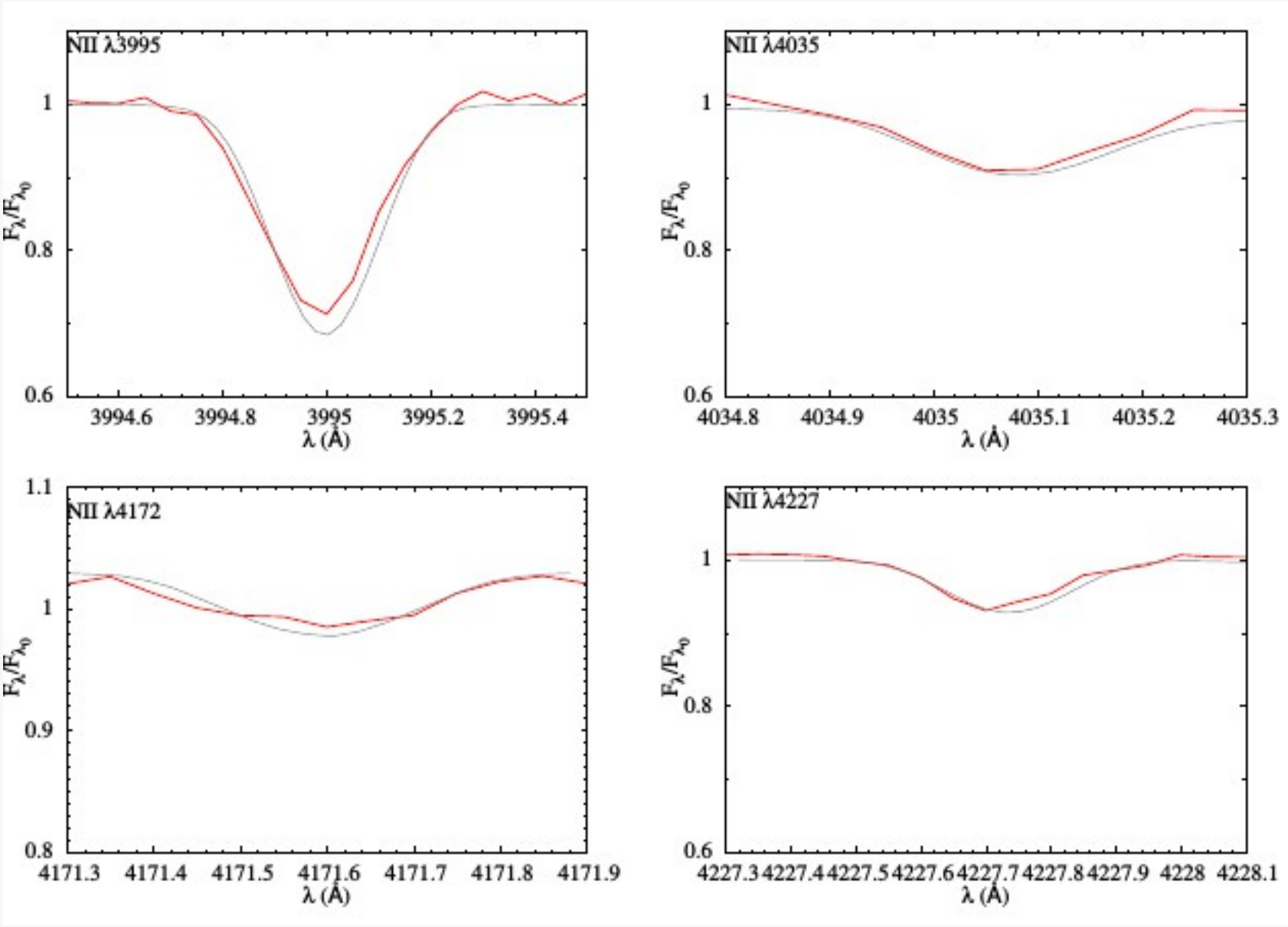


Species	Multiplet	λ(mÅ)	log gf	EP(ev)	W_λ(mÅ)	NLTE log N/N_T	LTE log N/N_T	$\Delta \log\epsilon$
C II(8.52)						8.23±0.25	8.23±0.23	
	42	4374.27	0.66	24.50	21.4	8.23	8.25	-0.02
	40	4410.06	0.50	24.50	9.7	7.95	7.96	-0.01
	39	4411.20	0.53	24.50	19.5	8.01	8.04	-0.03
		4411.52	0.69	24.50	17.2	8.00	8.02	-0.02
	14	6779.74	0.03	20.61	29.6	8.40	8.39	0.01
		6780.27	-0.38	20.61	17.4	8.53	8.48	+0.05
		6783.75	0.30	20.62	46.7	8.41	8.48	-0.07

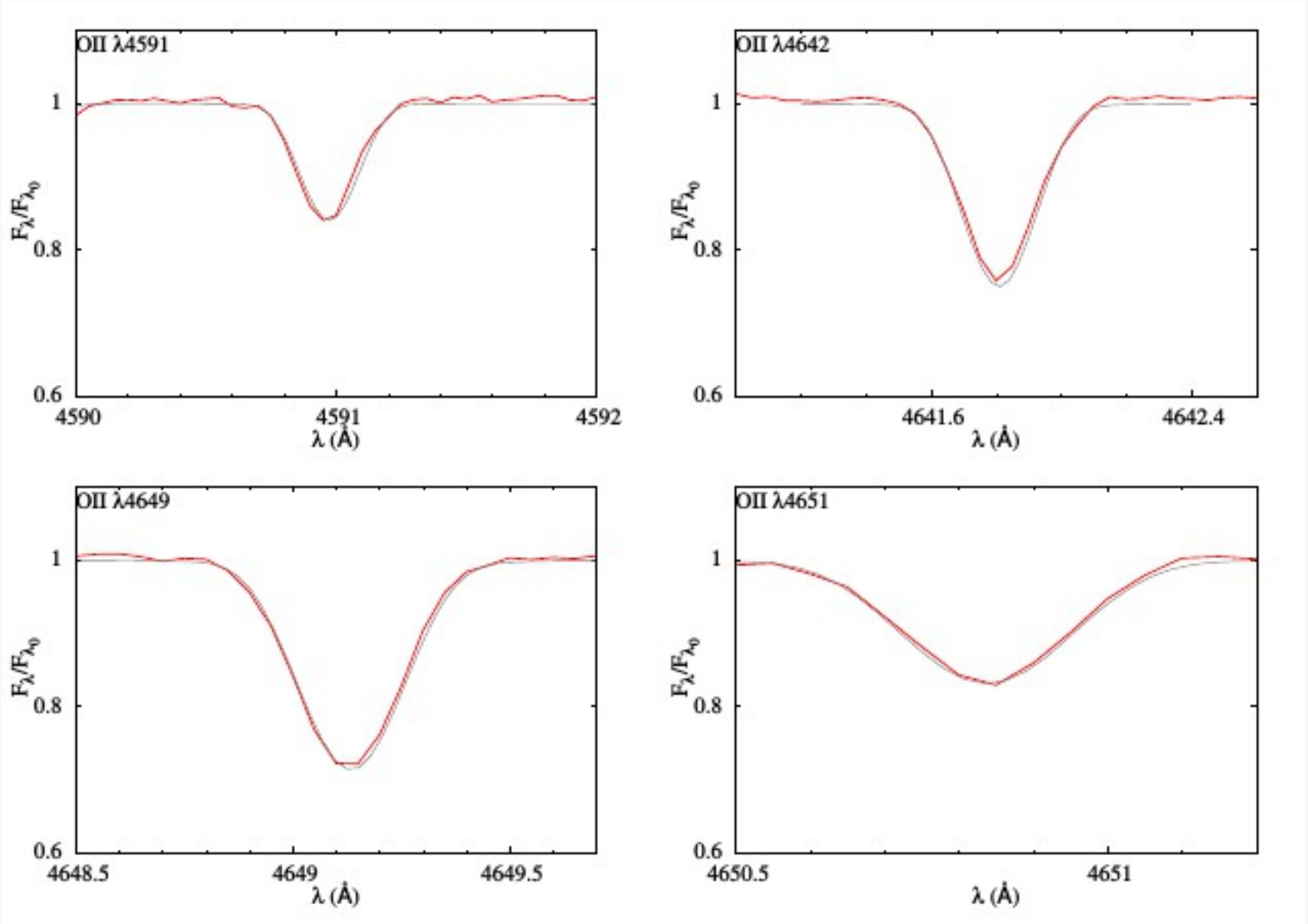

Fe III 4008.763 9
He I 4009.258 221
S II 4009.373 5
C II 4009.882 10
Si III 4010.236 2
1.2
1.0
0.8
0.6
0.4
0.2
4006
4008
4010
4012
4014


C II 4021.166 3
Fe III 4021.750 4
Fe III 4022.349 31
O II 4023.753 2
He I 4023.973 103
Fe III 4025.016 12
N II 4026.078 15
He I 4026.185 68
He I 4026.187 255
He I 4026.187 204
He I 4026.198 204
He I 4026.199 238
He I 4026.358 225
Si II 4028.465 44
S II 4028.750 11
1.2
1.0
0.8
0.6
0.4
0.2
4018
4020
4022
4024
4026
4028
4030
4032
4034


O II 43
N II 4
4465.445
4465.529
O II 32
O II 30
4466.235
4466.602
O II 29
S III 23
O II 32
4467.465
4467.756
4467.950
Si III 2
4468.447
O II 5
O II 12
4469.237
4469.440
He I 127
He I 301
He I 248
He I 248
He I 283
He I 271
4471.469
4471.473
4471.473
4471.485
4471.488
4471.682
N II 13
4477.852
1.2
1.0
0.8
0.6
0.4
0.2
4465
4470
4475
4480


NII λ3995
NII λ4035
NII λ4172
NII λ4227
F_λ/F_{λ_0}
λ (Å)
1
0.8
0.6
0.9
1.1
3994.6
3994.8
3995
3995.2
3995.4
4034.8
4034.9
4035
4035.1
4035.2
4035.3
4171.3
4171.4
4171.5
4171.6
4171.7
4171.8
4171.9
4227.3
4227.4
4227.5
4227.6
4227.7
4227.8
4227.9
4228
4228.1

Species	Multiplet	λ(mÅ)	log gf	EP(ev)	W_λ(mÅ)	NLTE log N/N_T	LTE log N/N_T	$\Delta \log\epsilon$
N II(7.92)						7.75±0.14	7.72±0.15	
	12	3995.00	0.21	18.42	79.0	7.78	7.86	-0.01
	39	4035.08	0.69	23.02	26.1	7.53	7.47	0.06
	43	4171.63	0.28	23.10	13.3	7.72	7.63	0.09
	42	4176.16	0.60	23.10	17.9	7.76	7.70	0.06
	33	4227.75	-0.06	21.51	17.0	7.78	7.72	0.06
	48	4236.93	0.38	23.14	32.8	7.66	7.63	0.03
	21	4507.56	-0.82	20.58	5.5	7.77	7.74	0.03
	20	4779.71	-0.59	20.56	10.2	7.85	7.74	0.11
	20	4788.13	-0.36	20.56	14.6	7.82	7.82	0.00


OII λ4591
1
0.8
0.6
F_λ/F_{λ_0}
4590
4591
4592
λ (Å)
OII λ4642
1
0.8
0.6
F_λ/F_{λ_0}
4641.6
4642.4
λ (Å)
OII λ4649
1
0.8
0.6
F_λ/F_{λ_0}
4648.5
4649
4649.5
λ (Å)
OII λ4651
1
0.8
0.6
F_λ/F_{λ_0}
4650.5
4651
λ (Å)

Species	Multiplet	λ(mÅ)	log gf	EP(ev)	W_λ(mÅ)	NLTE log N/N_T	LTE log N/N_T	$\Delta \log\epsilon$
O II(8.83)						8.67±0.08	8.75±0.08	
	6	3982.71	-0.70	23.34	28.2	8.67	8.71	-0.04
	10	4078.84	-0.09	25.53	25.5	8.73	8.75	-0.02
	2	4345.56	-0.70	22.88	25.3	8.76	8.83	0.00
	5	4452.38	-0.79	23.34	29.0	8.73	8.79	0.00
	15	4590.97	-0.09	25.55	44.6	8.59	8.69	-0.10
	49	4071.24	-0.28	28.57	13.8	8.83	8.83	0.00
	36	4185.56	0.60	28.24	27.3	8.57	8.83	0.00
	1	4641.84	0.06	22.88	71.1	8.67	8.84	-0.17
		4649.14	0.31	22.90	86.5	8.60	8.84	-0.20
		4650.84	-0.36	22.87	47.3	8.60	8.65	-0.15
		4661.63	-0.28	22.88	52.4	8.67	8.69	-0.02
		4676.24	-0.39	22.90	43.2	8.62	8.73	-0.11
	25	4696.35	-1.38	22.90	13.0	8.73	8.77	-0.04
		4705.35	-0.28	26.14	40.3	8.62	8.69	-0.07
	24	4703.16	0.26	28.39	14.3	8.55	8.58	-0.03
		4710.10	-0.23	26.11	20.9	8.70	8.76	-0.00
		4751.24	-0.28	26.14	7.8	8.69	8.72	-0.03
	28	4890.86	-0.44	26.19	14.2	8.79	8.85	-0.06
		4906.83	-0.16	26.19	18.4	8.63	8.71	-0.08
	33	4943.01	0.24	26.45	24.9	8.55	8.62	-0.00
		4955.71	0.57	26.45	9.5	8.74	8.78	-0.04

Table 6. Metal abundances for the sample stars.

#	HD	C	N	O	Ne	Mg	Si	Fe
1	36591	8.33±0.08 (30)	7.75±0.09 (61)	8.75±0.11 (53)	8.09±0.08 (21)	7.58±0.10 (6)	7.50±0.04 (5)	7.48±0.11 (32)
2	61068	8.27±0.07 (23)	8.00±0.12 (61)[a]	8.76±0.09 (49)	8.07±0.11 (17)	7.56±0.03 (3)	7.53±0.06 (5)	7.51±0.11 (28)
3	63922	8.33±0.07 (19)	7.77±0.08 (23)	8.79±0.10 (39)	8.07±0.07 (8)	7.60±0.01 (2)	7.49±0.12[b]	7.51±0.08 (9)
4	74575	8.37±0.10 (19)	7.92±0.10 (56)[a]	8.79±0.08 (45)	8.05±0.08 (12)	7.51±0.10 (6)	7.52±0.12[b]	7.51±0.09 (27)
5	122980	8.32±0.09 (22)	7.76±0.08 (47)	8.72±0.06 (52)	8.07±0.07 (14)	7.50±0.05 (4)	7.25±0.04 (4)[a]	7.44±0.11 (27)
6	149438	8.30±0.12 (32)	8.16±0.12 (73)[a]	8.77±0.08 (49)	8.14±0.07 (18)	7.62±0.03 (3)	7.52±0.06 (2)	7.54±0.09 (21)
7	886	8.37±0.08 (17)	7.76±0.07 (40)	8.73±0.11 (52)	8.11±0.08 (13)	7.61±0.05 (4)	7.38±0.03 (5)	7.51±0.07 (30)