News on HE 0107–5240, and new surveys for metal-poor stars

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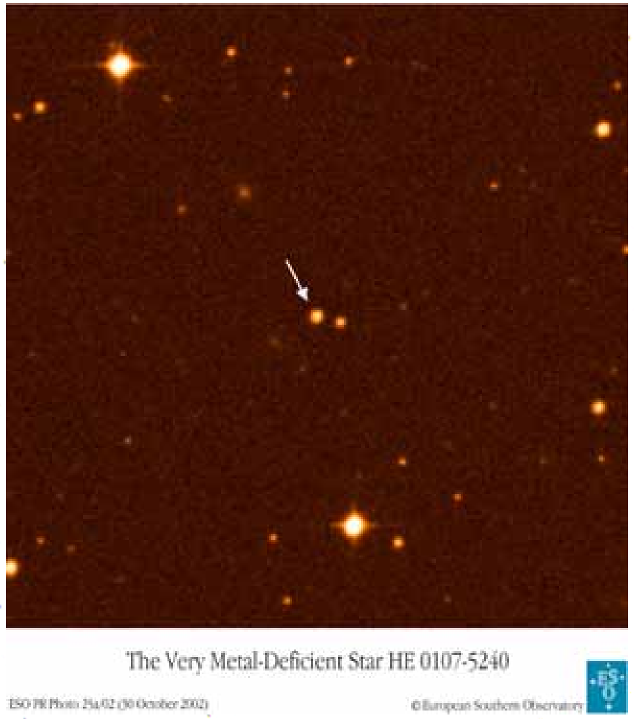
HE 0107–5240
[Fe I/H]$_{NLTE}$ = –5.3

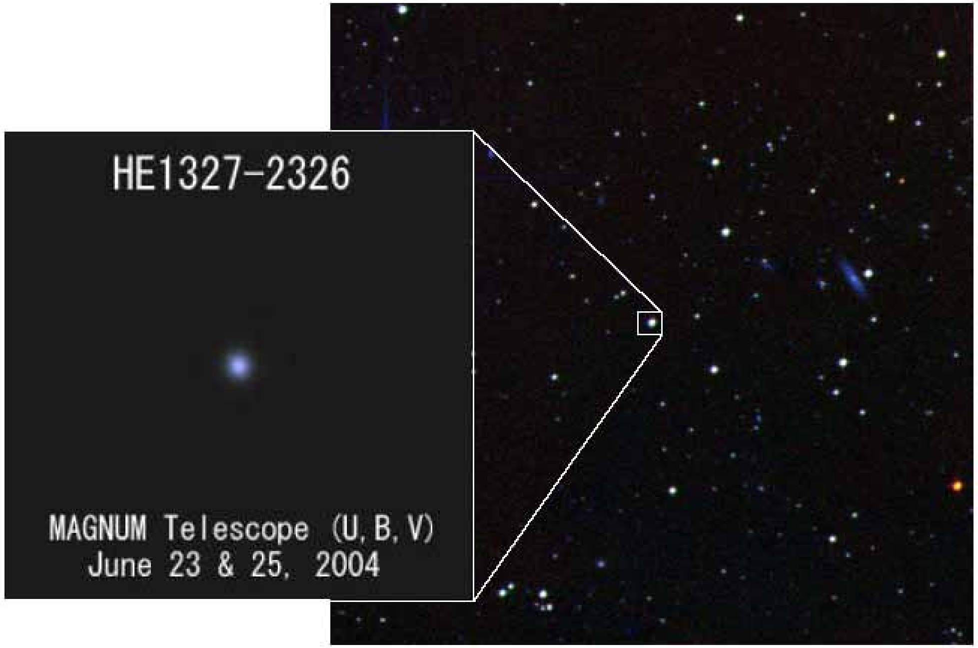


Christlieb et al. (2002), Nature 419, 904
Christlieb et al. (2004), ApJ 603, 708
Bessell et al. (2004), ApJ 612, L61
Christlieb et al. (2007), in preparation

The most heavy-element deficient stars known

HE 1327–2326
[Fe I/H]$_{NLTE}$ = –5.4

Frebel et al. (2005), Nature 434, 871
Frebel et al. (2006), ApJ 638, L17
Aoki et al. (2006), ApJ 639, 897



DSS Image (R,G,B)

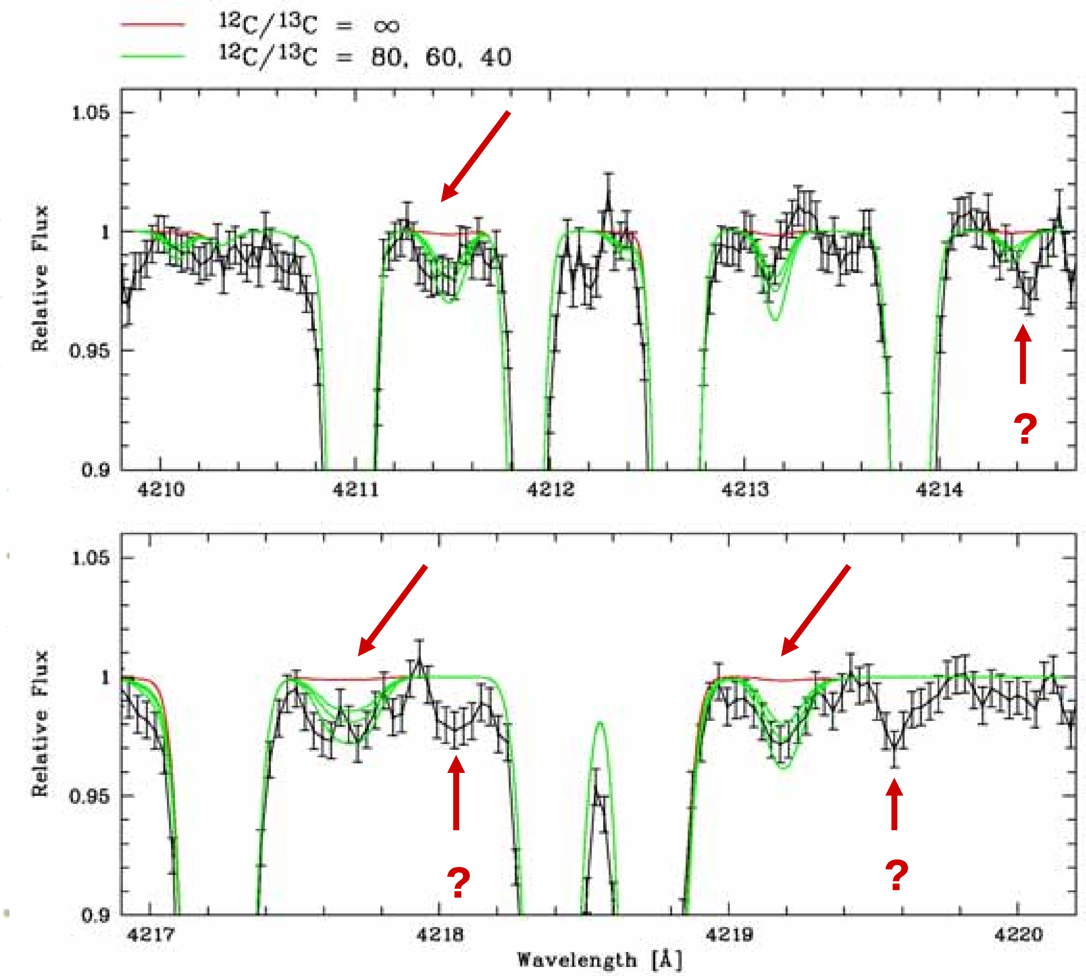
Some basic facts

	HE 0107−5240	HE 1327−2326
T_{eff}	5100 K	6180 K
log g	2.2 dex	3.7 dex
$[\mathrm{Fe\ I/H}]_{\mathrm{NLTE}}$	−5.3 dex	−5.4 dex
μ	?	0.0733 arcsec/yr
B	15.86 mag	14.016 mag
$E(B-V)$	0.013 mag	0.060–0.096 mag
$(B-V)_0$	0.68 mag	0.40 mag
$(V-K)_0$	1.90 mag	1.32 mag

The UV spectra

- Analysis of the UV spectra was done in collaboration with Mike Bessell (Australian National University) and Kjell Eriksson (Uppsala).
- Results will be published in Christlieb, Bessell & Eriksson (2008, to be submitted to ApJ).

$^{12}C / ^{13}C$

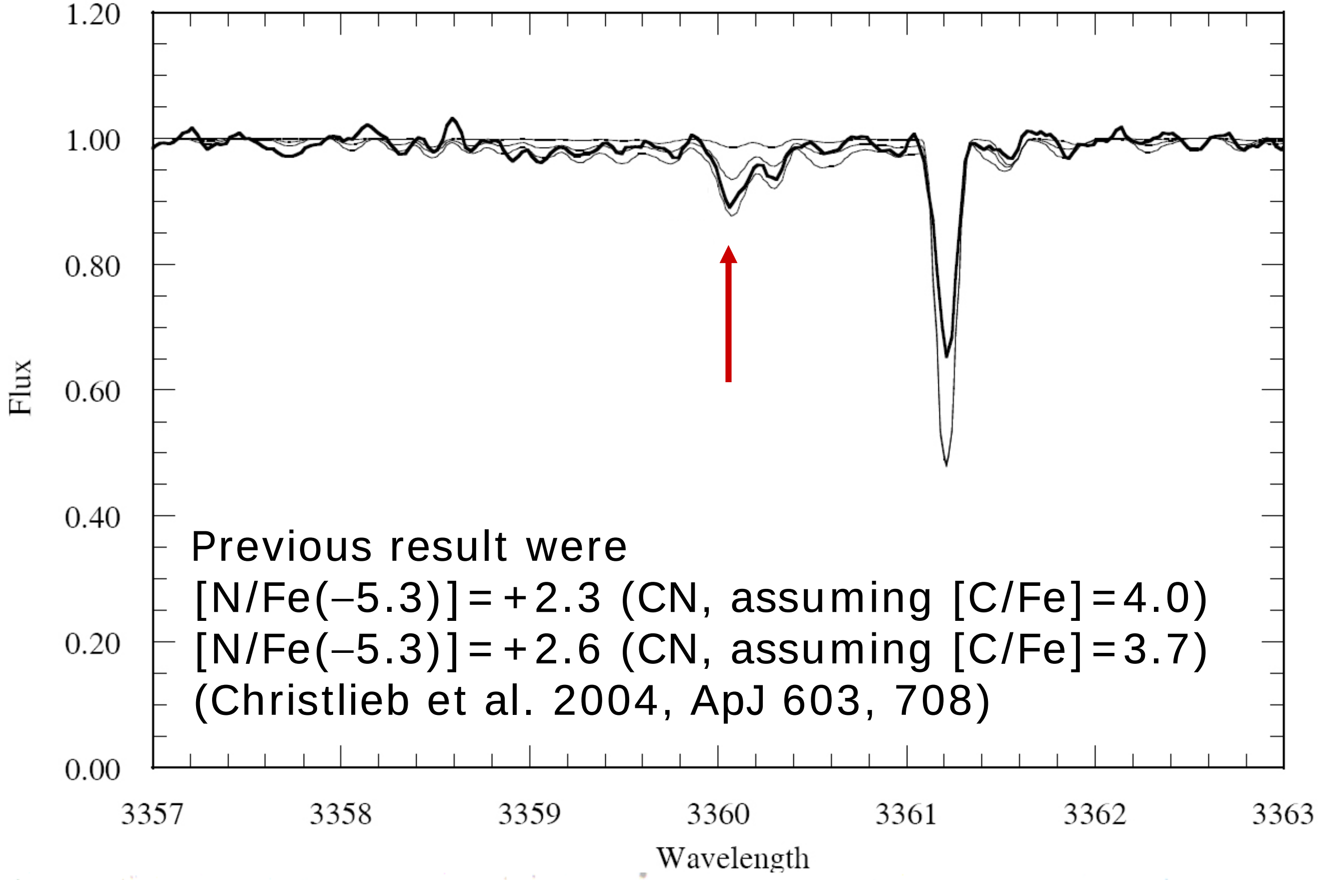


$^{12}C / ^{13}C \sim 60$

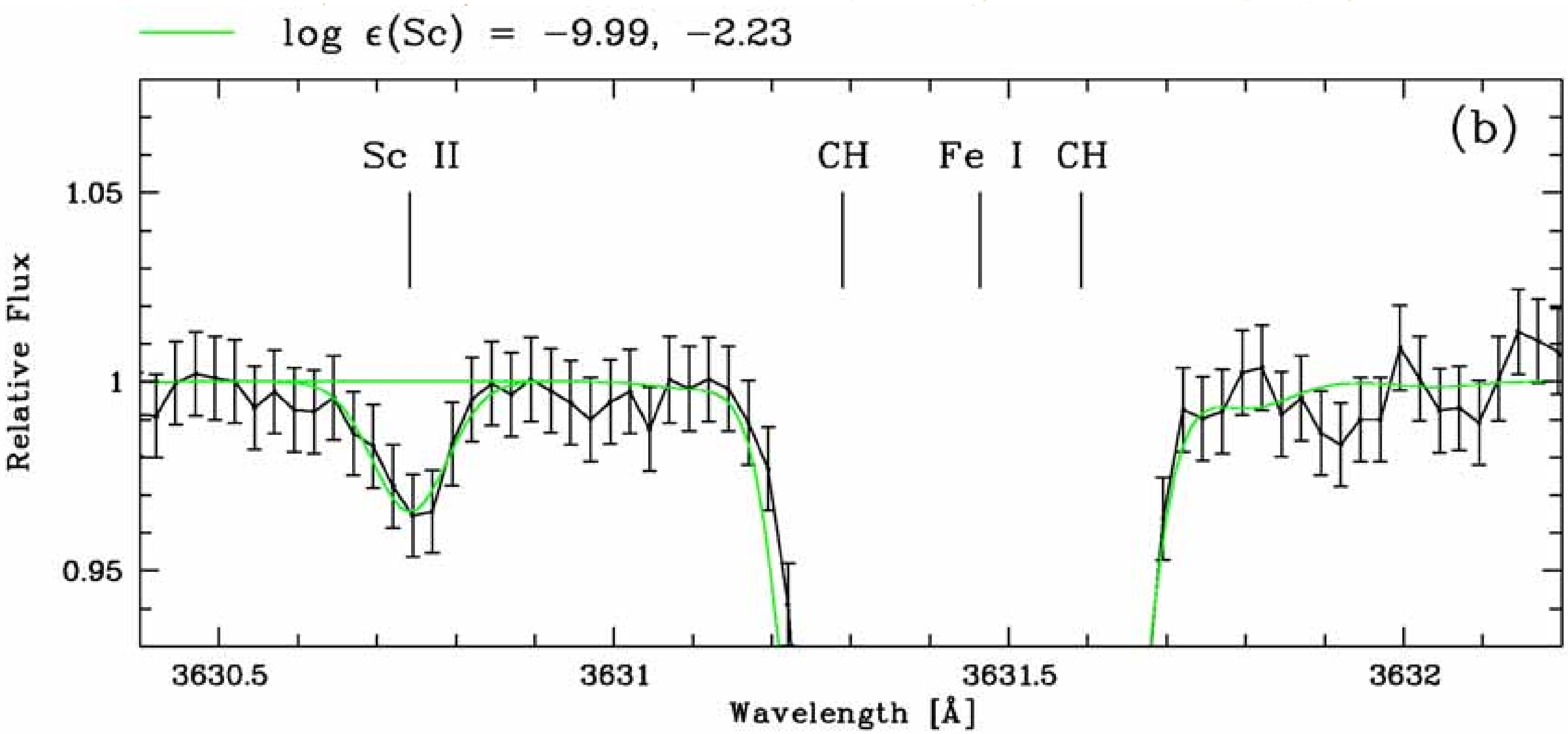
This is consistent with previous result of Christlieb et al. (2004), i.e., $^{12}C/^{13}C > 50$.

Nitrogen abundance from NH

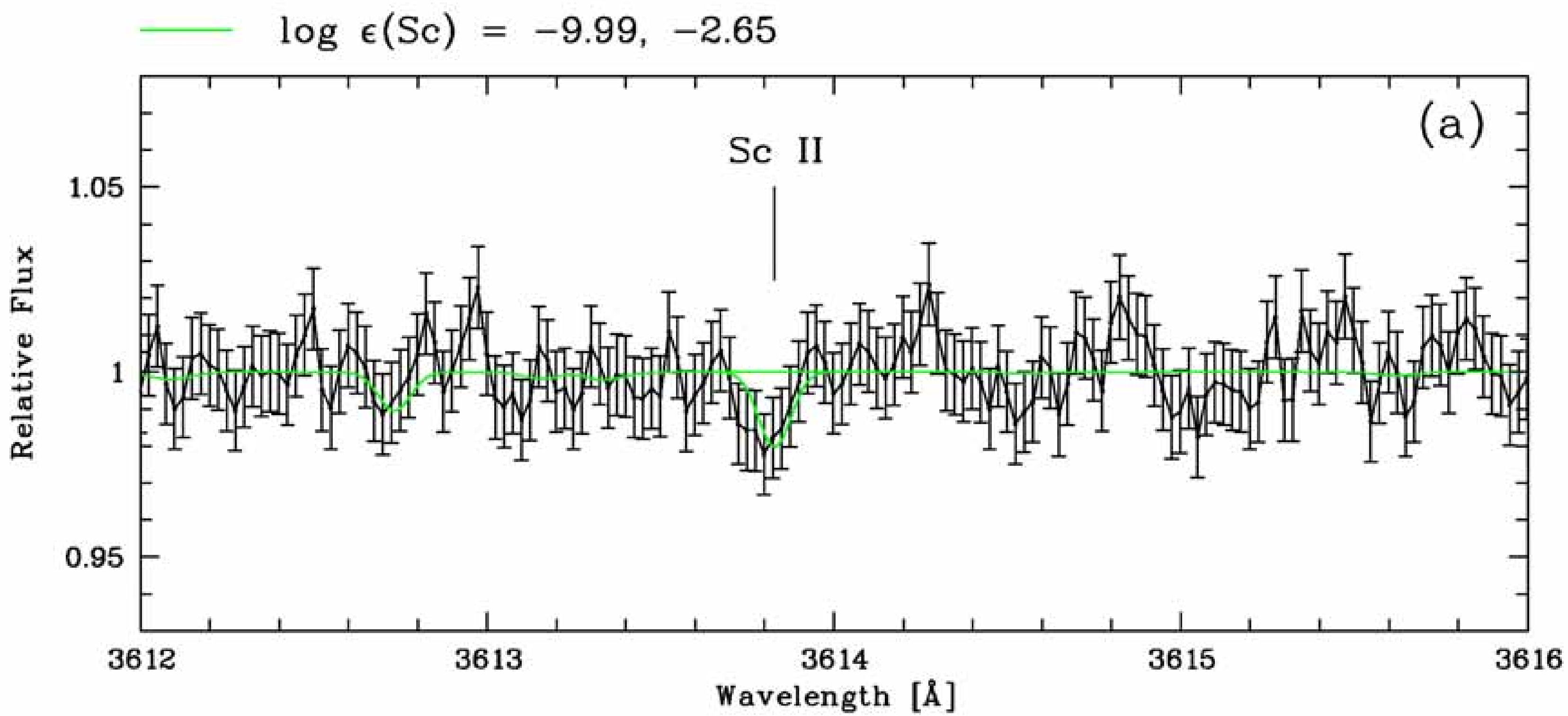
[N/Fe(−5.3)]=+1.5, +2.2, +2.5. Best fit: +2.4.



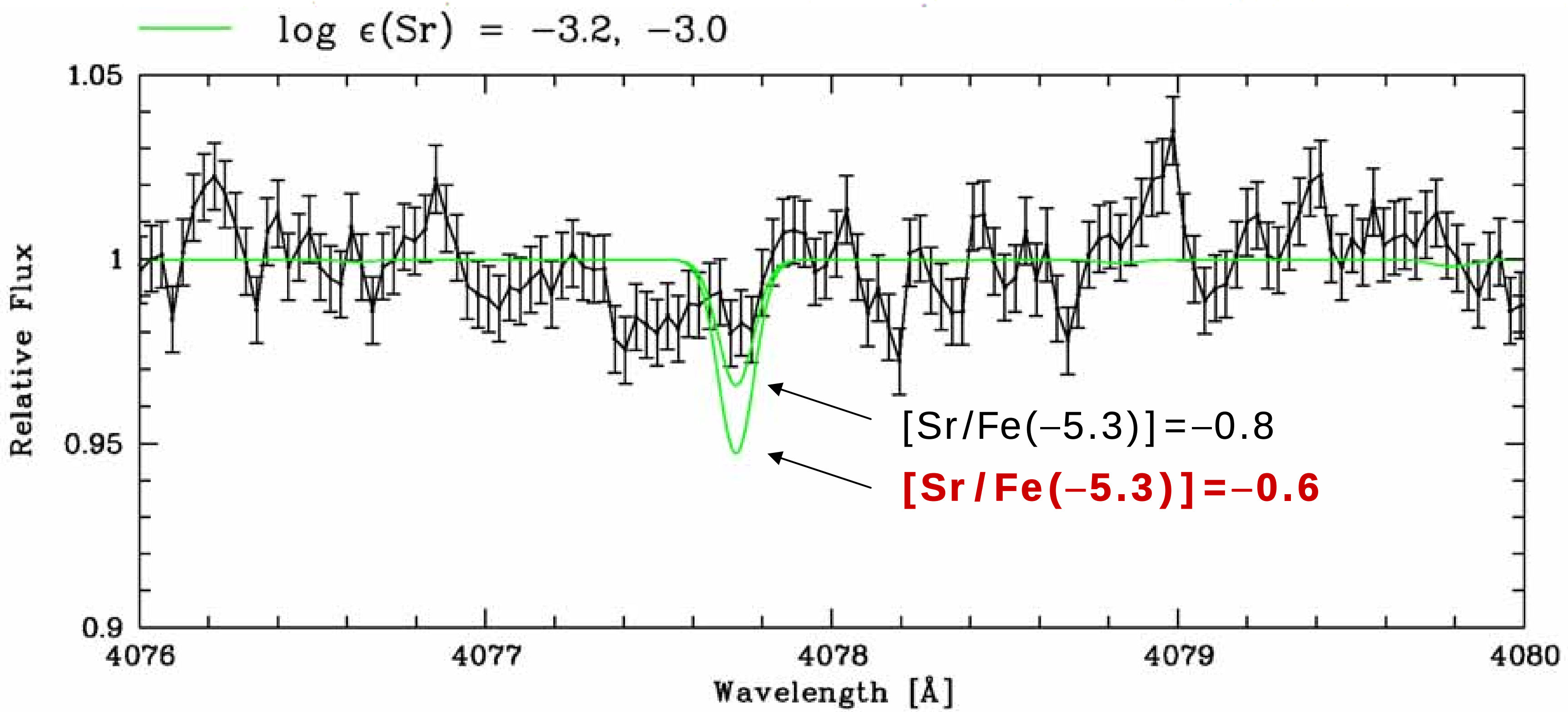
Sc II 3630.74Å



Sc II 3613.83Å

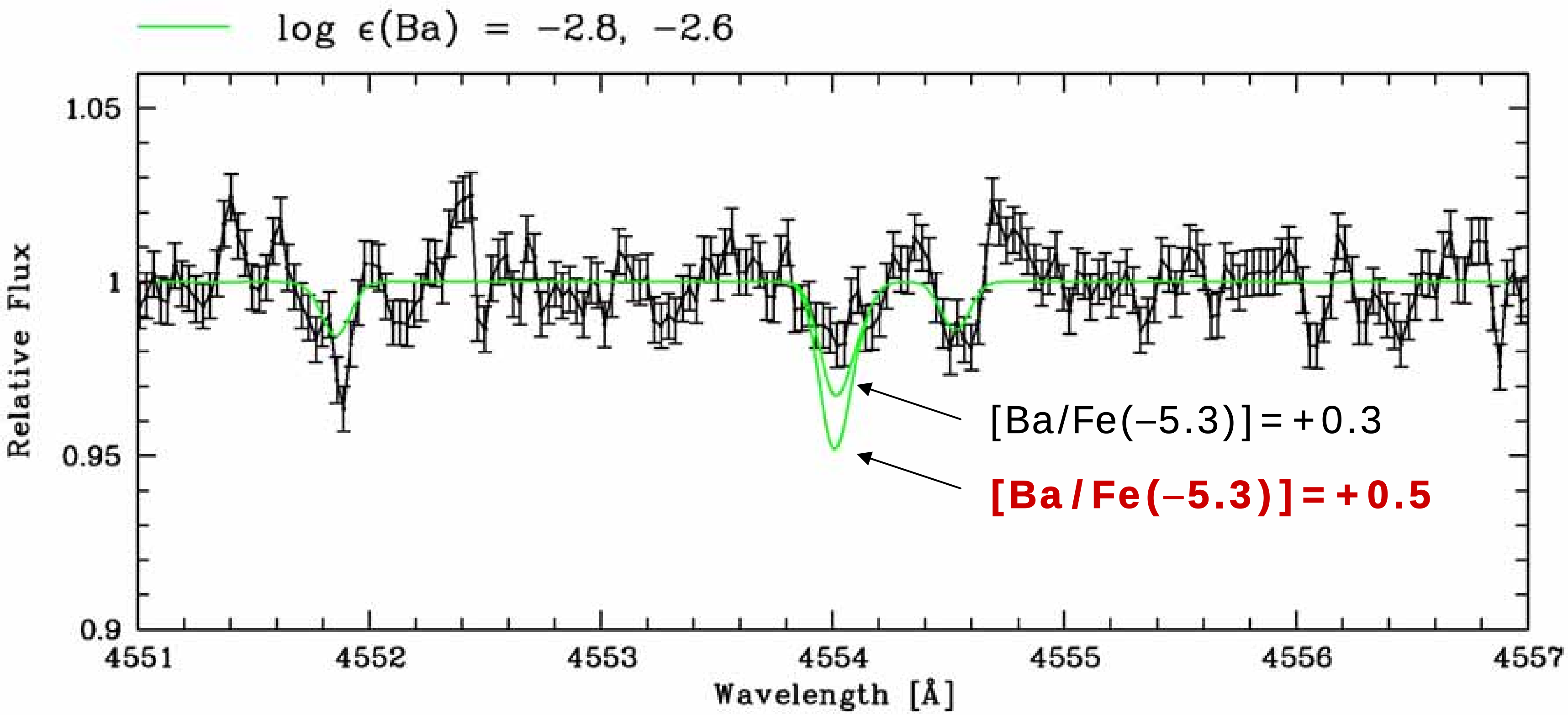


Sr II 4077



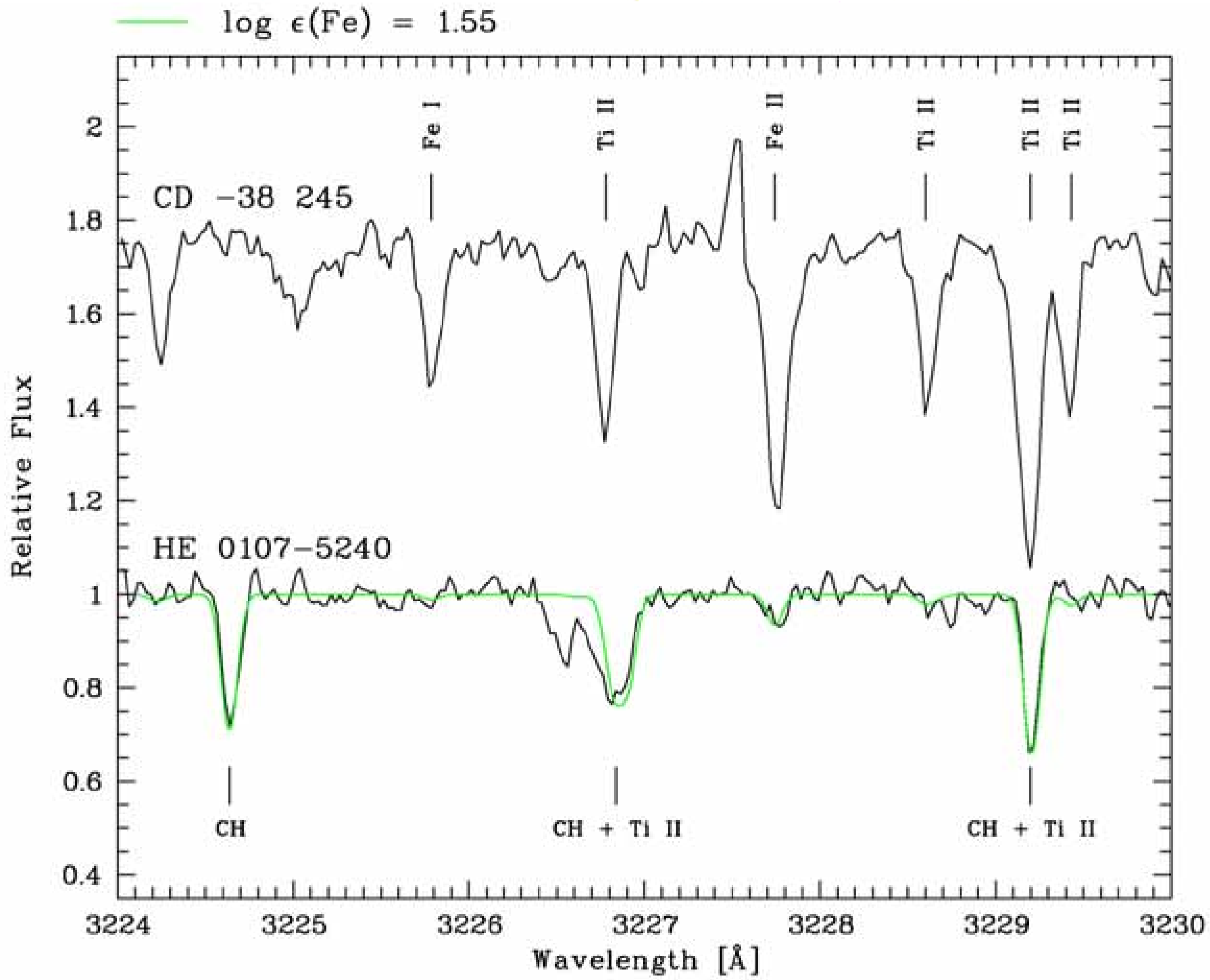
Previous result was [Sr/Fe(–5.3)] < –0.5 (Christlieb et al. 2004, ApJ 603, 708)

Ba II 4554

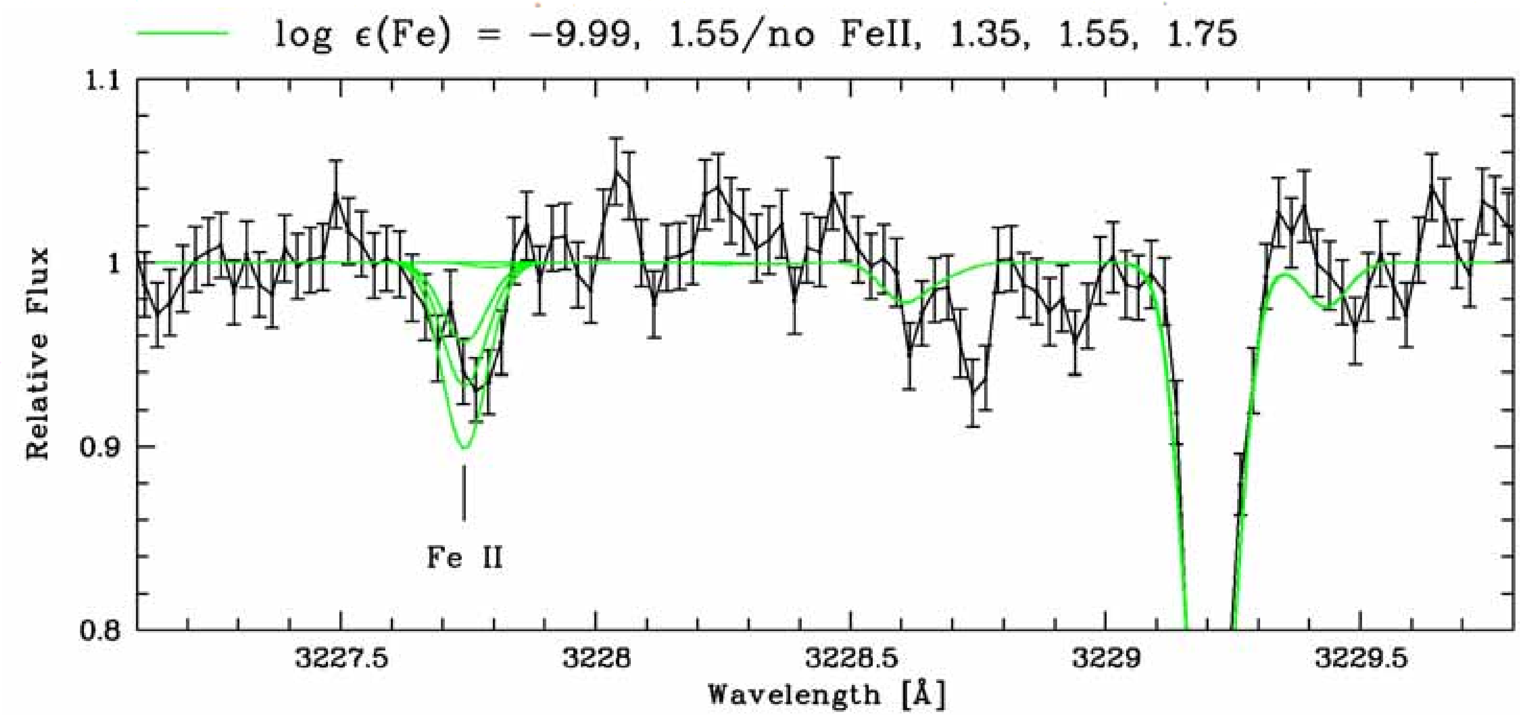


Previous result was [Ba/Fe(–5.3)] < +0.8 (Christlieb et al. 2004, ApJ 603, 708)

Detection of Fe II 3227.74Å



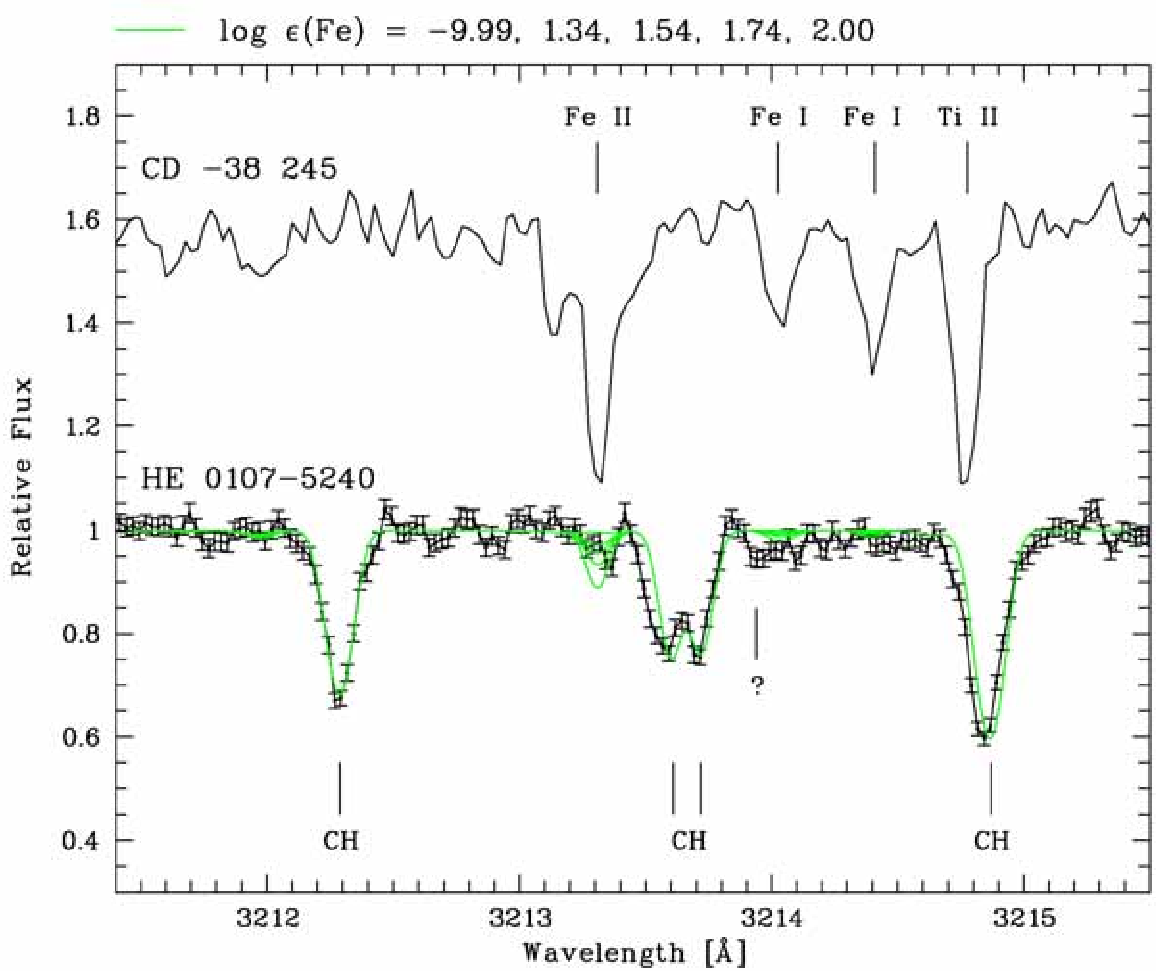
Detection of Fe II 3227.74Å



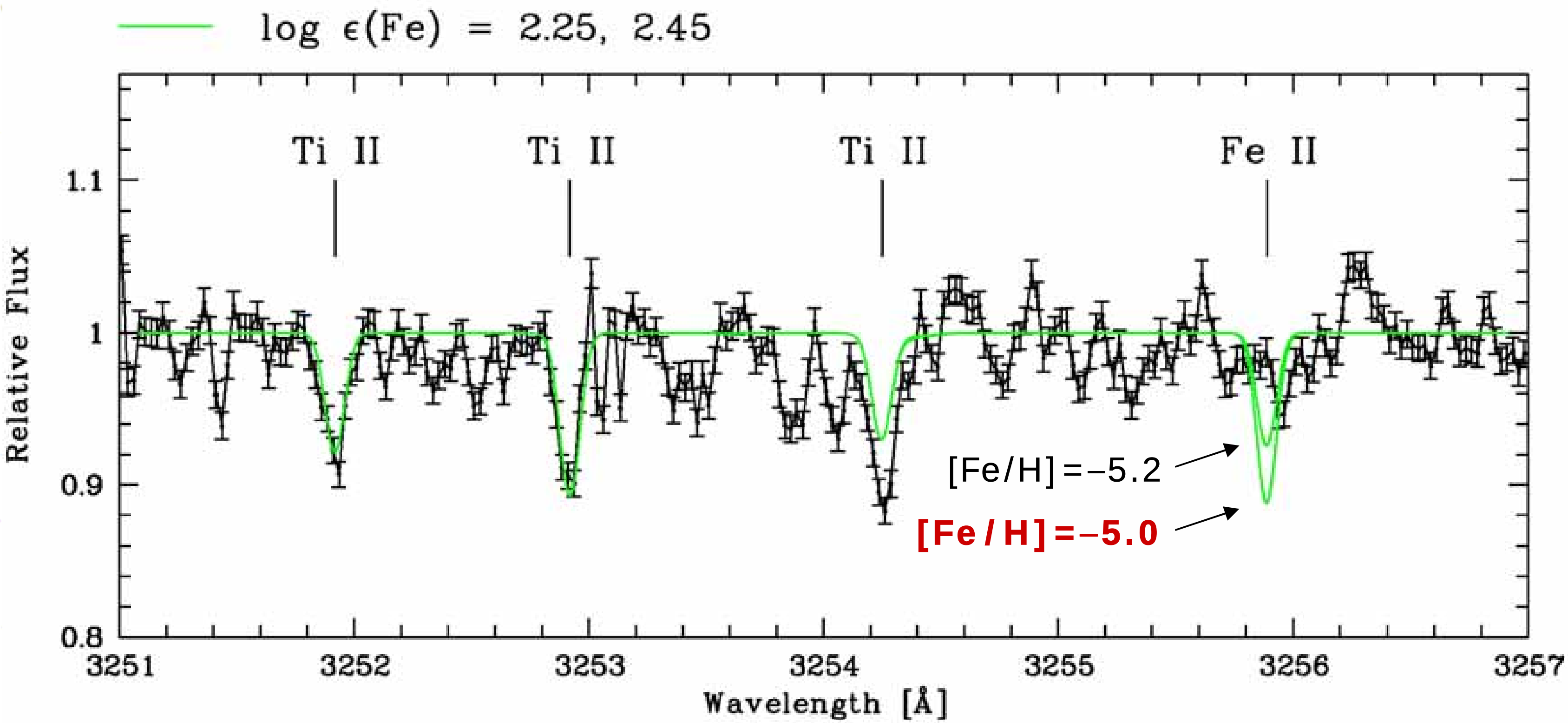
Continuum is a bit low here, hence we adopt result of equivalent width-based analysis, i.e.,

log ε = 1.7±0.2 ⇔ [Fe II / H] = –5.7±0.2

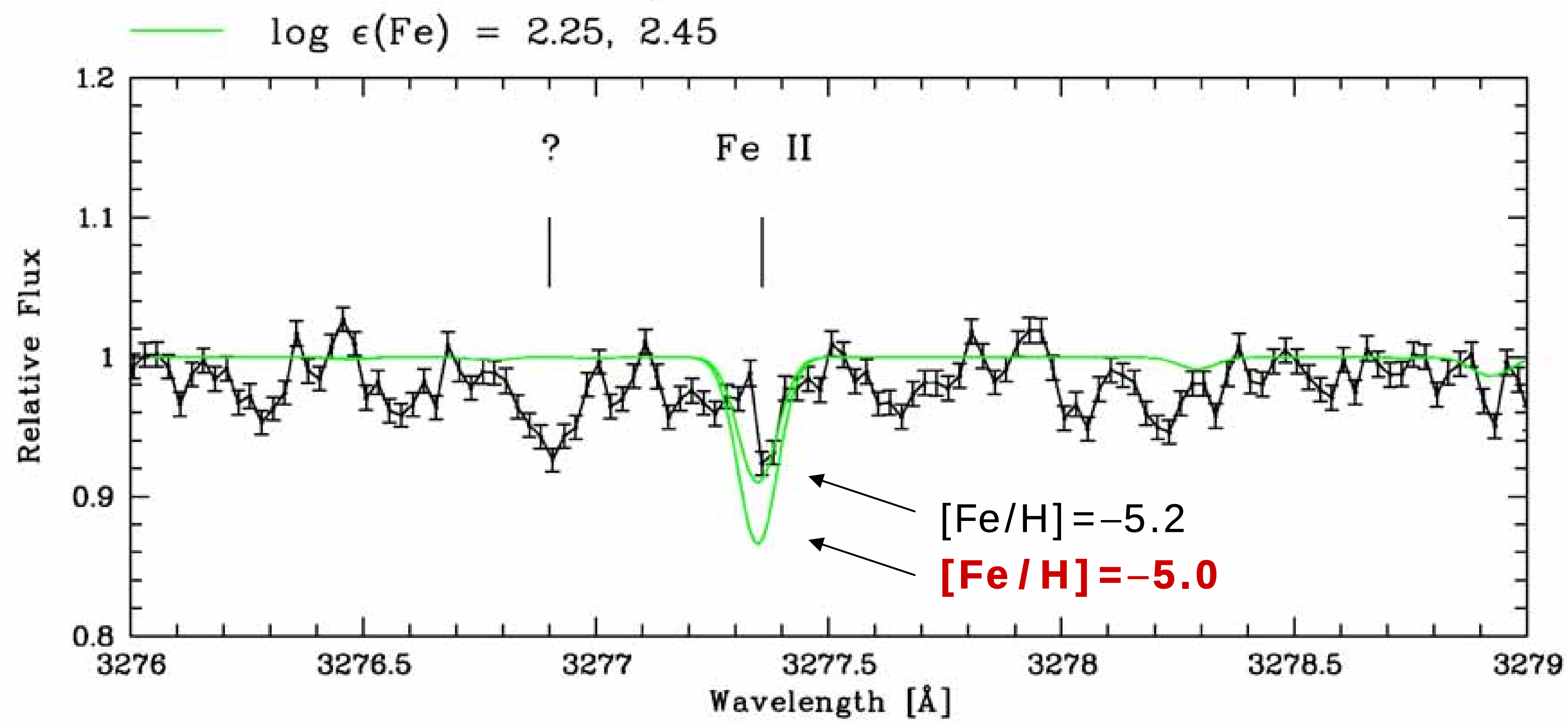
Fe II 3213.31Å detected?



Fe II 3255

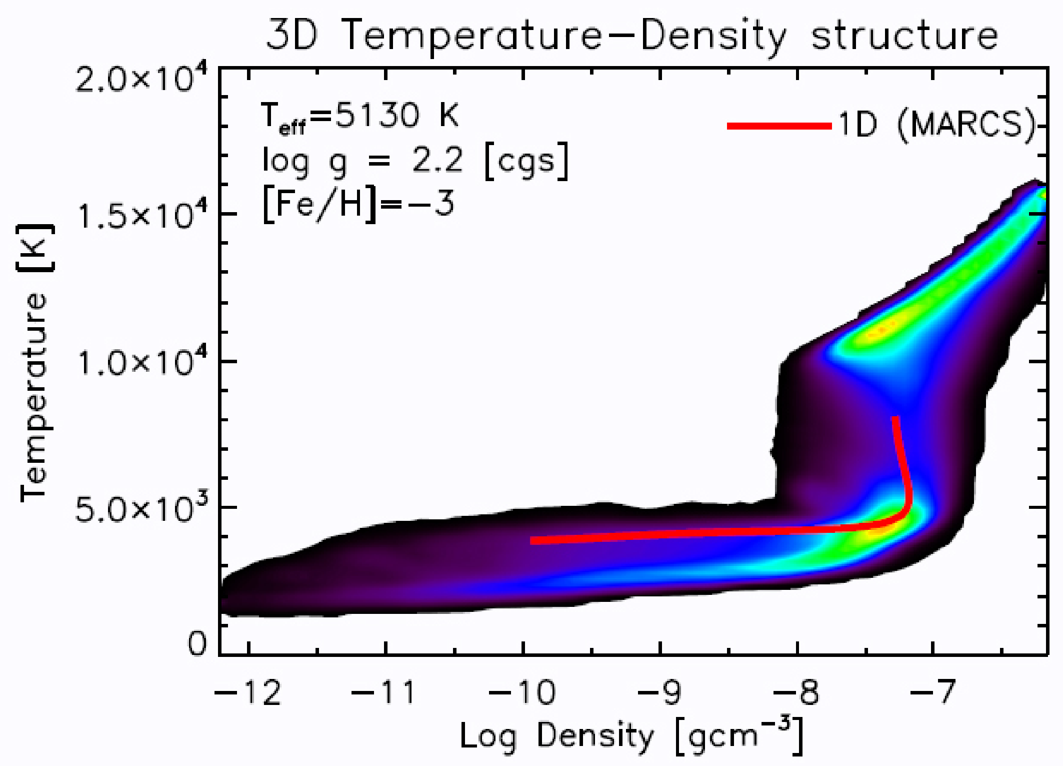

log ϵ(Fe) = 2.25, 2.45
Ti II
Ti II
Ti II
Fe II
[Fe/H]=−5.2
[Fe/H]=−5.0
Relative Flux
Wavelength [Å]
0.8
0.9
1
1.1
3251
3252
3253
3254
3255
3256
3257

Fe II 3277



log ϵ(Fe) = 2.25, 2.45
?
Fe II
Relative Flux
Wavelength [Å]
1.2
1.1
1
0.9
0.8
3276
3276.5
3277
3277.5
3278
3278.5
3279
[Fe/H]=–5.2
[Fe/H]=–5.0

3D corrections for HE 0107–5240



Collet et al. (2005, Proceedings of IAU Symposium 228).

Species	Δ3D
CH	–1.09
NH	–1.05
OH	–0.71
Mg I	–0.08
Sc II	–0.13
Fe I	–0.23
Fe II	+0.06
Co I	–0.26
Ni I	–0.31

Collet et al. (2006, ApJ 644, L121)

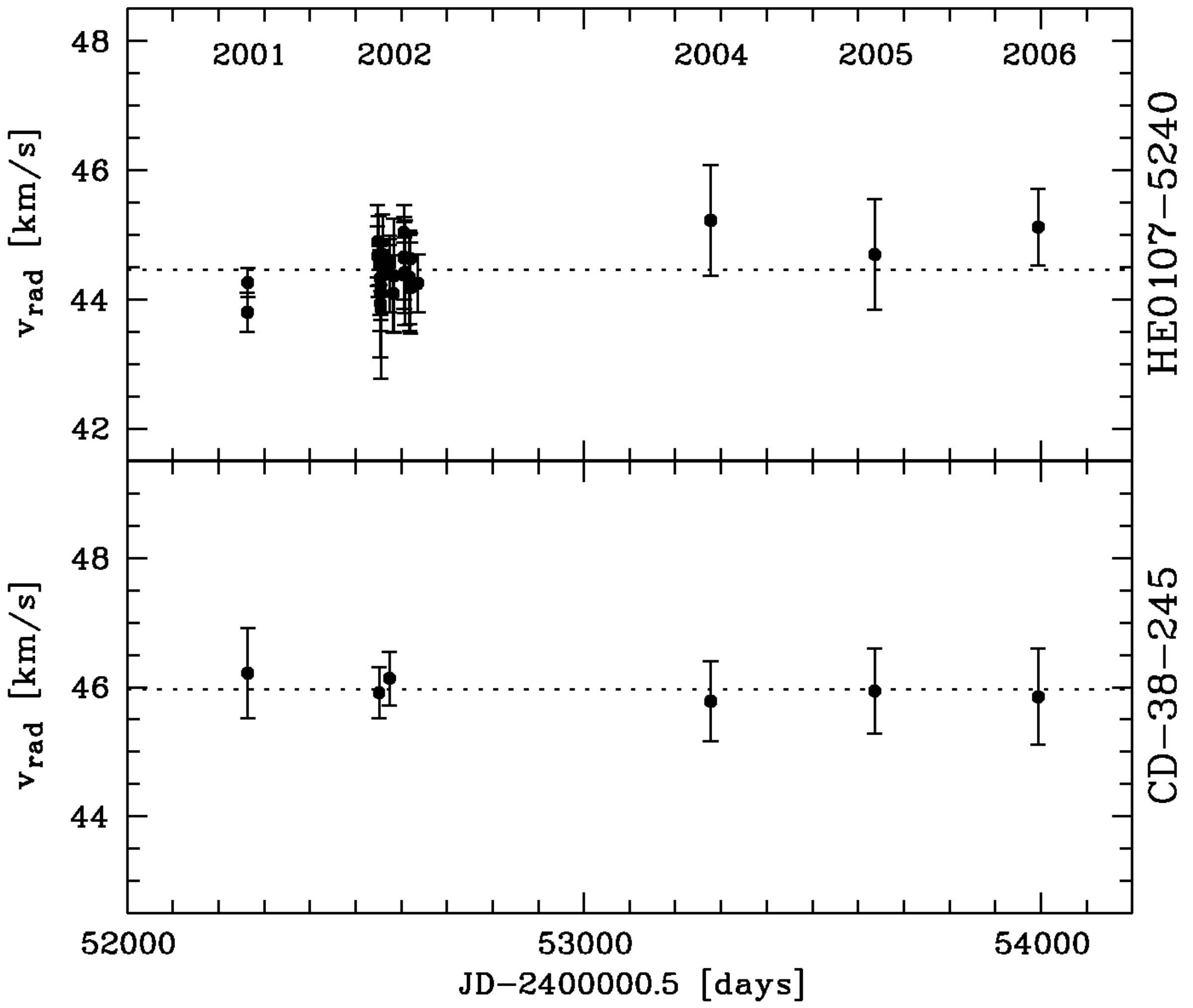
Selected abundances of HE 0107–5240

	1D	3D	σ
[C/Fe]	+3.9	+2.9	0.2
$^{12}C/^{13}C$	60	60	10
[N/Fe]	+2.7	+1.7	0.2
[O/Fe]	+2.6	+1.9	0.2
[Mg/Fe]	+0.6	+0.5	0.2
[Sc/Fe]	+0.2	+0.1	0.2
$[FeI/H]_{LTE}$	−5.4	–5.6	0.1
[FeII/H]	–5.7	–5.7	0.2
[Co/Fe]	+0.7	+0.5	0.2
[Ni/Fe]	+0.1	–0.2	0.1

Remarks:

- Solar abundances are from Asplund, Grevesse & Sauval (2005)
- 3D corrections from Collet, Asplund & Trampedach (2006, ApJ 644, L121)
- Adopted [Fe/H] is –5.7. This value has been used when computing [X/Fe].
- Note the good agreement between Fe I and Fe II abundances, which constraints the maximum possible NLTE effect of Fe I (assuming log *g* derived from isochrone is correct).

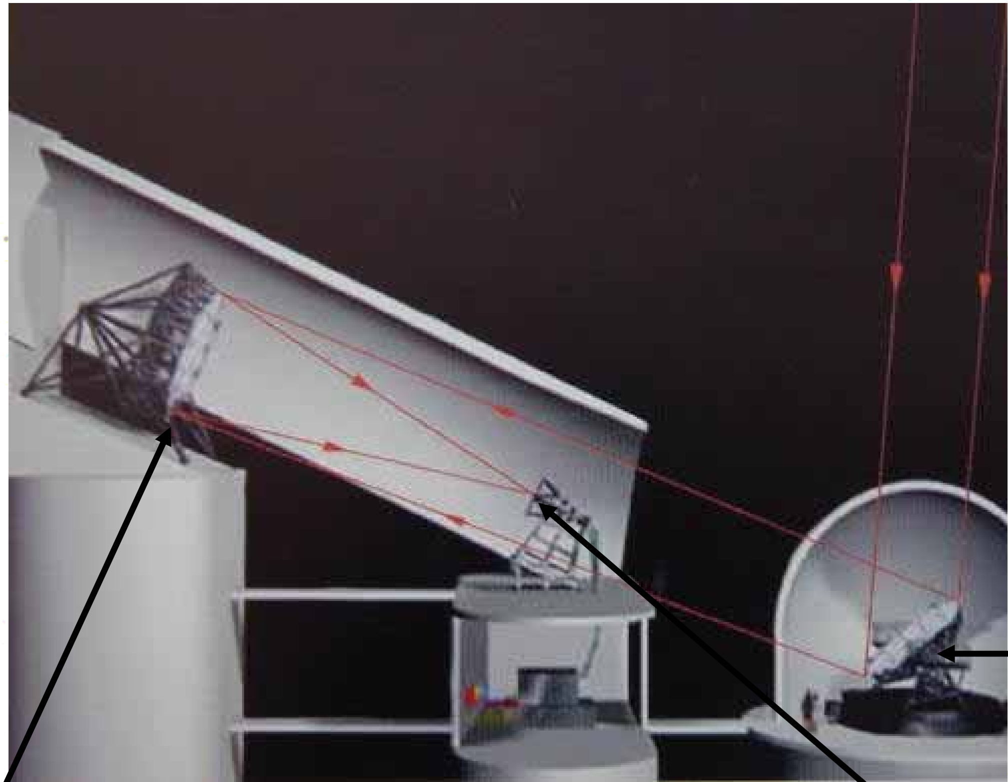
Radial velocity monitoring



Future surveys
for metal-poor stars

www.lamost.org

LAMOST optical design



A. Luo (2006, priv. comm.)

M_A Reflecting Schmidt Corrector

M_B: Spherical Primary Mirror

It's a meridian reflecting Schmidt telescope, laid down on the ground with its optical axis fixed in the meridian plane

Focal Plane


7 September 2006
Clear Aperture: 4m
5° diameter field of view
4,000 fibers
16 fiber-fed two-arm spectrographs for low- to medium-resolution
In low-res mode, S/N = 10 for 20.5 mag object in 1.5 h
First Light planned for mid-2007

Instrument configurations

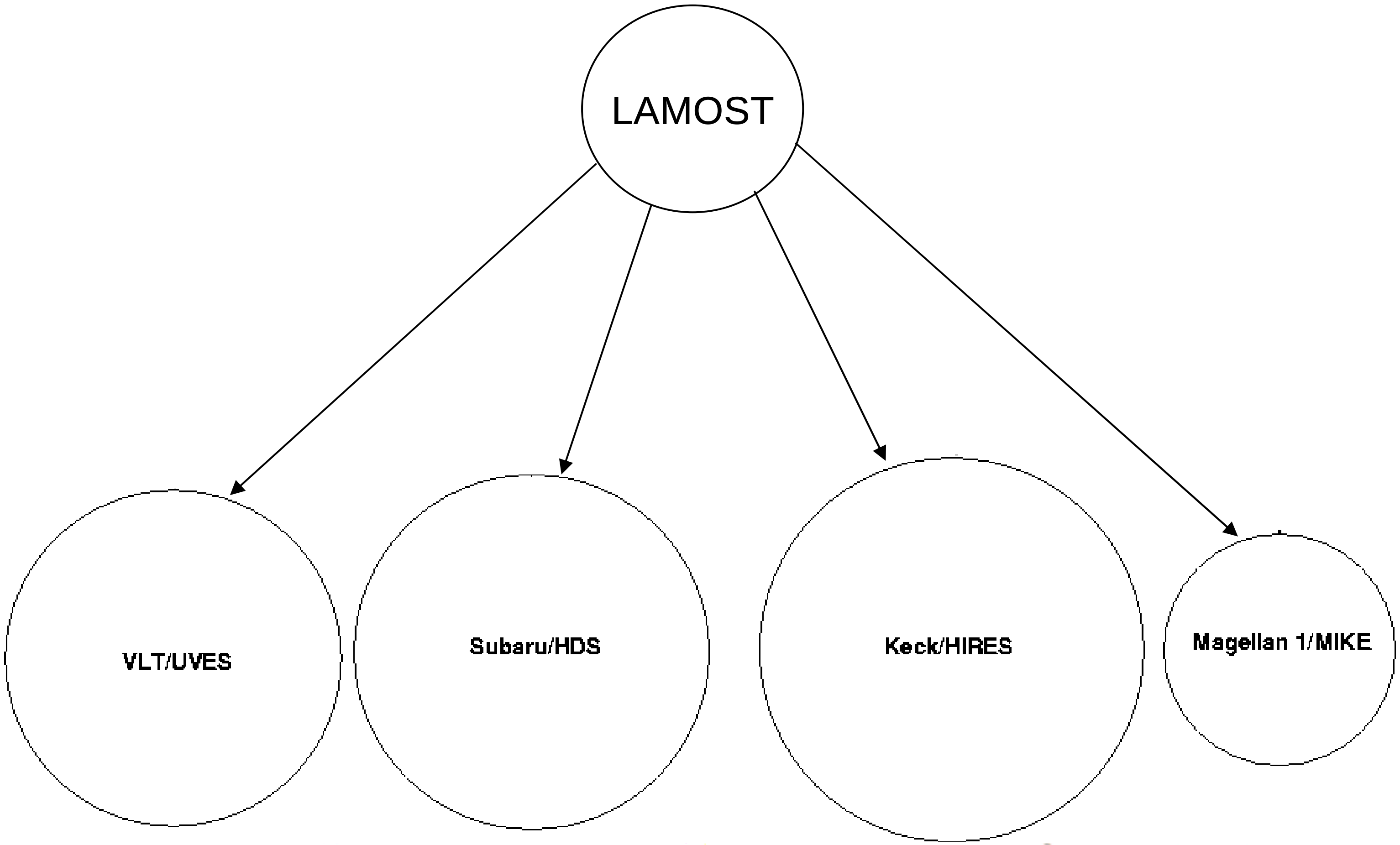
Low-resolution mode

	Blue Arm		Red Arm	
	R	Wave. range (nm)	R	Wave. range (nm)
Full slit	1000	370-590	1000	570-900
1/2 slit	2000	370-590	2000	570-900

Medium-resolution mode

	Blue Arm		Red Arm	
	R	Wave. range (nm)	R	Wave. range (nm)
Full slit	5000	510-550	5000	830-890
1/2 slit	10000	510-550	10000	830-890

The LAMOST survey for metal-poor stars



EMP and HMP stars expected to be found

Survey	Effective sky coverage	Effective mag limit	$N < -3.0$	$N < -5.0$
HES	6400 deg^2	$B < 16.5$	200	2
SEGUE	1000 deg^2	$B < 19$	1000	10
LAMOST	10,000 deg^2	$B < 19$	10,000	100
SSS	20,000 deg^2	$B < 18$	5000	50

- Number of stars to be found in SEGUE will mainly be limited by number of fibers allocated for follow-up. Only about 10% of all candidates down to $B = 19$ can be observed.
- SSS follow-up will be done with SSO 2.3m + WiFeS, hence follow-up will not be obtained for the faintest stars. See talk of Stefan Keller for details on SSS.
- The above estimates are at best accurate to within a factor of 2.

Summary / conclusions

- A new, more robust estimate of the iron abundance of HE 0107–5240, based on Fe II lines, yields $[Fe/H]_{3D} = -5.7$.
- The absence of neutron-capture elements is confirmed by tighter upper limits derived from the UV spectrum of HE 0107–5240.
- Weak odd-even effect is seen, as in other extremely metal-poor stars (see e.g. Cayrel et al. First Stars sample).
- Up to now, there are no indications for a radial velocity variation of HE 0107–5240. Further monitoring over a much longer period of time is needed (VLT/UVES proposal for P80 submitted).
- Upcoming deeper surveys for metal-poor stars:
  - LAMOST
  - Southern Sky Survey (SSS)
- It is expected that in these surveys significant numbers of new stars with $[Fe/H] < -5.0$ will be found in the next few years.