STARLib – A JINA Stellar Abundance Database

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Outline of Presentation

- Motivation
  - Why is a stellar abundance database needed?
- Examples of Where the Field is Going
  - HERES
  - SDSS-II (SEGUE)
- Philosophy
  - What should such a database DO for the astronomer ?
  - What should such a database DO for the nuclear astro-physicist ?
- Execution
  - How is STARlib implemented ?
  - How is STARlib maintained ?
- Future
  - What additional information is needed ?
  - The transition to full spectral archiving

Motivation

- The abundances of elements in stars, in particular stars of the halo population of the Milky Way, provide fundamental constraints on the astrophysical origins of the elements
- In the past few years, availability of large-aperture telescopes equipped with high efficiency spectrographs has led to an explosion of available elemental abundance information for stars of interest to astronomers and nuclear astrophysicists alike
- Development and refinement of analysis codes (some of which are automated) has made elemental abundance analysis techniques widely available
- However, derivation of useful information from stellar spectra remains, by and large, in the realm of the specialist

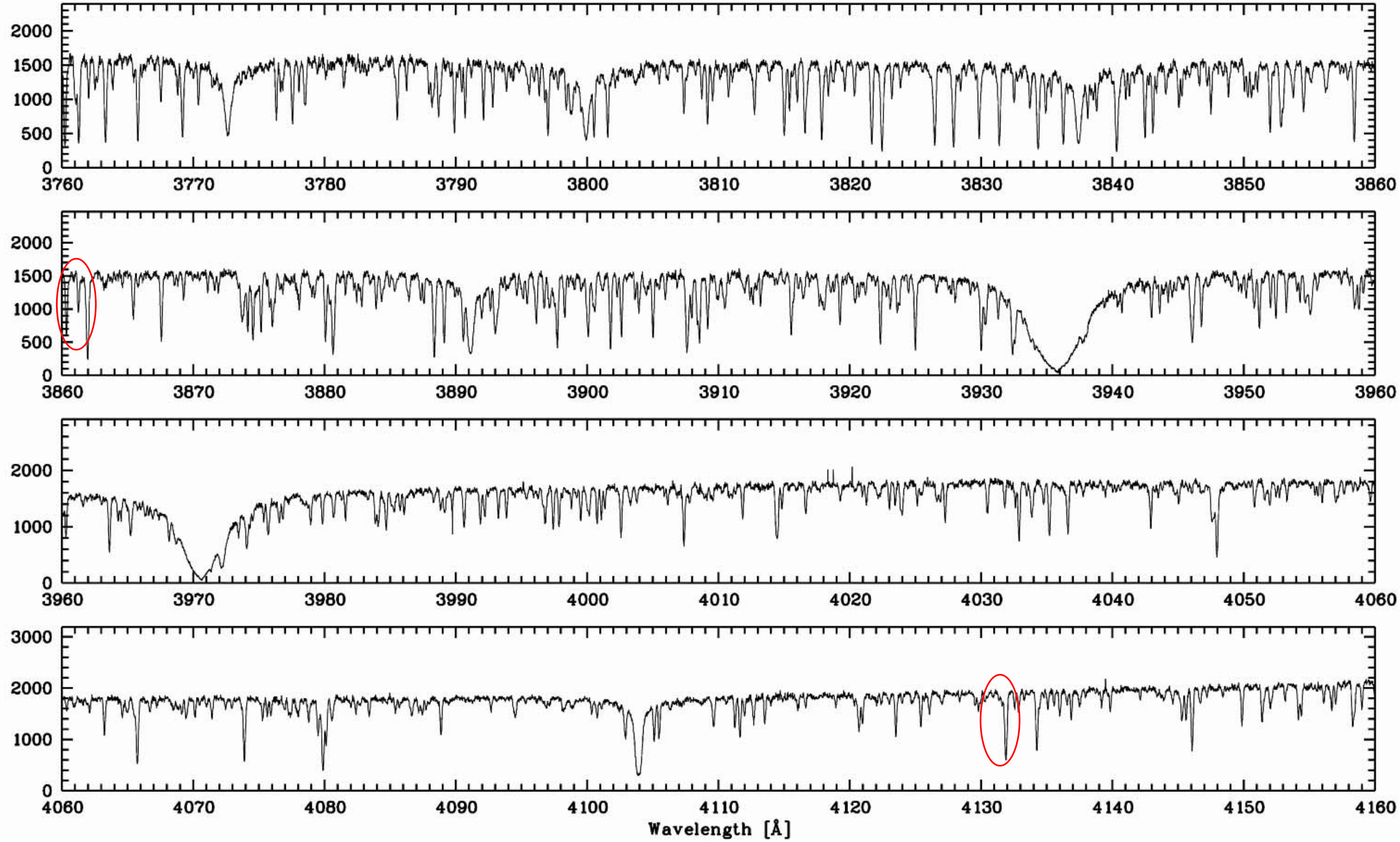
Motivation (cont…)

- Astronomers do not measure elemental abundances, they are inferred based on:
  - Observed stellar spectra
  - Estimation of parameters (temperature, surface gravity, average metal content) of a given stellar atmosphere
  - Adoption of a theoretical model atmosphere
  - Adoption of a set of lines for each elemental species
  - Knowledge (?) of atomic physics (oscillator strengths) and reference abundances (solar)
  - Comparison of measured line strengths and/or line synthesis with that predicted by integration of flux through the model atmosphere

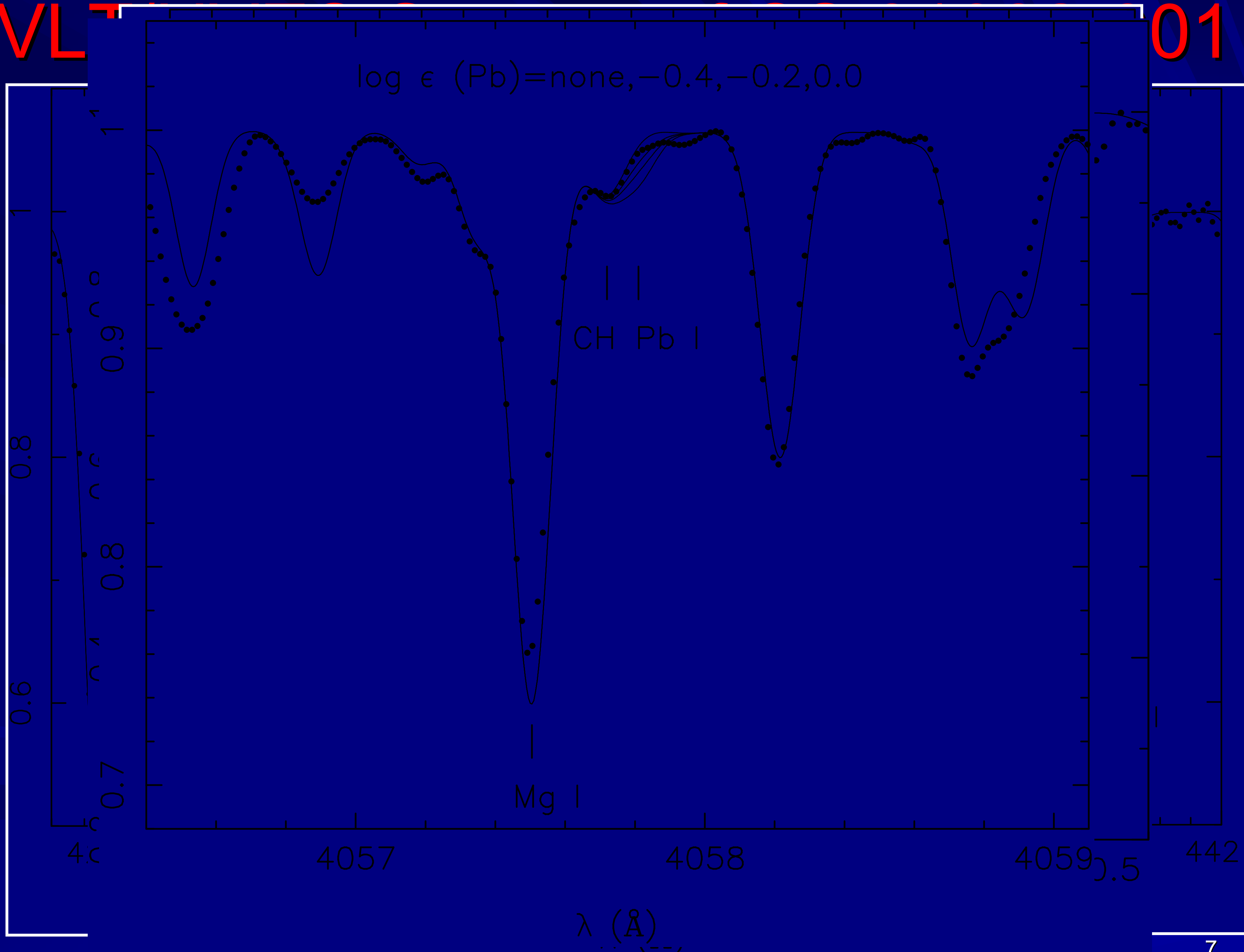
Motivation (cont…)

- Due to multiple assumptions, and ever-changing techniques employed
  - Derived elemental abundances (even for a given star) can vary, in some cases dramatically, from astronomer to astronomer, even when using the same input spectral data
  - The non-specialist is often unable to make an informed decision as to the “best available” abundances for a star, or set of stars
  - Assembly of required information is, at best, tedious, even for the specialist

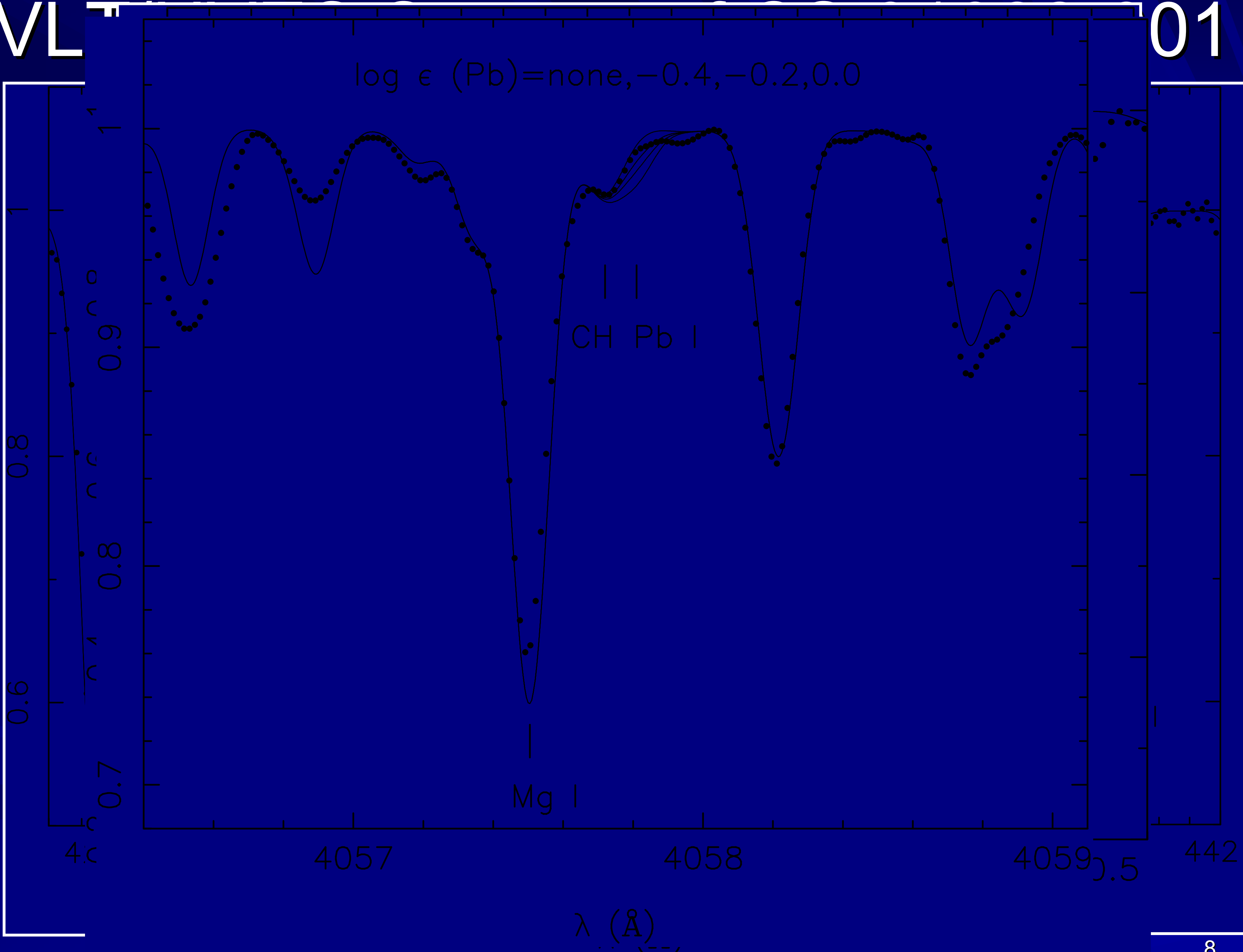
An Example: CS 31082-001



VLT 01



VL… 01



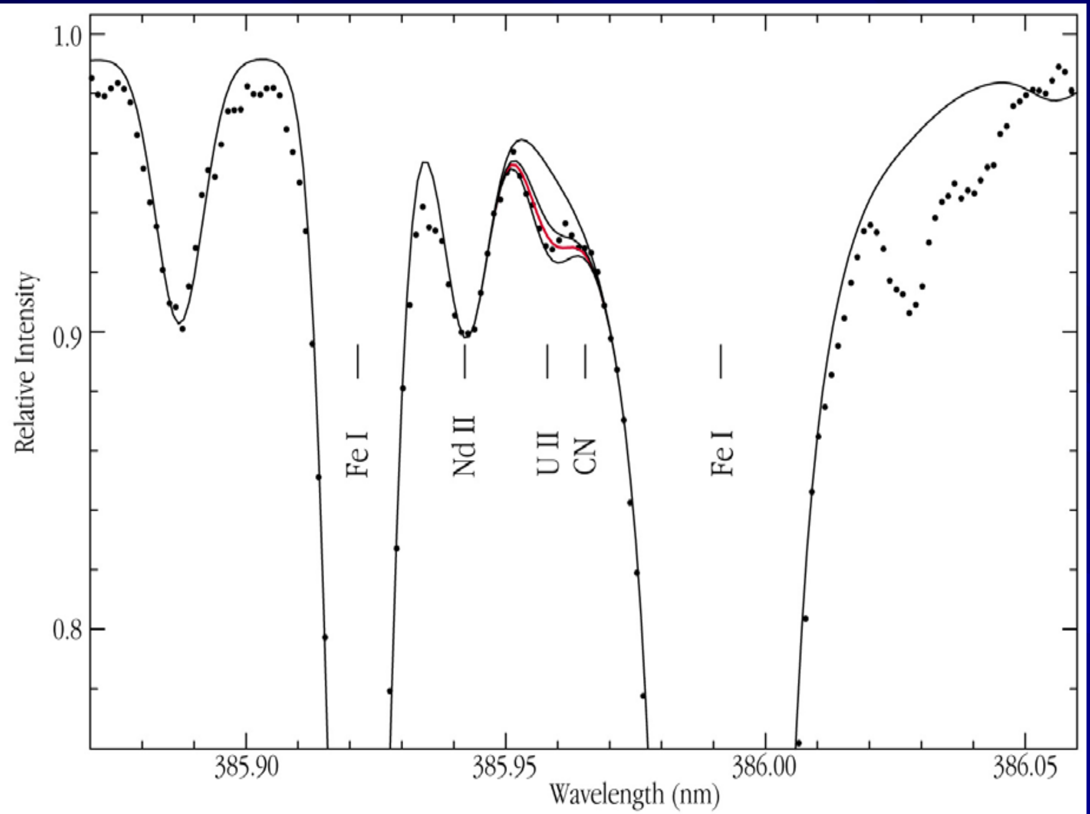
log ϵ (Pb)=none,−0.4,−0.2,0.0
CH
Pb I
Mg I
1
0.9
0.8
0.7
0.8
0.6
4057
4058
4059
4421
λ (Å)

Atomic Physics / Equivalent Widths

λ (Å)	Exc. Pot. (eV)	log gf	Ref.	W (mÅ)	log ϵ
Ba II					
3891.776	2.51	0.280	6	syn	0.15
4130.645	2.72	0.560	6	syn	0.20
4554.029	0.00	0.170	6	syn	0.40
4934.076	0.00	−0.150	6	syn	0.60
5853.668	0.60	−1.010	6	syn	0.50
6141.713	0.70	−0.070	6	syn	0.40
La II					
3849.006	0.00	−0.450	7[a]	syn	−0.60
4086.709	0.00	−0.070	7[b]	syn	−0.55
4123.218	0.32	0.130	7[b]	syn	−0.65
5122.988	0.32	−0.850	7[b]	syn	−0.58
6320.376	0.17	−1.520	7[b]	7.0	−0.61
Ce II					
4073.474	0.48	0.320	8	26.3	−0.45
4083.222	0.70	0.240	8	21.0	−0.24
4120.827	0.32	−0.240	8	16.0	−0.37
4127.364	0.68	0.240	8	21.0	−0.27
4222.597	0.12	−0.180	1	33.0	−0.25
4418.780	0.86	0.310	8	14.0	−0.38
4486.909	0.30	−0.360	1	22.0	−0.14
4562.359	0.48	0.330	1	31.0	−0.41
4628.161	0.52	0.260	1	26.6	−0.40
Pr II					
3964.262	0.22	−0.400	8	syn	−0.80
3964.812	0.05	0.090	9	28.0	−0.99
3965.253	0.20	−0.130	9	18.0	−0.84
4062.805	0.42	0.330	10	37.0	−0.70
5220.108	0.80	0.170	9	7.3	−1.01
5259.728	0.63	−0.070	9	8.1	−0.93
Nd II					
3973.260	0.63	0.430	11	syn	−0.17
4018.823	0.06	−0.880	12	19.0	−0.20
4021.327	0.32	−0.170	13	35.0	−0.22
4061.080	0.47	0.300	11	62.0	0.07
4069.265	0.06	−0.400	13	34.4	−0.32
4109.448	0.32	0.180	11	syn	0.15
4232.374	0.06	−0.350	13	34.5	−0.39
4446.384	0.20	−0.630	12	35.0	0.04
4462.979	0.56	−0.070	11	38.0	−0.03
5130.586	1.30	0.100	11	13.3	−0.00
5212.361	0.20	−0.700	13	14.6	−0.48
5234.194	0.55	−0.460	12	16.0	−0.25
5249.576	0.98	0.080	14	20.0	−0.16
5293.163	0.82	−0.200	14	21.3	−0.04
5311.453	0.99	−0.560	14	5.4	−0.16
5319.815	0.55	−0.350	14	27.7	−0.06
5361.467	0.68	−0.400	13	12.6	−0.29
5442.264	0.68	−0.900	13	4.2	−0.31
Sm II					
3793.978	0.10	−0.500	15	19.0	−0.71
3896.972	0.04	−0.580	15	21.0	−0.66
4023.222	0.04	−0.830	15	16.0	−0.57
4068.324	0.43	−0.710	15	7.0	−0.65
4318.927	0.28	−0.270	15	33.0	−0.45
4499.475	0.25	−1.010	15	13.0	−0.30
4519.630	0.54	−0.430	15	18.0	−0.37
4537.941	0.48	−0.230	15	16.0	−0.71
4577.688	0.25	−0.770	15	18.0	−0.38

λ (Å)	Exc. Pot. (eV)	log gf	Ref.	W (mÅ)	log ϵ
Eu II					
3724.931	0.00	−0.090	16[b]	syn	−0.59
3930.499	0.21	0.270	16[b]	syn	−0.78
3971.972	0.21	0.270	16[b]	syn	−0.84
4129.725	0.00	0.220	16[b]	syn	−0.77
4205.042	0.00	0.210	16[b]	syn	−0.66
4435.578	0.21	−0.110	16[b]	syn	−0.76
4522.581	0.21	−0.670	16[b]	syn	−0.91
6437.640	1.32	−0.320	16[b]	syn	−0.88
6645.064	1.38	0.120	16[b]	3.0	−0.72
Gd II					
3768.396	0.08	0.250	17	61.0	−0.33
3796.384	0.03	0.030	18	63.0	−0.13
3836.915	0.49	−0.320	4[a]	19.0	−0.27
3844.578	0.14	−0.510	17	30.0	−0.22
3916.509	0.60	0.060	17	22.0	−0.45
4037.893	0.73	0.070	18	15.0	−0.53
4085.558	0.56	−0.230	18	17.0	−0.37
4130.366	0.73	0.140	18[a]	25.0	−0.32
4191.075	0.43	−0.680	17	18.0	−0.06
Tb II					
3658.886	0.13	−0.010	19[b]	12.5	−1.27
3702.853	0.13	0.440	19[b]	33.0	−1.19
3848.734	0.00	0.280	19[b]	38.0	−1.34
3874.168	0.00	0.270	19[b]	29.0	−1.19
3899.188	0.37	0.330	19[b]	17.0	−1.23
4002.566	0.64	0.100	19[b]	4.0	−1.38
4005.467	0.13	−0.020	19[b]	17.3	−1.23
Dy II					
3869.864	0.00	−0.940	20	29.3	−0.21
3996.689	0.59	−0.190	20	32.6	−0.20
4011.285	0.93	−0.630	20	5.5	−0.32
4103.306	0.10	−0.370	20	61.2	−0.01
4468.138	0.10	−1.500	20	8.5	−0.27
5169.688	0.10	−1.660	20	5.5	−0.38
Er II					
3692.649	0.05	0.138	21	syn	−0.25
3786.836	0.00	−0.640	21	46.0	−0.26
3830.482	0.00	−0.360	21	58.5	−0.26
3896.234	0.05	−0.240	22	64.0	−0.19
3938.626	0.00	−0.520	8	38.0	−0.40
Tm II					
3700.256	0.03	−0.290	8	25.0	−1.28
3761.333	0.00	−0.250	8	syn	−1.10
3795.760	0.03	−0.170	8	28.0	−1.34
3848.020	0.00	−0.520	8	syn	−1.25
Hf II					
3399.793	0.00	−0.490	23	syn	−0.50
3719.276	0.61	−0.870	8	syn	−0.70
Os I					
4135.775	0.52	−1.260	8	9.0+syn	0.52
4260.848	0.00	−1.440	8	12.0+syn	0.21
4420.468	0.00	−1.530	24	syn	0.50
Ir I					
3513.648	0.00	−1.260	4[a]	34.0+syn	0.20
3800.120	0.00	−1.450	4[a]	syn	0.20
Pb I					
4057.807	1.32	−0.170	25[a]	syn	<-0.2

Abundances



Uranium Line in the Spectrum of the Old Star CS 31082-001
(VLT KUEYEN + UVES)

ESO PR Photo 05b/01 (7 February 2001)

Table 5. Neutron-capture-element abundances in CS 31082-001

El.	Z	log ϵ(X)	σ	Δ log ϵ (X/Th)	N_{lines}	[X/Fe]
Sr	38	0.72	0.03	0.08	3	+0.65
Y	39	−0.23	0.07	0.06	9	+0.43
Zr	40	0.43	0.15	0.09	5	+0.73
Nb	41	−0.55		0.15	1	+0.93
Ru	44	0.36	0.10	0.14	5	+1.42
Rh	45	−0.42	0.03	0.13	3	+1.36
Pd	46	−0.05	0.10	0.15	3	+1.16
Ag	47	−0.81	0.17	0.22	2	+1.15
Ba	56	0.40	0.17	0.11	6	+1.17
La	57	−0.60	0.04	0.06	5	+1.13
Ce	58	−0.31	0.10	0.04	9	+1.01
Pr	59	−0.86	0.12	0.06	6	+1.33
Nd	60	−0.13	0.17	0.05	18	+1.27
Sm	62	−0.51	0.16	0.06	9	+1.38
Eu	63	−0.76	0.11	0.05	9	+1.63
Gd	64	−0.27	0.15	0.06	9	+1.51
Tb	65	−1.26	0.07	0.04	7	+1.74
Dy	66	−0.21	0.13	0.07	6	+1.55
Er	68	−0.27	0.08	0.09	5	+1.70
Tm	69	−1.24	0.10	0.08	4	+1.66
Hf	72	−0.59		0.17	2	+1.43
Os	76	0.43	0.17	0.16	3	+1.30
Ir	77	0.20		0.11	2	+1.75
Pb	82	< −0.2:			1	
Th	90	−0.98	0.05	0.11	8	+1.83
U	92	−1.92		0.11	1	+1.49

Nature Paper

Measurement of stellar age from uranium decay

R. Cayrel[1], V. Hill[2], T. C. Beers[3], B. Barbuy[4], M. Spite[5], F. Spite[5], B. Plez[6], J. Andersen[7], P. Bonifacio[8], P. François[9], P. Molaro[8], B. Nordström[7,10] & F. Primas[2]

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[2] *European Southern Observatory, D 85748 Garching b. München, Germany*
[3] *Michigan State University, East Lansing, Michigan 48824, USA*
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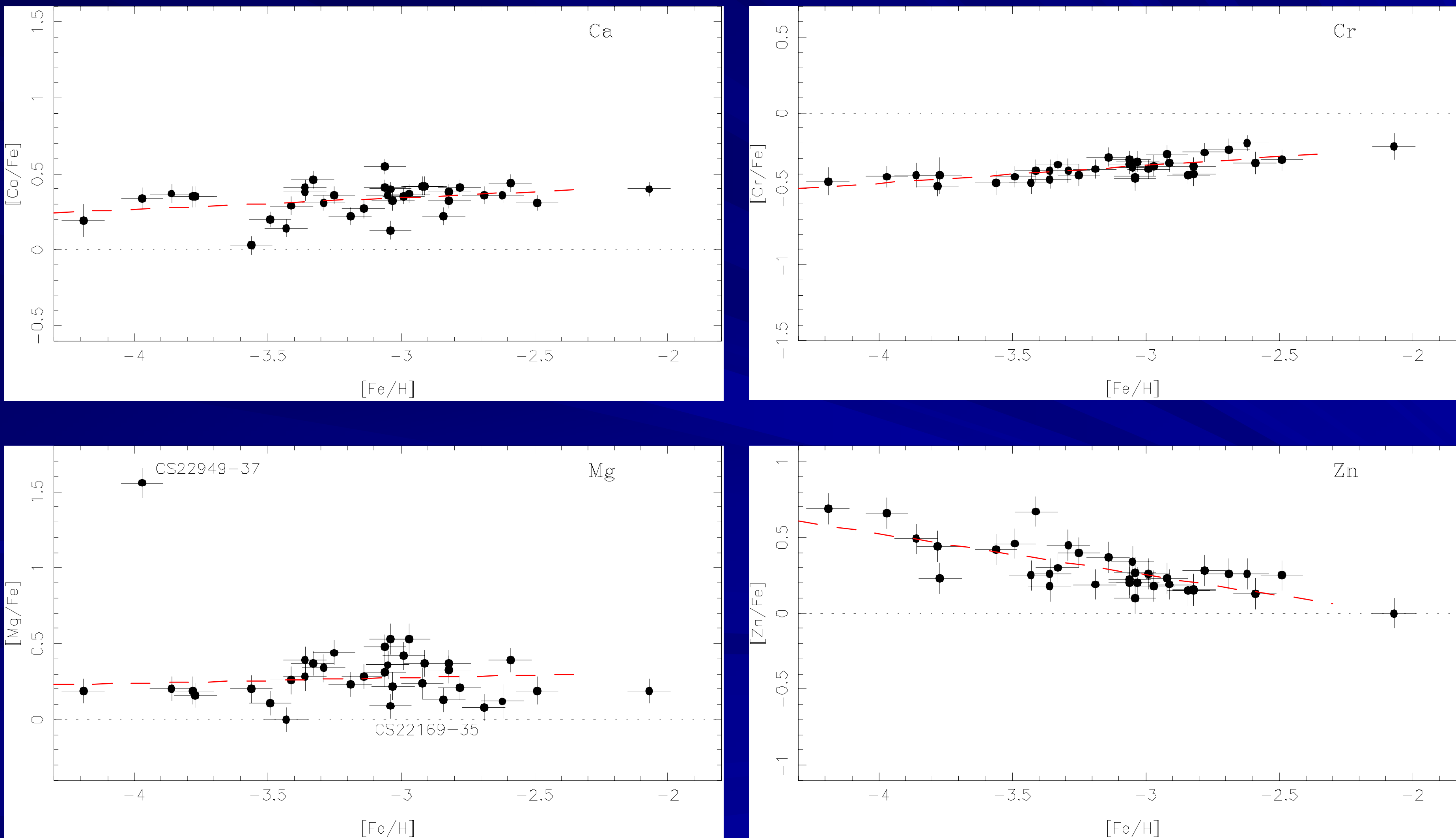
[8] *Osservatorio Astronomico di Trieste, I-34131 Trieste, Italy*
[9] *European Southern Observatory, Casilla 19001, Santiago 19, Chile*
[10] *Lund Observatory, Lund University, S 22100 Lund, Sweden*

The ages of the oldest stars in the Galaxy indicate when star formation began, and provide a minimum age for the Universe. Radioactive dating of meteoritic material[1] and stars[2] relies on comparing the present abundance ratios of radioactive and stable nuclear species to the theoretically predicted ratios of their production. The radioisotope ^{232}Th (half-life 14 Gyr) has been used to date Galactic stars[2–4], but it decays by only a factor of two over the lifetime of the Universe. ^{238}U (half-life 4.5 Gyr) is in principle a more precise age indicator, but even its strongest spectral line, from singly ionized uranium at a wavelength of 385.957 nm, has previously not been detected in stars[4–7]. Here we report a measurement of this line in the very metal-poor star CS31082-0018, a star which is strongly overabundant in its heavy elements. The derived uranium abundance, $\log(U/H) = -13.7 \pm 0.14 \pm 0.12$ yields an age of 12.5 ± 3 Gyr, though this is still model dependent. The observation of this cosmochronometer gives the most direct age determination of the Galaxy. Also, with improved theoretical and laboratory data, it will provide a highly precise lower limit to the age of the Universe.

Other Examples of Low Metallicity Trends (alpha and iron-peak elements)

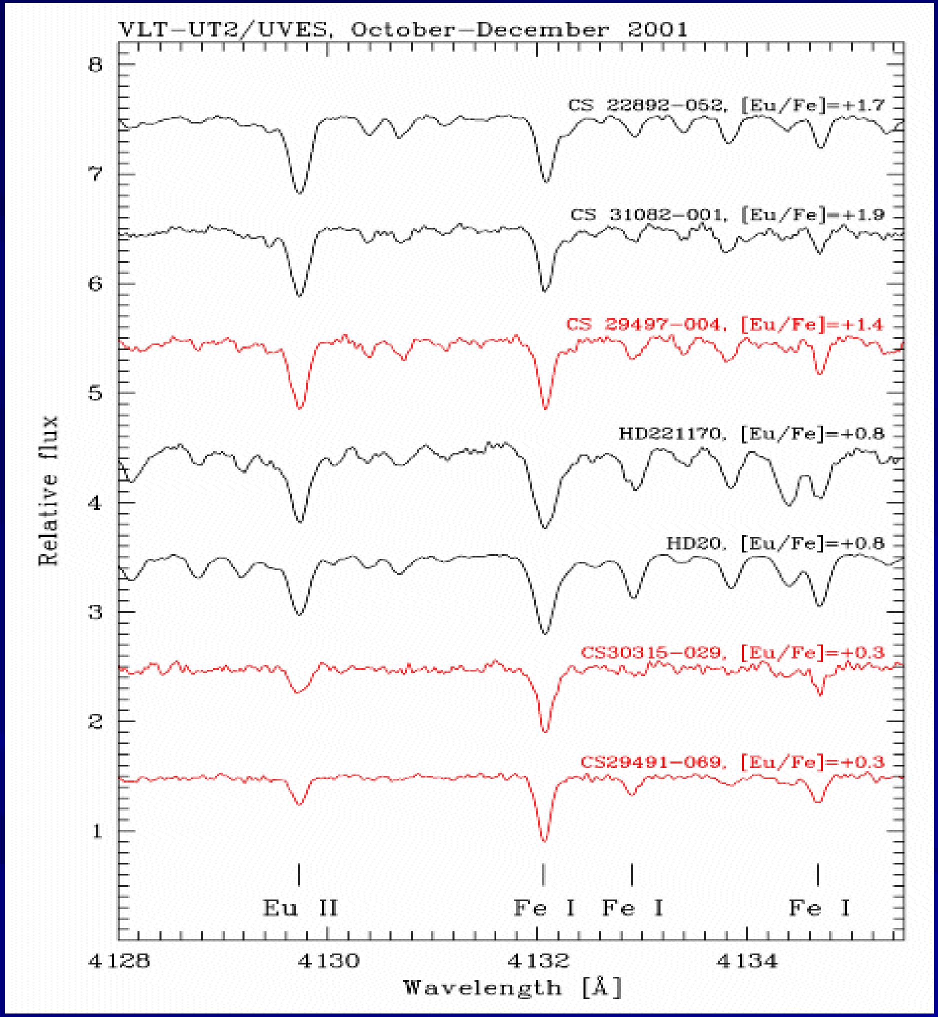


Another Example -- HERES

- The Hamburg/ESO R-Process Enhanced Star survey (HERES) has obtained high-resolution (R ~ 20,000), moderate S/N (30/-1 to 50/1) spectra of ~ 380 candidate [Fe/H] < -2.0 stars from the HES (Christlieb et al. 2004; Barklem et al. 2005)

- This is represents a one order of magnitude increase in numbers of low-metallicity stars with available high-resolution spectroscopic data (e.g., Cayrel et al. 2004 "First Stars" series)

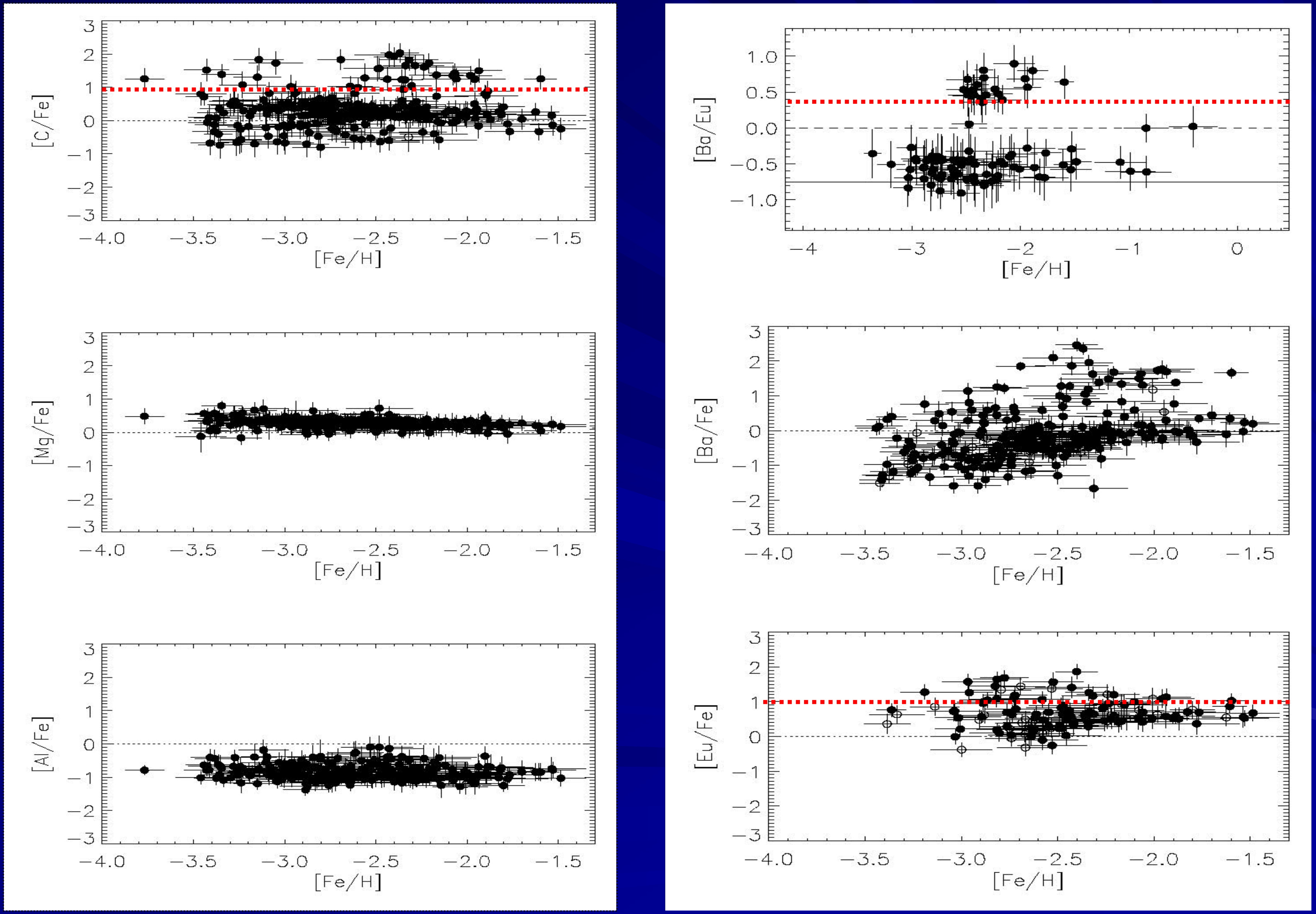
HERES Eu Survey Spectra and Results to Date



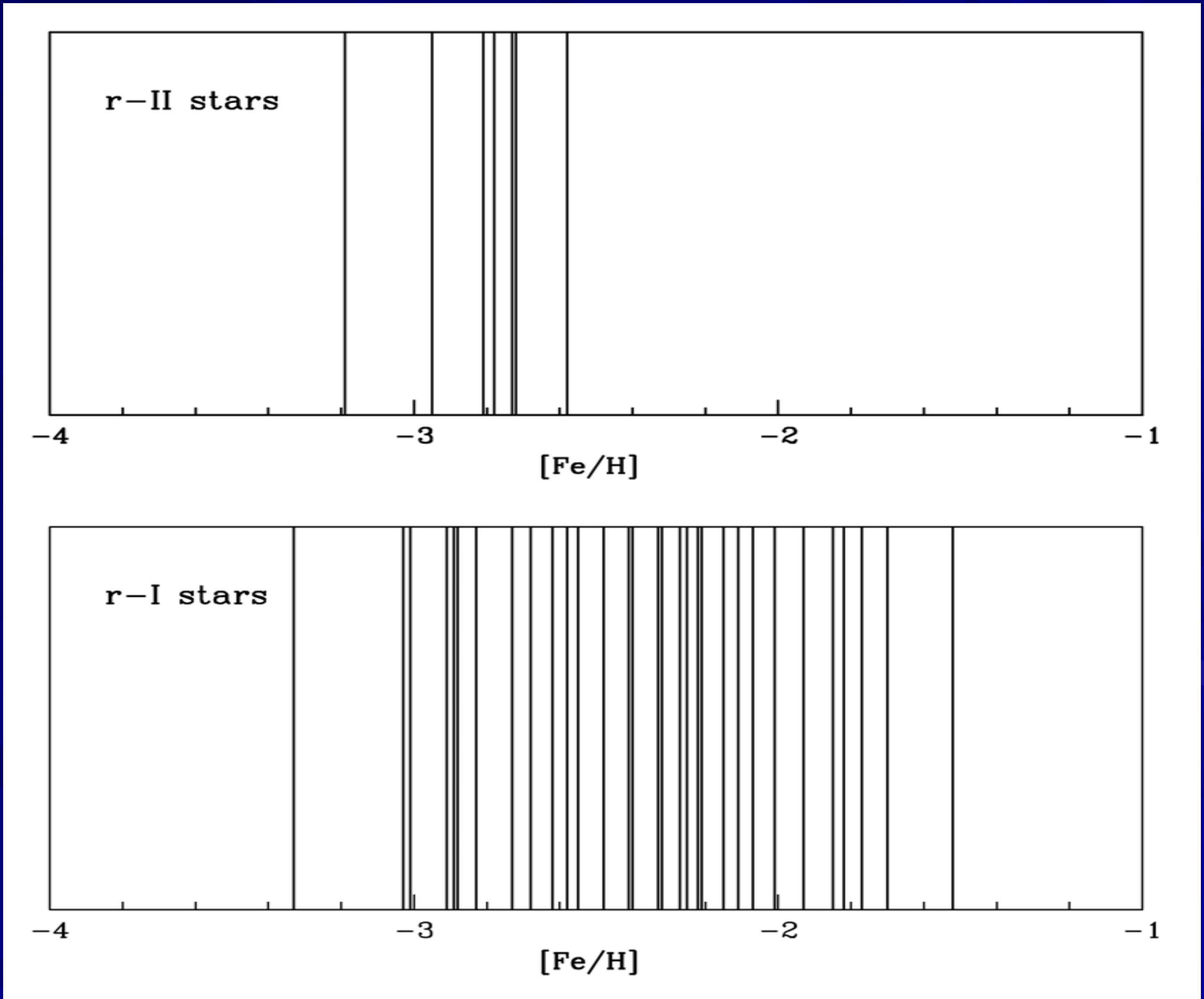
- HERES is based on “snapshot” high-resolution spectroscopy
- Neutron-capture-enhanced stars indicated by presence of Eu 4129
- 8 new r-II stars with [r/Fe] ≥ +1.0
- 35 new r-I stars with [r/Fe] ~ + 0.5

The apparent frequency of r-II stars is ~ 5 % of giants with [Fe/H] < -2.5

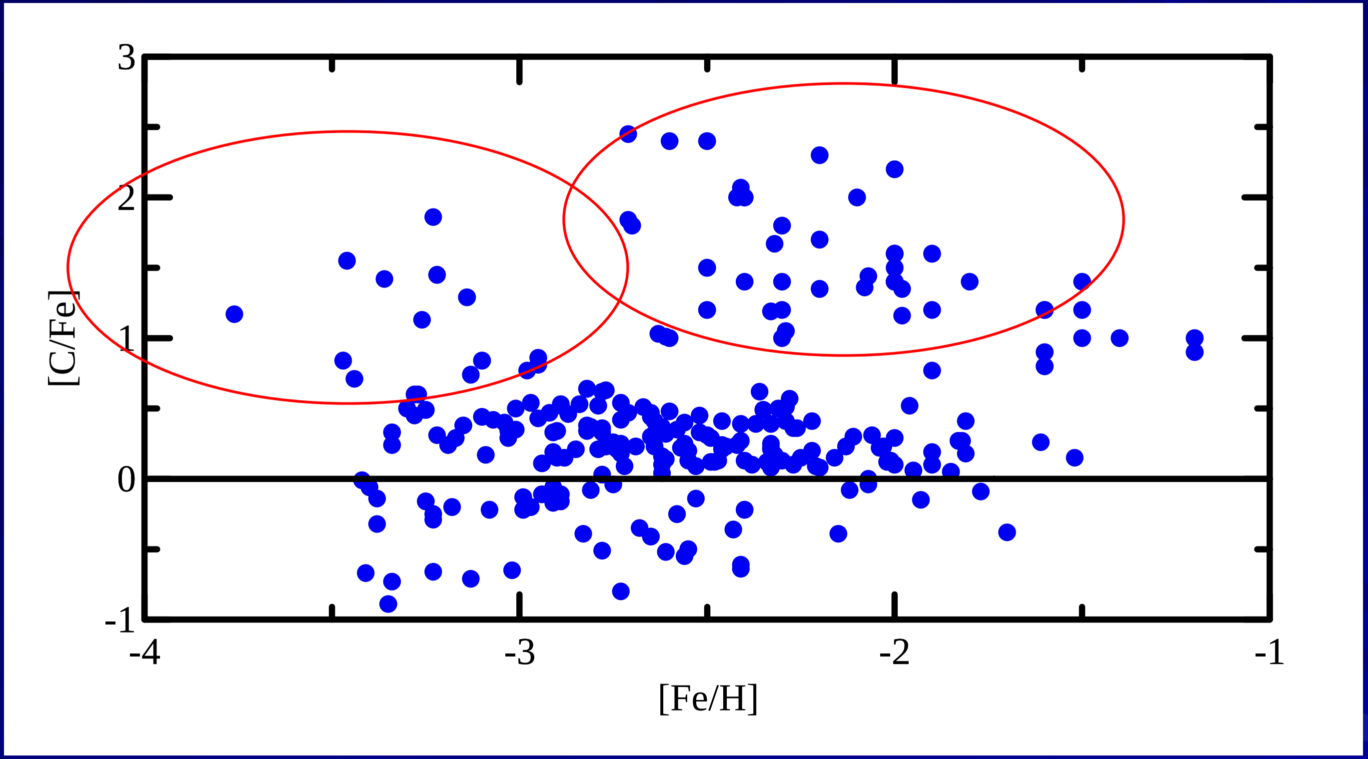
The Power Of Large N: 274 Stars from HERES



Distribution of [Fe/H] for R-process Enhanced Stars from HERES

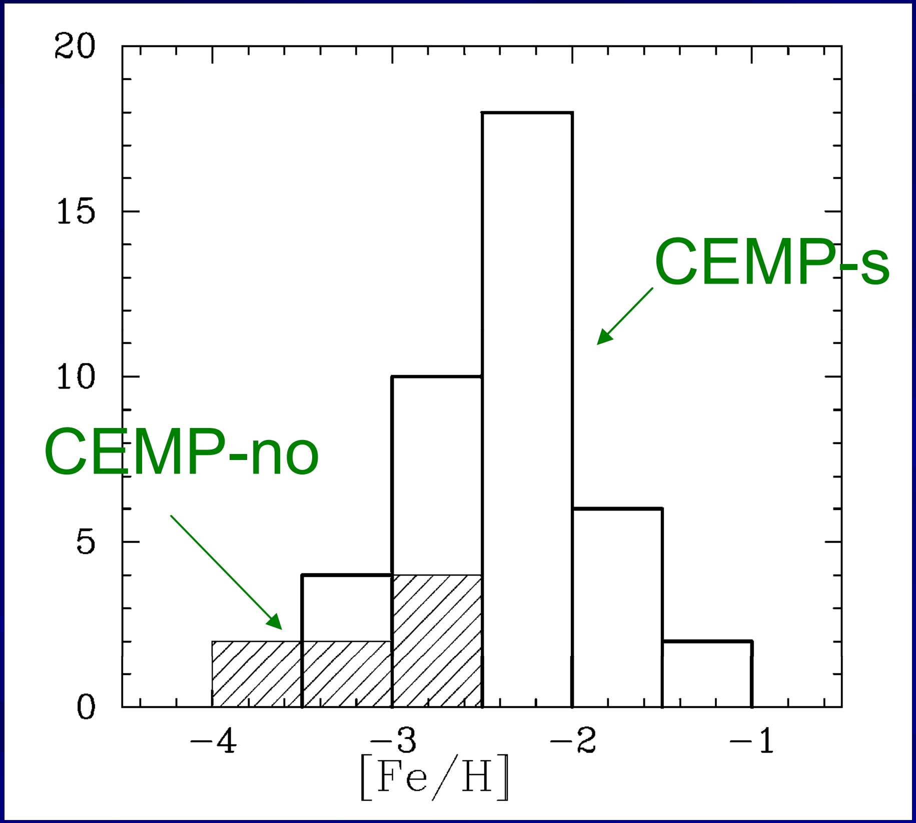


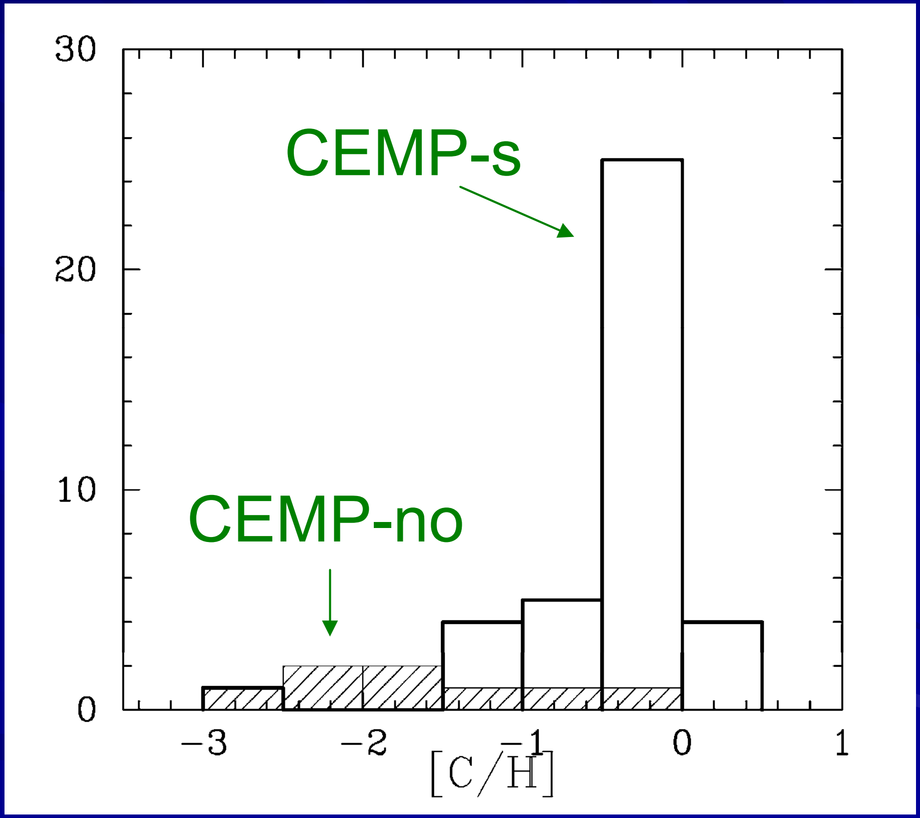
[C/Fe] vs. [Fe/H] – 252 HERES Stars



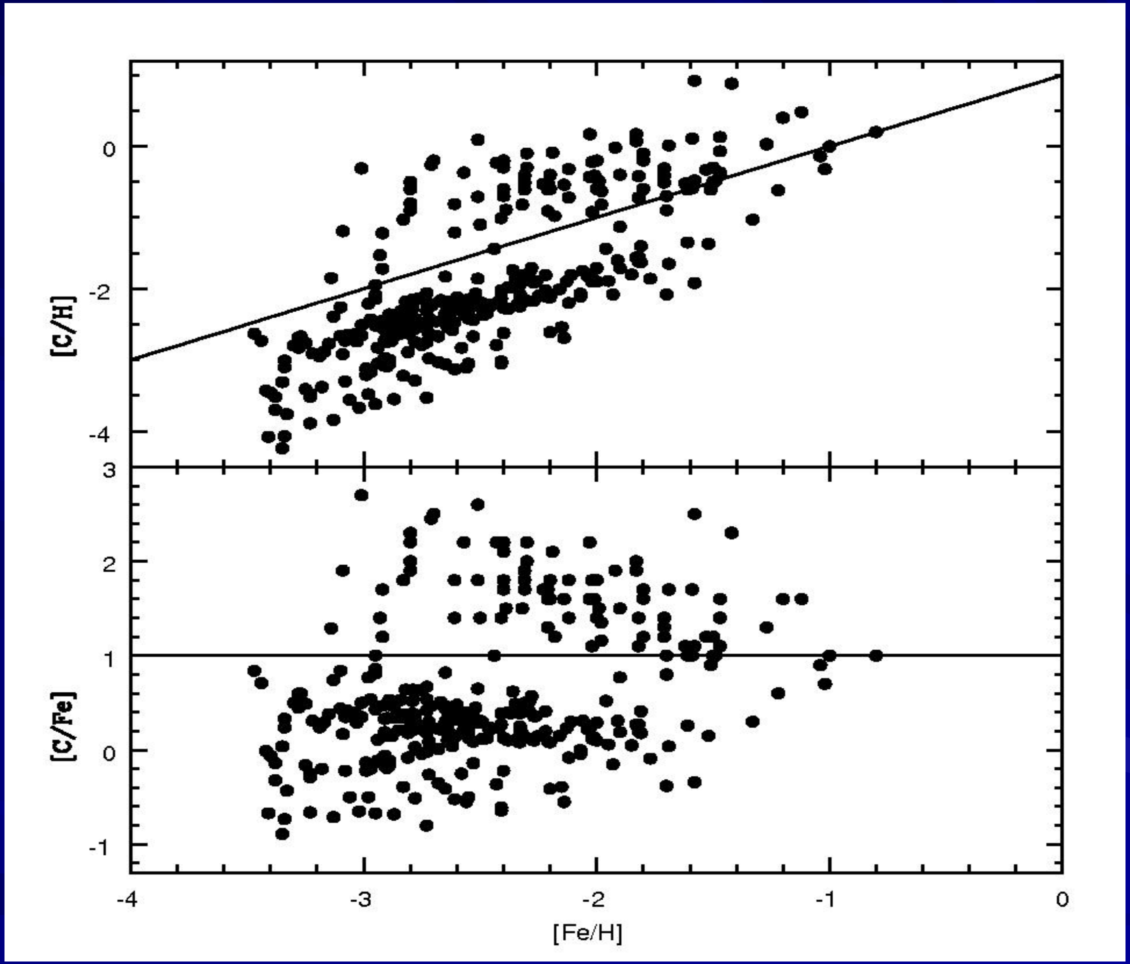
Note: Likelihood of two possible regimes of CEMP stars – higher [Fe/H] and lower [Fe/H] – different production sites / mechanisms ?

Differences in [Fe/H] Distribution CEMP-s vs. CEMP-no (Aoki et al. 2006)



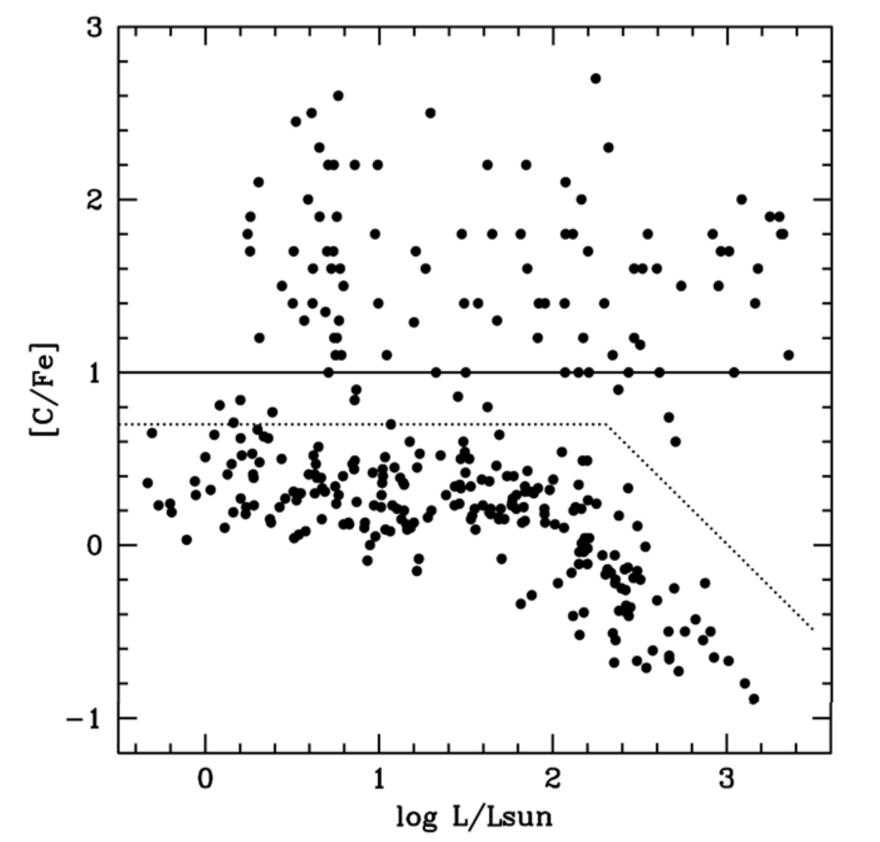


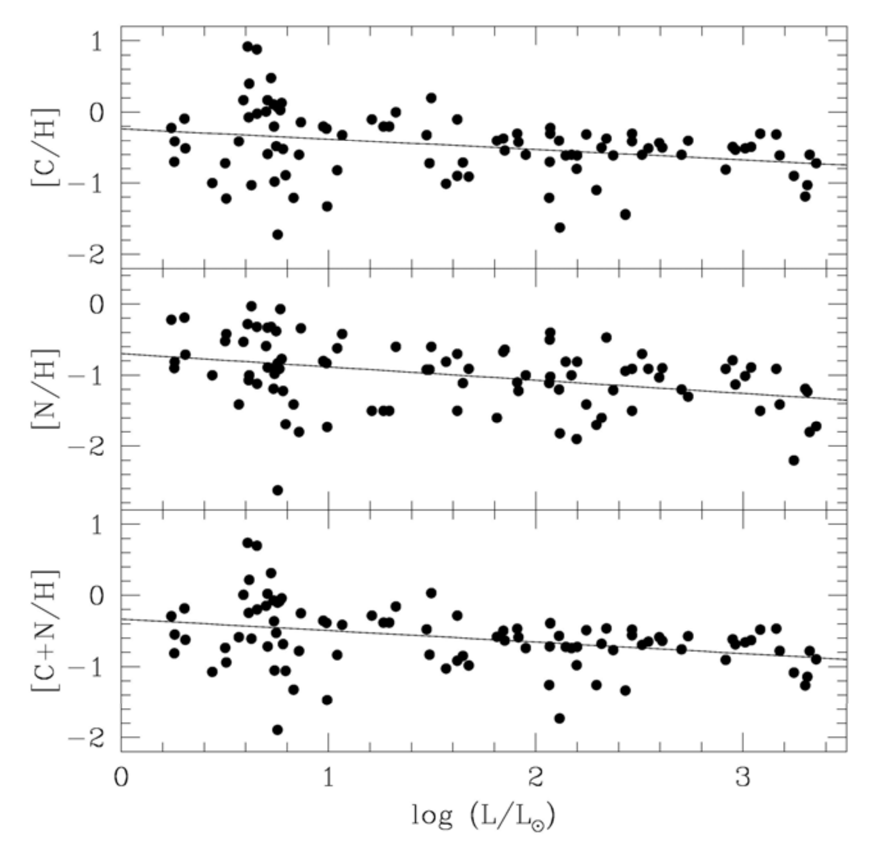
New Results for the HERES Sample (Lucatello et al. 2006) Includes Carbon Abundances for 75 Stars not Analyzed by Barklem et al.



Note, while upper envelope of [C/H] is approximately constant, the upper envelope of [C/Fe] increases with declining [Fe/H].

Additional Results from Lucatello et al.





On the left, two different definitions of CEMP stars. One from Beers & Christlieb (2005), the other from Aoki et al. (2006). On the right, there appears to be a dilution of the outer envelope.

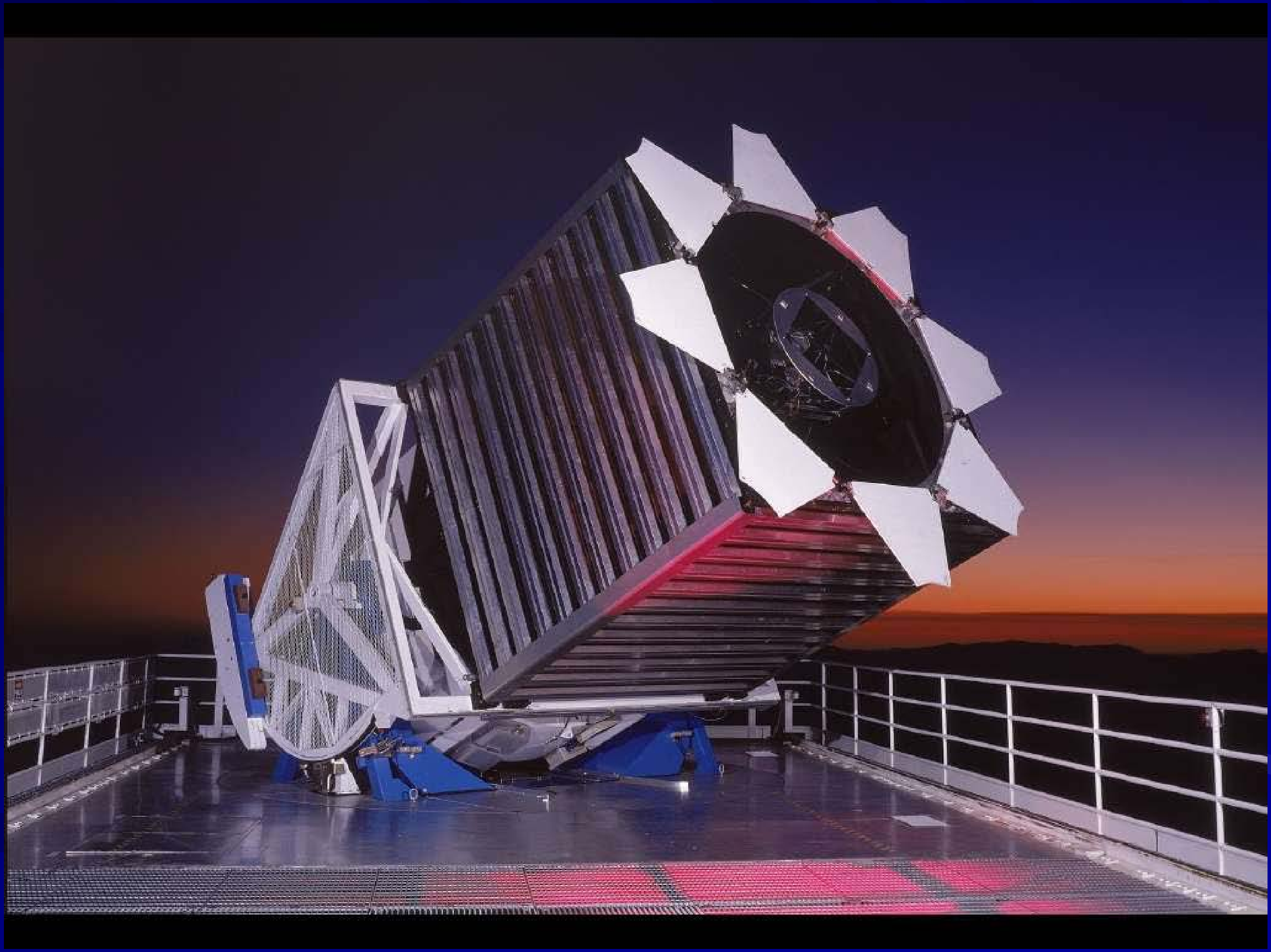
Frequencies of CEMP Stars Based on the Lucatello et al. Analysis

- When adopting the definition of CEMP from Beers & Christlieb ([C/Fe] > +1.0)
  - f (CEMP) < -2.0 = 20 ± 2 %
- When adopting the definition of CEMP from Aoki et al. (2006)
  - f (CEMP) < -2.0 = 23 ± 2 %
- Note that neither definition adequately takes into account "evolutionary dilution", which would drive fraction up further still
- A better sample would be comprised of stars that are sufficiently unevolved to not suffer from evolutionary effects

The Sloan Digital Sky Survey

- The most ambitious astronomy project ever undertaken
  - Obtain accurately calibrated imaging of 10,000 square degrees of (northern) sky, in five filters (*ugriz*)
  - Obtain medium-resolution spectroscopy for
    - 1,000,000 galaxies
    - 100,000 quasars
- Has been fully operational since ~ Jan 1999
- Completed its primary imaging mission in July 2005

SDSS -- The Telescope and Data

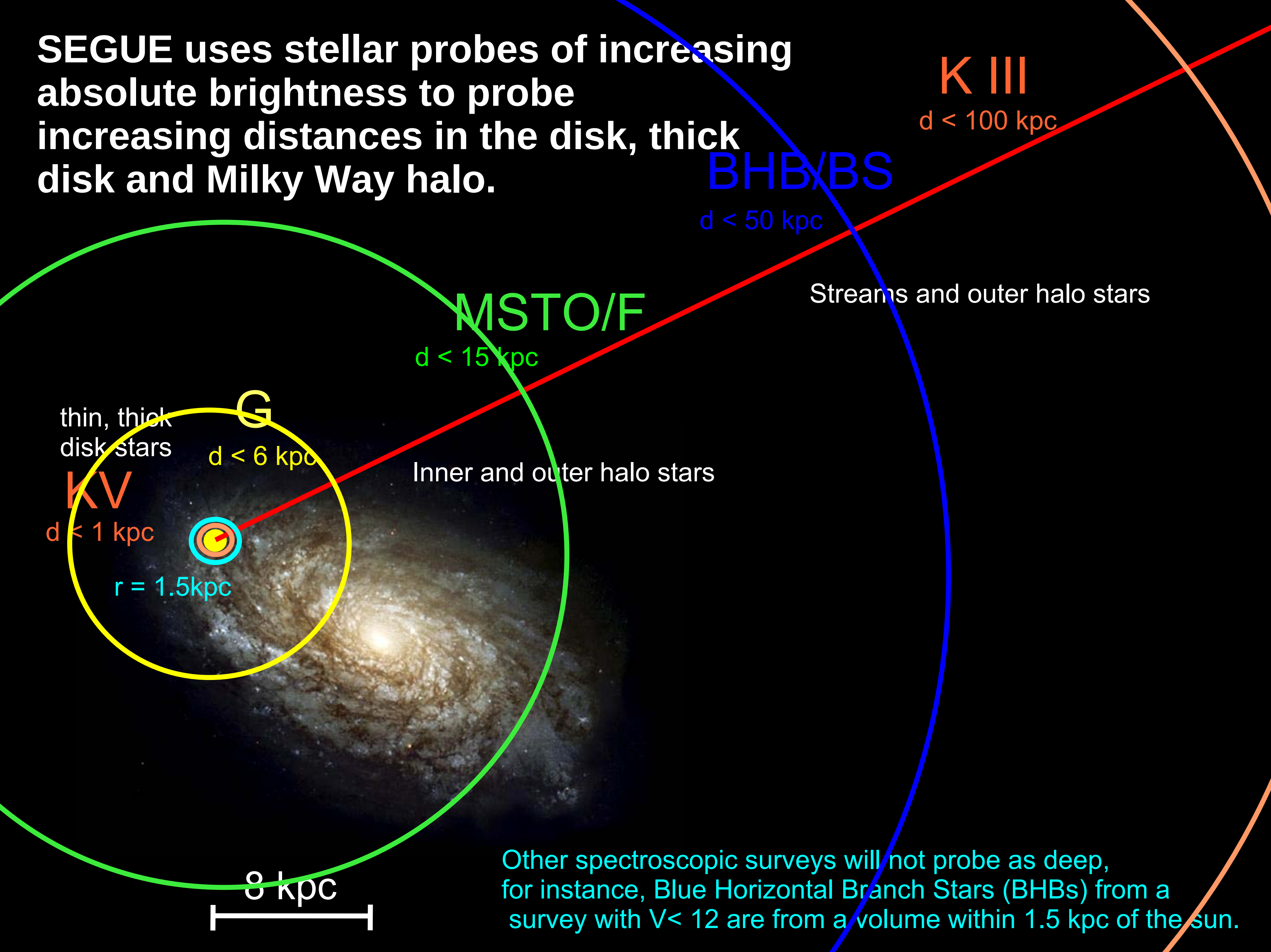


ARC 2.5m SDSS Telescope (3 deg FOV)

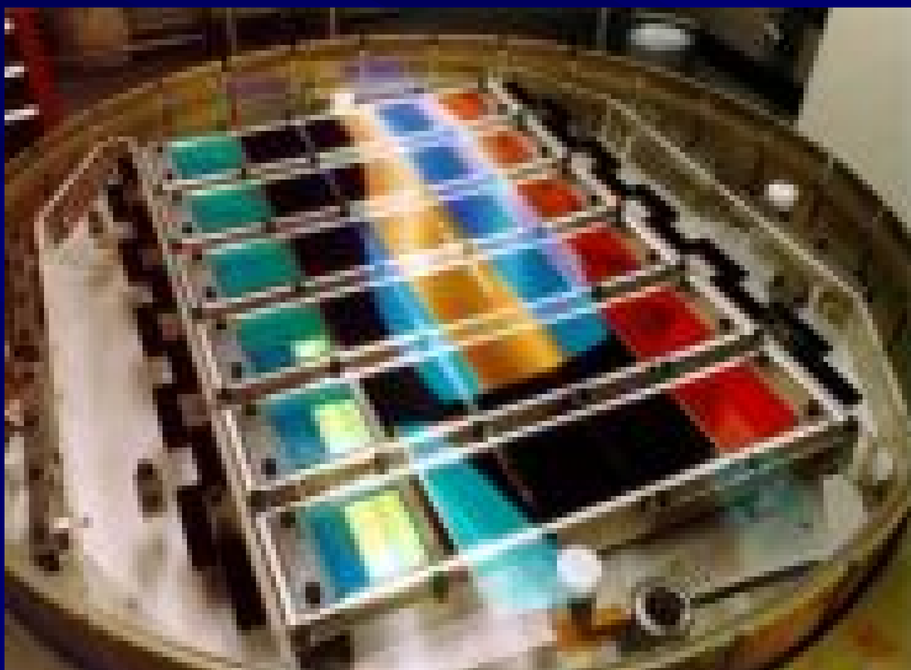
SEGUE: The Sloan Extension for Galactic Understanding and Exploration

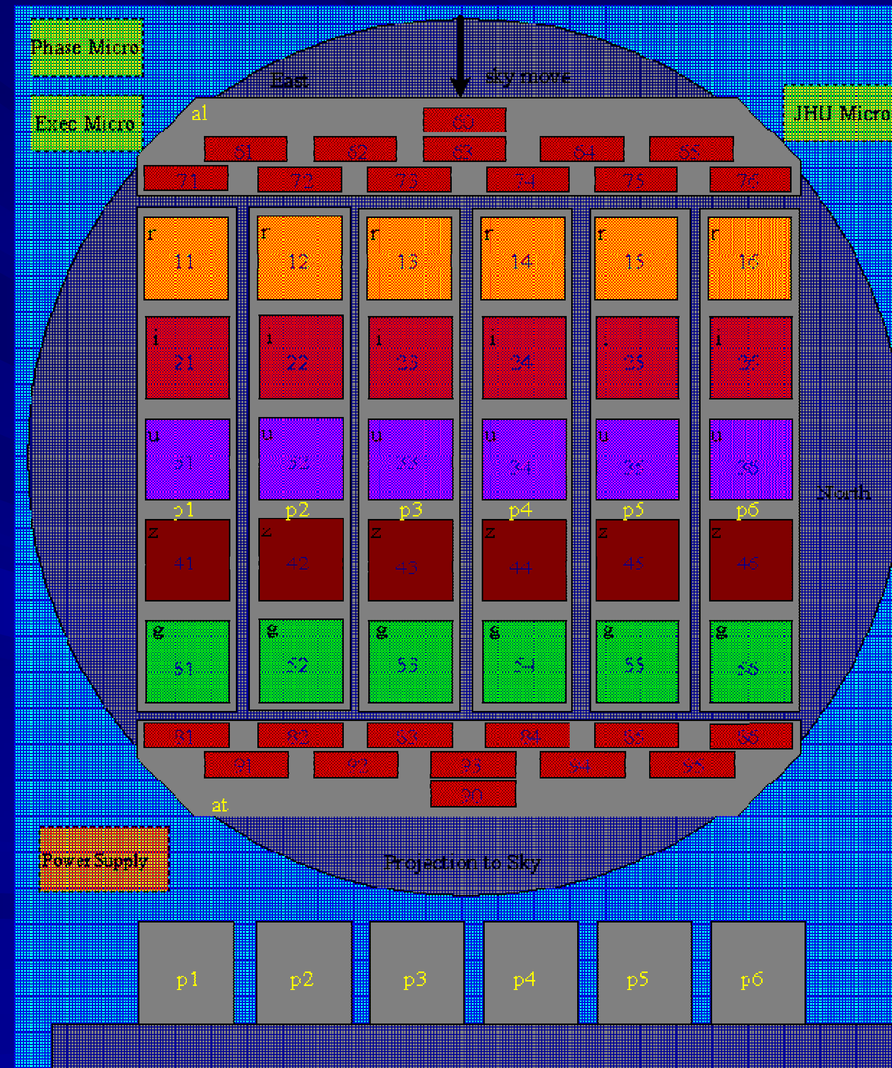
- Fully funded ($15 Million: Sloan Foundation / NSF / Partners (JINA) for operation through July 2008
- Use existing SDSS hardware and software to obtain:
  - 3500 square degrees of additional *ugriz* imaging at lower latitudes
  - Medium-resolution spectroscopy of 250,000 "optimally selected" stars in the thick disk and halo of the Galaxy
    - 200 "spectroscopic plate" pairs of 45 / 135 min exposures
    - Objects selected to populate distances from 1 to 100 kpc

SEGUE uses stellar probes of increasing absolute brightness to probe increasing distances in the disk, thick disk and Milky Way halo.



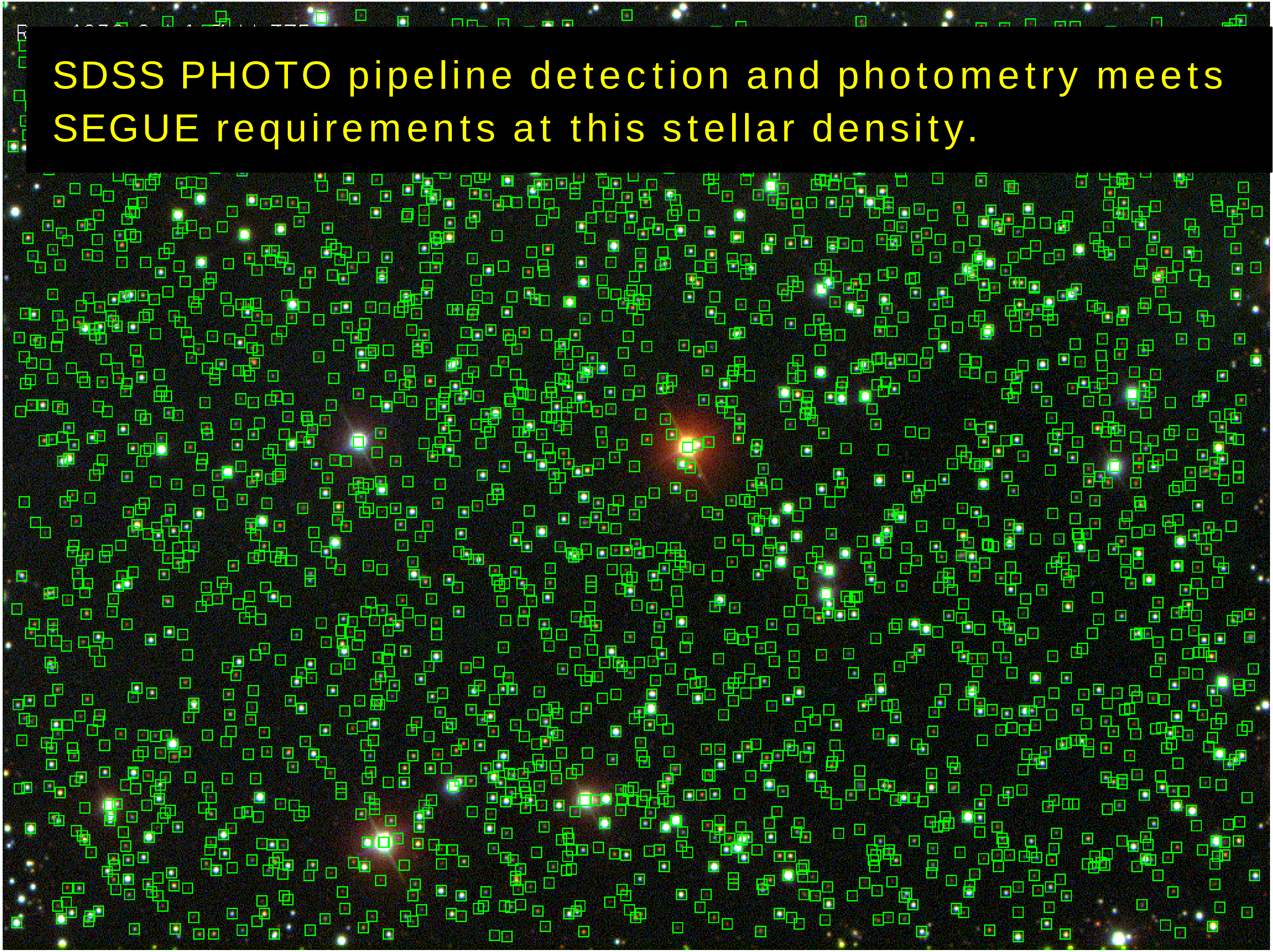
The SDSS Imaging Camera



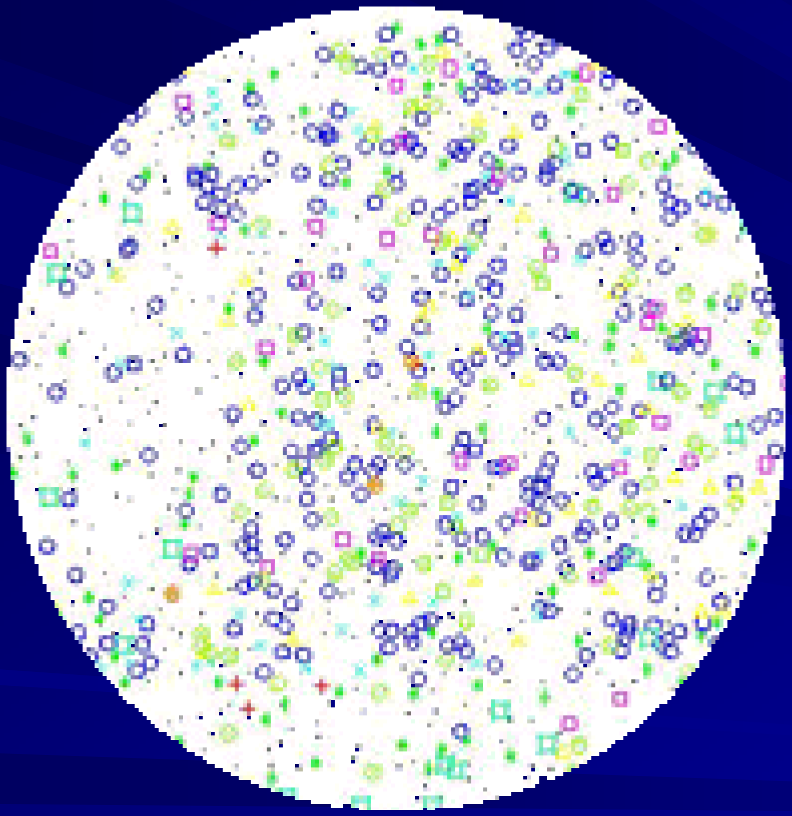


The actual camera and a block diagram of the CCD layout

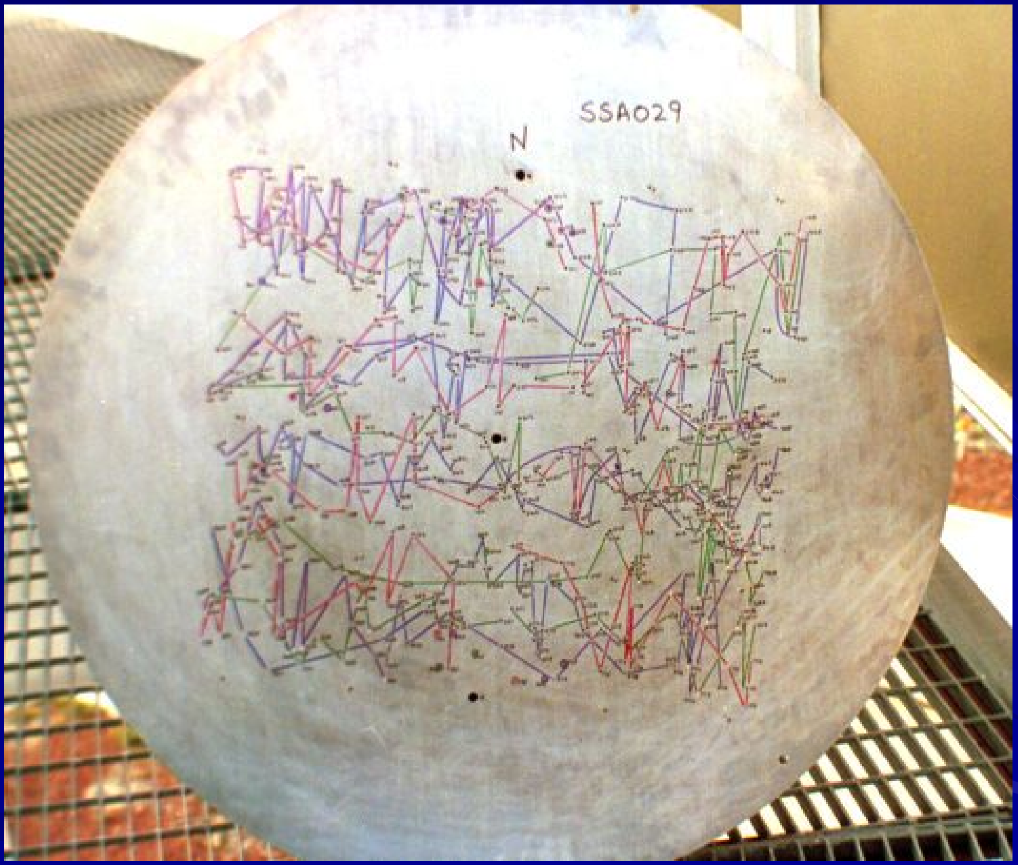
Run 4832 Col 4 Field 375
1'
(l,b) = (50, -15) Star Density = 50,000 per sq. deg with g<23


SDSS PHOTO pipeline detection and photometry meets SEGUE requirements at this stellar density.

The SDSS Spectrograph Plug Plate

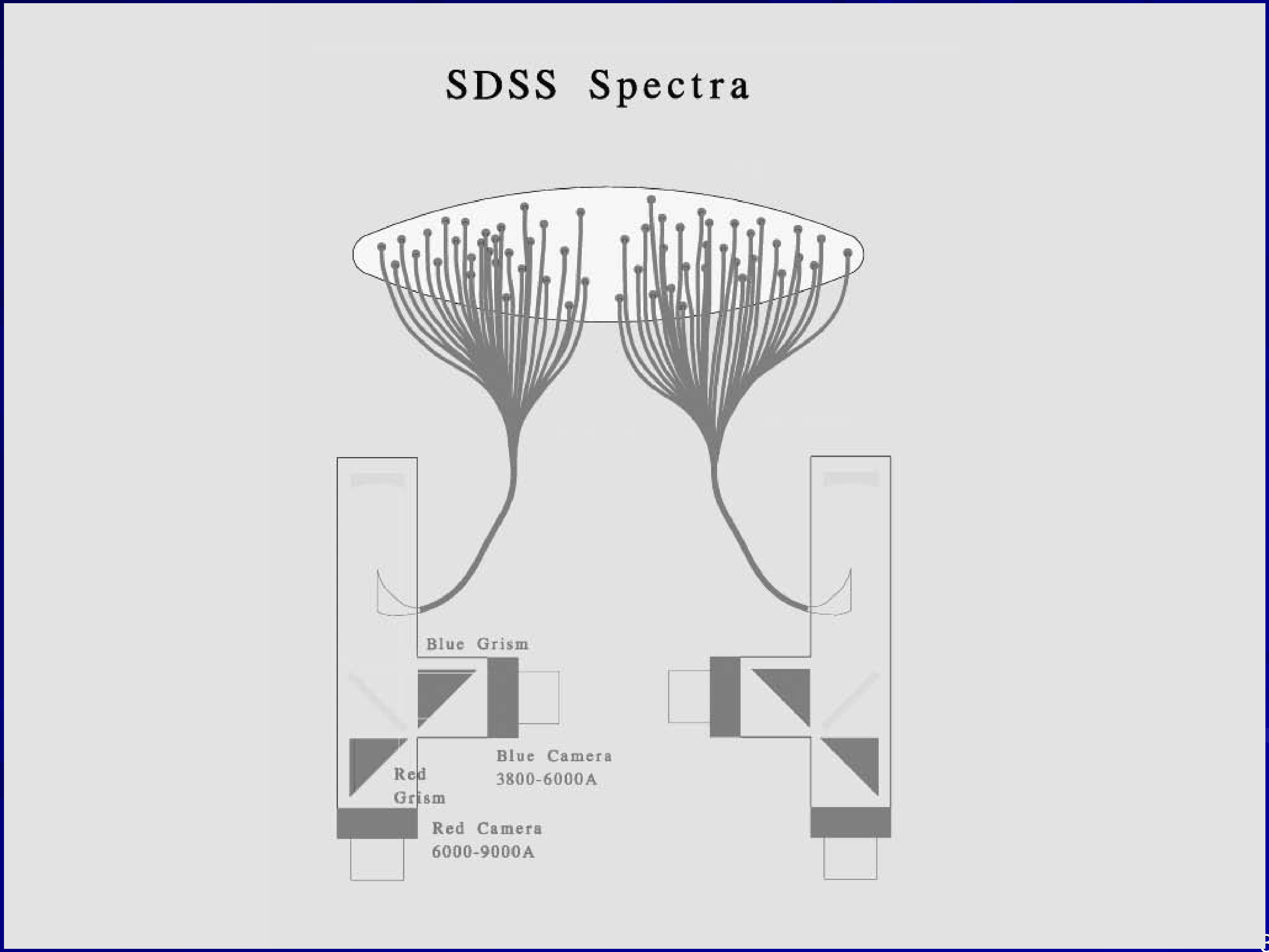


Identification of targets on the sky

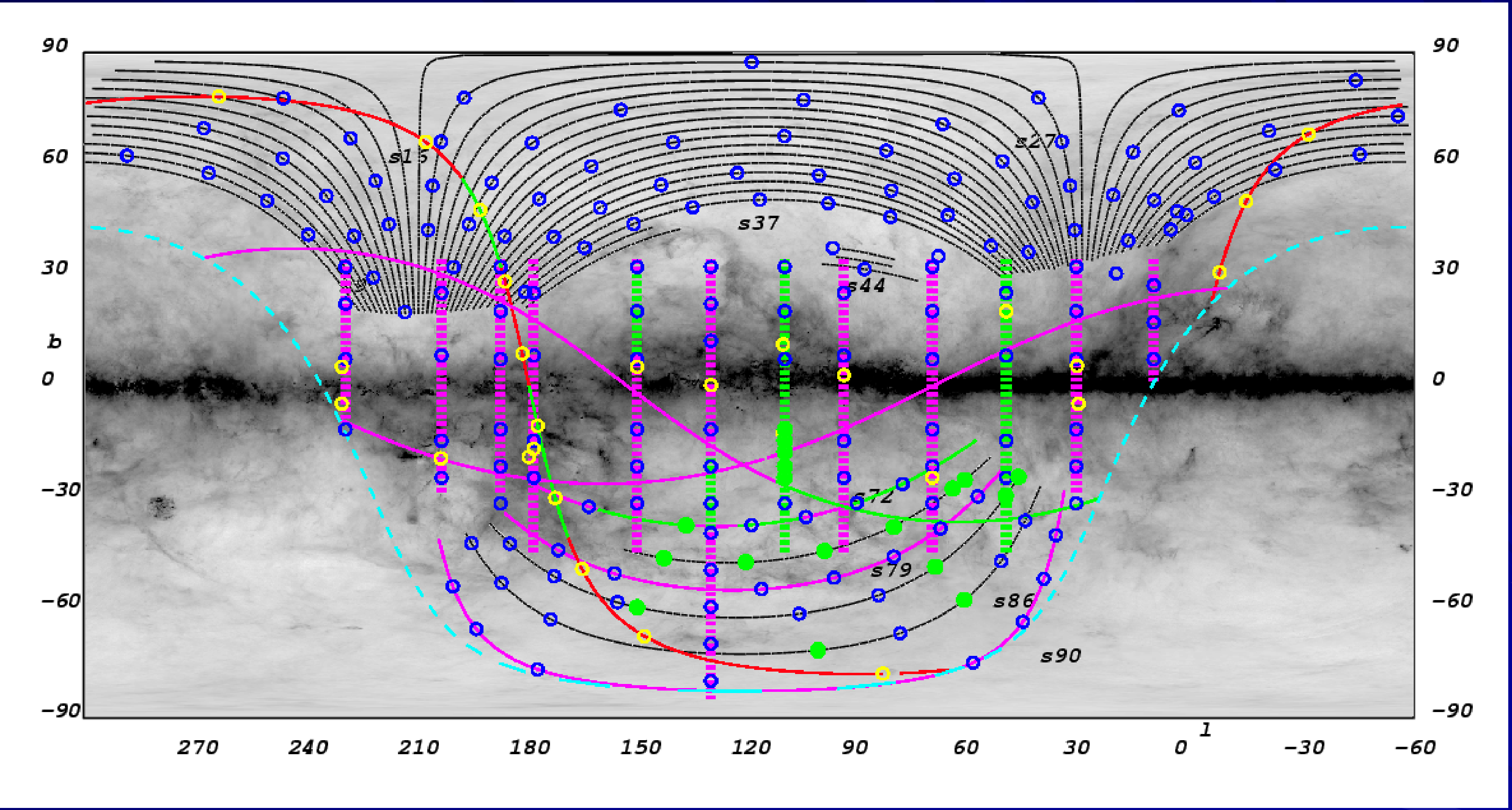


A prepped and drilled plate

A Cartoon Version



SEGUE observing plan and status as of June 2006



SDSS Imaging scan

Planned SEGUE scan (3500 sq deg)

Sgr stream planned scan

Completed SEGUE imaging

Declination = -20 degrees

Planned SEGUE grid pointings (200)

Planned targeted SEGUE pointings(60)

Completed SEGUE plate pointing

SEGUE Targets per Pointing (1200 Stars)

Based on *ugriz* color selections / split into two plates at "bright": 14.0 < g < 18.0 ; "faint": 18.0 < g < 20.5

WD	**25**	**KII**	**95**
Cool WD	**10**	**LOW [Fe/H]**	**150**
A/BHB	**50**	**MS+WD**	**~5**
MP-MSTO	**200**	**high-PM**	**25-30**
F/GV	**50**	**sdM**	**<5**
GV	**375**	**AGB**	**10**
KV	**95**	**L,T**	**<5**

The SEGUE Spectroscopic Pipeline -- Determination of Atmospheric Parameters

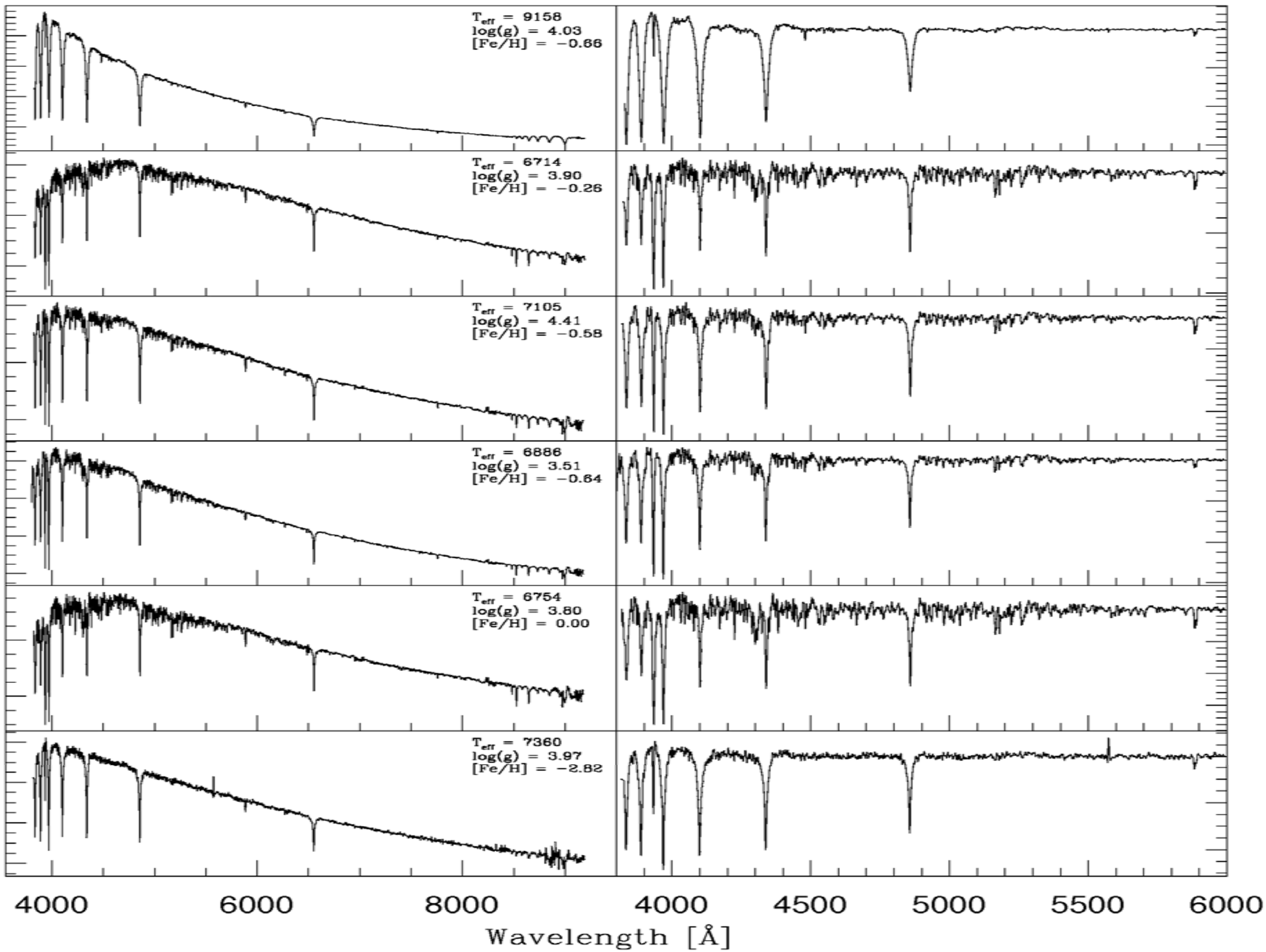
- 5 methods for abundance determination based on line indices or Spectral Matching
  - CaII K (KP) vs. predicted (B-V)o [(g-r)o]
  - Autocorrelation Function vs. predicted (B-V)o [(g-r)o]
  - Ca Triplet vs. predicted (B-V)o [(g-r)o]
  - CaII K + metallic line regions + ugriz
  - Spectral/Photometric matching (ugriz)
- 4 methods for log g determination
  - CaI 4227 vs. predicted (B-V)o
  - MgH vs. predicted (B-V)o
  - MgH (and other gravity sensity features) vs. ugriz
  - Spectral/Photometric matching
- 2 methods for Teff determination
  - Balmer lines + ugriz
  - Spectra/Photometric Matching

Example of Value-Added Catalog Output

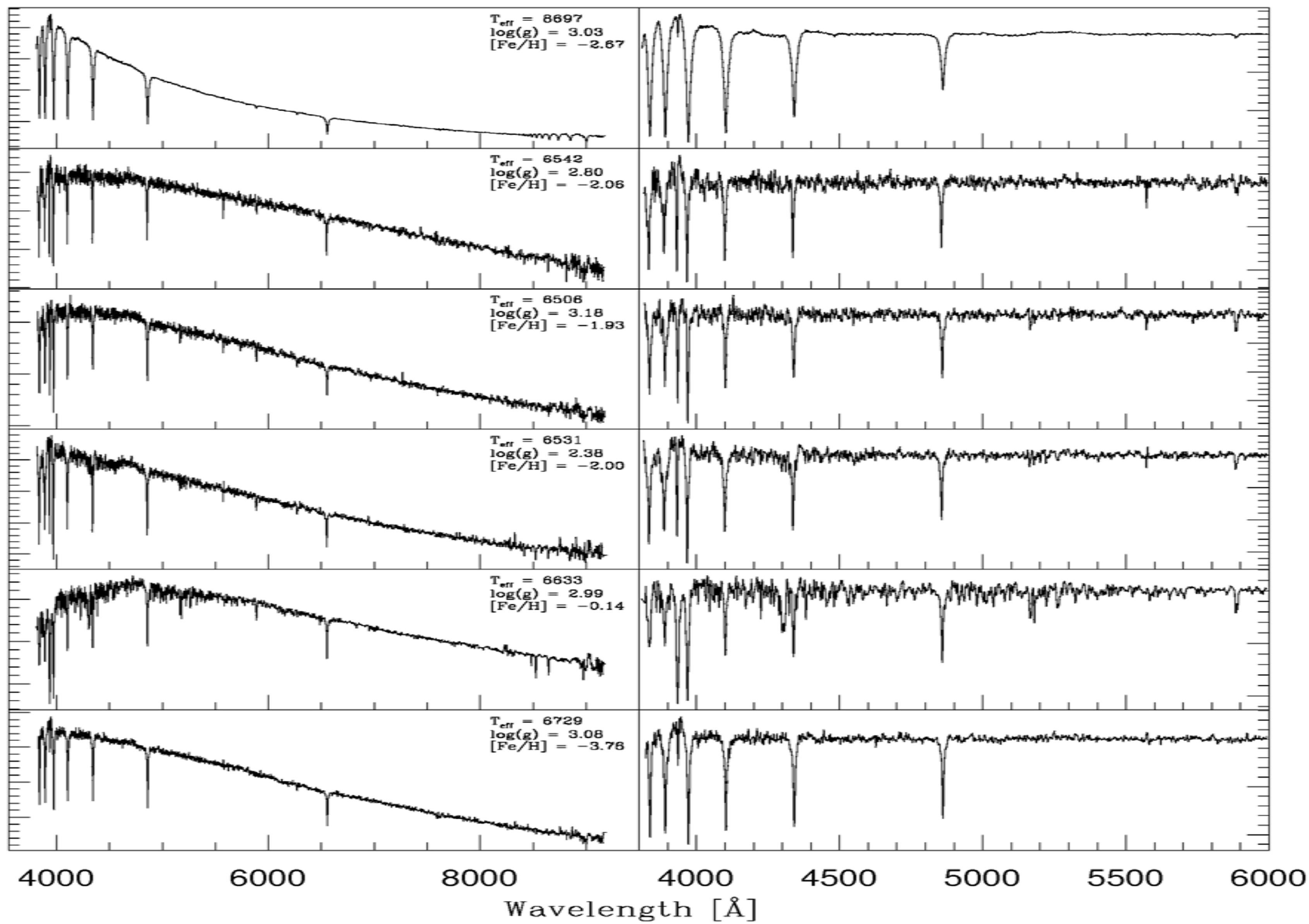
SDSS STAR	RA (DEG)	DEC (DEG)	G_MAG	G-R	~B-V	VEL	FEH	SIGF	NF	LOGG	SIGG	NG	TEFFA	SIGT	NT
52518-0737-001	336.810840	12.047003	18.428	1.08	1.26	-24.4	-1.14	...	1	...	...	0	4279	...	0
52518-0737-030	337.549880	12.628333	17.338	0.41	0.56	-2.5	-1.00	0.22	5	3.82	0.28	4	5845	64	2
52518-0737-032	337.552970	13.147942	18.399	0.77	0.93	-36.0	-1.08	0.37	4	4.42	0.52	3	4766	...	1
52518-0737-039	337.488620	12.759767	19.220	0.52	0.65	-46.0	-2.05	1.48	2	3.95	0.80	3	5375	...	1
52518-0737-047	336.371220	12.346197	17.415	0.49	0.65	-73.7	-0.67	0.11	5	3.84	0.14	4	5607	21	2
52518-0737-065	336.663620	12.607524	20.903	0.76	0.88	56.8	-0.78	...	1	4.15	0.00	3	4732	...	1
52518-0737-075	337.092970	12.769260	16.007	0.29	0.44	-217.7	-1.44	0.22	5	3.31	1.19	2	6220	158	2
52518-0737-080	337.035320	12.970552	18.716	0.03	0.19	-351.8	-1.33	0.99	2	4.36	...	1	7631	164	2
52518-0737-086	336.298600	12.112614	17.997	0.40	0.58	-109.4	-1.02	0.31	5	3.59	0.39	4	5844	32	2
52518-0737-094	336.297150	12.284820	18.463	0.72	0.91	-1.9	-1.12	0.39	4	4.10	0.55	3	4986	...	1
52518-0737-112	336.478040	12.656192	19.099	0.89	1.07	-67.7	-2.01	0.73	2	1.40	0.40	3	4575	...	1
52518-0737-128	336.043610	12.122969	17.736	0.43	0.57	-7.8	-1.04	0.42	4	3.68	0.59	3	5664	...	1
52518-0737-129	336.095300	12.053612	20.473	0.52	0.67	-291.4	-1.55	...	1	4.36	0.04	2	5391	...	1
52518-0737-178	336.018120	13.123265	16.768	0.26	0.40	-262.4	-2.06	0.16	4	3.74	0.26	2	6390	92	2
52518-0737-235	335.638350	13.102211	15.973	0.43	0.58	-116.9	-0.75	0.06	5	3.82	0.08	4	5774	46	2
52518-0737-237	335.615940	13.010118	16.588	1.01	1.18	-46.3	-1.02	...	1	3.89	0.41	2	4377	...	0
52518-0737-241	335.526850	11.932741	16.831	0.31	0.47	-27.7	-1.24	0.46	4	3.71	0.64	3	6154	...	1
52518-0737-249	335.492610	12.278062	18.428	1.09	1.26	11.8	-1.11	...	1	...	...	0	4278	...	0
52518-0737-267	335.176260	12.736045	17.511	0.41	0.56	57.3	-0.93	0.21	5	3.79	0.26	4	5822	35	2
52518-0737-283	335.349100	12.182276	20.142	0.82	0.98	-37.5	-1.88	0.65	2	2.74	0.35	3	4580	...	1
52518-0737-286	335.276540	12.043587	20.624	0.73	0.86	-80.3	-0.06	...	1	5.53	...	1	4961	...	1
52518-0737-288	335.093170	12.234200	16.629	0.23	0.37	-124.4	-1.83	0.14	3	3.80	0.19	2	6593	51	2
52518-0737-313	334.837850	13.114356	17.457	0.39	0.54	10.0	-1.16	0.35	5	3.81	0.45	4	5884	110	2
52518-0737-322	335.336110	14.301547	16.887	0.51	0.67	-40.6	-0.47	0.09	4	4.47	0.13	3	5544	...	1
52518-0737-324	335.003250	13.971341	17.385	1.03	1.22	15.2	-0.54	...	1	...	...	0	4342	...	0
52518-0737-361	335.517290	14.330617	18.814	0.96	1.12	-70.4	-2.30	...	1	3.55	0.44	2	4454	...	0
52518-0737-362	335.531240	14.218181	16.835	0.42	0.58	-11.1	-0.55	0.23	4	4.20	0.32	3	5988	...	1
52518-0737-372	335.419960	14.191317	17.485	0.72	0.89	-44.3	-0.80	0.15	4	4.44	0.20	3	4986	...	1

Actually, this is a HIGHLY abbreviated version of the VAC, which will also include additional photometry, astrometry, spectral classification, distances, spectral indices, and notes on peculiarities of individual stars.

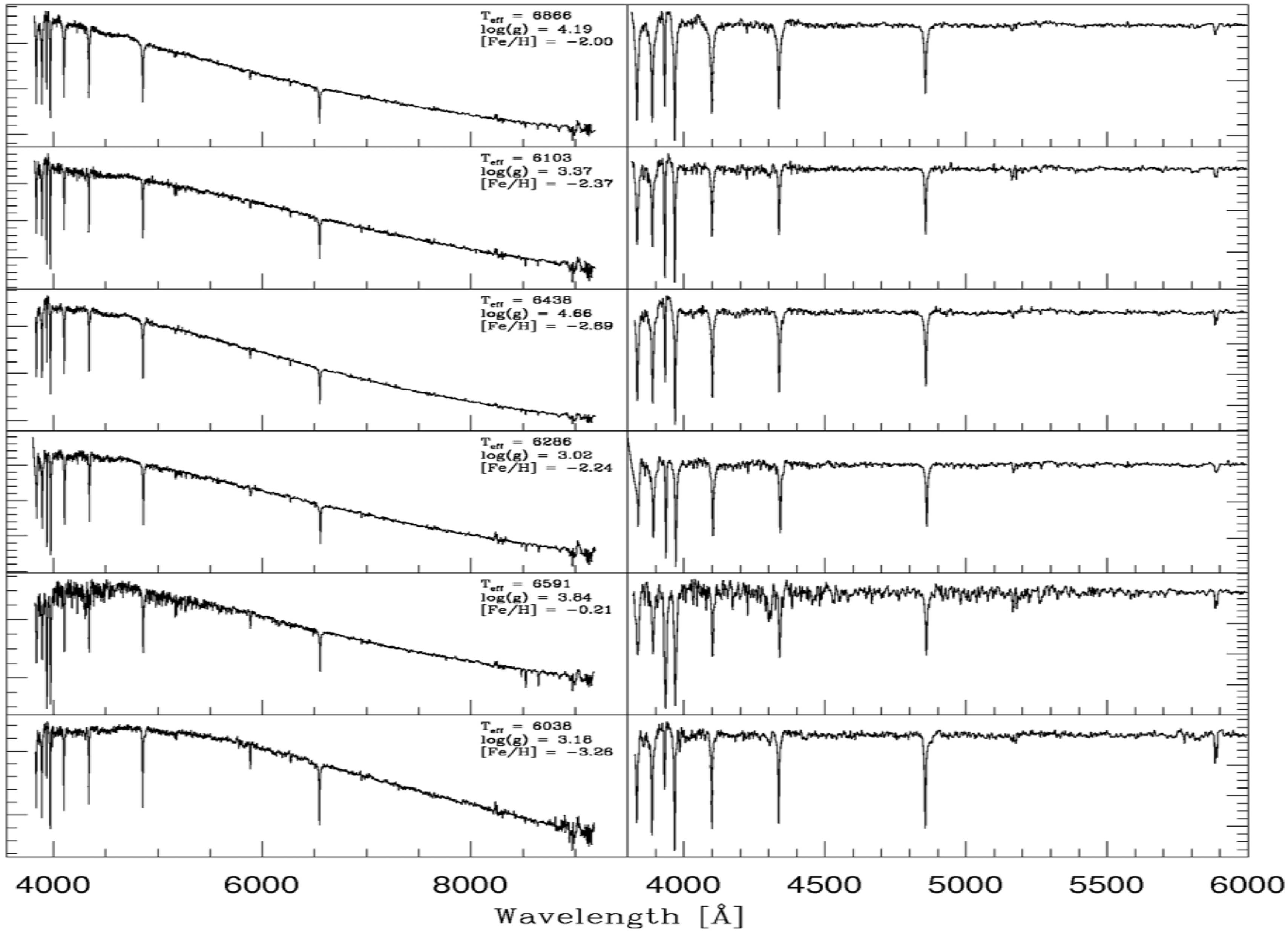
SEGUE Sample Spectra – A type halo blue stragglers



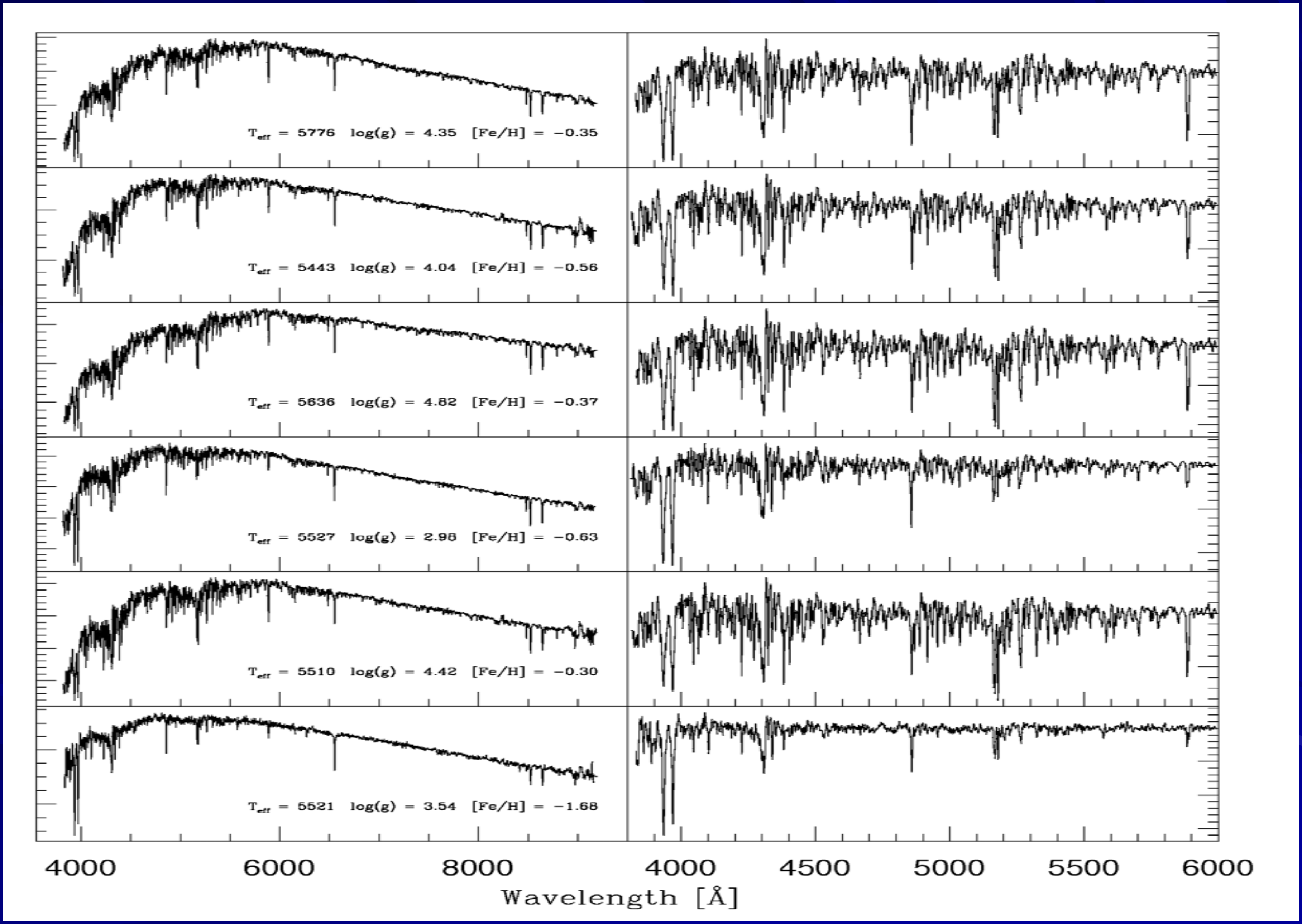
SEGUE Sample Spectra – Field Horizontal-Branch Stars



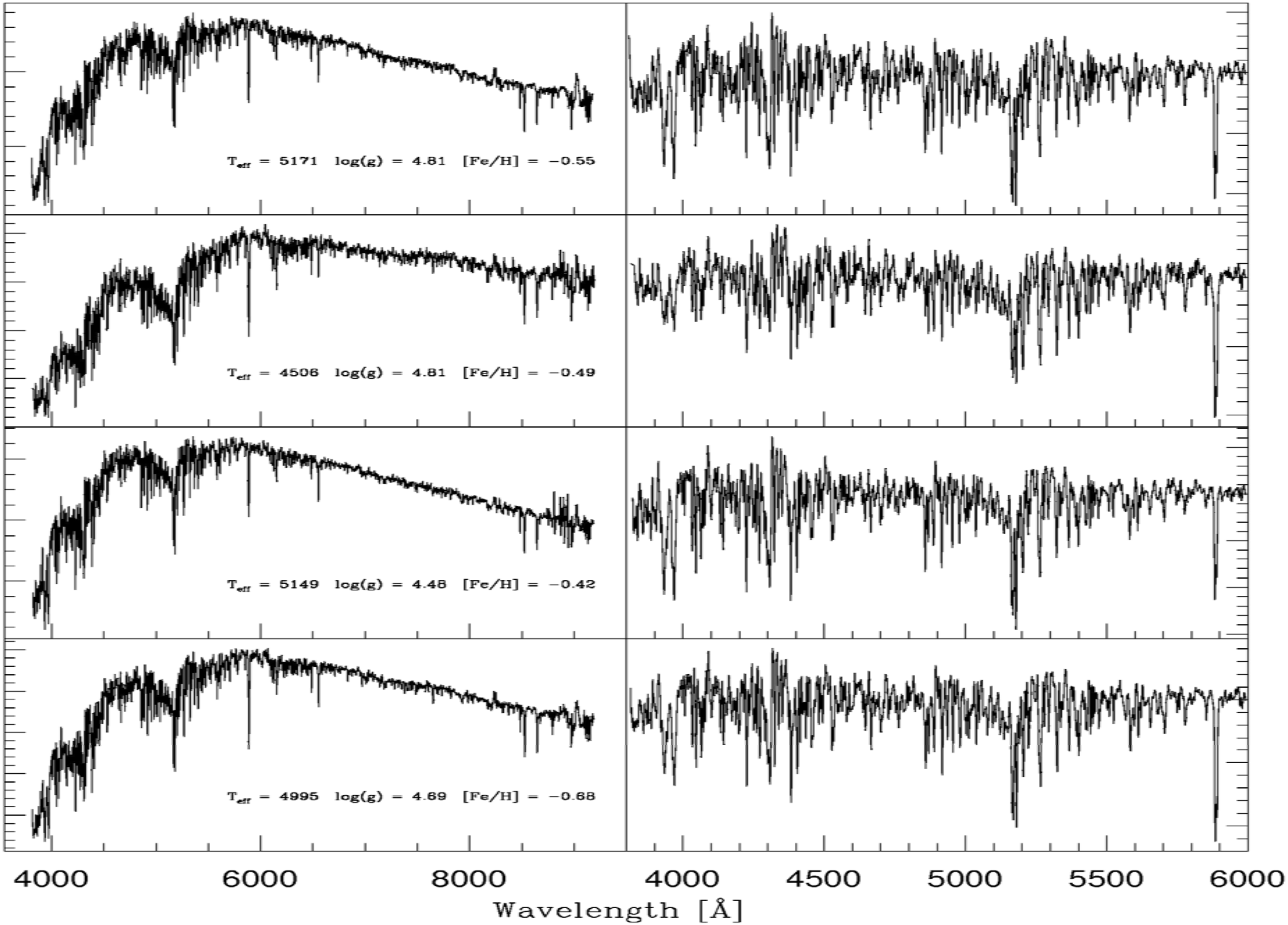
SEGUE Sample Spectra – F Turnoff Stars



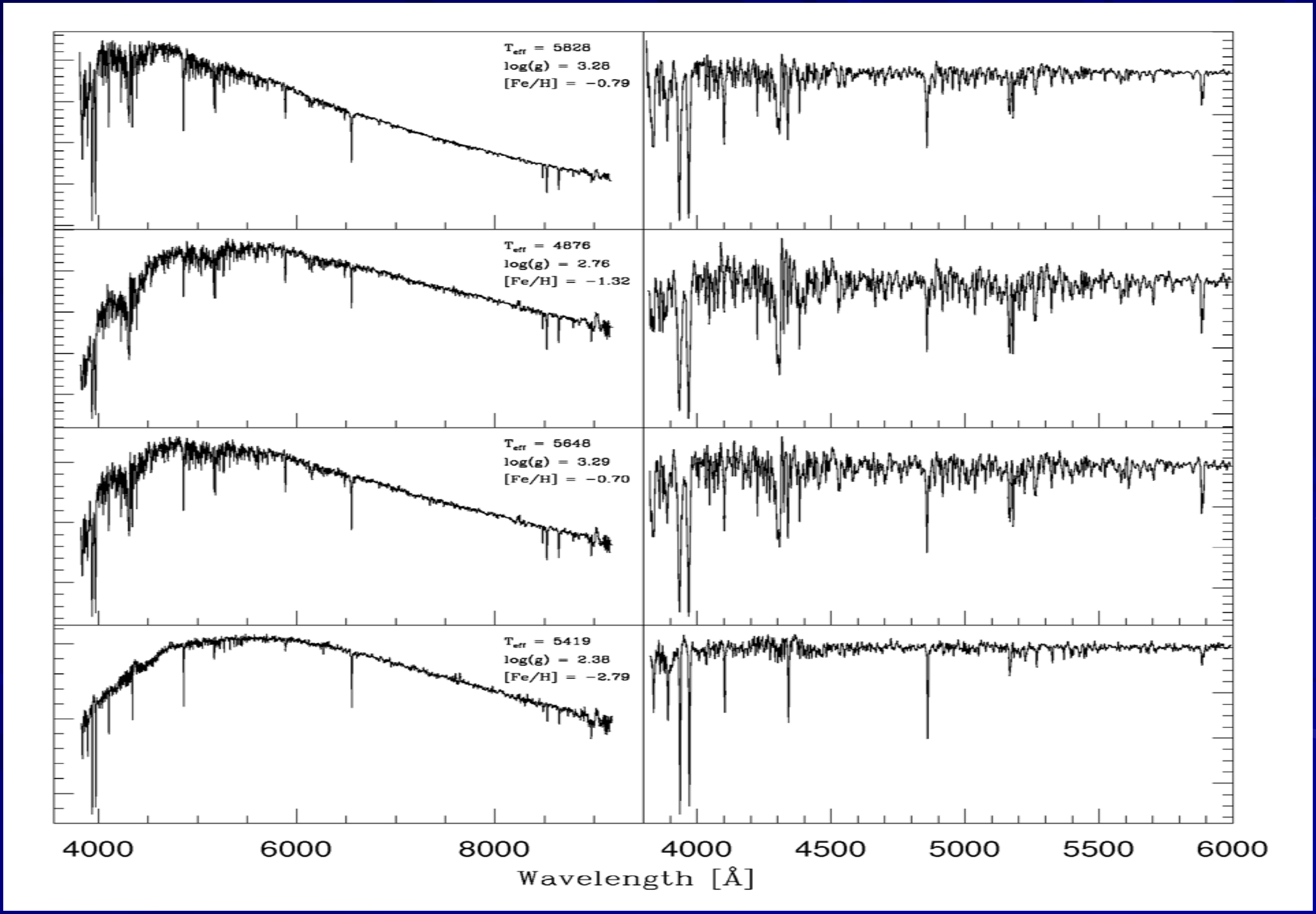
SEGUE Sample Spectra – G Dwarf Stars



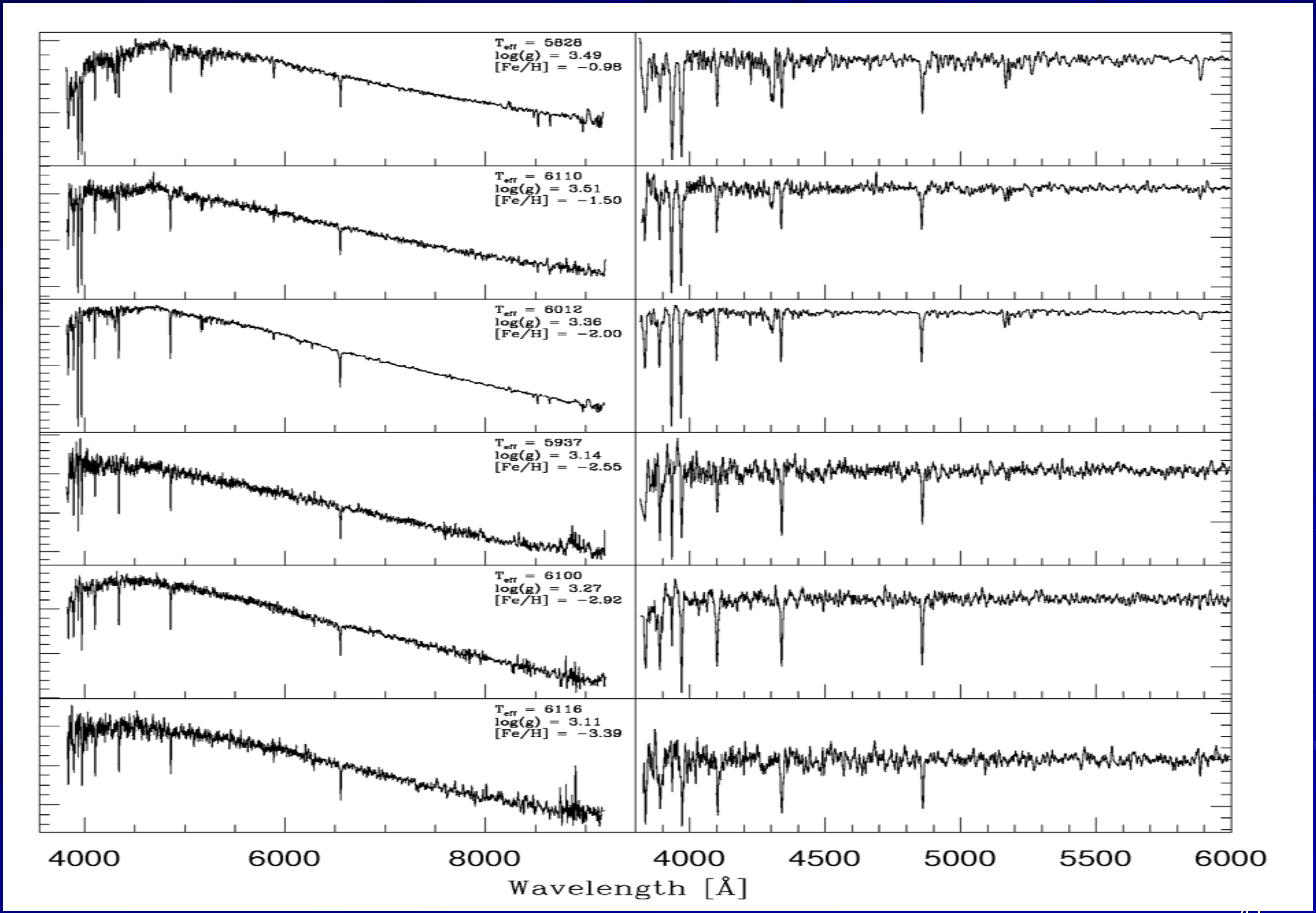
SEGUE Sample Spectra – K dwarf Stars



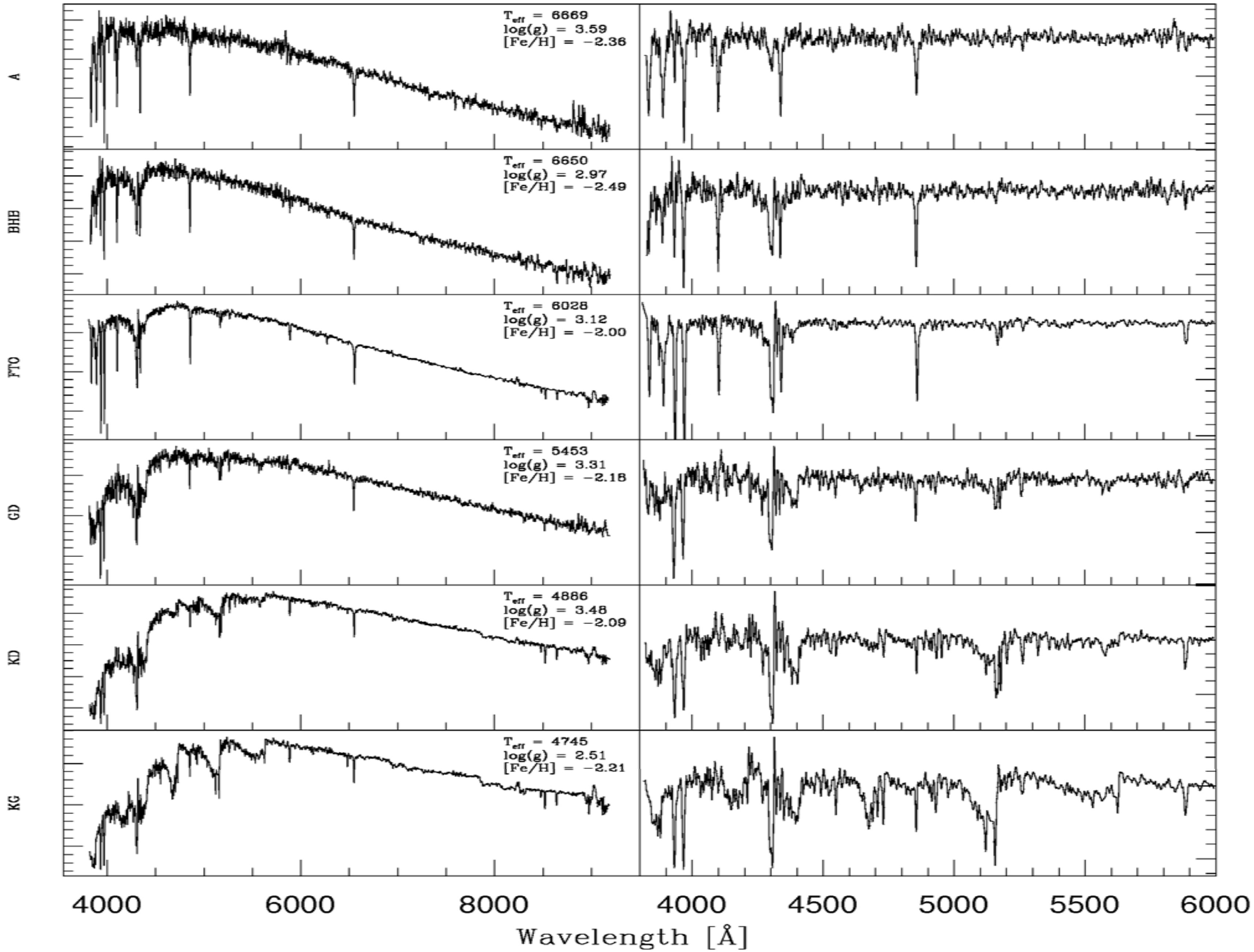
SEGUE Sample Spectra – K Giant Stars



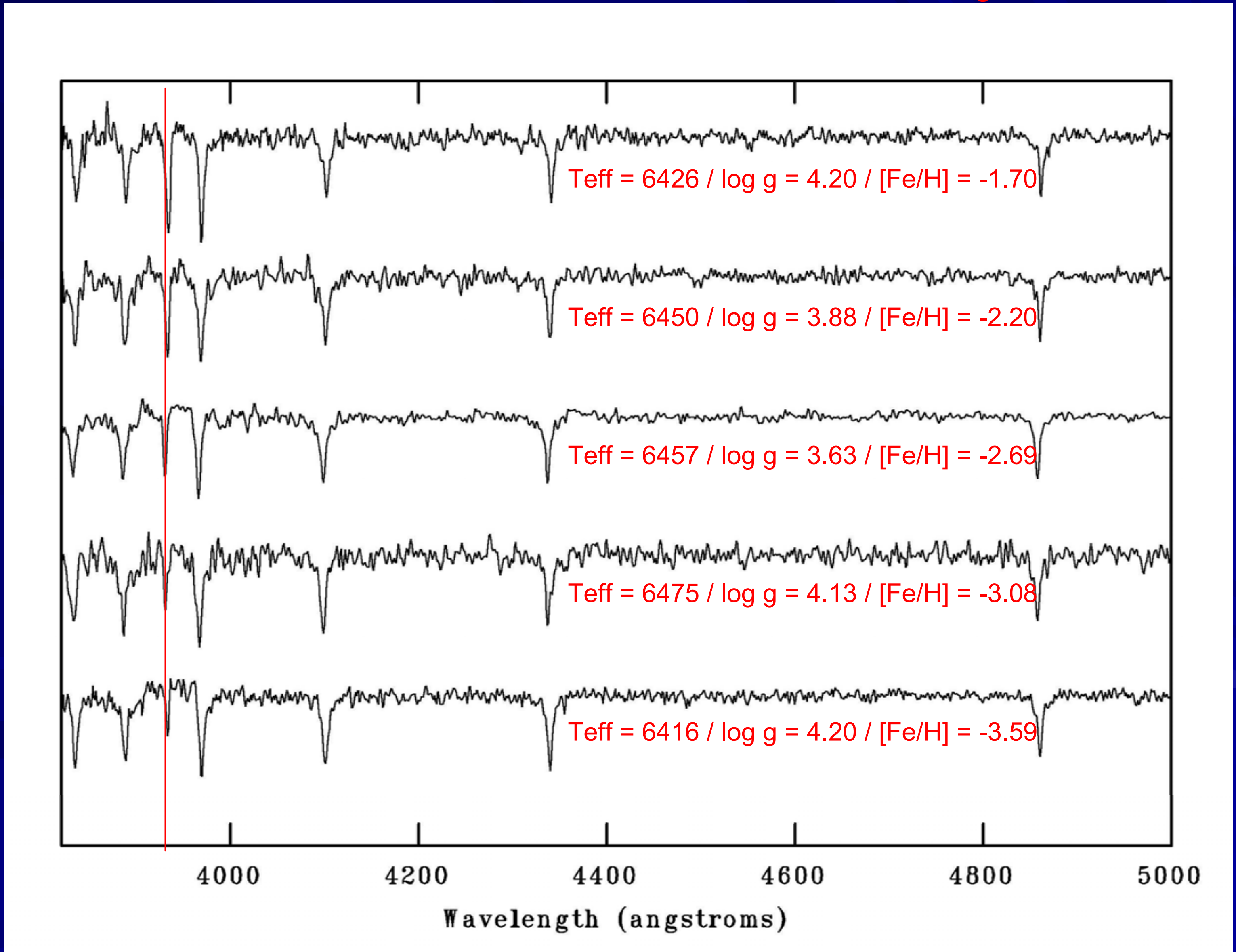
SEGUE Sample Spectra – Low Metallicity Stars



SEGUE Sample Spectra – Carbon Enhanced Metal-Poor Stars



Example Main-Sequence Turnoff Stars of Low Metallicity

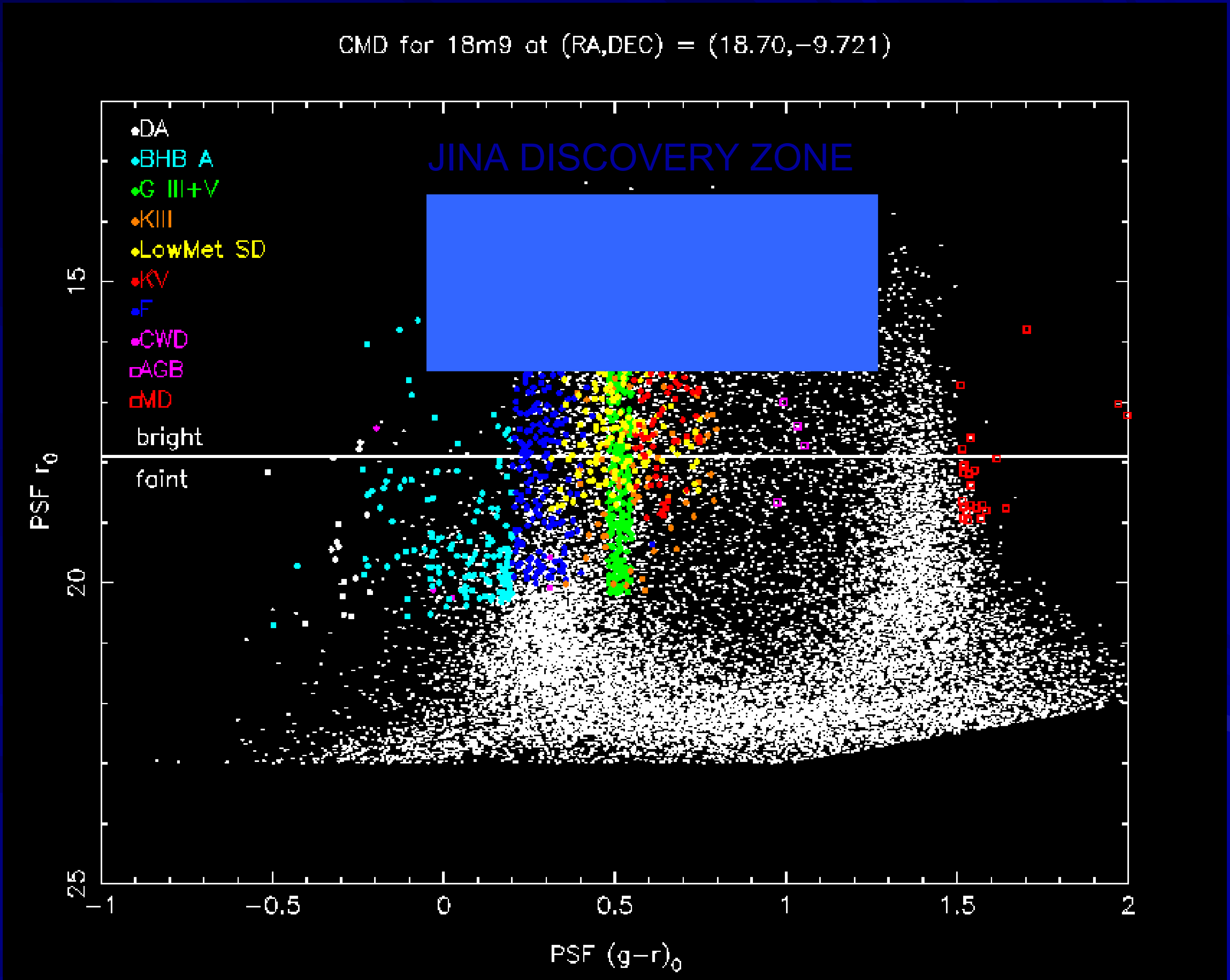


Likely Numbers of Detected MP Stars from SEGUE

- Actual numbers will depend on the shape of the halo Metallicity Distribution Function

–	[Fe/H] < -2.0	~ 20,000 (VMP)
–	[Fe/H] < -3.0	~ 2,000 (EMP)
–	[Fe/H] < -4.0	~ 200 ? (UMP)
–	[Fe/H] < -5.0	~ 20 ? (HMP)
–	[Fe/H] < -6.0	~ 2 ? (MMP)

SEGUE Target Selection– “JINA-fied”



The Plan of Attack

- SEGUE identification of bright MP giants with [Fe/H] < -2.0
- Brightest 2000-3000 taken to HET, etc., for "snapshot" high-resolution spectroscopy
- Most interesting (e.g., r-process / s-process-enhanced) stars thus identified taken to, e.g., Subaru/Keck/LBT, etc. for higher S/N determinations of elemental abundance patterns
- Construction of astrophysically-consistent scenarios to account for patterns and frequency of n-capture (and other) abundance patterns
- Note: Within 5 years, expect to be able to obtain medium-res data for millions of individual stars; Within 10 years, billions; high-resolution to follow

What Should Such a Database DO ?

- For the astronomer
  - Make available as complete as possible a record of published elemental abundances, in particular for the modern era (CCD detectors)
  - Provide sufficient information so that one can determine if additional spectroscopy is required for a given star (e.g., S/N, # lines, wavelength coverage)
  - Enable "rescaling" of derived results (e.g., for different model atmosphere, reference element assumptions)
  - Enable intelligent selection of sample of greatest interest for research topic in hand

What Should Such a Database Do ?

- For the nuclear astrophysicist
  - Provide readily understandable, well documented access to the derived elemental abundances for stars of interest
  - Not put undue demands on full understanding of the methodologies employed in order to use best available abundance estimates
  - Point out where potential problems lie with inclusion of certain results

Execution of STARLib

- STARLib is JINA's attempt to develop and maintain a library of stellar abundances which satisfies many of the above requirements

- Basic design is still in the process of development and implementation
  - Postdoc / grad student

- Input of astrophysical data is presently underway
  - Undergrad student
  - Checking by JINA faculty

Maintenance of STARLib

- Once basic inputs / structure are fully defined, future maintenance requires
  - Additional (quarterly) updates of newly published materials
  - Input (revision) of new information on astrophysical nature of object (e.g., binary, binary period, variable)
  - Development of presentation and query structures for improved access to information
  - Ability to perform adjustments in abundances, based on preferred atmospheric parameters (e.g., Teff), or solar reference abundances
  - Development of quality assessment mechanism for the listed data

The Future of STARLib

- What additional information is required ?
  - Advice needed from astronomers, and in particular, from nuclear astrophysicists
- The transition to full spectral archiving
  - The international virtual observatories will eventually be collecting all available spectroscopic data in (newly) published literature
  - STARLib can provide database info on the published literature, to be used in parallel