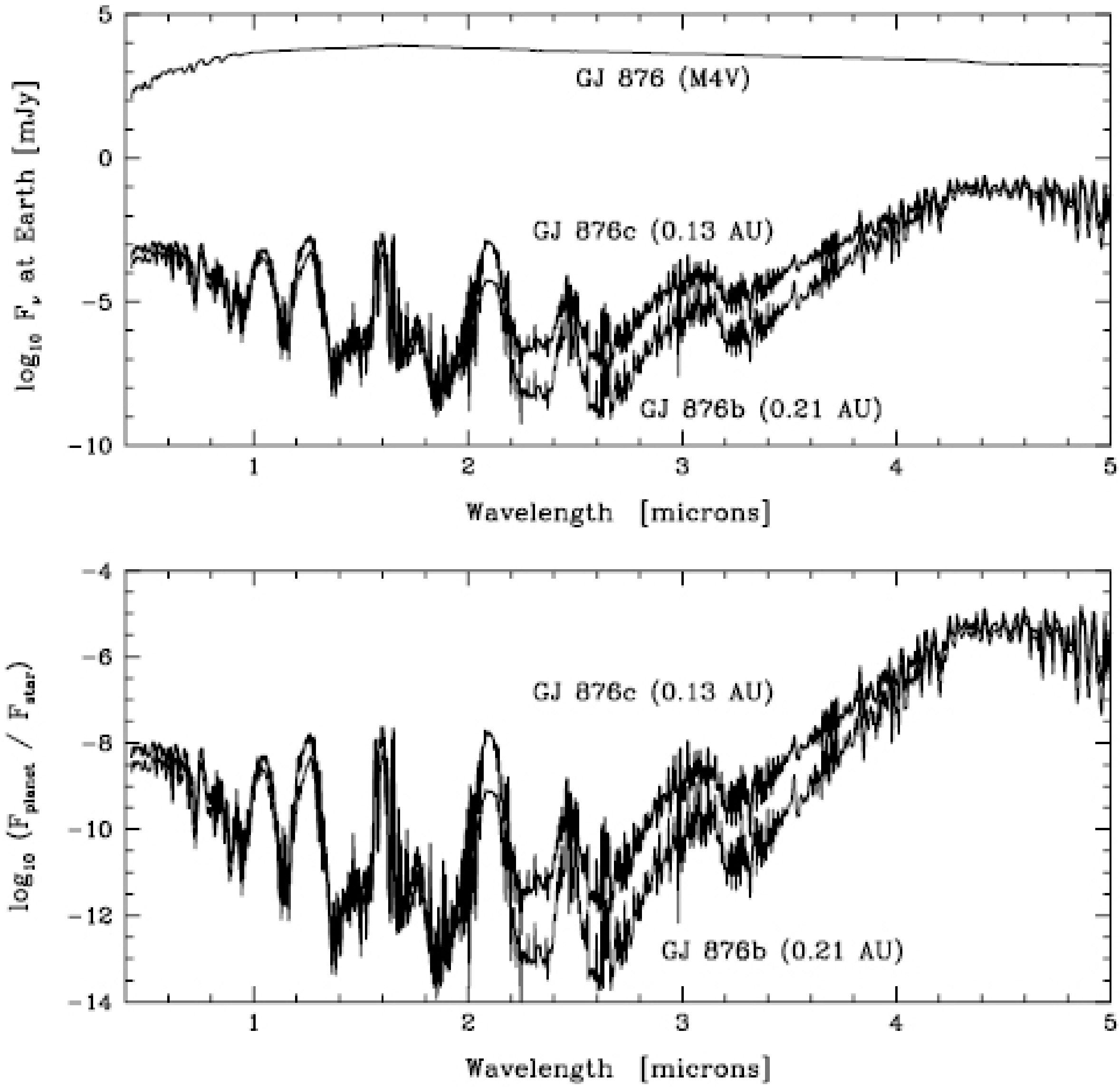
Nicht-stellare Spektroskopie in optischen Wellenlängen

Overwiew

- Planets
- Diffuse Interstellar Bands
- Quasi Stellar Objects (QSO)
- Quasars
- Pulsars
- Integrated spectra of Open Clusters
- Galaxies (Paul Eigenthaler)
- [IR more interesting]

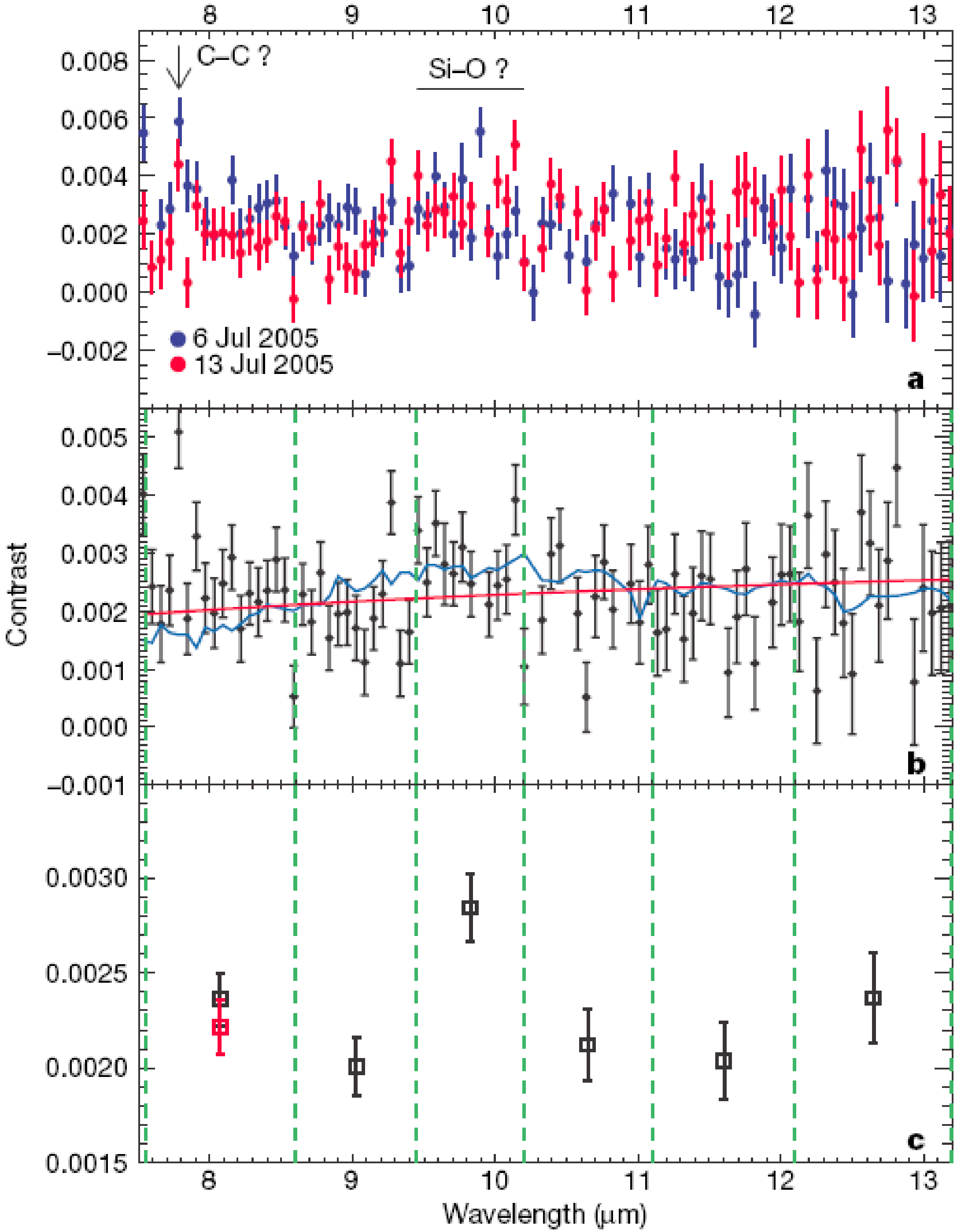
Spectrum of an extrasolar Planet

- Idea: During an eclipse => spectrum of star and planet => remove stellar spectrum => spectrum of the planet
- Problem: large absolute luminosity difference
- Solution: IR observations



Sudarsky et al., 2003, ApJ, 558, 1121

Star spectrum almost featureless!



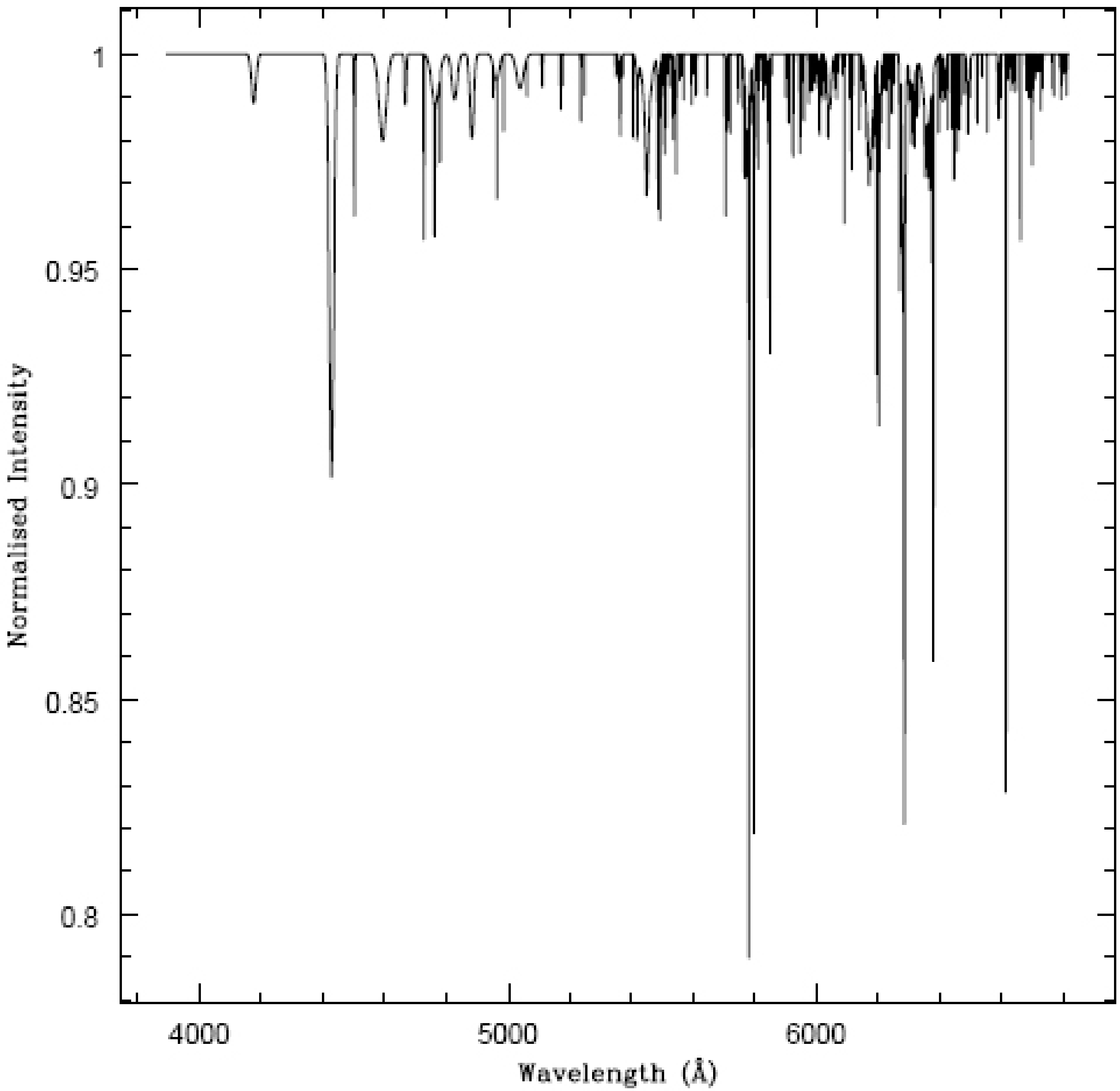
Richardson et al., 2007, Nature, 445, 892

Observations with the Spitzer telescope

HD 209458b: hot Jupiter

Diffuse Interstellar Bands

- Discovery in 1922
- About 300 known in the region from 4000 to 14000A
- Found in all wavelength regions
- Unidentifed absorption features (missing line data?)
- From faint to strong, narrow and wide
- Literature: Sarre, 2006, Journal of Molecular Spectroscopy, Volume 238, Issue 1, p. 1

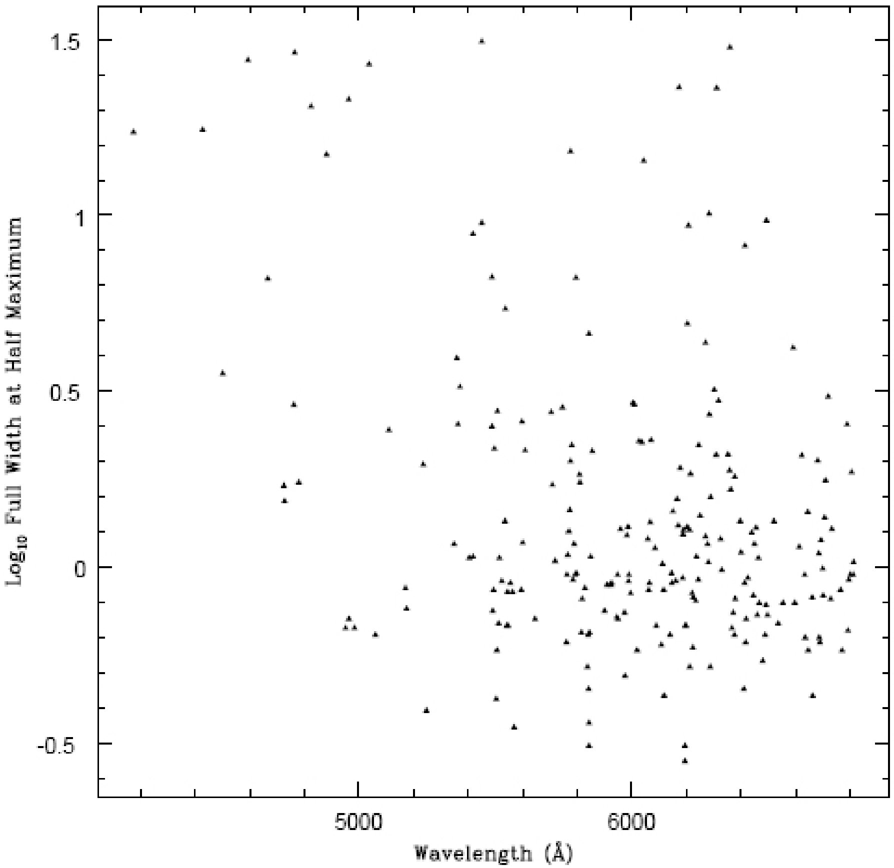


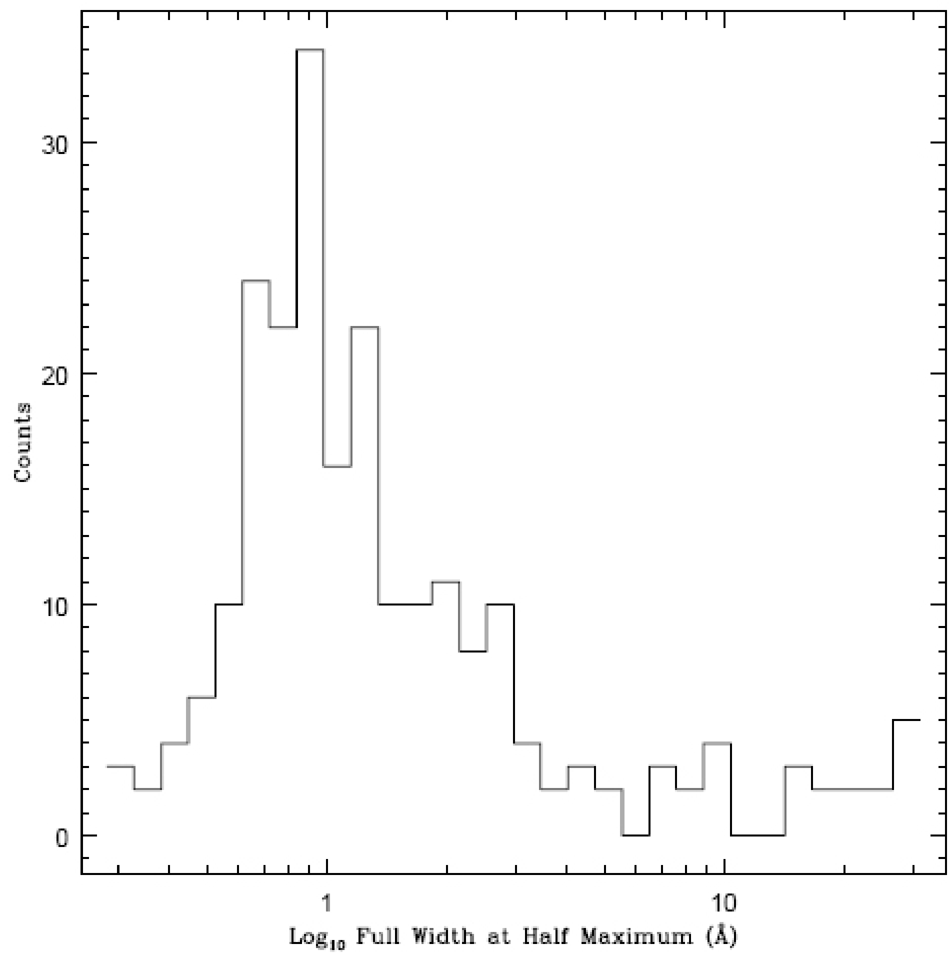
Tuairisg et al., 2000, A&AS, 142, 225

Stellar spectrum was subtracted

Fig. 1. A synthetic spectrum of all 226 DIBs confirmed towards BD+63° 1964 between 3906 Å and 6812 Å

No systematics





Quasars and Quasi Stellar Objects

- They have very prominent emission features in the UV
- Redshift => optical region
- Large Surveys, for example SLOAN
- Only low resolution needed to detect
- But very faint
- More flux in the IR

Surdej et al., 1982, A&A, 113, 182

Redshift!

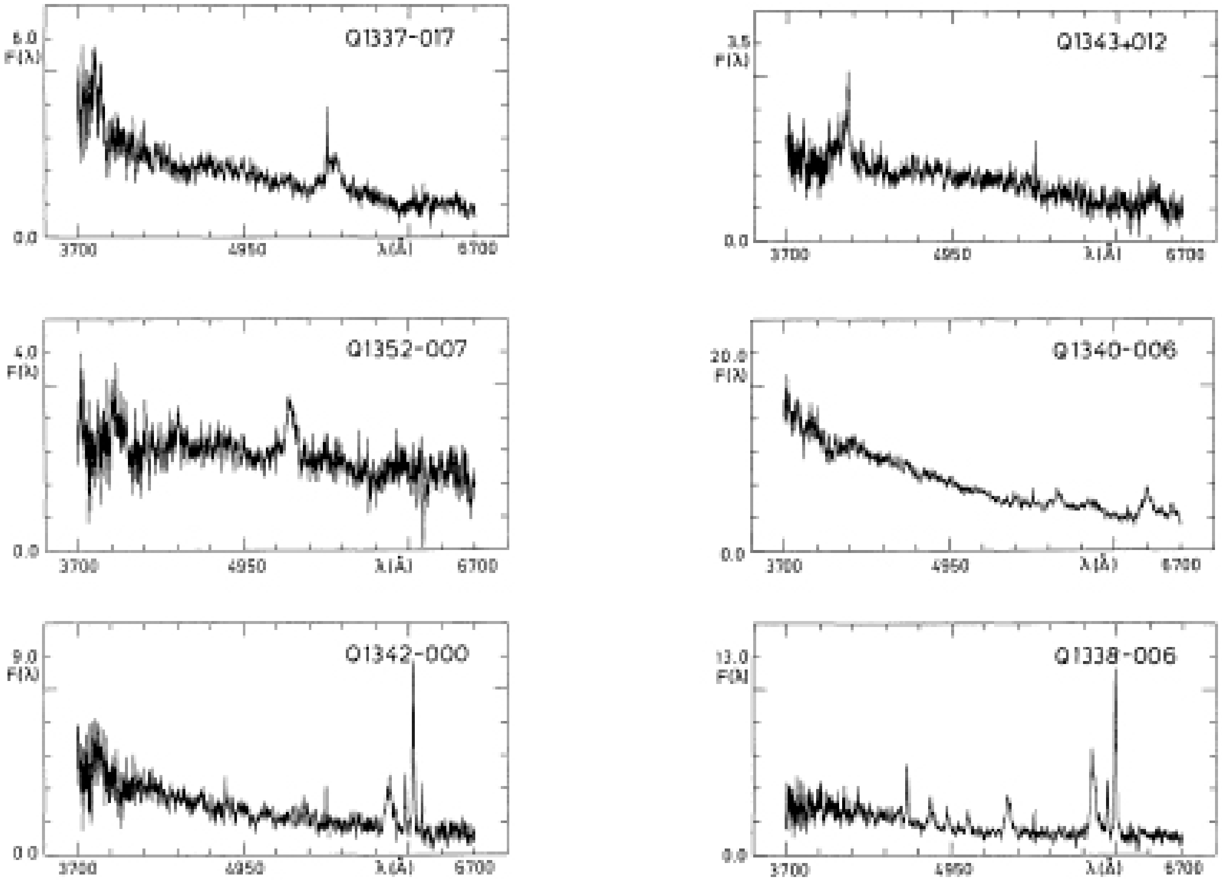
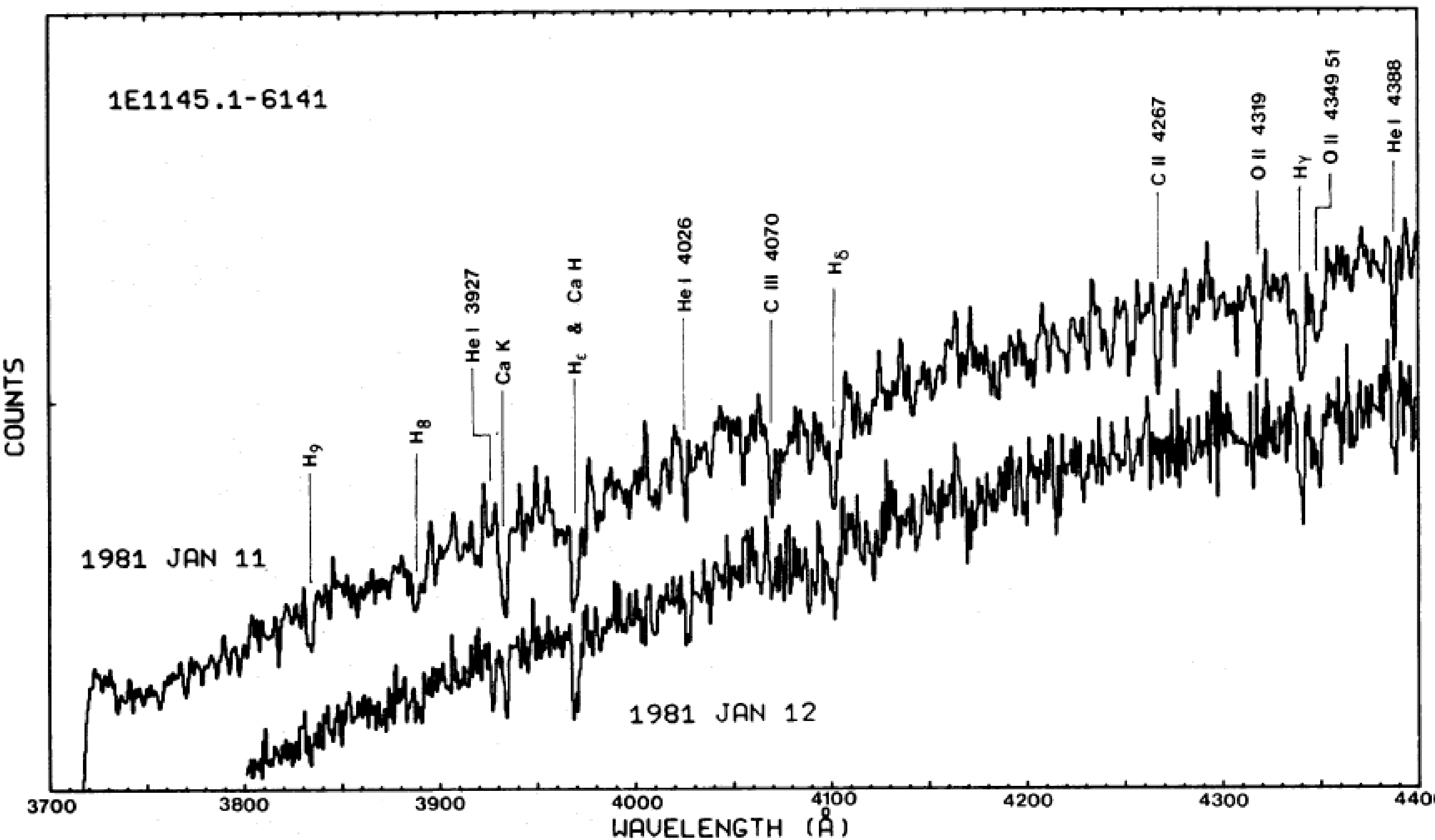


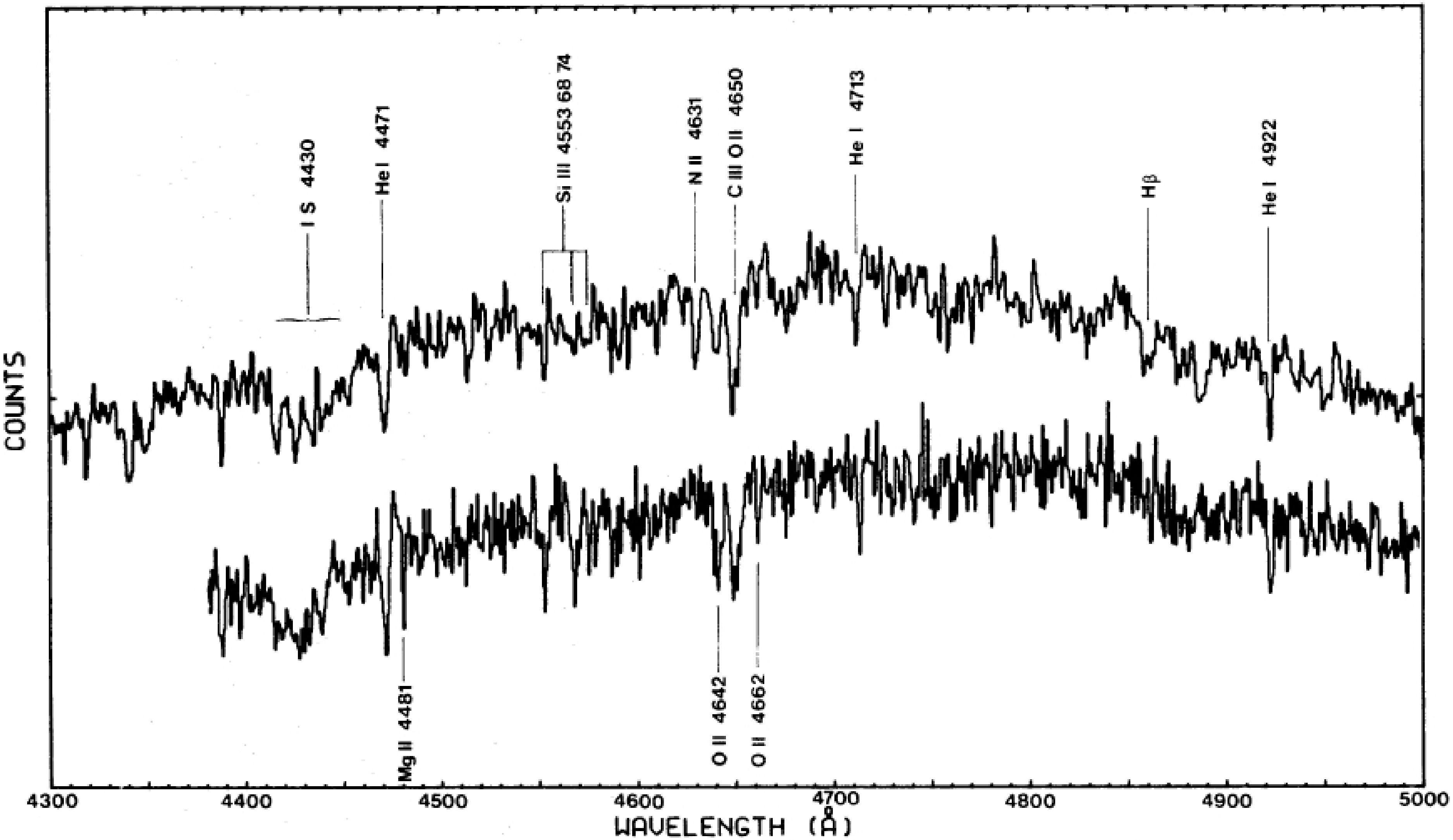
Table 2a. Line identifications (Å) and associated redshifts

Quasar	Z_e	Si IV/O IV] 1401.62*	C IV 1549.48	He II 1640.4	C III] 1910.11 § or 1907.64	Remarks (Explanation below table)
1338 − 018	2.079 ± 0.002	4317.4 ± 1.4⁺ 1402.1	4768.4 ± 1.9 1548.6		5882.9 ± 0.1 : 1910.5	1
1337 − 024	2.035 ± 0.009	4249.8 ± 4.9 : 1400.3	4691.8 ± 1.1 1546.0		5815.3 ± 0.8 : 1916.2	2
1345 − 016	1.925 ± 0.008	4106.5 ± 0.2 : 1404.1	4537.0 ± 1.9 1551.3		5569.8 ± 0.3 1904.4	3
1337 + 005	1.902 ± 0.002	I.D.	4493.8 ± 0.1 1548.8	?	5544.7 ± 0.3 1911.0	4
1349 + 001	1.426 ± 0.012 : :		3747.4 ± 0.3 1544.4	3970.0 ± 1.3 1636.2	4655.6 ± 0.3 1918.7	5

Pulsars

- Exhibit „more stellar like“ spectra
- Rapid variations with time
- Again, very faint objects
- Just two examples from Densham & Charles, 1982, MNRAS, 201, 171


1E1145.1-6141
COUNTS
WAVELENGTH (Å)
3700
3800
3900
4000
4100
4200
4300
4400
1981 JAN 11
1981 JAN 12
H9
H8
He I 3927
Ca K
Hε & Ca H
He I 4026
C III 4070
Hδ
C II 4267
O II 4319
Hγ
O II 4349 51
He I 4388



I S 4430
He I 4471
Si III 4553 68 74
N II 4631
C III O II 4650
He I 4713
Hβ
He I 4922
Mg II 4481
O II 4642
O II 4662
COUNTS
4300
4400
4500
4600
4700
4800
4900
5000
WAVELENGTH (Å)

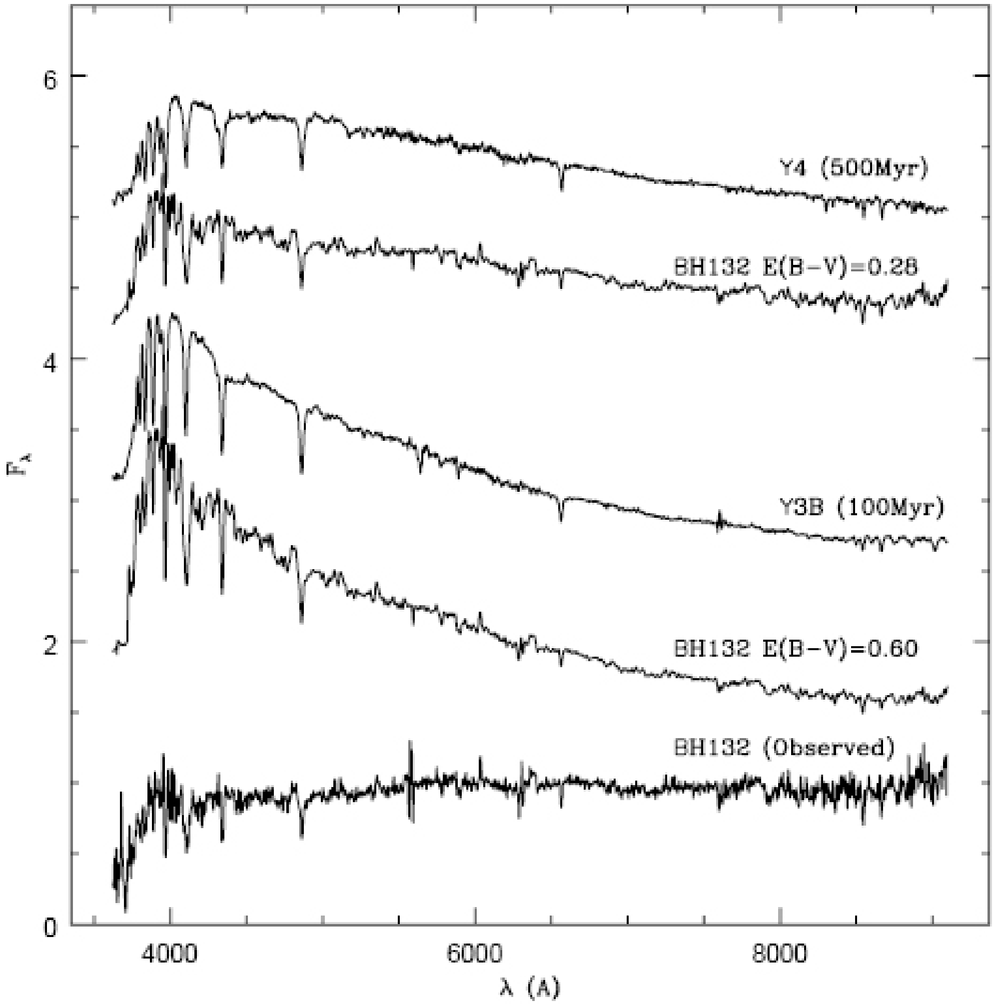
Integrated spectra of Open Clusters I

- Idea: clusters of different ages have different stellar content
- Example: old clusters (log t > 100 Myr) will not have any very hot (O and B) type stars any more as members because they have evolved
- Technique: slit spectrum over cluster => integrated spectrum of all members
- Assumption: slit covers a representative sample for the cluster

Integrated spectra of Open Clusters II

- How to get a standard library?
  1. Use isochrones together with Initial Mass Function (= statistical knowledge how much star form with a specific mass)
  2. Let the cluster evolve
  3. Calculate an integrated spectrum of „what's left“ in the cluster taking into account the luminosity of a star.
  4. Do this for a wide variety of ages and metallicities

Beispiele aus: Ahumada et al., 2000, A&AS, 141, 79



Cluster	$E(B-V)$	Age (Balmer) (Myr)	Age (template match) (Myr)	Adopted age (Myr)
Ruprecht 144	0.32 ± 0.02	200	100	150 ± 50
Melotte 105	0.31 ± 0.02	300	100	200 ± 100
BH 132	0.60 ± 0.05	200	100	150 ± 50
Hogg 15[a]	1.05 ± 0.05	30	3−6	5 ± 2
Pismis 21	1.50 ± 0.03	110	50	80 ± 30
Lyngå 11	0.12 ± 0.03	400	500	450 ± 50
BH 217	0.80 ± 0.03	20	50	35 ± 15