Table 1. Element abundances in the present-day solar photosphere and in meteorites (C1 chondrites). Indirect solar estimates are marked with [..]

Elem.	Photosphere	Meteorites	Elem.	Photosphere	Meteorites
H	12.00	8.25 ± 0.05	Ru	1.84 ± 0.07	1.77 ± 0.08
He	[10.93 ± 0.01]	1.29	Rh	1.12 ± 0.12	1.07 ± 0.02
Li	1.05 ± 0.10	3.25 ± 0.06	Pd	1.69 ± 0.04	1.67 ± 0.02
Be	1.38 ± 0.09	1.38 ± 0.08	Ag	0.94 ± 0.24	1.20 ± 0.06
B	2.70 ± 0.20	2.75 ± 0.04	Cd	1.77 ± 0.11	1.71 ± 0.03
C	8.39 ± 0.05	7.40 ± 0.06	In	1.60 ± 0.20	0.80 ± 0.03
N	7.78 ± 0.06	6.25 ± 0.07	Sn	2.00 ± 0.30	2.08 ± 0.04
O	8.66 ± 0.05	8.39 ± 0.02	Sb	1.00 ± 0.30	1.03 ± 0.07
F	4.56 ± 0.30	4.43 ± 0.06	Te		2.19 ± 0.04
Ne	[7.84 ± 0.06]	-1.06	I		1.51 ± 0.12
Na	6.17 ± 0.04	6.27 ± 0.03	Xe	[2.27 ± 0.02]	-1.97
Mg	7.53 ± 0.09	7.53 ± 0.03	Cs		1.07 ± 0.03
Al	6.37 ± 0.06	6.43 ± 0.02	Ba	2.17 ± 0.07	2.16 ± 0.03
Si	7.51 ± 0.04	7.51 ± 0.02	La	1.13 ± 0.05	1.15 ± 0.06
P	5.36 ± 0.04	5.40 ± 0.04	Ce	1.58 ± 0.09	1.58 ± 0.02
S	7.14 ± 0.05	7.16 ± 0.04	Pr	0.71 ± 0.08	0.75 ± 0.03
Cl	5.50 ± 0.30	5.23 ± 0.06	Nd	1.45 ± 0.05	1.43 ± 0.03
Ar	[6.18 ± 0.08]	-0.45	Sm	1.01 ± 0.06	0.92 ± 0.04
K	5.08 ± 0.07	5.06 ± 0.05	Eu	0.52 ± 0.06	0.49 ± 0.04
Ca	6.31 ± 0.04	6.29 ± 0.03	Gd	1.12 ± 0.04	1.03 ± 0.02
Sc	3.05 ± 0.08	3.04 ± 0.04	Tb	0.28 ± 0.30	0.28 ± 0.03
Ti	4.90 ± 0.06	4.89 ± 0.03	Dy	1.14 ± 0.08	1.10 ± 0.04
V	4.00 ± 0.02	3.97 ± 0.03	Ho	0.51 ± 0.10	0.46 ± 0.02
Cr	5.64 ± 0.10	5.63 ± 0.05	Er	0.93 ± 0.06	0.92 ± 0.03
Mn	5.39 ± 0.03	5.47 ± 0.03	Tm	0.00 ± 0.15	0.08 ± 0.06
Fe	7.45 ± 0.05	7.45 ± 0.03	Yb	1.08 ± 0.15	0.91 ± 0.03
Co	4.92 ± 0.08	4.86 ± 0.03	Lu	0.06 ± 0.10	0.06 ± 0.06
Ni	6.23 ± 0.04	6.19 ± 0.03	Hf	0.88 ± 0.08	0.74 ± 0.04
Cu	4.21 ± 0.04	4.23 ± 0.06	Ta		-0.17 ± 0.03
Zn	4.60 ± 0.03	4.61 ± 0.04	W	1.11 ± 0.15	0.62 ± 0.03

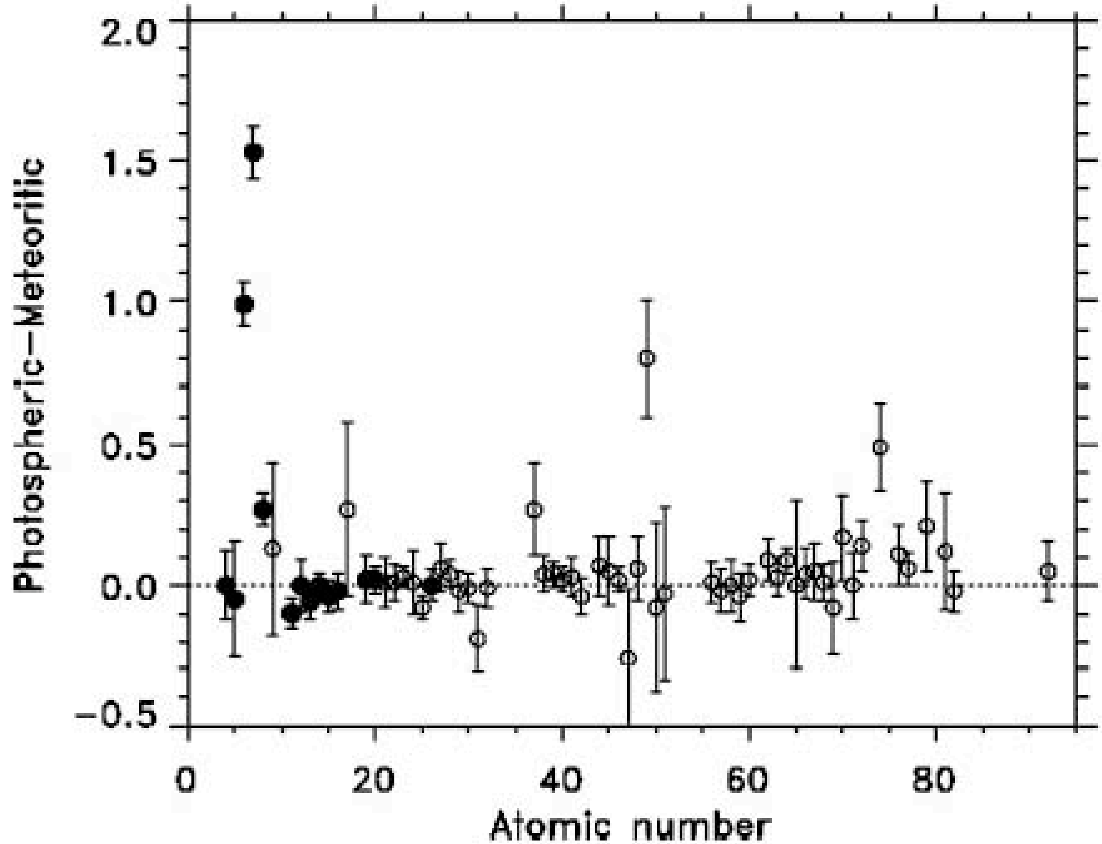


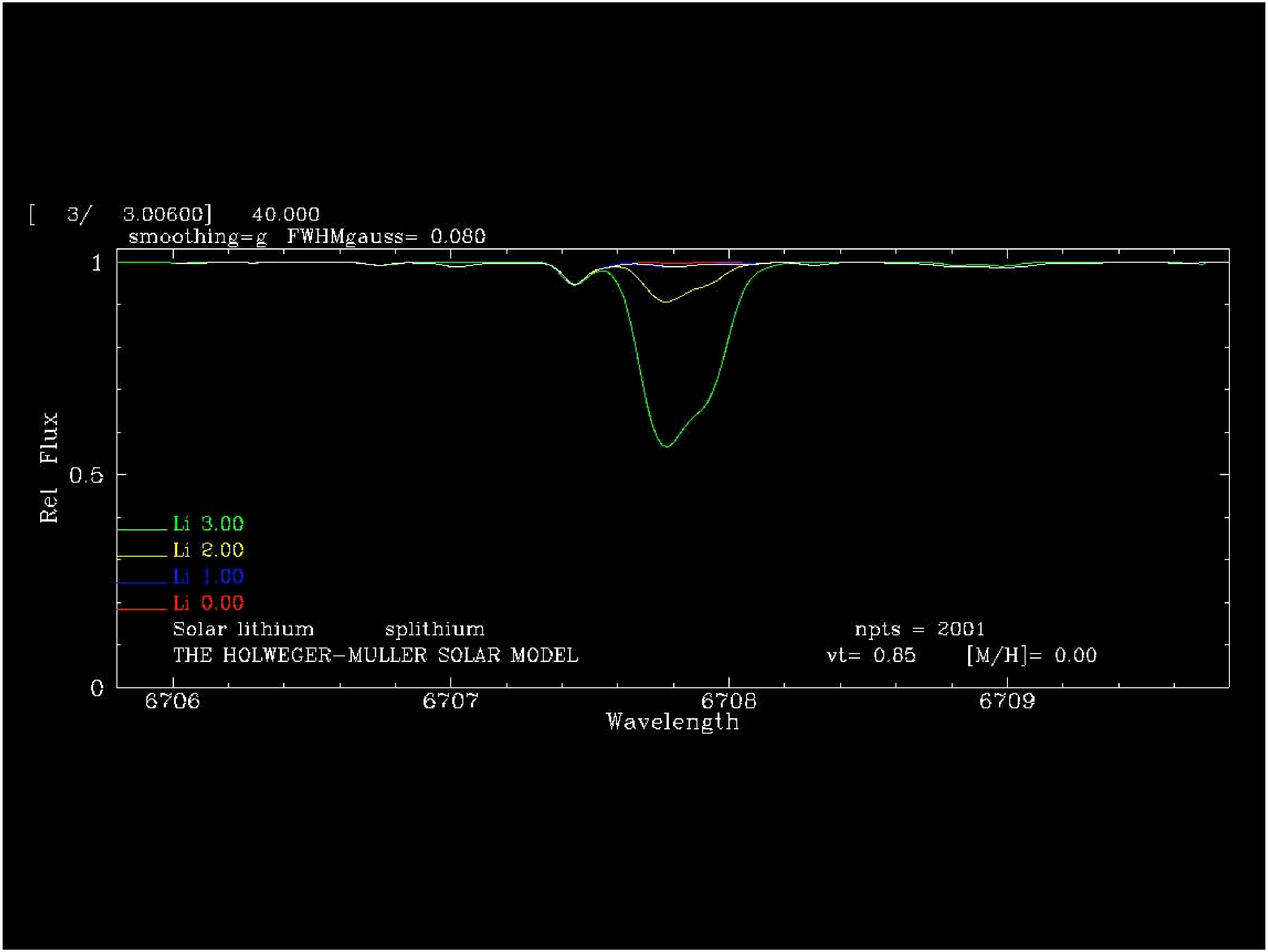
Figure 1. Comparison of photospheric and meteoritic abundances (as measured in C1 chondrites). The elements which have been analysed using a 3D hydrodynamical solar model atmosphere are shown as filled circles while the 1D-based results with open circles. H, Li and the noble gases all fall outside the figure due to significant depletion either in the Sun or in the meteorites, which also affects C, N and O.

EARLY GALACTIC NUCLEOSYNTHESIS: THE HALO FIELD STARS

The Starry Universe: Cecelia Payne-Gaposchkin Centenary
A. G. Davis Philip & Rebecca A. Koopmann, eds.
p. 11

be detected suddenly near $\log L/L_{\odot} = 1.9$. The fragile element Li, susceptible to proton captures at relatively low temperatures, reveals more complex behavior. In lower main sequence stars ($\log L/L_{\odot} < 0$) Li abundances are small probably because during the very low lifetimes of such stars, slow circulation currents cycle essentially all the envelope material down to Li fusion temperatures.[1] Near the main sequence turnoff and subgiant evolutionary

[1]An intriguing aspect of Payne-Gaposhkin's Thesis lies in spotting all the near-discoveries of chemical composition effects whose implications were not able to be fully understood due to spectroscopic data or atomic physics limitations of that era. In the case of Li in the solar spectrum, she writes on p. 59, "Russell has called attention to the fact that [the 6707 Å Li I resonance doublet] is fainter, in the sun, than would be anticipated from the terrestrial abundance of the element." She goes on to quote another investigator's incorrect explanation for the Li I line weakness involving Doppler effect blurring of this feature, but actually she was seeing evidence of main sequence Li destruction. It is tempting to speculate, though impossible to prove, that Payne-Gaposhkin would have eventually hit upon the correct nucleosynthesis idea underlying this and other stellar spectroscopic anomalies, had her research attention not turned to variable stars.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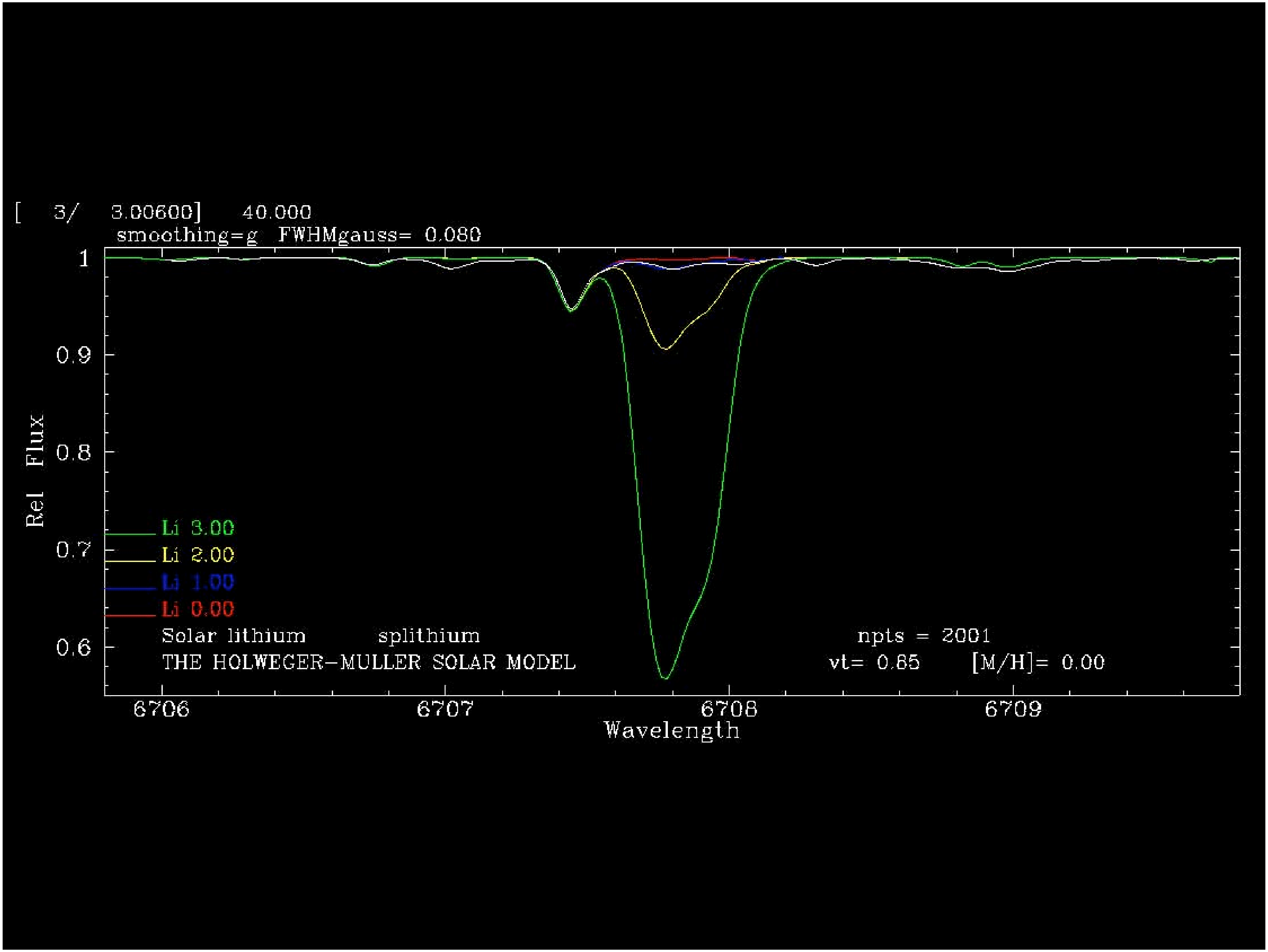
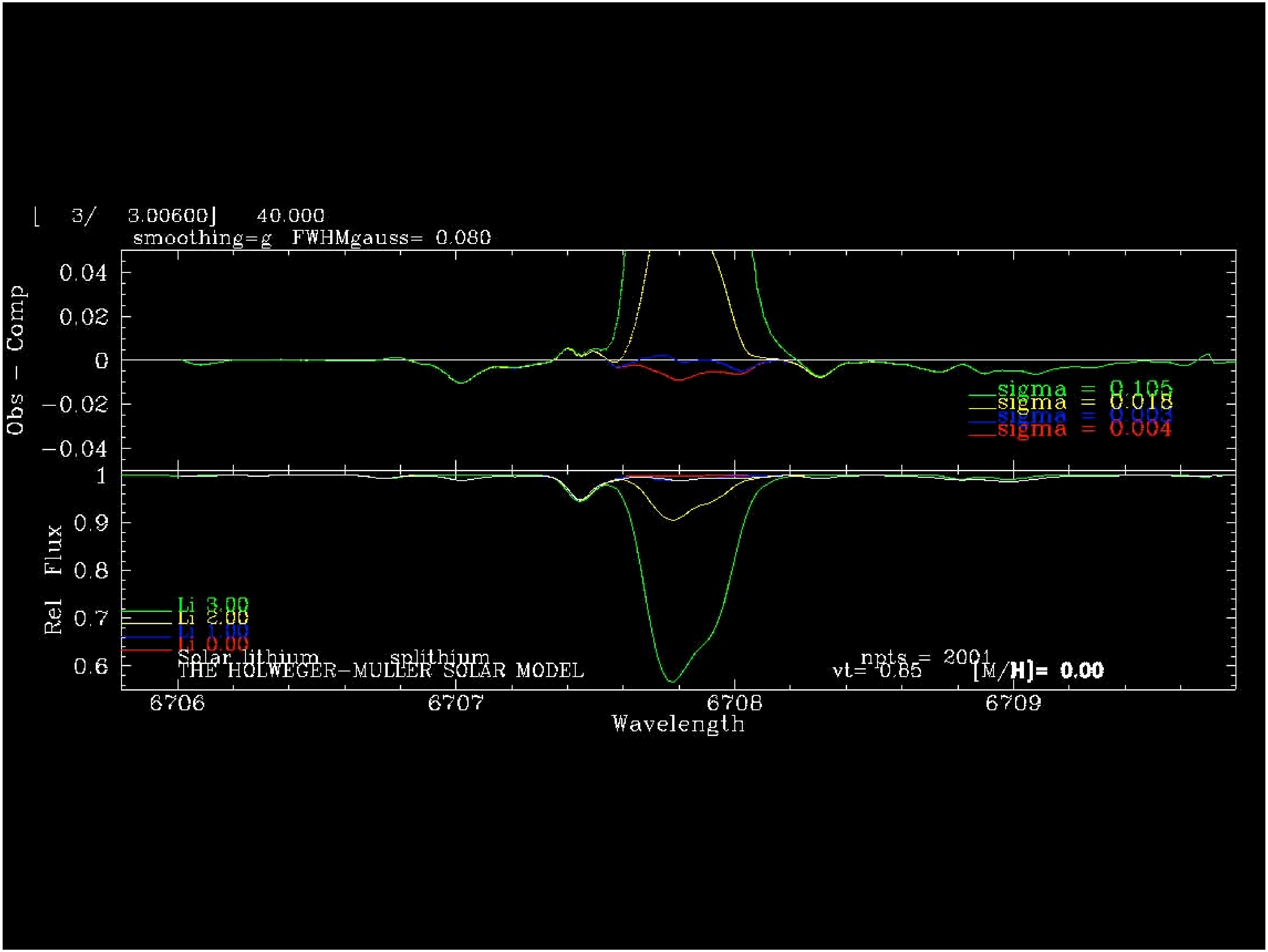
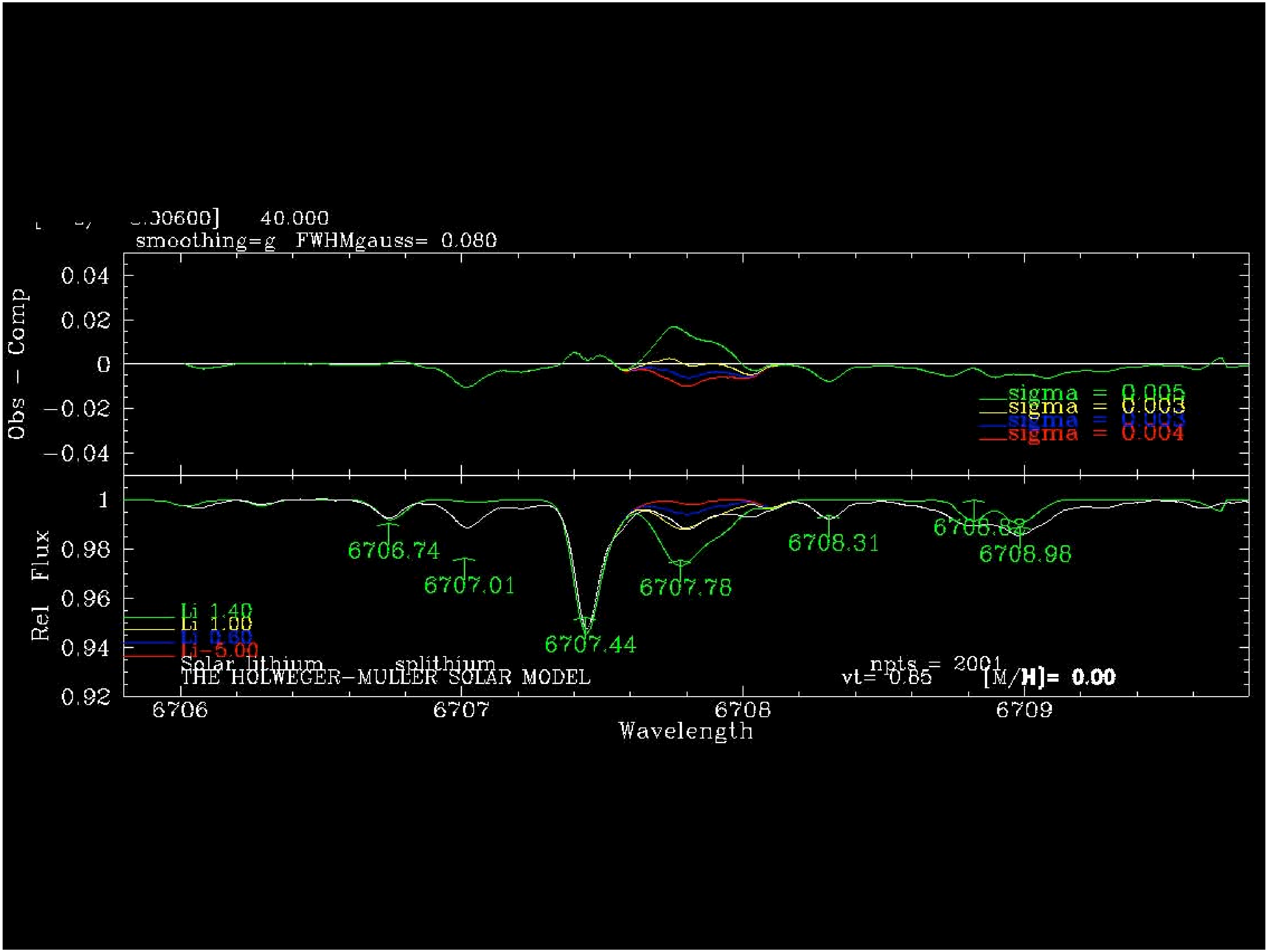
smoothing=g FWHMgauss= 0.080
Rel Flux
1
0.5
0
Li 3.00
Li 2.00
Li 1.00
Li 0.00
Solar lithium splithium
npts = 2001
THE HOLWEGER-MULLER SOLAR MODEL
vt= 0.85 [M/H]= 0.00
6706
6707
6708
6709
Wavelength


[3/ 3.00600] 40.000
smoothing=g FWHMgauss= 0.080
Rel Flux
1
0.9
0.8
0.7
0.6
Li 3.00
Li 2.00
Li 1.00
Li 0.00
Solar lithium splithium
THE HOLWEGER-MULLER SOLAR MODEL
npts = 2001
vt= 0.85 [M/H]= 0.00
6706
6707
6708
6709
Wavelength



[3/ 3.00600] 40.000
smoothing=g FWHMgauss= 0.080
Obs - Comp
sigma = 0.105
sigma = 0.018
sigma = 0.003
sigma = 0.004
Rel Flux
Li 3.00
Li 2.00
Li 1.00
Li 0.00
Solar lithium
splithium
npts = 2001
THE HOLWEGER-MULLER SOLAR MODEL
vt= 0.85
[M/H]= 0.00
Wavelength


.30600]   40.000
smoothing=g FWHMgauss= 0.080
Obs - Comp
0.04
0.02
0
−0.02
−0.04
sigma = 0.005
sigma = 0.003
sigma = 0.004
Rel Flux
1
0.98
0.96
0.94
0.92
6706.74
6707.01
6707.44
6707.78
6708.31
6708.98
Li 1.40
Li 1.00
Li 0.60
Li−5.00
Solar lithium
splithium
THE HOLWEGER-MULLER SOLAR MODEL
npts = 2001
vt= 0.85
[M/H]= 0.00
6706
6707
6708
6709
Wavelength

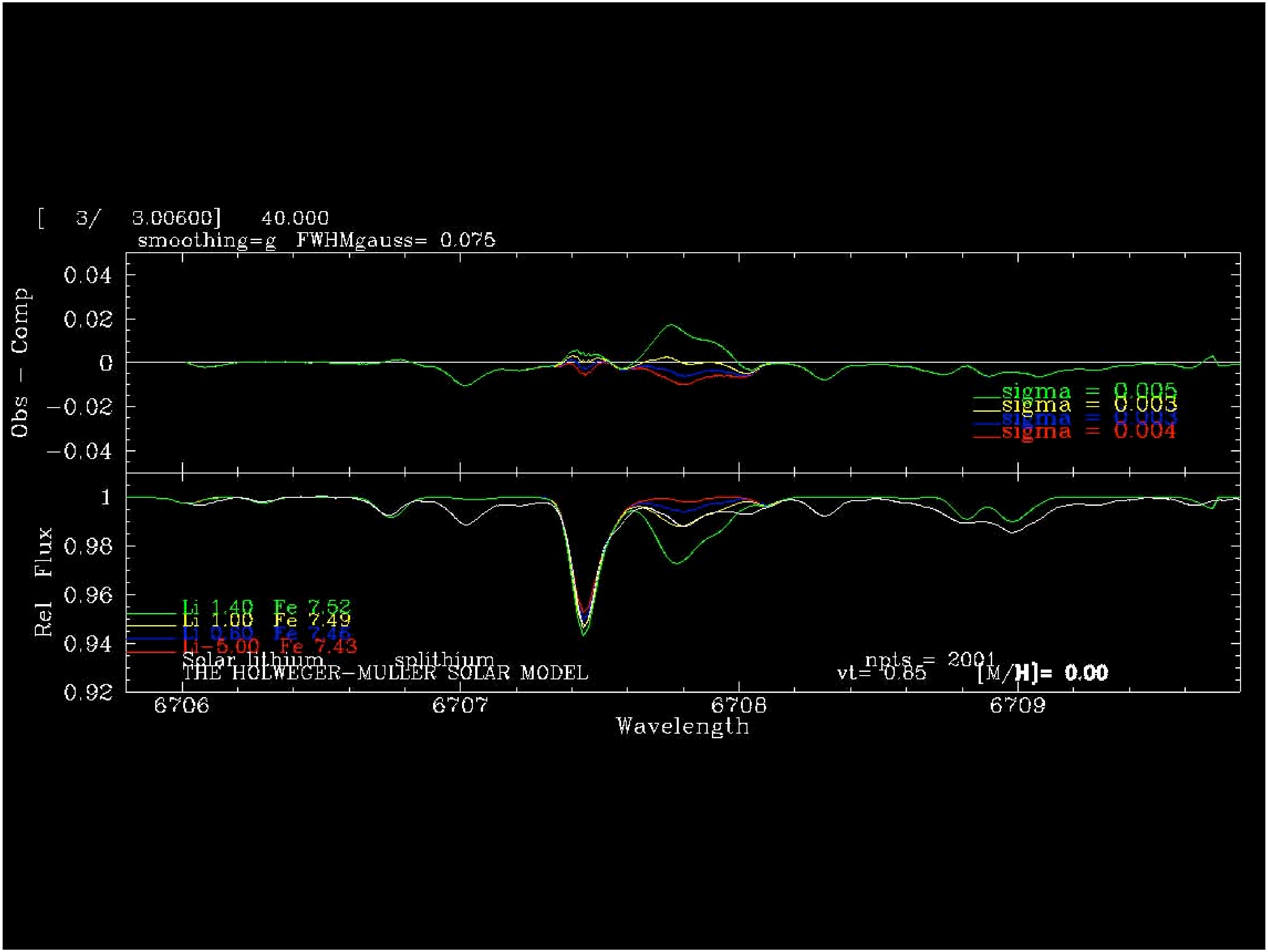
Solar ID's list near Li I

6703.370A	1.	0.	CN	Q23	7,3	12
6703.576M	32.	5.S	FE 1	2.76	268	
6703.970A	3.	0.	CN	P16	7,3	12
6704.500R	5.	1.S	FE 1	4.22	1052	
6705.105	42.	7.W	FE 1	4.61	1197	
6705.105	42.	7.W	(FE 1P)	4.95	1280	
6705.507R	2.	0.	SUN"			
6706.750	1.	0.	CN"	Q22	7,3	12
6707.050	2.	0.	SI 1"P	5.95	61	
6707.449R	5.	1.S"	SUN			57
6707.760	2.	0.SS	LI 1	0.00	1	
6707.980	1.	0.SS,NN	LI 1	0.00	1	
6708.320	1.	0.	SUN			
6708.800	1.	0.U,NNNN	SUN			
6709.100A	2.	0.0	CN"	P17	7,3	12
6709.870M	0.	0.S	CA 1	2.93	45	13
6709.935R	2.	0.				
6710.323R	12.	2.S	FE 1	1.48	34	
6710.542R	1.	0.	SUN			
6710.700A	2.	0.				

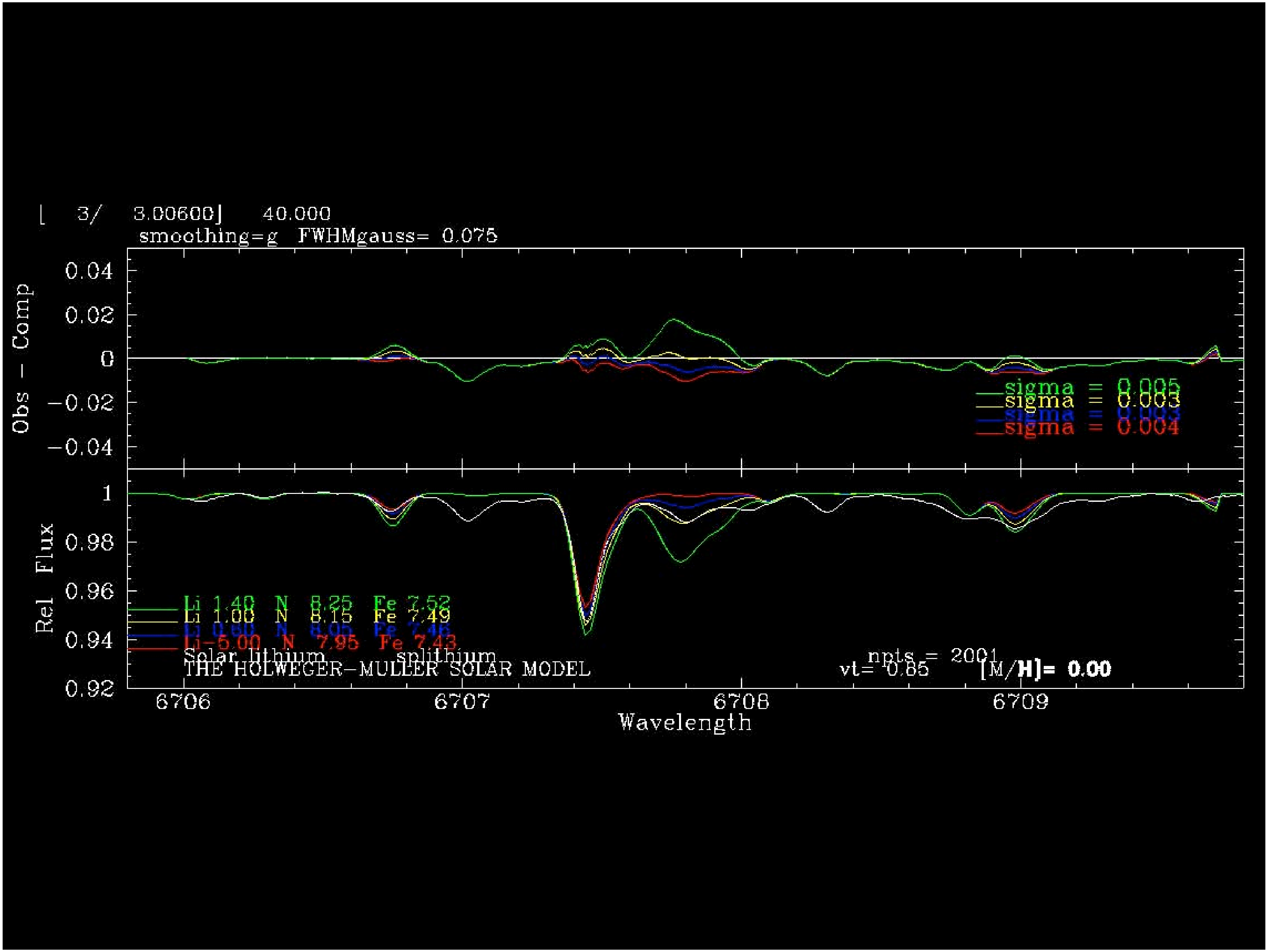
Line list near Li I

A line list for Li I 6708A

6703.5720	26.00	2.76	-3.0000	
6705.1010	26.00	4.61	-1.0500	
6705.1310	26.00	4.96	-2.2650	
6706.0200	14.00	5.95	-3.3710	
6706.2900	22.00	1.50	-3.0270	
6706.3880	25.00	5.88	-2.0840	
6706.7490	607.00	0.87	-1.7620	7.65
6706.8690	20.00	5.88	-3.6910	
6707.0500	14.00	5.95	-3.6990	
6707.4410	26.00	4.61	-2.2500	
6707.4640	607.00	0.79	-3.1120	7.65
6707.4730	62.10	0.93	-2.3790	
6707.5180	23.00	2.74	-1.9950	
6707.5210	607.00	2.17	-1.4280	7.65
6707.5290	607.00	0.96	-1.6090	7.65
6707.5290	607.00	2.01	-1.7850	7.65
6707.5290	607.00	2.02	-1.7850	7.65
6707.5360	44.00	2.90	-1.2400	
6707.5630	23.00	2.74	-1.5300	
6707.5660	55.00	1.80	-3.2650	
6707.6440	24.00	4.21	-2.1400	
6707.7520	21.00	4.05	-2.6720	
6707.7561	3.007	0.00	-0.4271	
6707.7682	3.007	0.00	-0.2062	
6707.7710	20.00	5.80	-4.0150	
6707.8160	607.00	1.21	-2.0487	7.65
6707.9066	3.007	0.00	-0.9318	
6707.9080	3.007	0.00	-1.1612	
6707.9187	3.007	0.00	-0.7122	
6707.9196	3.006	0.00	-0.4789	
6707.9200	3.007	0.00	-0.9318	
6707.9230	3.006	0.00	-0.1778	
6708.0728	3.006	0.00	-0.3036	
6708.0990	58.10	0.71	-2.12	
6708.1000	23.00	1.22	-2.3340	
6708.3750	607.00	2.10	-1.9750	7.65
6708.6090	26.00	5.45	-3.4050	
6708.8150	22.00	3.92	-0.0930	
6708.9670	607.00	0.89	-1.7400	7.65
6709.0340	607.00	0.82	-2.1660	7.65
6709.6100	40.00	0.51	-3.3970	
6709.7030	607.00	0.98	-1.9170	7.65
6709.8700	20.00	2.93	-3.2550	
6709.8870	607.00	0.84	-2.1570	7.65
6710.3200	26.00	1.48	-4.8800	
6717.6800	20.00	2.71	-0.6130	



[3/ 3.00600] 40.000
smoothing=g FWHMgauss= 0.075
Obs - Comp
sigma = 0.005
sigma = 0.003
sigma = 0.003
sigma = 0.004
Rel Flux
Li 1.40 Fe 7.52
Li 1.00 Fe 7.49
Li 0.60 Fe 7.46
Li-5.00 Fe 7.43
Solar lithium splithium
THE HOLWEGER-MULLER SOLAR MODEL
npts = 2001
vt= 0.85 [M/H]= 0.00
Wavelength


[3/ 3.00600] 40.000
smoothing=g FWHMgauss= 0.075
Obs - Comp
0.04
0.02
0
-0.02
-0.04
sigma = 0.005
sigma = 0.003
sigma = 0.003
sigma = 0.004
Rel Flux
1
0.98
0.96
0.94
0.92
Li 1.40 N 8.25 Fe 7.52
Li 1.00 N 8.15 Fe 7.49
Li 0.60 N 8.05 Fe 7.46
Li-5.00 N 7.95 Fe 7.43
Solar lithium splithium
THE HOLWEGER-MULLER SOLAR MODEL
npts = 2001
vt= 0.85 [M/H]= 0.00
6706
6707
6708
6709
Wavelength

Astron. Astrophys. 115, 357–366 (1982)

ASTRONOMY
AND
ASTROPHYSICS

Abundance of Lithium in Unevolved Halo Stars and Old Disk Stars: Interpretation and Consequences*

F. Spite and M. Spite
Observatoire de Paris-Meudon, Place Janssen, F-92195 Meudon, France

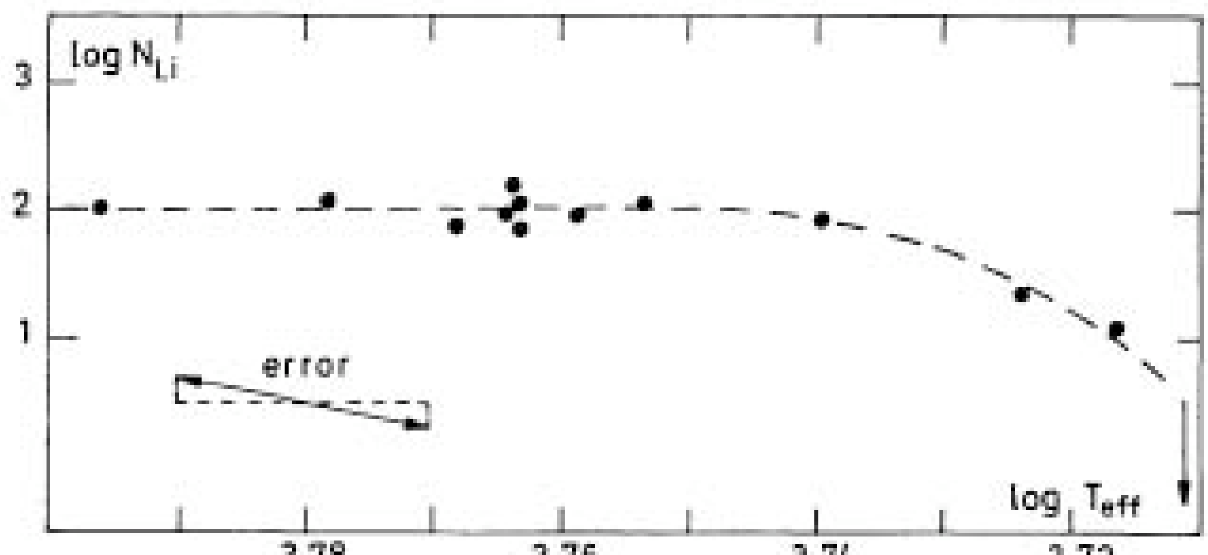
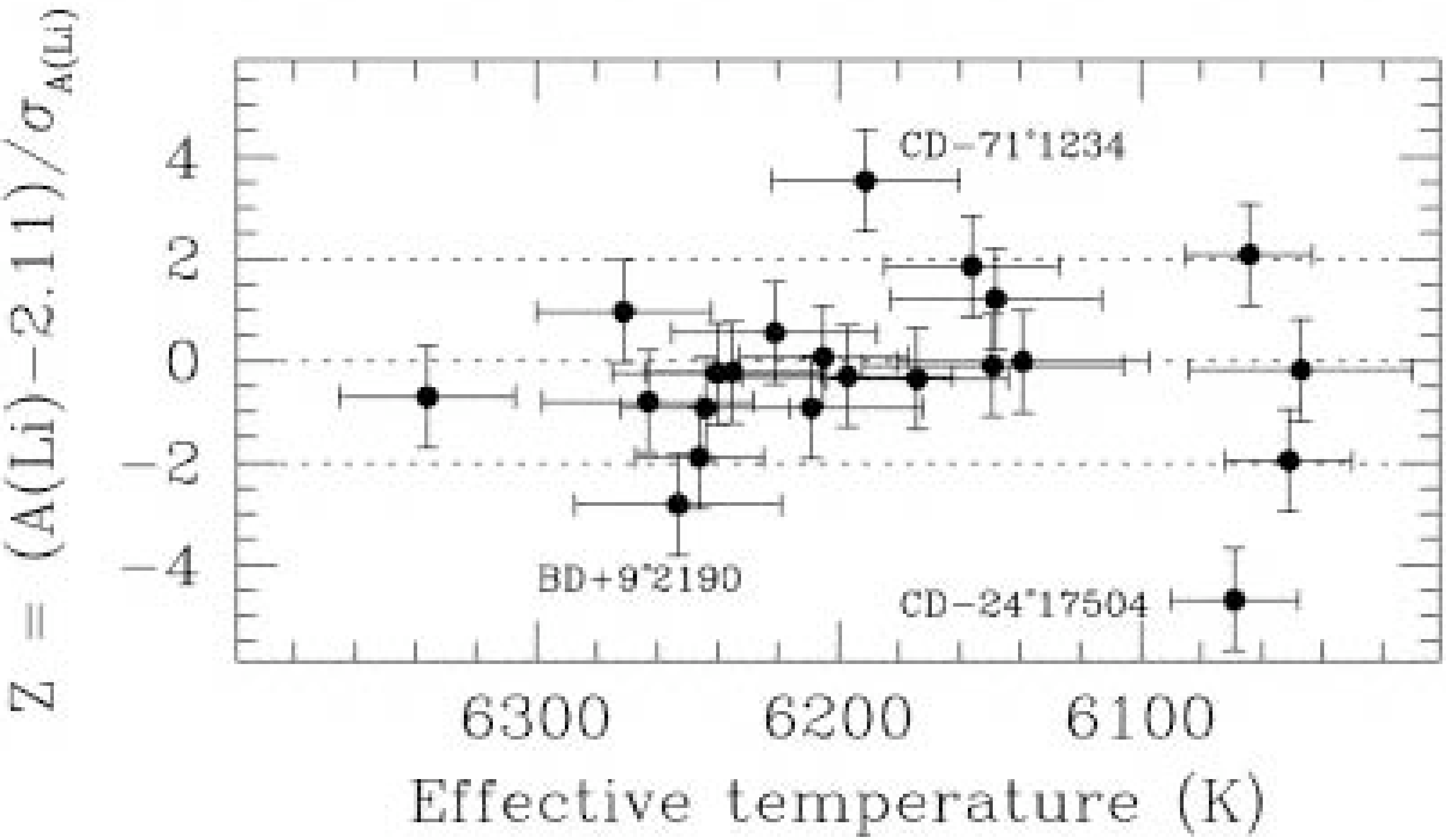


Fig. 5. N_{Li} versus log T_{eff} for old halo stars


CD−71°1234
BD+9°2190
CD−24°17504
4
2
0
−2
−4
6300
6200
6100
Effective temperature (K)
Z = (A(Li)−2.11)/σA(Li)

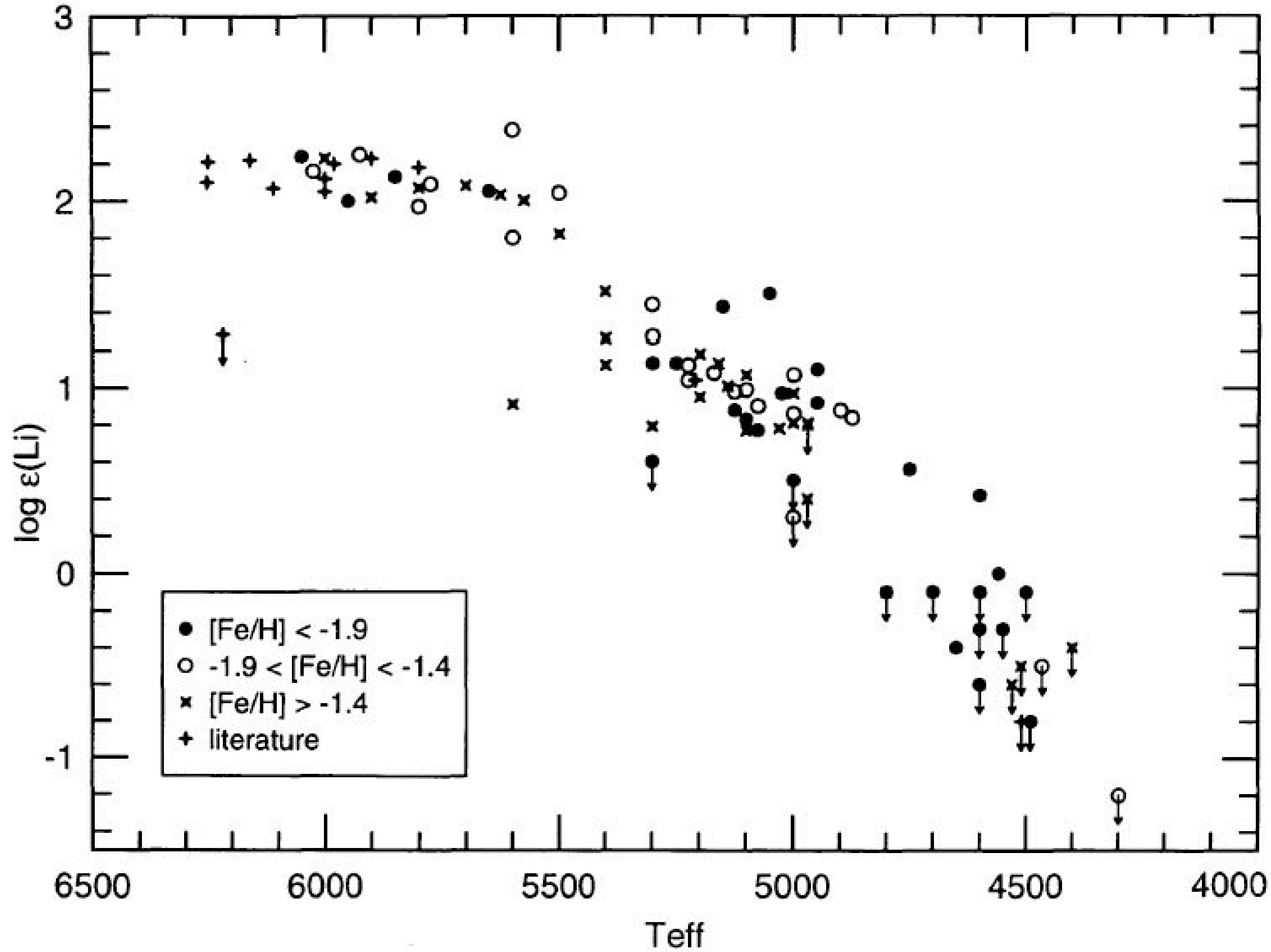
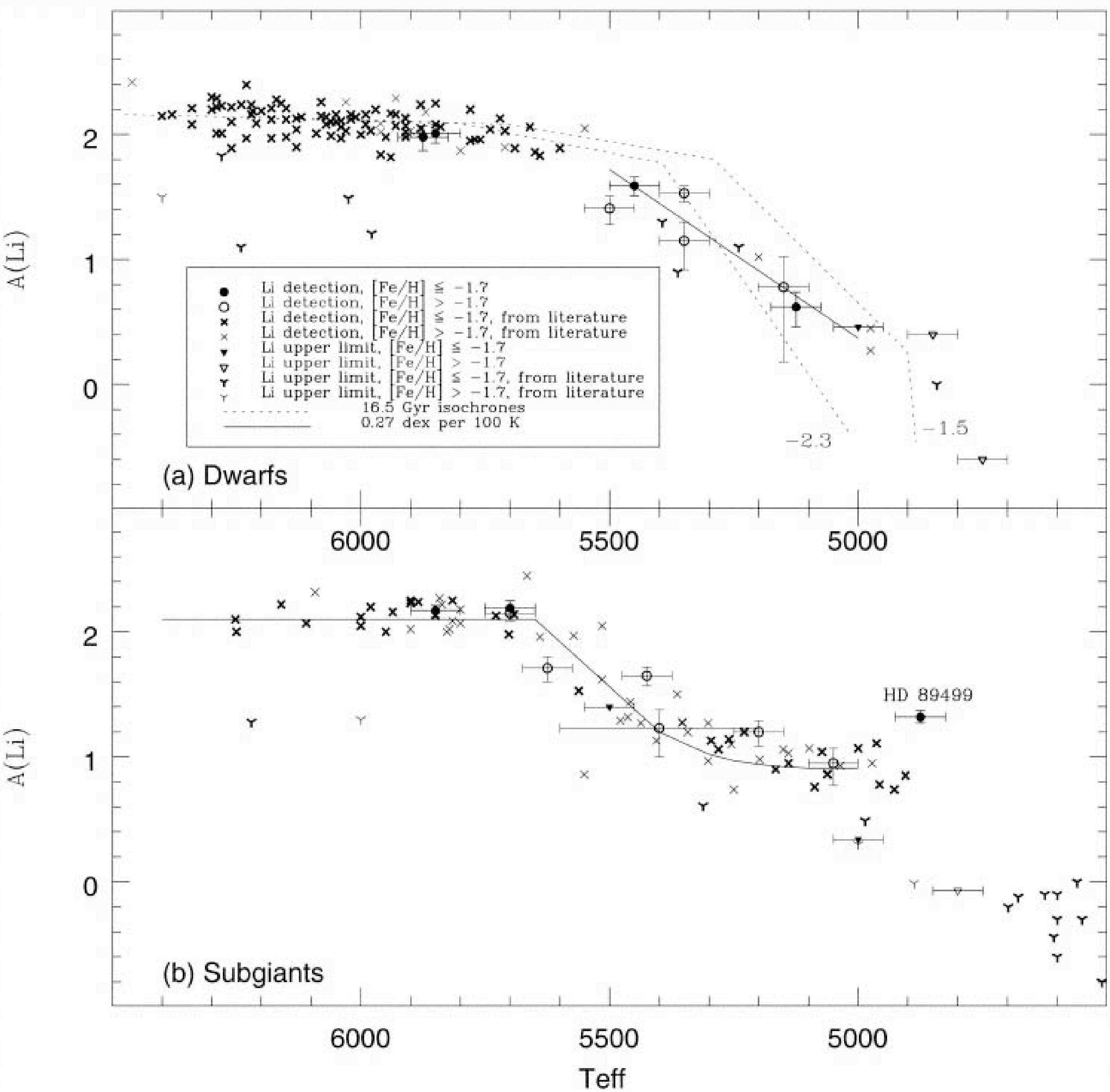
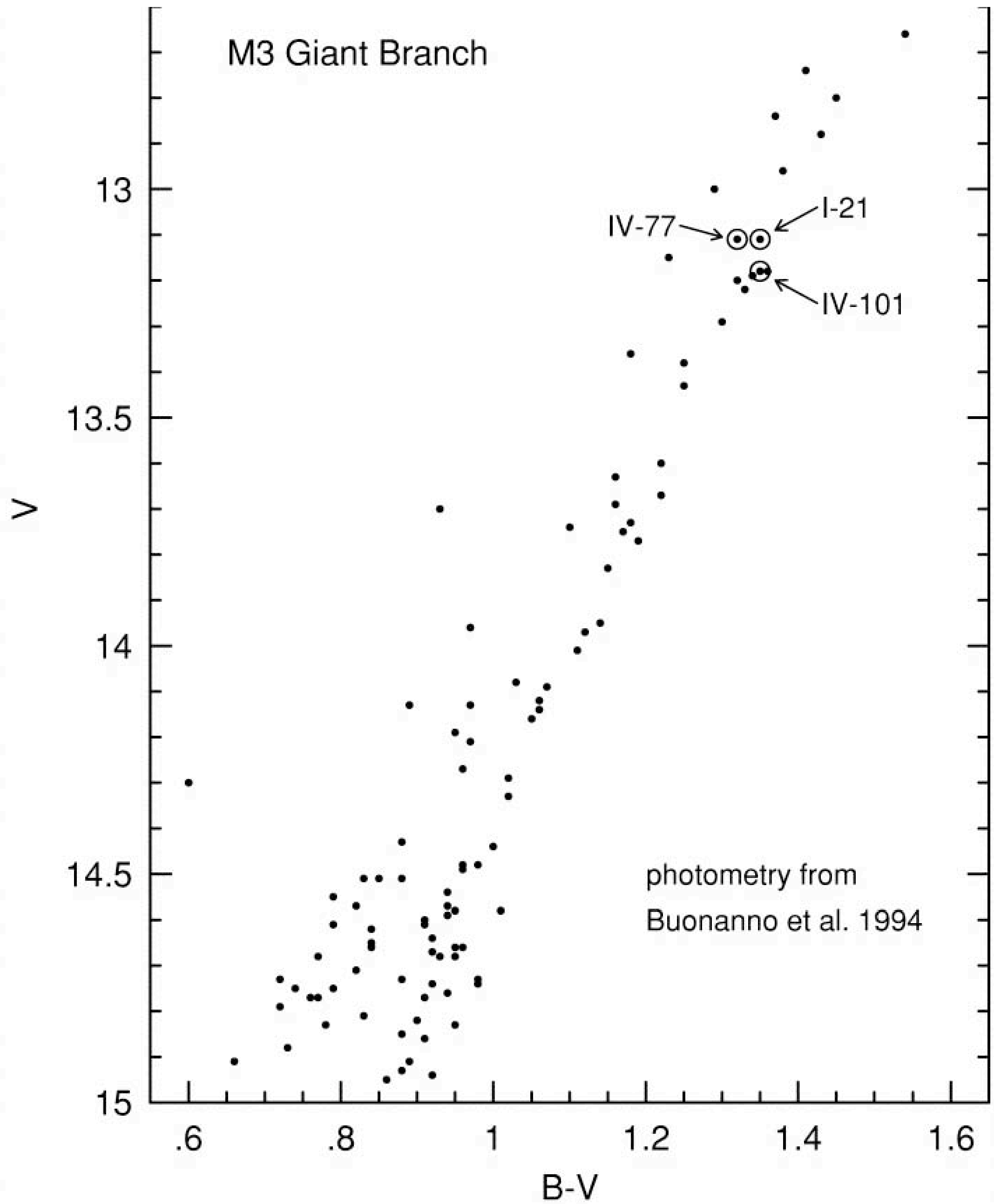


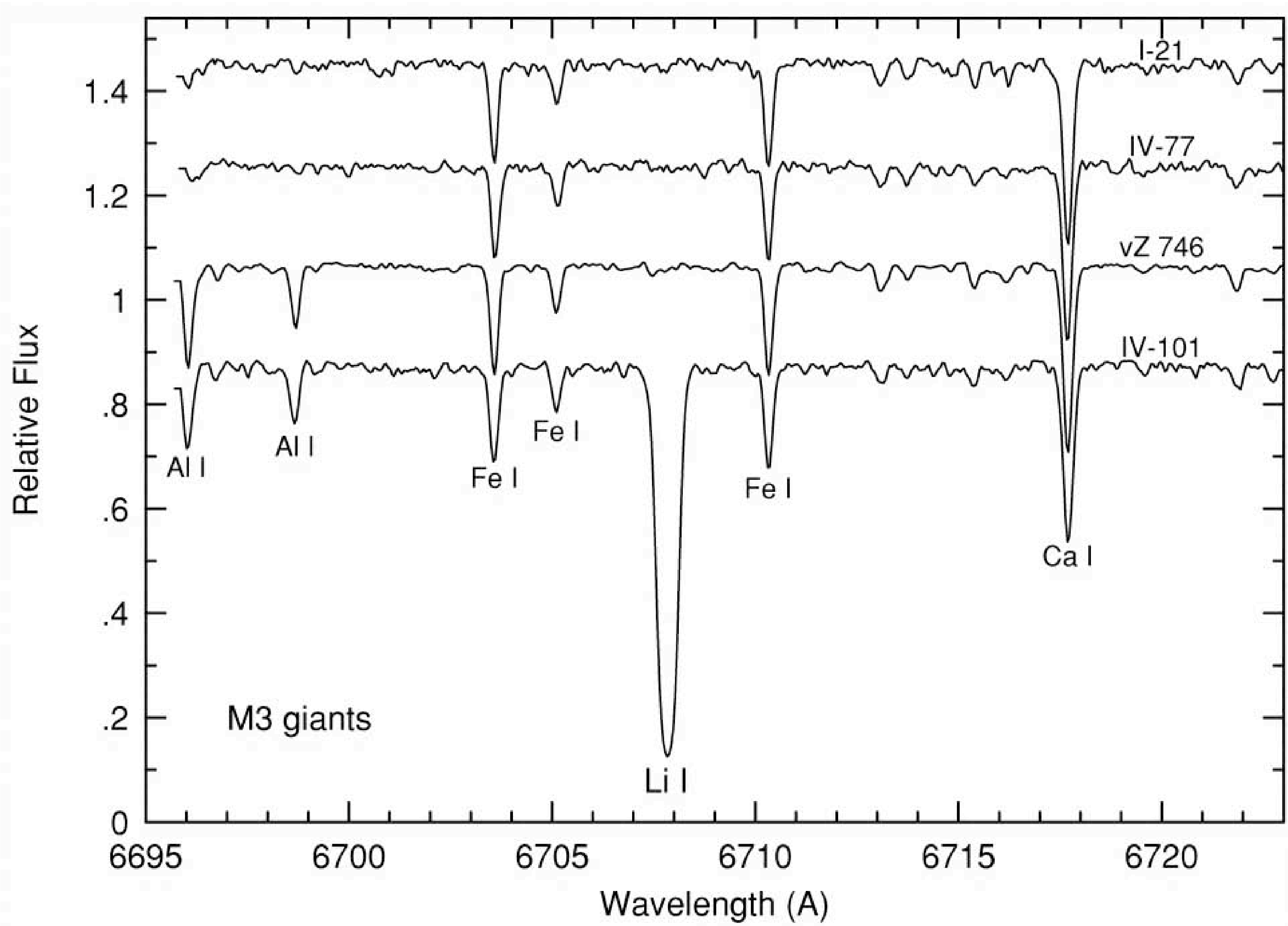
FIG. 7.—Lithium abundances plotted against stellar effective temperatures for all of the program stars. Different symbols have been employed to separate the stars into the three metallicity regimes indicated in the inset.



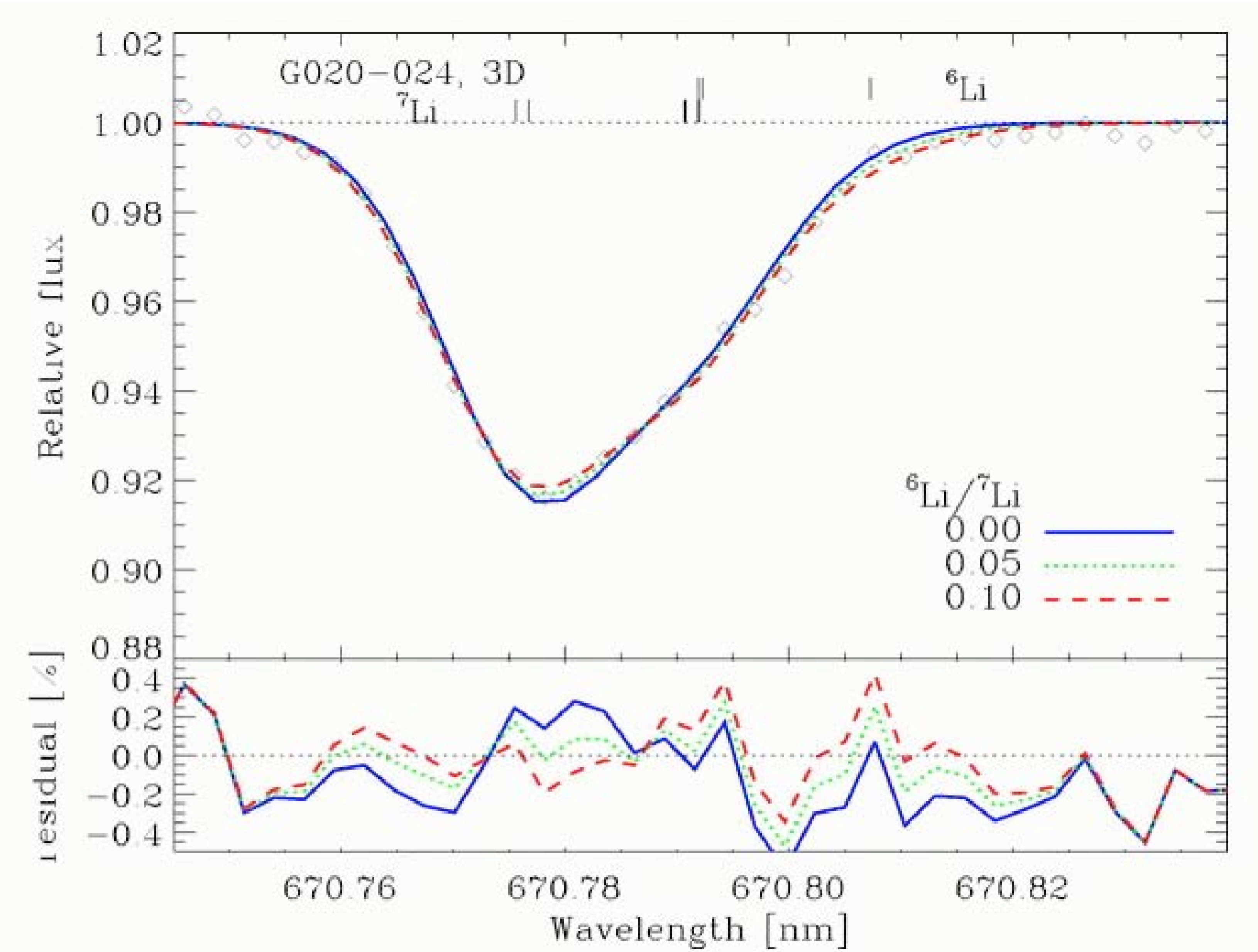
A(Li)
Li detection, [Fe/H] ≤ −1.7
Li detection, [Fe/H] > −1.7
Li detection, [Fe/H] ≤ −1.7, from literature
Li detection, [Fe/H] > −1.7, from literature
Li upper limit, [Fe/H] ≤ −1.7
Li upper limit, [Fe/H] > −1.7
Li upper limit, [Fe/H] ≤ −1.7, from literature
Li upper limit, [Fe/H] > −1.7, from literature
16.5 Gyr isochrones
0.27 dex per 100 K
−2.3
−1.5
(a) Dwarfs
HD 89499
(b) Subgiants
6000
5500
5000
Teff



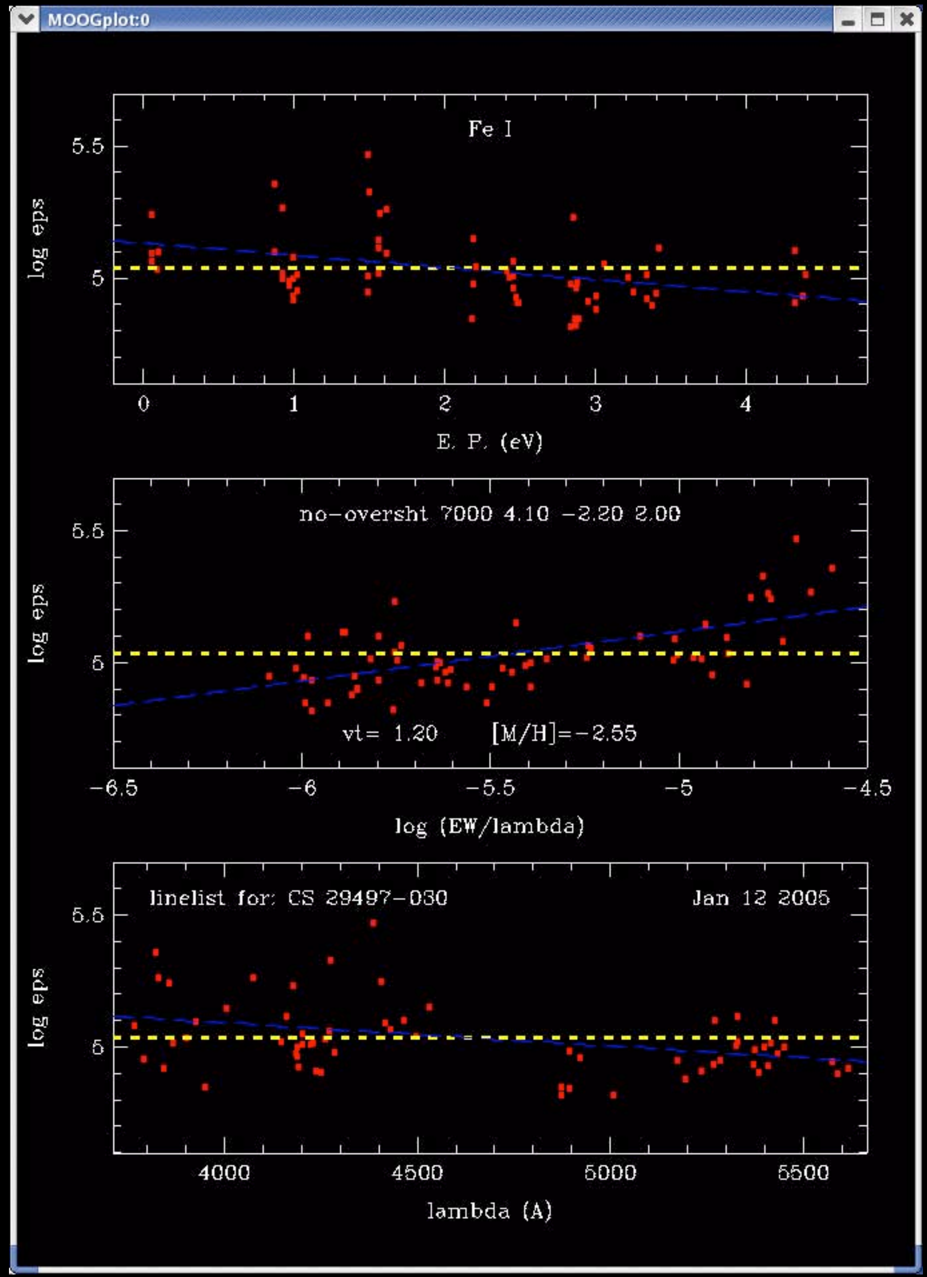
M3 Giant Branch
IV-77
I-21
IV-101
photometry from
Buonanno et al. 1994
V
13
13.5
14
14.5
15
.6
.8
1
1.2
1.4
1.6
B-V

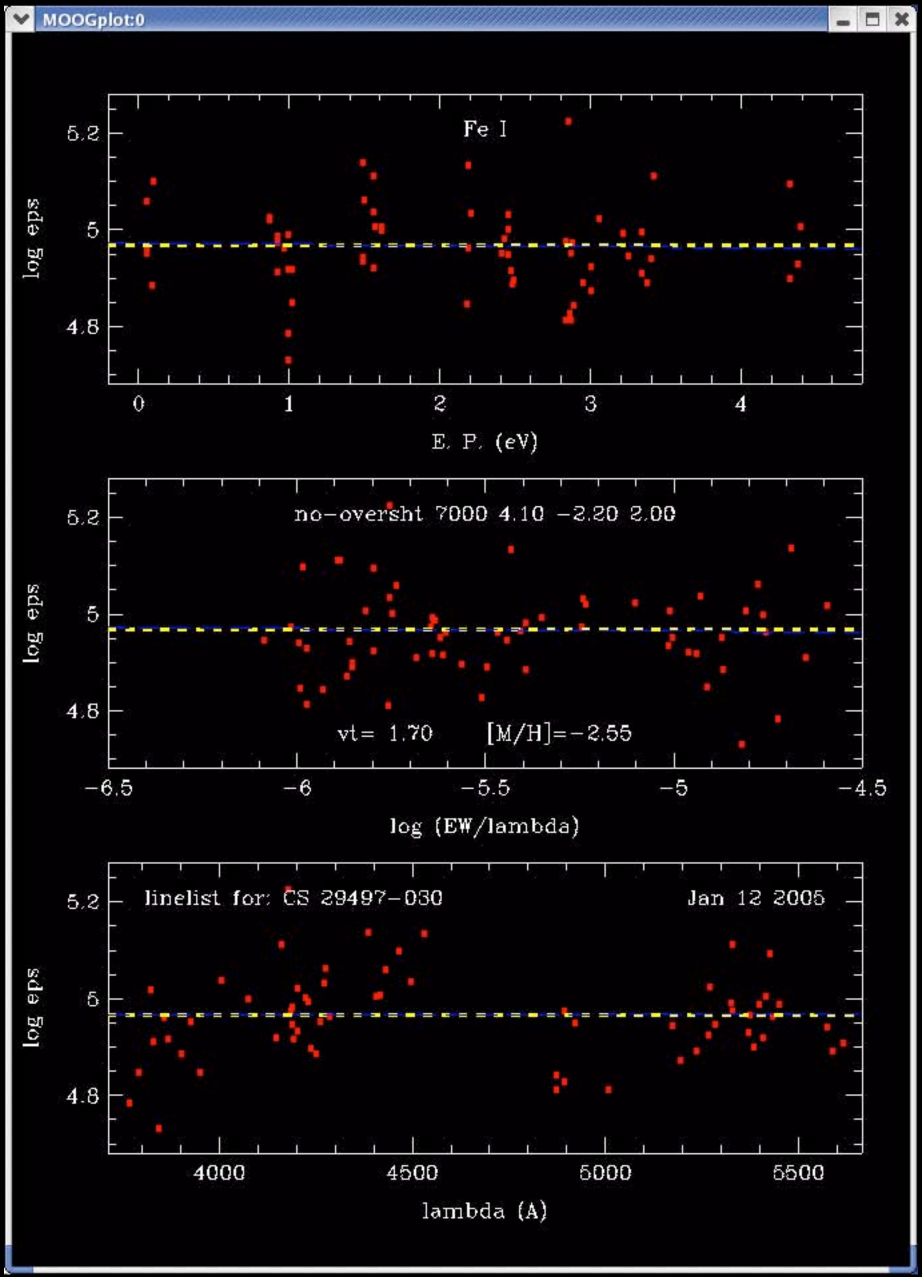


I-21
IV-77
vZ 746
IV-101
Al I
Al I
Fe I
Fe I
Li I
Fe I
Ca I
M3 giants
Relative Flux
Wavelength (A)
0
.2
.4
.6
.8
1
1.2
1.4
6695
6700
6705
6710
6715
6720



G020-024, 3D
^{7}Li
^{6}Li
Relative flux
^{6}Li/^{7}Li
0.00
0.05
0.10
residual [%]
1.02
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.4
0.2
0.0
−0.2
−0.4
670.76
670.78
670.80
670.82
Wavelength [nm]


MOOGplot:0
Fe I
log eps
5.5
5
0
1
2
3
4
E. P. (eV)
no-oversht 7000 4.10 -2.20 2.00
vt= 1.20
[M/H]=-2.55
-6.5
-6
-5.5
-5
-4.5
log (EW/lambda)
linelist for: CS 29497-030
Jan 12 2005
4000
4500
5000
5500
lambda (A)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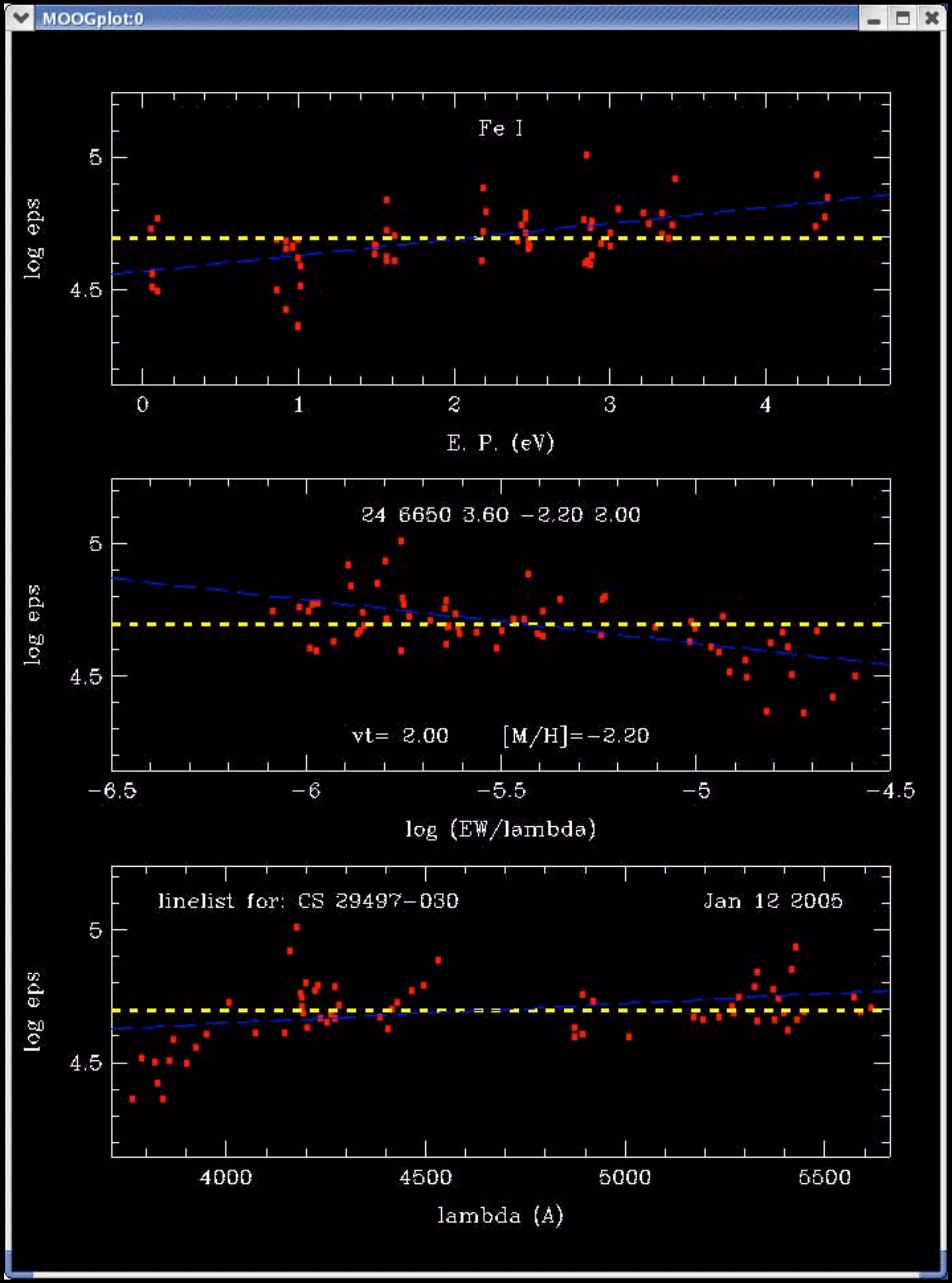
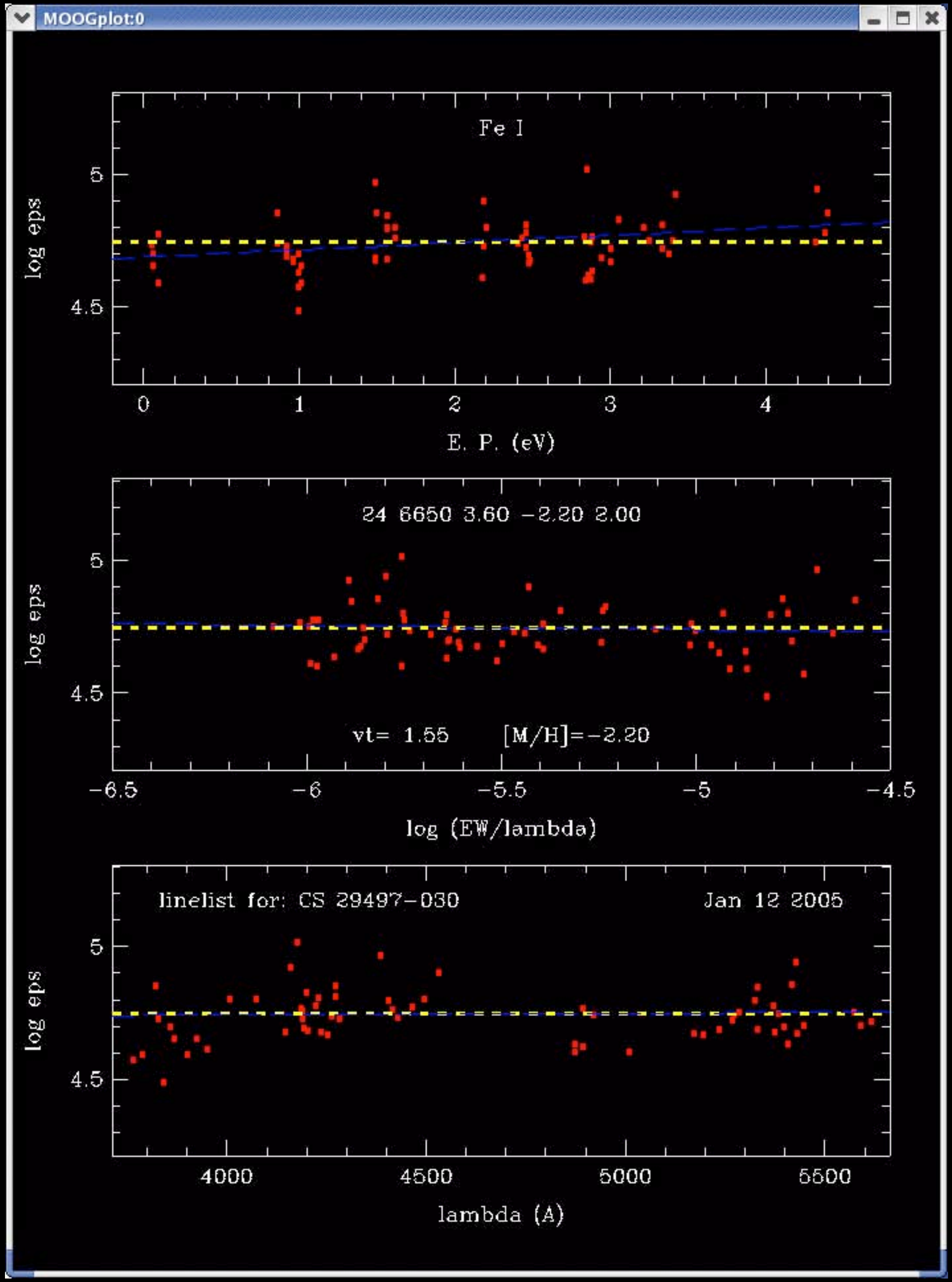
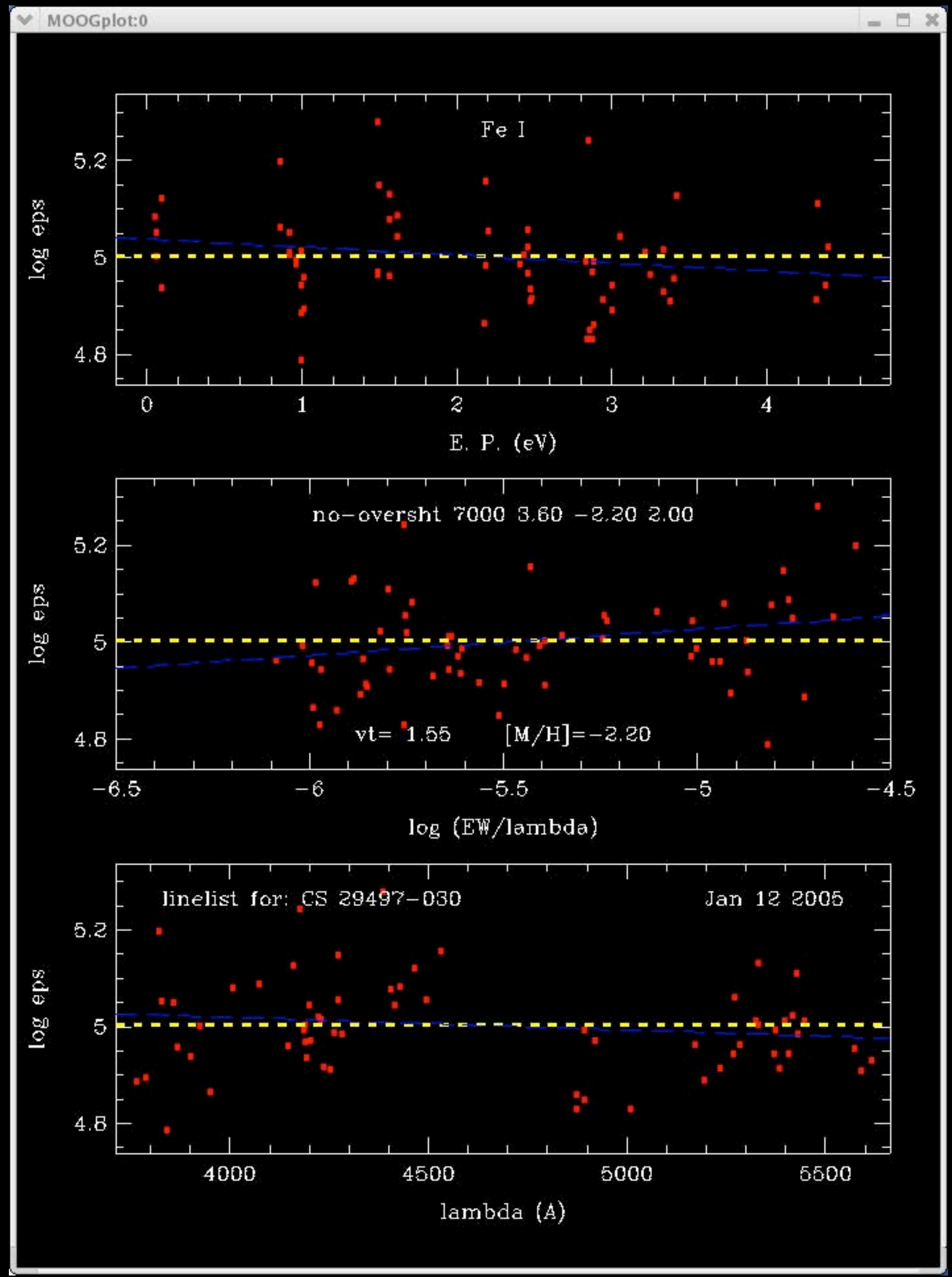
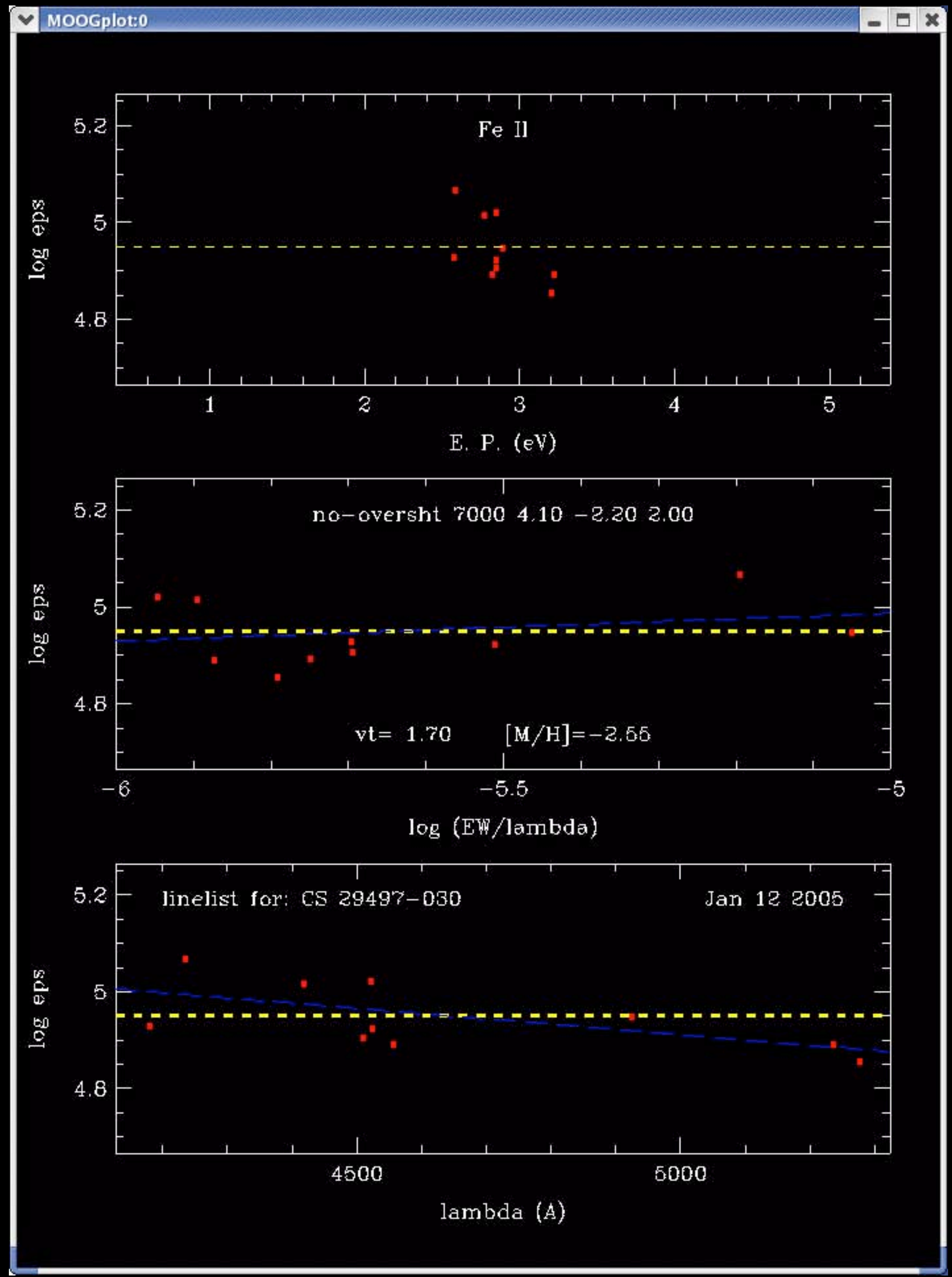
Fe I
log eps
5.2
5
4.8
0
1
2
3
4
E. P. (eV)
no-oversht 7000 4.10 −2.20 2.00
vt= 1.70
[M/H]=−2.55
−6.5
−6
−5.5
−5
−4.5
log (EW/lambda)
linelist for: CS 29497-030
Jan 12 2005
4000
4500
5000
5500
lambda (A)

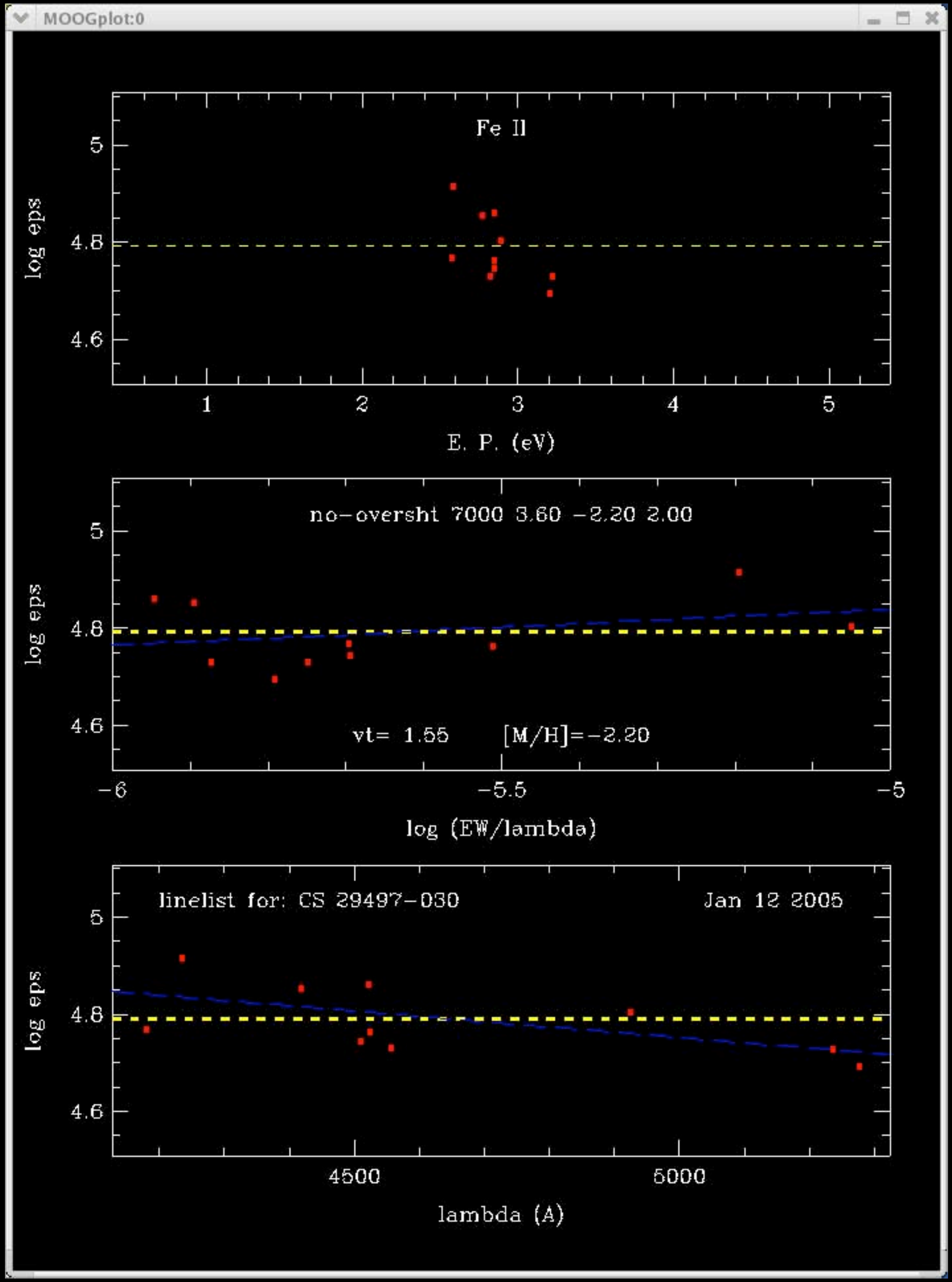

MOOGplot:0
Fe I
log eps
5
4.5
0
1
2
3
4
E. P. (eV)
24 6650 3.60 −2.20 2.00
vt= 2.00 [M/H]=−2.20
−6.5
−6
−5.5
−5
−4.5
log (EW/lambda)
linelist for: CS 29497−030
Jan 12 2005
4000
4500
5000
5500
lambda (A)


MOOGplot:0
Fe I
log eps
E. P. (eV)
24 6650 3.60 −2.20 2.00
vt= 1.55 [M/H]=−2.20
log (EW/lambda)
linelist for: CS 29497-030
Jan 12 2005
lambda (A)


MOOGplot:0
Fe I
log eps
E. P. (eV)
no-oversht 7000 3.60 -2.20 2.00
vt= 1.55 [M/H]=-2.20
log (EW/lambda)
linelist for: CS 29497-030
Jan 12 2005
lambda (A)



MOOGplot:0
Fe II
log eps
E. P. (eV)
no-oversht 7000 4.10 -2.20 2.00
vt= 1.70
[M/H]=-2.55
log (EW/lambda)
linelist for: CS 29497-030
Jan 12 2005
lambda (A)



MOOGplot:0
Fe II
log eps
E. P. (eV)
no-oversht 7000 3.60 -2.20 2.00
vt= 1.55 [M/H]=-2.20
log (EW/lambda)
linelist for: CS 29497-030
Jan 12 2005
lambda (A)