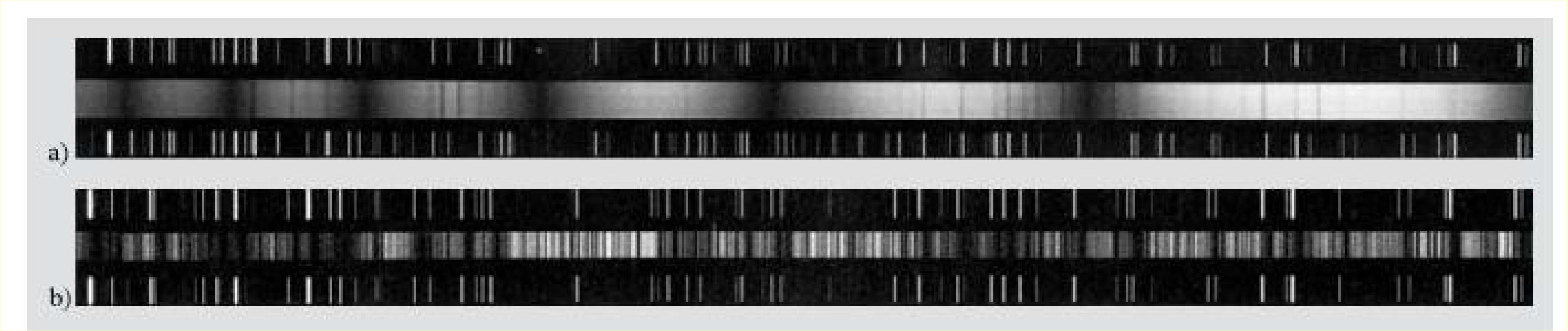
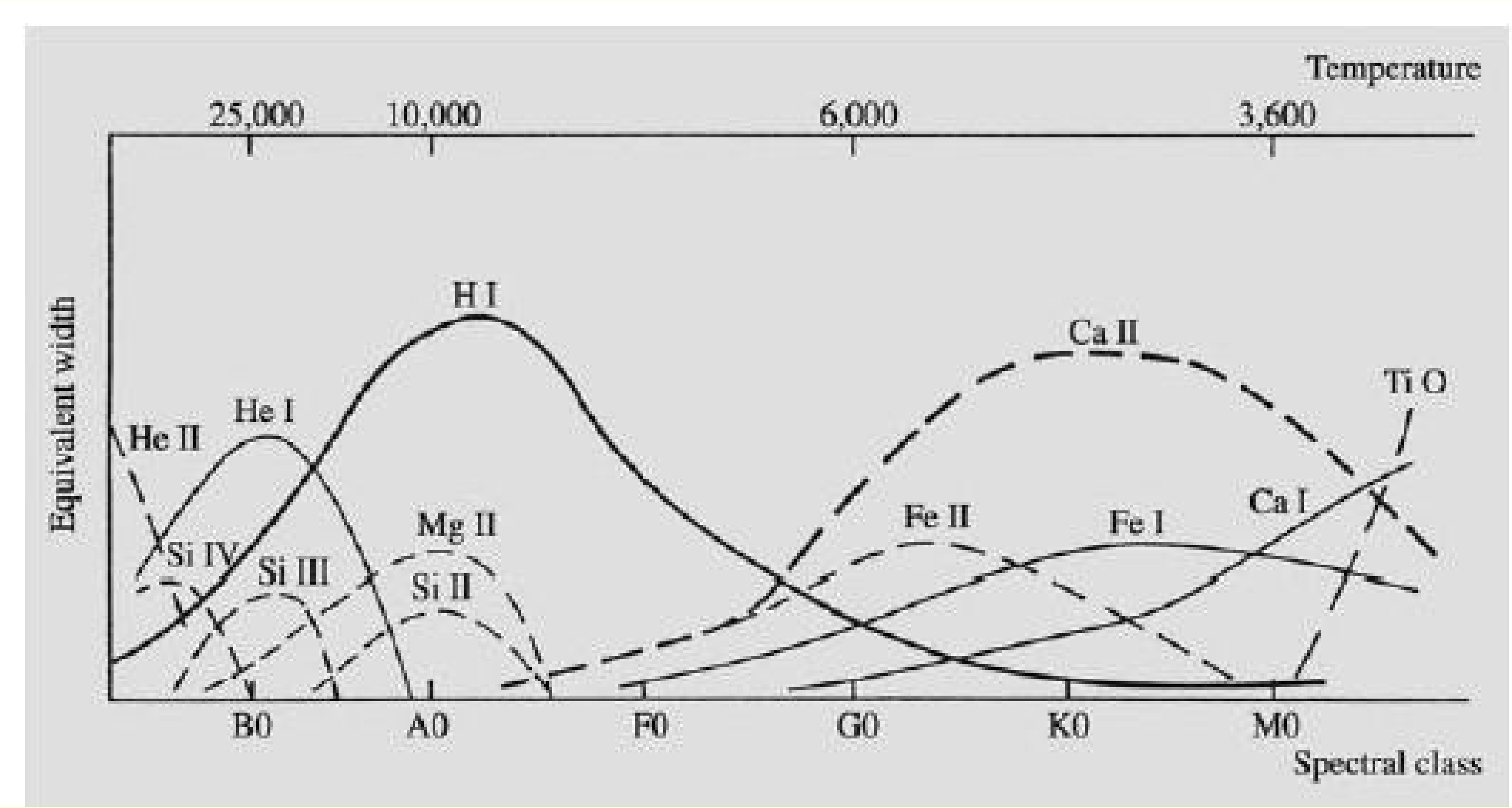
2D Spectra

Vega A0   vs   Aldebaran K5



Spectra: EW vs Spectral class



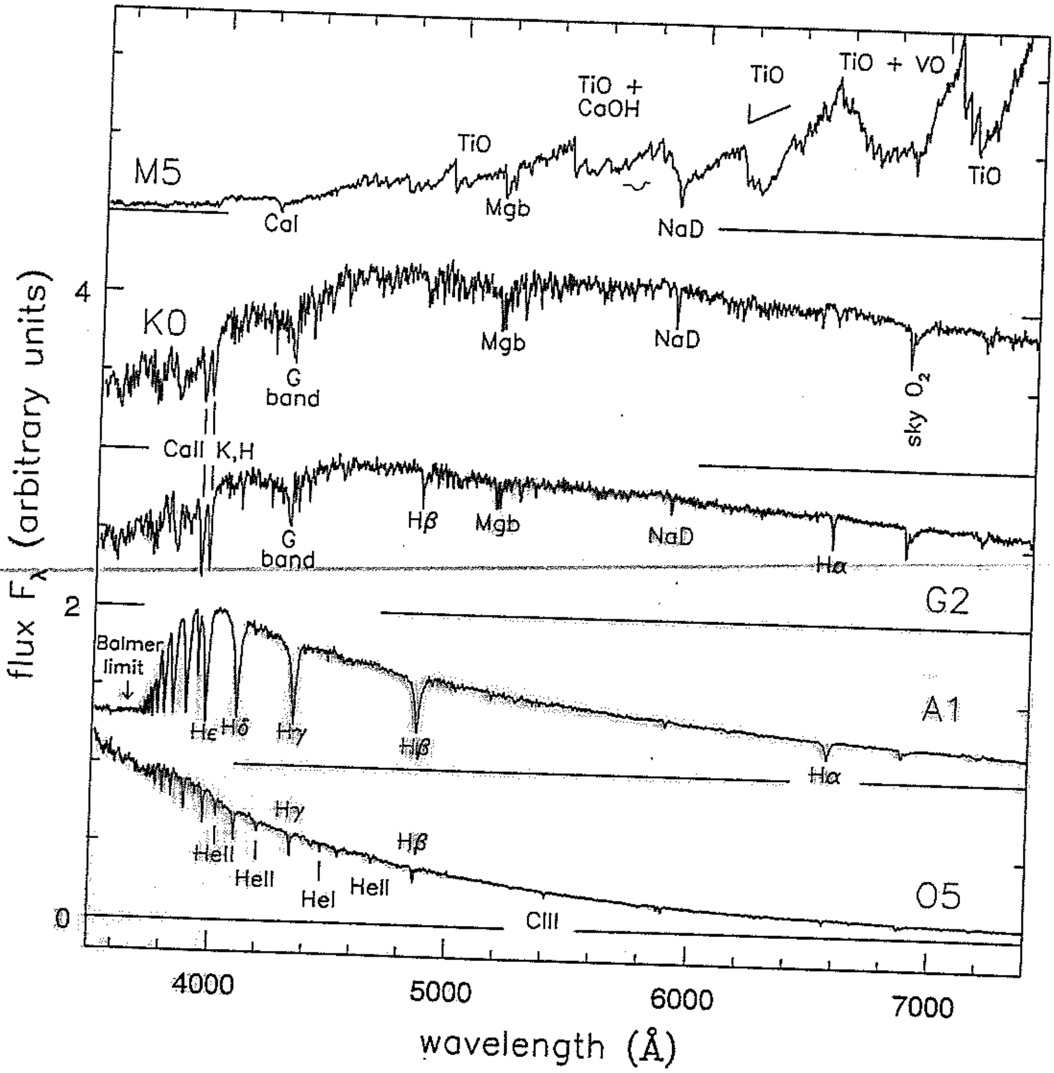


Figure 1.1 Optical spectra of main-sequence stars with roughly the solar chemical composition. From the top in order of increasing surface temperature, the stars have spectral classes M5, K0, G2, A1, and O5 – G. Jacoby *et al.*, spectral library.

The temperatures of O stars exceed 30 000 K. Figure 1.1 shows that the strongest lines are those of HeII (once-ionized helium) and CIII (twice-ionized carbon); the Balmer lines of hydrogen are relatively weak because hydrogen is almost totally ionized. The spectra of B stars, which are cooler, have stronger hydrogen lines, together with lines of neutral helium, HeI. The A stars, with temperatures below 11 000 K, are cool enough that the hydrogen in their atmospheres is largely neutral; they have the strongest Balmer lines, and lines of singly ionized metals such as calcium. Note that the flux decreases sharply at wavelengths less than 3800 Å; this is called the *Balmer jump*. A similar *Paschen jump* appears at wavelengths that are $3^2/2^2$ times longer, at around 8550 Å.

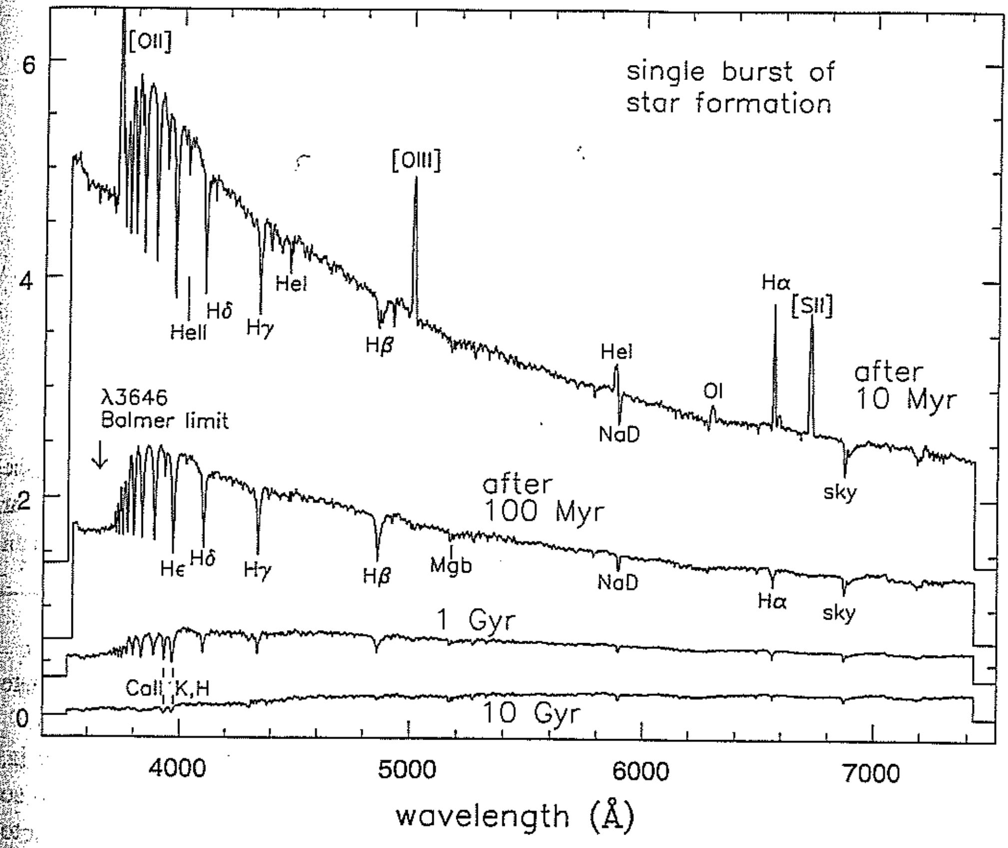


Figure 6.19 Spectra for a 'galaxy' that makes its stars in a 10^8 yr burst, all plotted to the same vertical scale. Emission lines of ionized gas are strong 10 Myr after the burst ends; after 100 Myr, the galaxy has faded and reddened, and deep hydrogen lines of A stars are prominent. Beyond 1 Gyr, the light dims and becomes slightly redder, but changes are much slower – B. Poggianti.

big ellipticals are richer in heavy elements than the midsized ones. The center of a galaxy is also more metal rich than its periphery: Figure 6.20 shows that the magnesium absorption is stronger, the greater the speed required for material to escape from that region of the galaxy. Smaller galaxies may have lost most of their metal-enriched gas, while larger systems were able to trap theirs, incorporating the heavy elements into new stars. Figure 1.5 showed us that metal poor stars of a given mass are bluer, especially while they are burning helium in their cores; so we are not surprised to find that smaller galaxies with lower metal content are bluer.

The most metal-rich parts of galaxies in Figure 6.20 correspond to abundances of 1–2 $Z_\odot$; stars at the center of luminous ellipticals are at least as metal-rich as the Sun. But they do not contain heavy elements in the same proportions as the Sun. Relatively light atoms such as oxygen, sodium, and magnesium are a few times more abundant relative to iron. We saw the same pattern in old metal-poor

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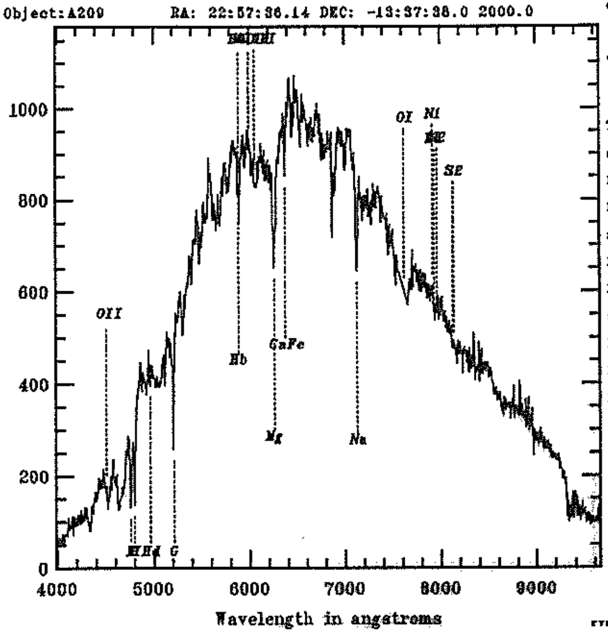

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*Corr vel = 62852.68 +- 29.16 km/sec R= 20.7

Emis vel = INDEF +- INDEF km/sec 0/0 lines

Template	CZ	error	R
mBix_E	62852.076	29.163	20.76
kenn_XL	62878.412	34.695	18.82
kenn_S0	62859.875	32.615	17.81
m31	62856.370	36.782	15.82
kenn_Sb	62854.145	47.133	11.35
kenn_Sa	62808.923	40.645	10.28
star	64089.982	68.464	9.84
kenn_Sc	65782.218	76.235	5.83
kenn_Ir	62644.212	118.483	4.54

No emission lines found?

rvsao.xcsao 2.2.4 03-Jun-2002 18:06

cD GALAXY

deep Hδ

File: p.fits JulDate: 2452199.54165

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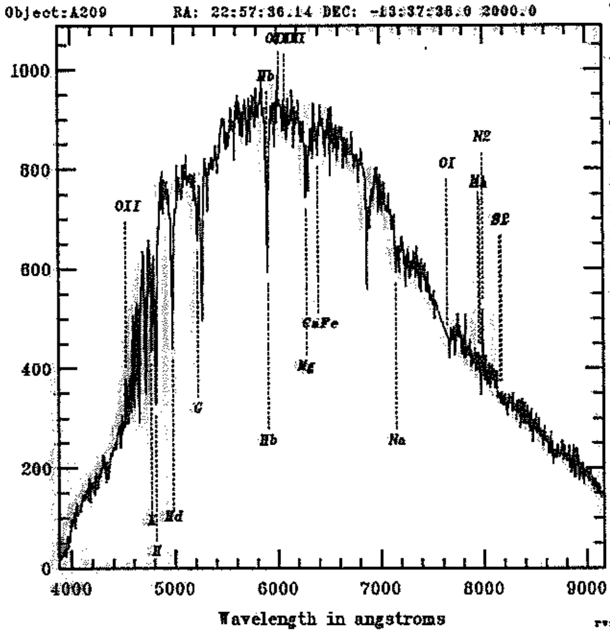

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VELOCITY = 64176.60 +- 33.23 km/sec _

?Corr vel = 64176.58 +- 29.65 km/sec R= 17.0

Emis vel = INDEF +- INDEF km/sec 0/0 lines

Template	CZ	error	R
kenn_Ir	64178.577	29.450	17.01
kenn_Sc	64214.835	28.620	17.76
kenn_Sb	64421.738	40.374	11.28
kenn_Sa	64383.806	57.052	8.50
kenn_S0	64465.841	58.694	7.38
kenn_XL	64502.048	80.403	6.02
mBix_E	64492.651	88.561	5.29
m31	64351.272	92.847	4.70
star	68457.270	432.061	2.50

No emission lines found?

rvsao.xcsao 2.2.4 03-Jun-2002 18:06

E+A GALAXY

POST-STARBUST GALAXY?

File: p.fits JulDate: 2452201.52465

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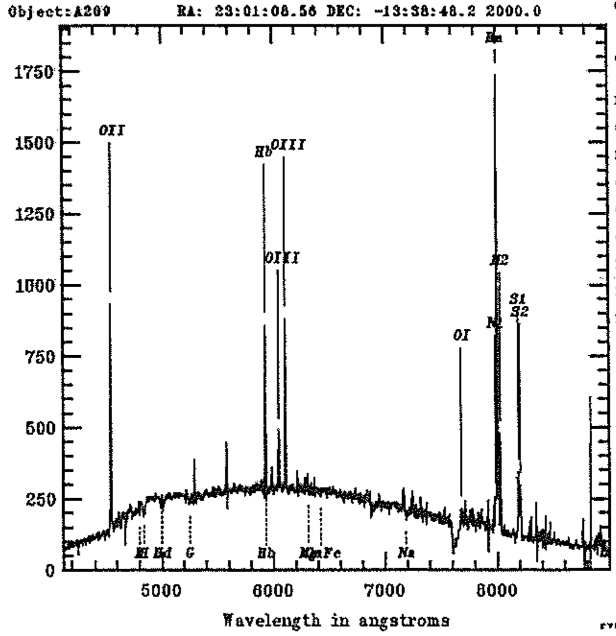

2001-Oct-19 00:00:00.00

Object BCV: 0.000

VELOCITY = 65618.65 +- 19.66 km/sec _

*Emis vel = 65613.95 +- 12.71 km/sec 10/10 l

Line	Rest	Obs.	CZ	error
OII	3727.38	4543.57	65638.10	12.35
Hb	4861.33	5926.41	65620.30	12.62
OIII	4958.91	6044.71	65642.14	38.47
OIII	5006.84	6102.80	65632.06	9.84
OI	6300.23	7678.53	65604.62	15.97
N1	6548.06	7981.04	65608.56	382.1
Ha	6562.82	7999.15	65612.35	8.84
N2	6583.57	8024.53	65618.26	22.24
S1	6716.44	8186.29	65607.71	12.18
S2	6730.81	8204.08	65618.77	16.11

rvsao.emsao 2.2.4 03-Jun-2002 18:10

EMISSION LINE GALAXY

... STARBUST?