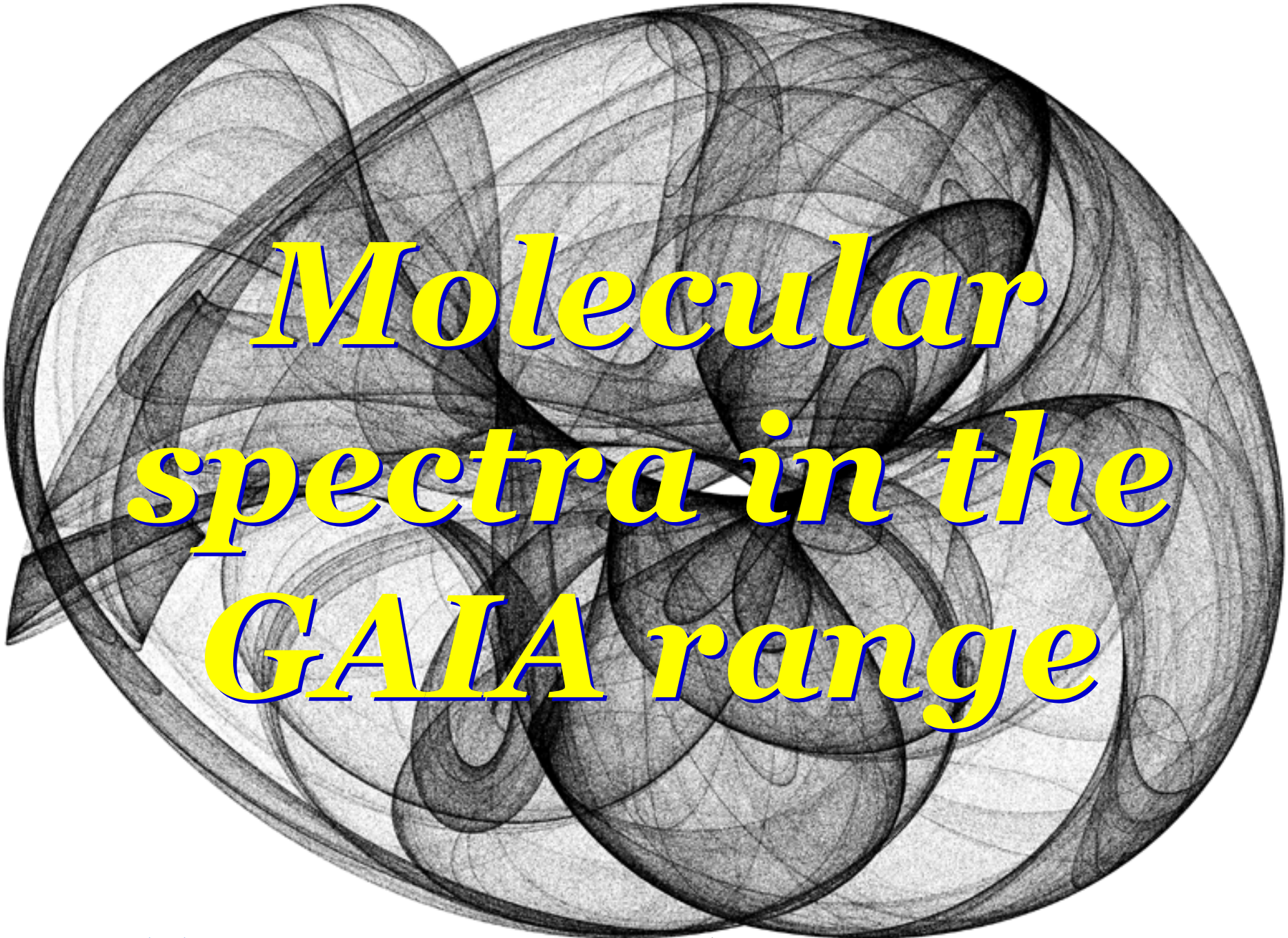
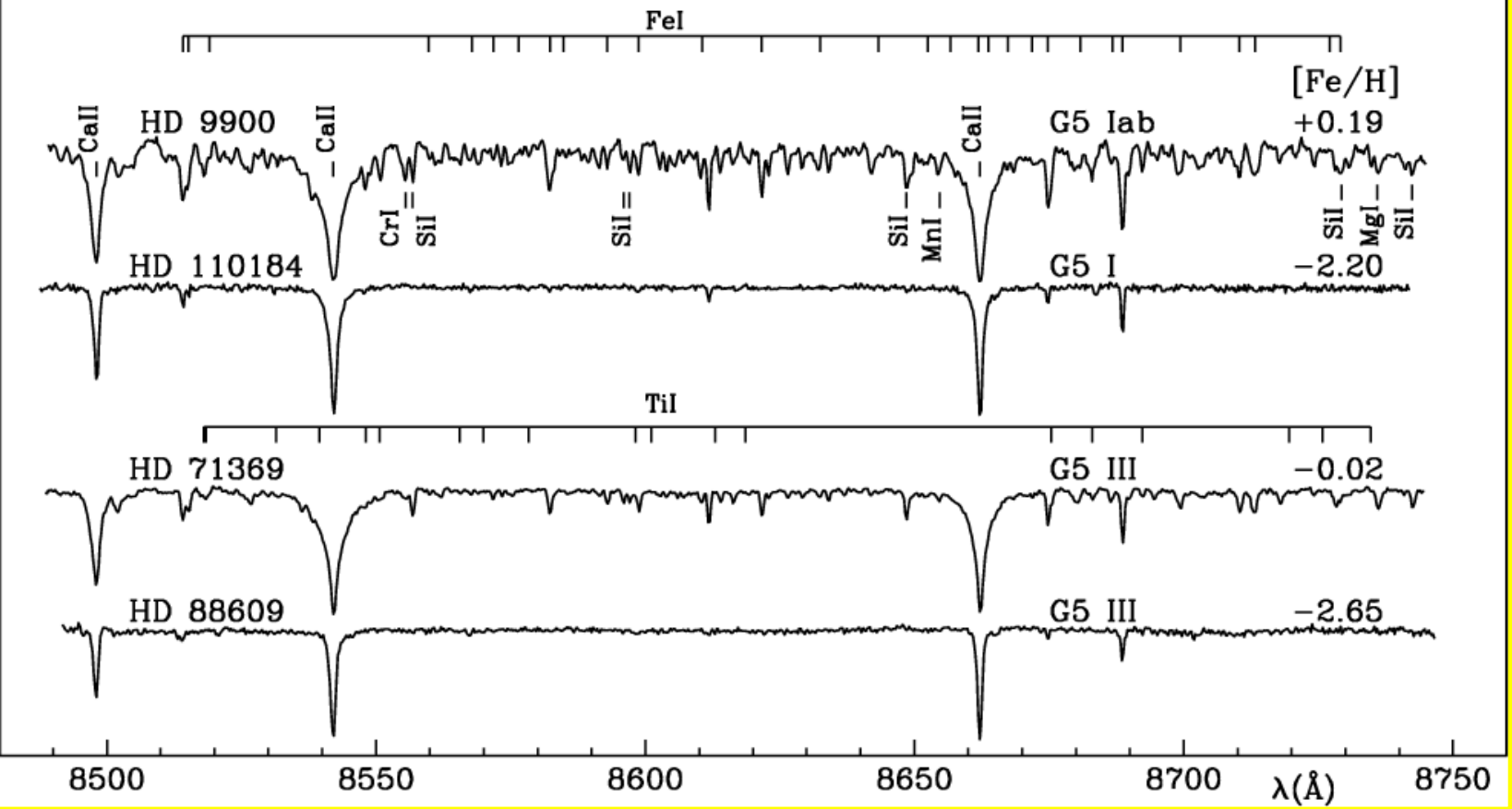


# Molecular spectra in the GAIA range

RVS workshop VIII

Padova, June 3-4, 2004




# Cool stars

# M S C

TABLE I

Revised Notation for Carbon Stars

| Equivalent types for oxygen stars | R sequence | N sequence | CH sequence |
|---|---|---|---|
| G4–G6 | C–R0 | | C–H0 |
| G7–G8 | C–R1 | C–N1 | C–H1 |
| G9–K0 | C–R2 | C–N2 | C–H2 |
| K1–K2 | C–R3 | C–N3 | C–H3 |
| K3–K4 | C–R4 | C–N4 | C–H4 |
| K5–M0 | C–R5 | C–N5 | C–H5 |
| M1–M2 | C–R6 | C–N6 | C–H6 |
| M3–M4 | | C–N7 | |
| M5–M6 | | C–N8 | |
| M7–M8 | | C–N9 | |

# MOLECULES identified in stellar spectra (Jorgensen 1996)

**TiO, VO**

**$CO$, $C_2$, CN, CH**

**ZrO, LaO, YO**

TABLE 1. The 40 diatomic, 8 polyatomic, and 3 ionic molecules observed in photospheres of M, S, and C stars and the Sun (photosphere + sunspots).

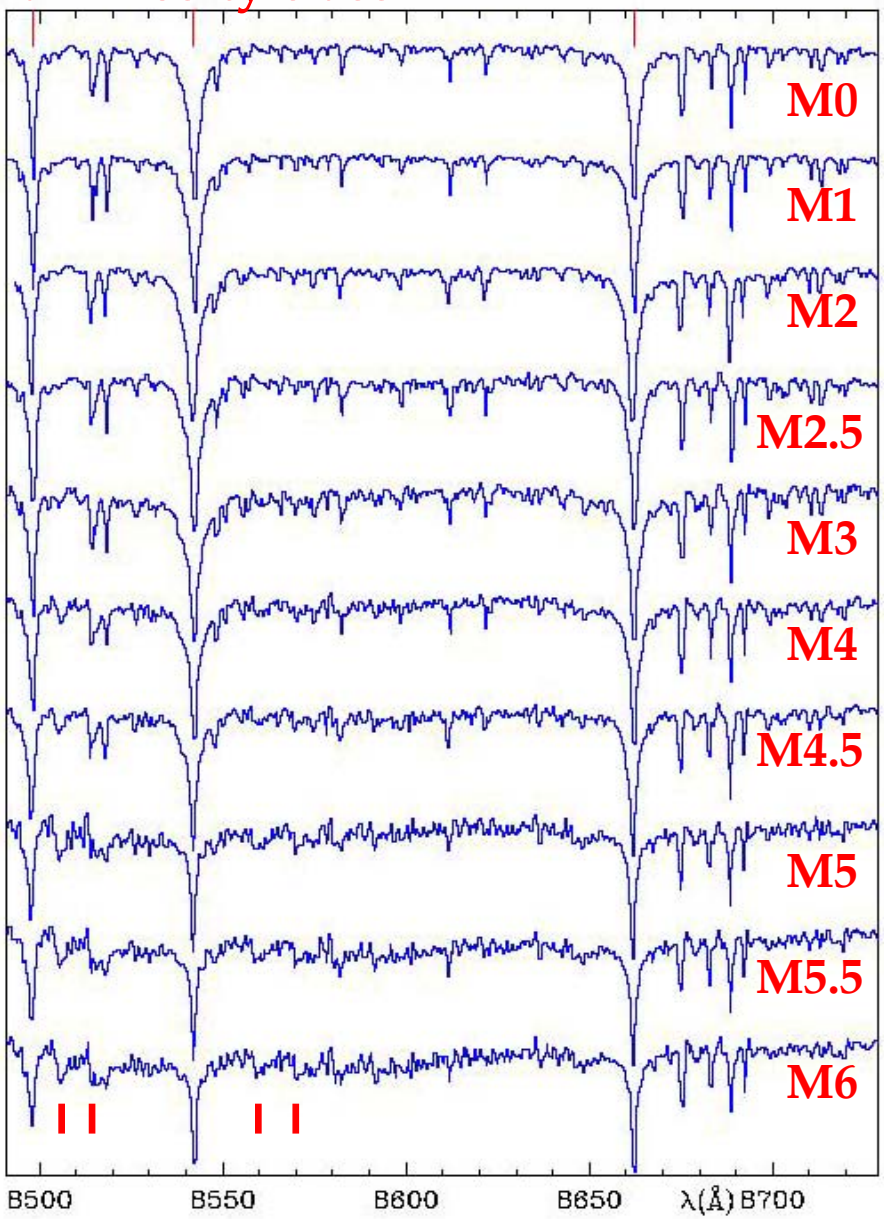
| Molecule | *observed in:* Sun | M | S | C | notes | Molecule | *observed in:* Sun | M | S | C | notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Diatomic molecules: | | | | | | | | | | | |
| | | | | | | SiN | | * | | | |
| AlH | * | * | * | * | | SiO | * | * | * | | K,S+ |
| AlO | | * | | | gi | SnH | | | | * | |
| BO | | * | | | | TiH | * | * | | | |
| CaH | * | * | | | CS, dw | TiO | * | * | * | | K |
| CaCl | | | | * | CS | TiS | | | * | | |
| CeO | | | * | | MS | VO | | * | * | | |
| CrO | | * | | | | YO | | * | * | | S+ |
| CrH | * | | | | | YS | | | * | | |
| $C_2$ | * | | | * | | ZnH | | | | * | |
| CH | * | * | * | * | G,K,Ap,d+ | ZrO | * | * | * | | SC,S+ |
| CN | * | * | * | * | G,K,RCrB, g+,S+ | ZrS | | | * | | |
| CO | * | * | * | * | K,SN,nova, g+,S+ | | | | | | |
| CS | | | | * | | Molecular ions: | | | | | |
| CuH | * | | | * | | | | | | | |
| FeH | * | * | * | | K,d+,S+ | $H^-$ | | * | * | * | d+ |
| GeH | | | | * | | $SiH^+$ | | * | | | |
| $H_2$ | * | * | * | * | | $CH^+$ | | * | | | |
| HF | * | * | * | * | K | | | | | | |
| HCl | * | | * | | | Polyatomic molecules: | | | | | |
| LaO | | | * | | | | | | | | |
| MgH | * | * | * | | K, dw | $C_2H$ | | | | * | |
| MgO | | * | | | | $C_2H_2$ | | | | * | |
| NH | * | * | | * | | $C_3$ | | | | * | |
| NiH | * | | | | | CaOH | | * | | | K7,dw |
| OH | * | * | * | | K, d+ | HCN | | | | * | |
| ScO | * | * | * | | | $H_2O$ | * | * | | | d+ |
| SiF | | * | | | | $SiC_2$ | | | | * | SC |
| SiH | * | * | * | * | | $CH_4$ | | * | | | bdw |

Notes: gi, dw means that the molecule has been observed only in giants or dwarfs, respectively. g+ and d+ refers to the bands of the molecule being stronger in giants than in dwarfs (g+) or visa versa (d+). S+ refers to the bands being stronger in S stars than in M type giants. G, K, SC, CS, MS, Ap, RCrB, SN (super nova), and nova, respectively, refers to the molecule having been identified also in these types of stars. The note bdw for $CH_4$ reminds us that $CH_4$ has been observed not in "real M-type dwarfs" but in Brown Dwarfs only.

# M stars

Literature: 78 M stars

## luminosity class III




**TiO** (Kirkpatrick 1991)

8506
8512
8558
8569

**VO** (Solf 1978)

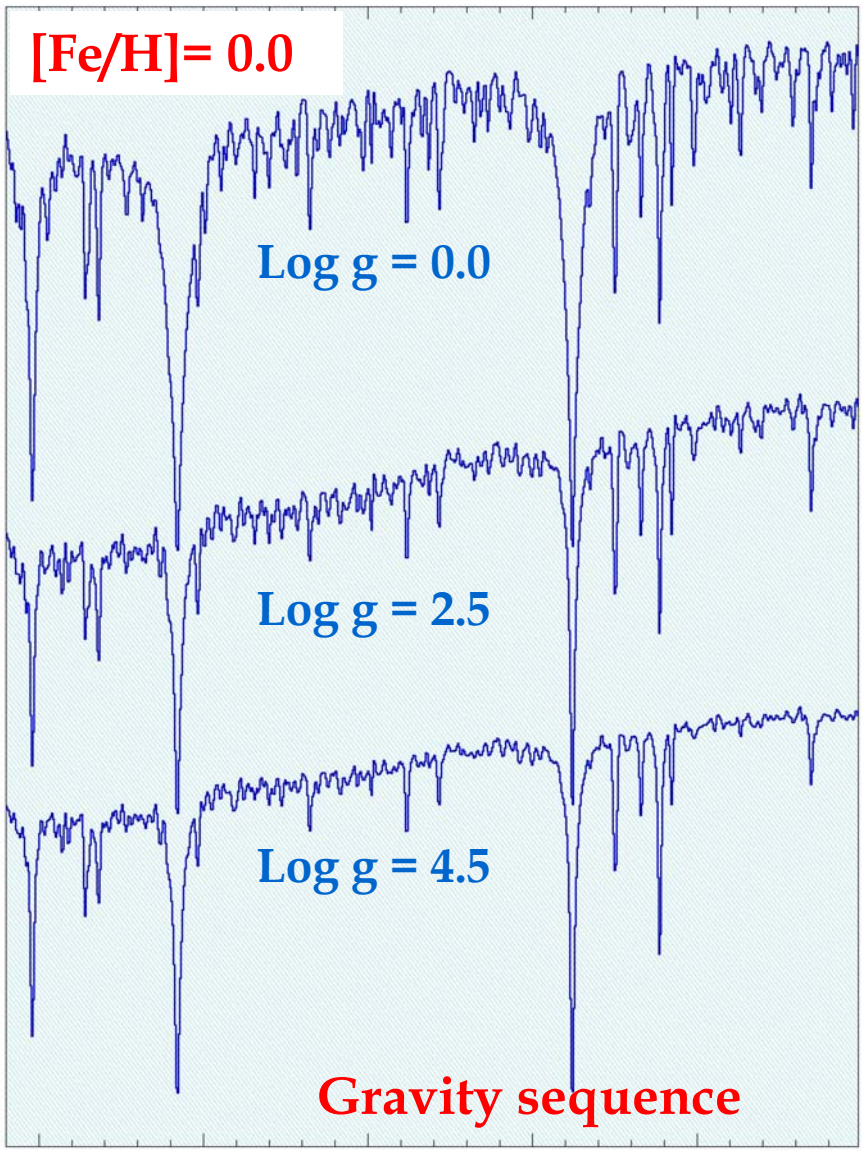
| | |
|---|---|
| 8521 | 8538 |
| 8574 | 8597 |
| 8605 | 8624 |
| 8649 | 8668 |

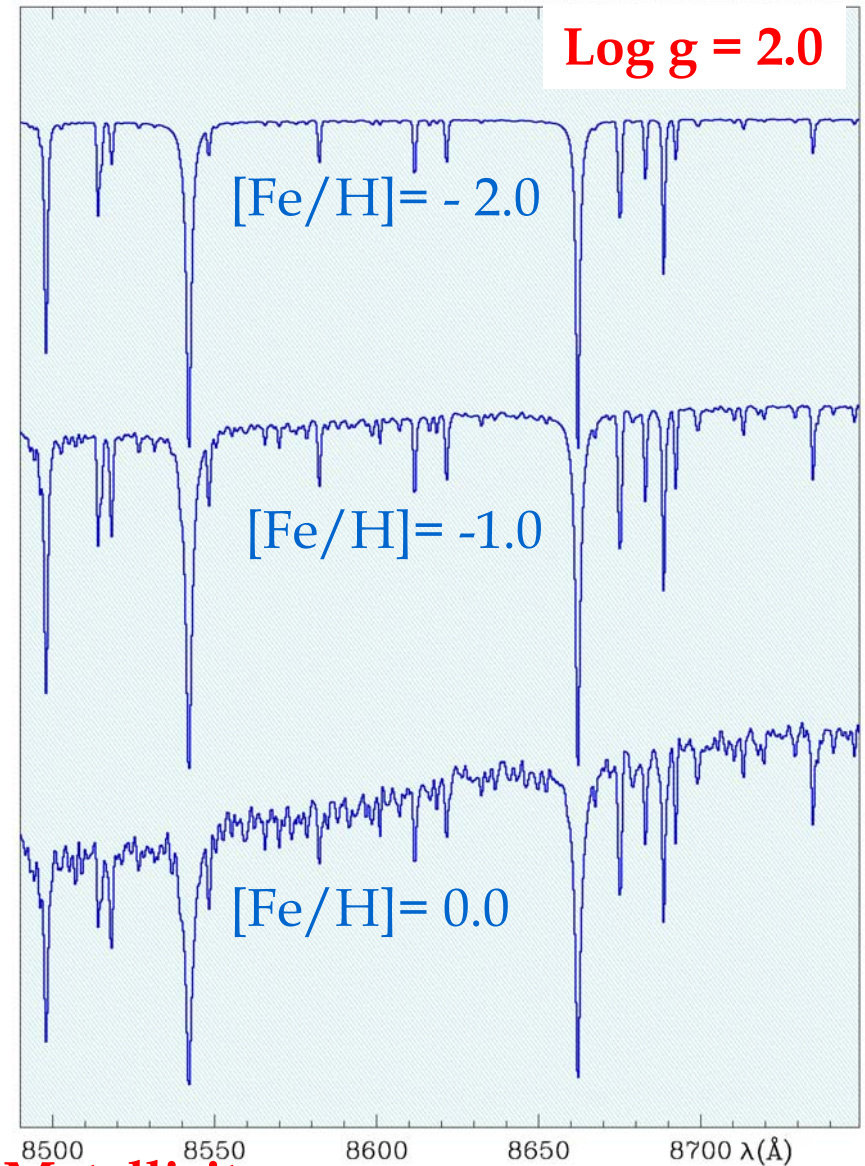
Munari &Tomasella 1999
Marrese et al. 2003

| | V | III | II | I | | V | III | II | I |
|---|---|---|---|---|---|---|---|---|---|
| F0 | o | o | o | o | K0 | xo | xo | x | xo |
| F2 | xo | | | xo | K1 | | x | | |
| F3 | xo | o | | | K2 | | x | | x |
| F4 | x | x | | | K3 | xo | xo | o | o |
| F5 | xo | xo | | xo | K4 | x | xo | | x |
| F6 | x | x | | | K5 | o | xo | x | o |
| F7 | x | | | x | K6 | | x | | |
| F8 | xo | x | | o | K7 | o | o | o | |
| F9 | x | | | | M0 | o | xo | | xo |
| G0 | o | xo | | xo | M1 | o | xo | | x |
| G1 | | x | | x | M2 | o | xo | xo | xo |
| G2 | xo | o | | xo | M3 | o | xo | o | xo |
| G3 | | | | | M4 | o | xo | | xo |
| G4 | | | | | M5 | | xo | | o |
| G5 | xo | xo | | xo | M6 | o | xo | | |
| G6 | x | x | | | M7 | | | x | |
| G7 | x | | x | | M8 | | o | | |
| G8 | xo | xo | | o | | | | | |
| G9 | x | x | | | | | | | |

# Kurucz synthetic spectra

T = 3500 K

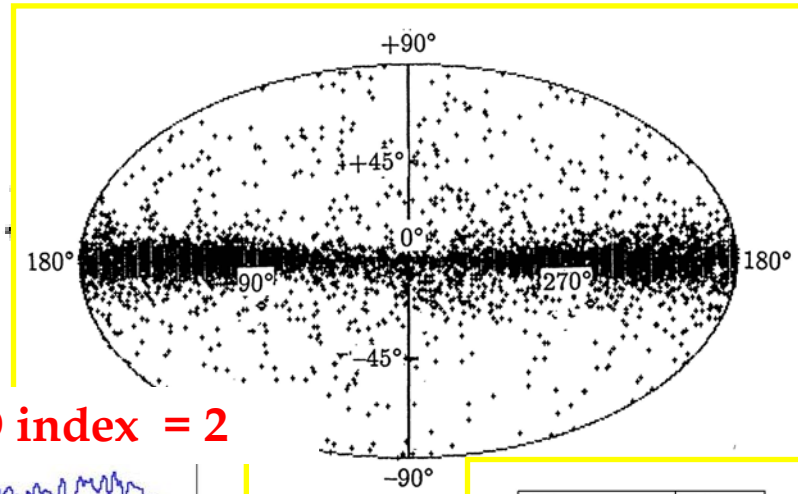


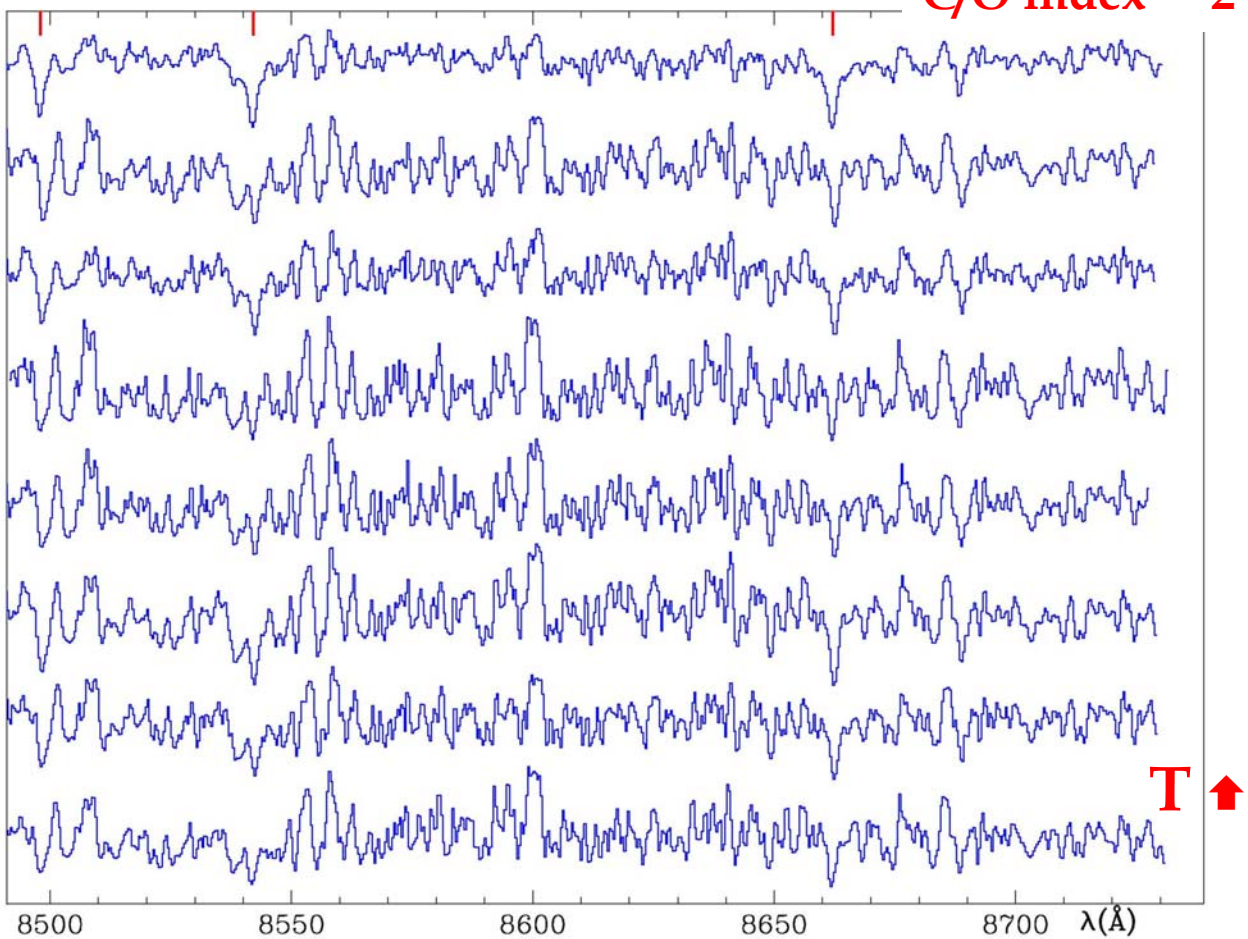
# Carbon stars

General Catalogue of Galactic Carbon stars by Stephenson (Alknis at al. 2001.) **6891 stars**

$T_{eff}$ 1900-4000 K (Bergeat at al.2001)



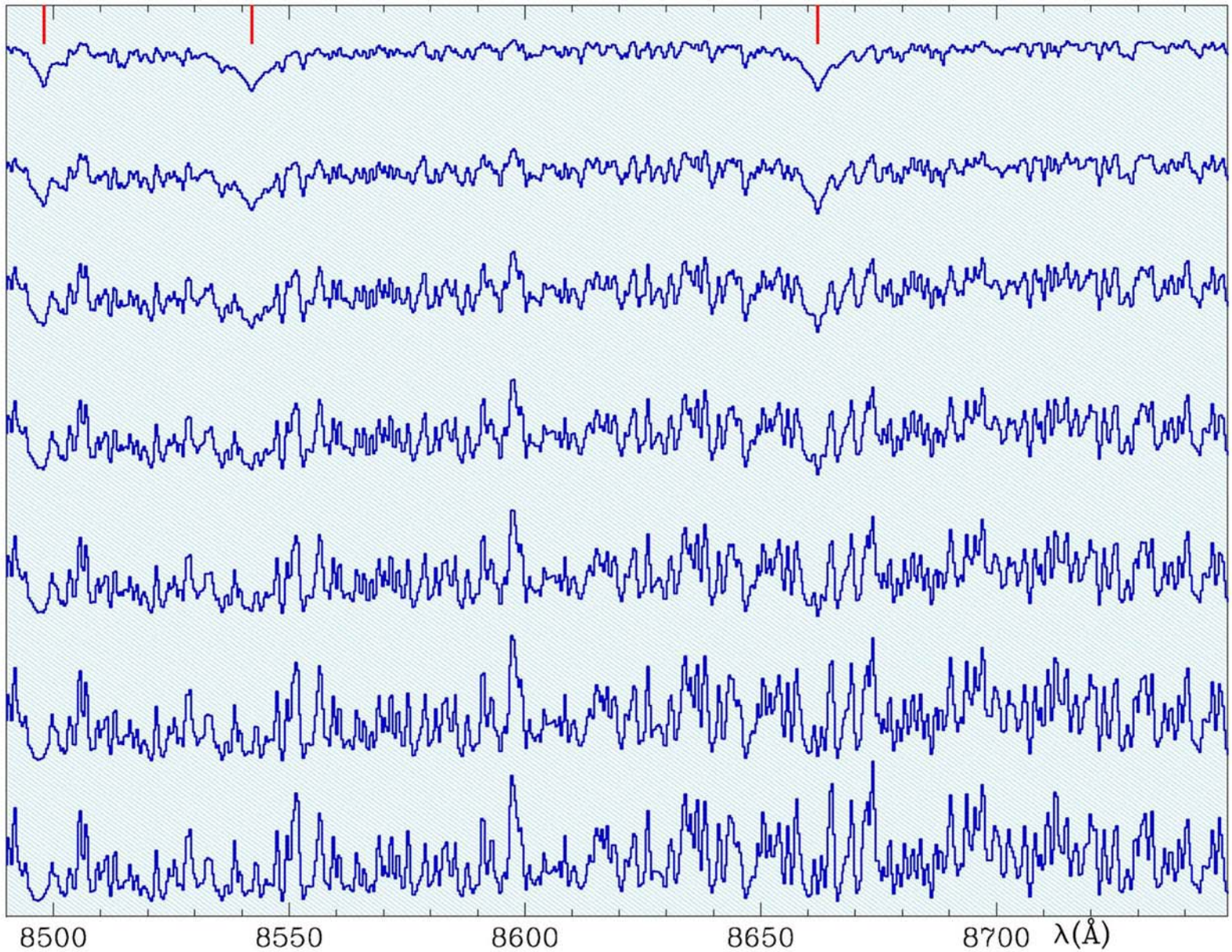

**C/O index = 2**




| Name | Class |
|---|---|
| HD 156074 | C1,2 |
| Ros51 | C2,1 |
| C* 888 | C2,2 |
| HD 16115 | C2,3 |
| HD 47396 | C3,1 |
| BD +21.64 | C3,3 |
| V738 Mon | C3,4 |
| DV Lac | C4,3 |
| HD 52432 | C4,4 |
| VX And | C4,5 |
| BG Mon | C5,2 |
| HD 25408 | C5,3 |
| VW Gem | C5,4 |
| V466 Per | C5,5 |
| NQ Gem | C6,2 |
| HD 92839 | C6,3 |
| TU Gem | C6,4 |
| V Hya | C6,5 |
| W CMi | C7,2 |
| HD 183556 | C7,3 |
| TT Tau | C7,4 |
| UV Aur | C8,1 |
| HD 192443 | C8,2 |
| HD 224855 | C9,1 |
| U Cyg | C9,2 |

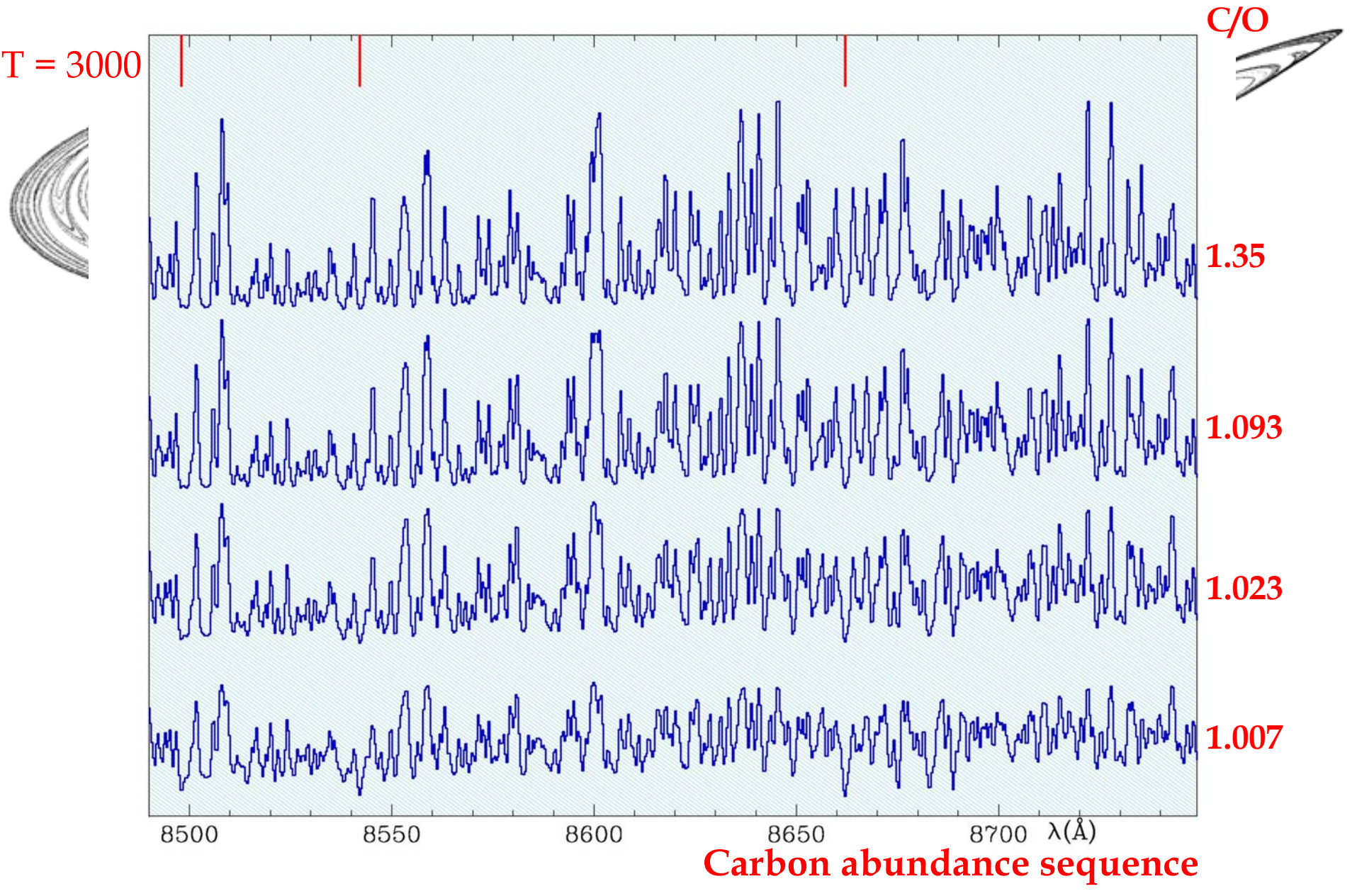
# Paylenko synthetic grid

C/O = 1.071



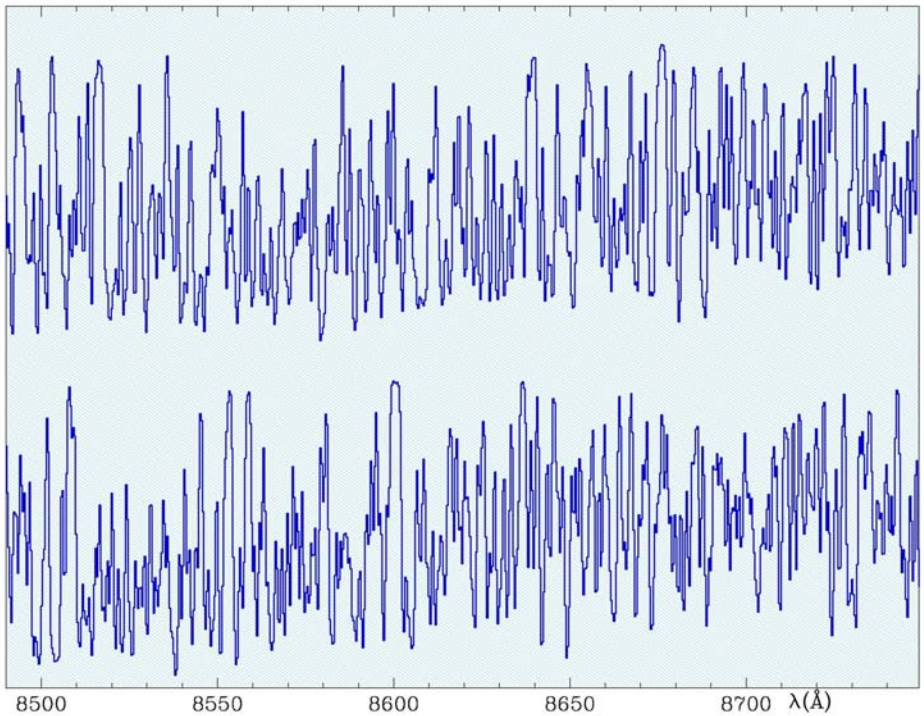

Temperature sequence

# Pavlenko synthetic grid




Carbon abundance sequence

# Pavlenko synthetic grid




$^{13}C/^{14}N$

$^{12}C/^{14}N$

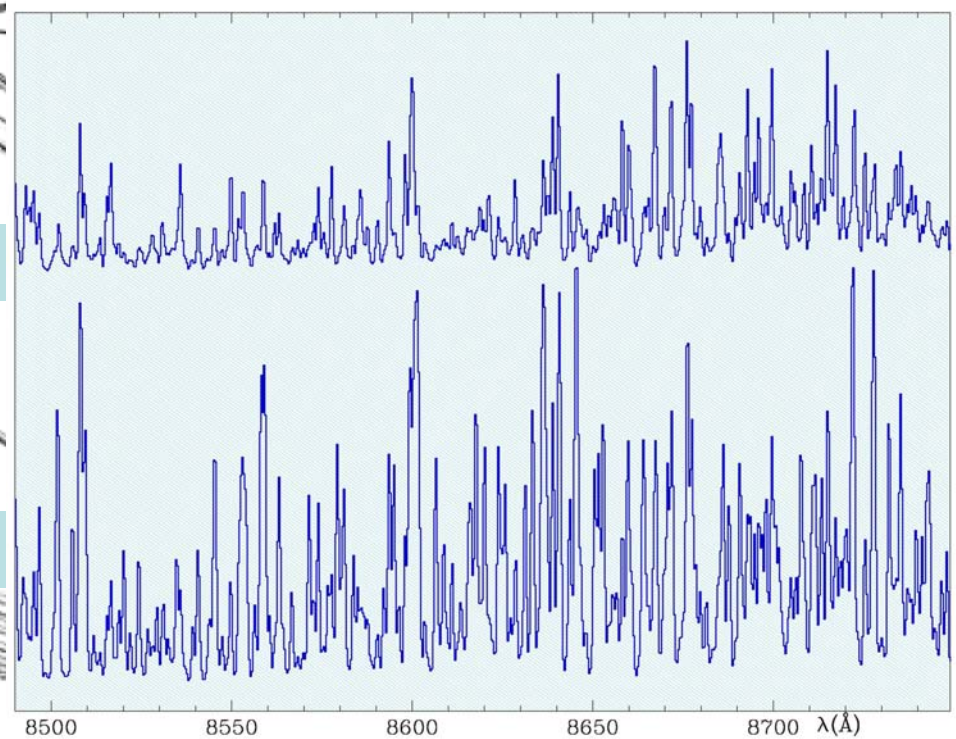
$^{12}C/^{13}C$ isotopic ratio

T = 3000

C/O = 1.35

$^{12}C/^{13}C$ = 7/3

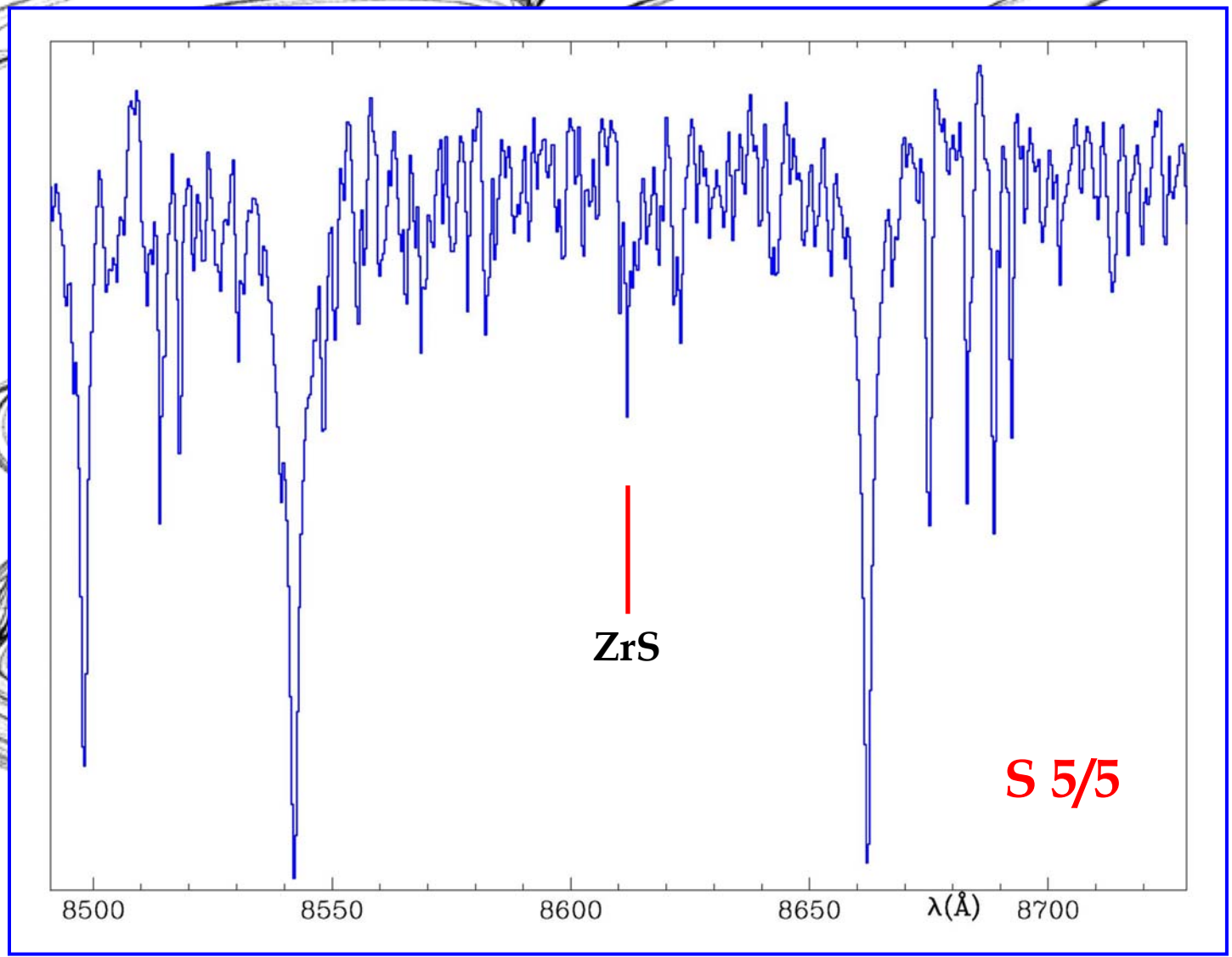
$^{12}C$ = 1



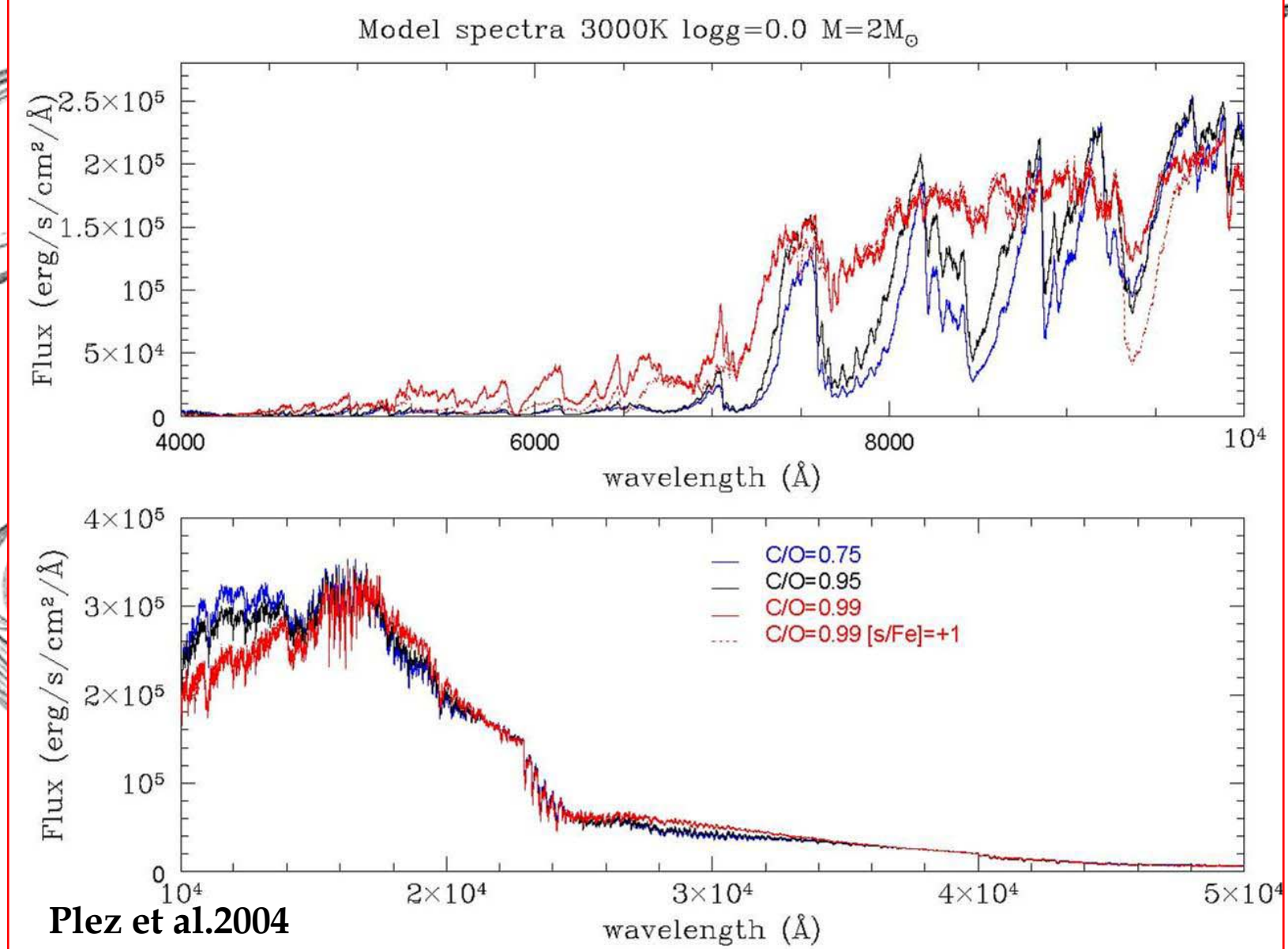
# S-type stars

6 in literature

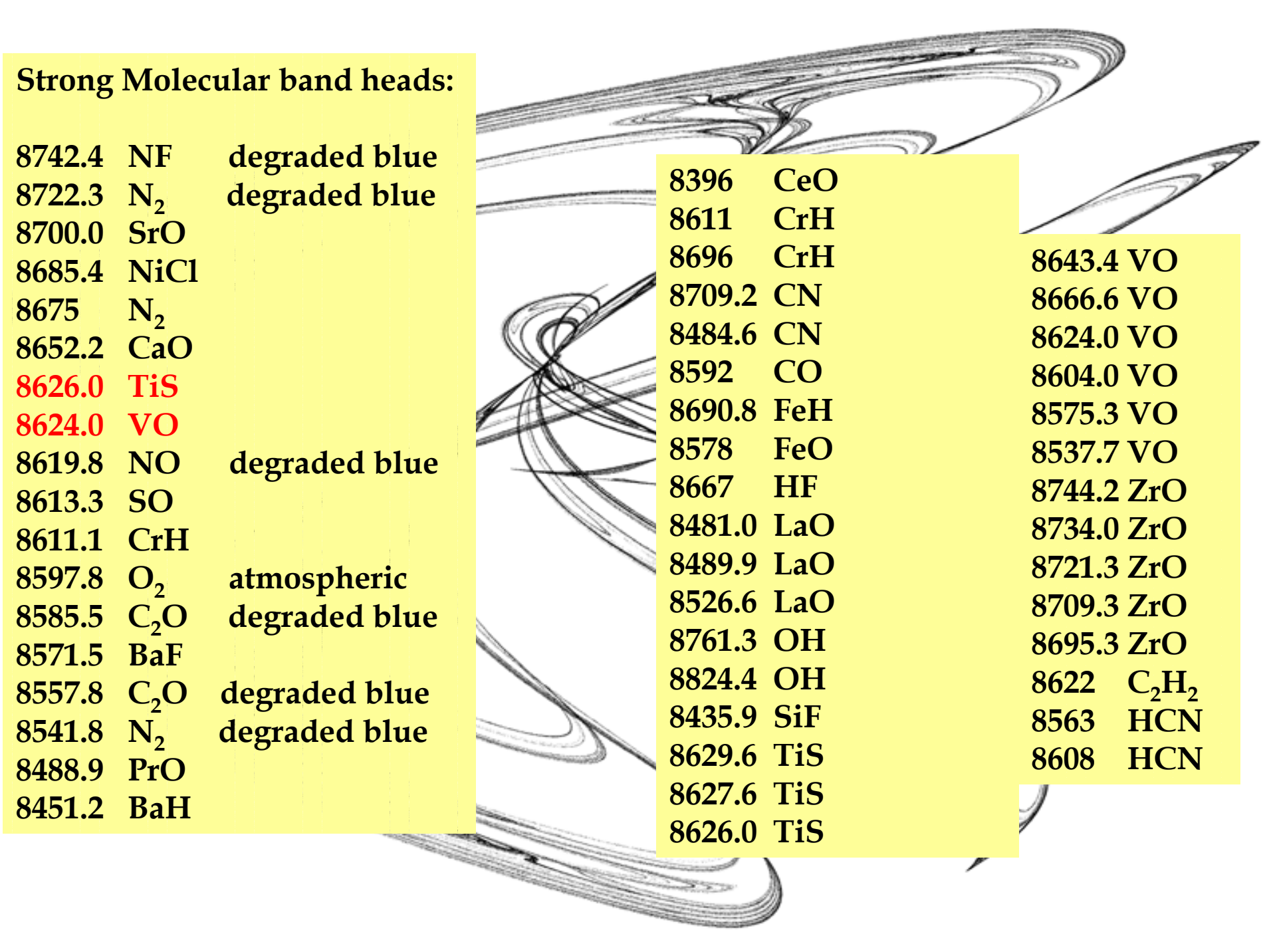
| Name | Class |
|---|---|
| HD 22649 | S4/2 |
| HD 283350 | S3+/3 |
| HD 286892 | S5.5/1 |
| BD+79.156 | S4/2 |
| BD+15.1200 | S4/2 |
| HD 110813 | S3/6 |
| BD+23.3093 | S3/3 |
| HD 170970 | S3/1 |
| HD 187796 | S7/1.5e |
| HD 190629 | S6/3 |
| V441 Cyg | S4/6 |
| HD 195665 | S5/5 |
| HD 198164 | CS |
| HD 200527 | S4/1 |
| CV Cep | S7/1.5 |
| BD+28.4592 | S2/3: |



# S-type stars




Plez et al.2004



**Strong Molecular band heads:**

| | | |
|---|---|---|
| 8742.4 | NF | degraded blue |
| 8722.3 | $N_2$ | degraded blue |
| 8700.0 | SrO | |
| 8685.4 | NiCl | |
| 8675 | $N_2$ | |
| 8652.2 | CaO | |
| 8626.0 | TiS | |
| 8624.0 | VO | |
| 8619.8 | NO | degraded blue |
| 8613.3 | SO | |
| 8611.1 | CrH | |
| 8597.8 | $O_2$ | atmospheric |
| 8585.5 | $C_2O$ | degraded blue |
| 8571.5 | BaF | |
| 8557.8 | $C_2O$ | degraded blue |
| 8541.8 | $N_2$ | degraded blue |
| 8488.9 | PrO | |
| 8451.2 | BaH | |

| | |
|---|---|
| 8396 | CeO |
| 8611 | CrH |
| 8696 | CrH |
| 8709.2 | CN |
| 8484.6 | CN |
| 8592 | CO |
| 8690.8 | FeH |
| 8578 | FeO |
| 8667 | HF |
| 8481.0 | LaO |
| 8489.9 | LaO |
| 8526.6 | LaO |
| 8761.3 | OH |
| 8824.4 | OH |
| 8435.9 | SiF |
| 8629.6 | TiS |
| 8627.6 | TiS |
| 8626.0 | TiS |

| | |
|---|---|
| 8643.4 | VO |
| 8666.6 | VO |
| 8624.0 | VO |
| 8604.0 | VO |
| 8575.3 | VO |
| 8537.7 | VO |
| 8744.2 | ZrO |
| 8734.0 | ZrO |
| 8721.3 | ZrO |
| 8709.3 | ZrO |
| 8695.3 | ZrO |
| 8622 | $C_2H_2$ |
| 8563 | HCN |
| 8608 | HCN |

| | $V_T$ | $(B-V)_T$ | Spectral Type | [Fe/H] | Var. name | $\phi$ | $\eta$ | $v_{rot} sini$ (km/sec) | Refs. | HJD (−2451000) | $v_0$ (km/sec) | S/N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HD 130817 | 6.181 | +0.40 | F2 V | −0.39 / −0.51 | | | | ~15 | 4 ,5a, , ,11 | 716.4 | − 36.8 ±1.2 | 120 |
| HD 182835 | 4.729 | +0.61 | F2 Ib | | NSV 12021 | S | | 3.8 ± 2.0 | 1d, ,10, ,11 | 770.4 | − 4.8 ±0.8 | 206 |
| HD 91752 | 6.337 | +0.45 | F3 V | −0.246 ± 0.044 | | | | 9.0 ± 3.0 | 4 ,6b, , ,11 | 681.3 | − 25.7 ±0.3 | 177 |
| HD 101606 | 5.790 | +0.46 | F4 V | −0.82 / −0.74 | | | | <15. | 4 ,5a, , ,11 | 681.5 | + 33.8 ±0.4 | 162 |
| HD 71433 | 6.657 | +0.55 | F4 III | +0.100 ± 0.100 | | | | 20 | 4 ,6n, , ,11 | 951.4 | + 50.8 ±1.4 | 108 |
| HD 87141 | 5.764 | +0.52 | F5 V | +0.047 ± 0.053 | | | | 15.0 ± 3.0 | 4 ,6b, , ,11 | 951.6 | − 20.5 ±0.8 | 107 |
| HD 171802 | 5.419 | +0.40 | F5 III | +0.10 | | | M | ~8 | 4 ,5a, ,15,11 | 770.3 | − 33.2 ±1.2 | 229 |
| HD 193370 | 5.235 | +0.71 | F5 Ib | +0.00 | NSV 12994 | S | | 10.0 | 1d,5b,10, ,11 | 770.5 | − 9.2 ±1.0 | 150 |
| HD 20902 | 1.866 | +0.55 | F5 Ib | −0.02 | NSV 01125 | S | | 17.9 ± 1.0 | 1c,7 ,10, ,11 | 919.3 | − 6.8 ±1.7 | 173 |
| HD 142860 | 3.882 | +0.52 | F6 V | −0.201 ± 0.047 | NSV 07350 | C | L | ~10 | 1d,6b,10,15,11 | 716.4 | + 5.6 ±0.6 | 172 |
| HD 124850 | 4.126 | +0.55 | F6 III | −0.129 ± 0.043 | NSV 06604 | C | L | ~15 | 4 ,6n, 9,15,11 | 655.5 | + 10.8 ±0.7 | 193 |
| HD 99373 | 6.376 | +0.47 | F7 V | | | | | ~8 | 4 , , , ,11 | 681.4 | − 25.0 ±0.5 | 140 |
| HD 14662 | 6.383 | +0.94 | F7 Ib | | V 440 Per | S | | 10.0 | 4 , , 9, ,11 | 951.3 | − 3.7 ±0.7 | 132 |
| HD 171635 | 4.832 | +0.68 | F7 Ib | | | | L | 4.8 ± 2.3 | 2b, , ,15,11 | 770.4 | − 12.9 ±0.7 | 196 |
| HD 90839 | 4.880 | +0.56 | F8 V | −0.220 ± 0.136 | | | L | 10 | 4 ,6b, ,15,11 | 681.3 | + 9.4 ±0.4 | 181 |
| HD 47703 | 6.538 | +0.53 | F8 III | | | | | ~6 | 4 , , , ,11 | 955.4 | + 84.7 ±0.8 | 117 |
| HD 102870 | 3.649 | +0.61 | F9 V | +0.180 ± 0.044 | | C | | ~5 | 1c,8 , 9, ,11 | 656.4 | + 4.9 ±0.5 | 140 |
| HD 74462 | 8.790 | +1.12 | G0 III | −1.61 / −1.36 | | | | | 3a,5a, , , | 565.5 | −168.8 ±0.4 | 152 |
| HD 208110 | 6.230 | +0.88 | G0 III | | | | | ~4 | 4 , , , ,11 | 770.5 | − 8.0 ±0.4 | 141 |
| HD 16901 | 5.534 | +1.01 | G0 Ib-IIa | +0.01 | | | L | 6.3 ± 2.2 | 1a,5a, ,14,11 | 565.4 | − 1.0 ±0.6 | 156 |
| HD 119605 | 5.655 | +0.88 | G0 Ib-IIa | +0.11 | | | | | 1b,5a, , , | 655.4 | + 0.2 ±0.6 | 197 |
| HD 65448 | 6.151 | +0.76 | G1 III | | | | | ~2.4 | 4 , , , ,11 | 655.4 | + 23.4 ±0.3 | 203 |
| HD 188650 | 5.867 | +0.87 | G1 Ib-II | −0.40 | | C | | | 1b,5b, 9, , | 715.6 | − 24.3 ±0.8 | 164 |
| HD 74395 | 4.716 | +0.92 | G1 Ib | −0.11 | | | L | ~7.5 | 1b,5a, ,14,11 | 955.4 | + 28.0 ±0.6 | 100 |
| HD 76151 | 6.069 | +0.74 | G2 V | +0.132 ± 0.051 | | | M | 1.6 ± 1.1 | 1a,6b, ,14,11 | 955.5 | + 31.3 ±0.6 | 107 |
| HD 67594 | 4.456 | +1.11 | G2 Ib | | | | M | 7.2 | 1a, , ,14,12 | 951.4 | + 28.6 ±0.5 | 156 |
| HD 71148 | 6.390 | +0.69 | G5 V | | | | H | <15 | 4 , , ,15,11 | 655.4 | − 30.4 ±0.3 | 169 |
| HD 71369 | 3.436 | +0.97 | G5 III | −0.043 ± 0.061 | NSV 04093 | C | L | ~3 | 1a,6a, 9,14,11 | 565.4 | + 20.6 ±0.4 | 226 |
| HD 88609 | 8.735 | +1.01 | G5 III | −3.01 / −2.10 | | | | | 5b,5a, , , | 565.6 | − 36.5 ±1.0 | 148 |
| HD 9900 | 5.696 | +1.65 | G5 Iab: | −0.144 ± 0.121 | | | L | 5.5 ± 1.0 | 5a,6a, ,15,13 | 565.4 | − 10.6 ±0.4 | 205 |
| HD 110184 | 8.431 | +1.32 | G5 I | −2.56 / −2.18 | | | | | 5b,5a, , , | 569.6 | +139.6 ±0.3 | 132 |
| HD 117043 | 6.574 | +0.86 | G6 V | | | | | | 4 , , , , | 951.6 | − 30.7 ±0.5 | 143 |
| HD 79452 | 6.070 | +0.93 | G6 III | −0.625 ± 0.072 | | | M | ~4.6 | 4 ,6n, ,14,11 | 656.4 | + 56.4 ±0.3 | 234 |
| HD 67767 | 5.806 | +0.92 | G7 V | | | S | M | | 4 , , 9,14, | 655.3 | − 43.6 ±0.6 | 167 |
| HD 77912 | 4.653 | +1.19 | G7 IIa | +0.38 | | | M | 4.4 ± 1.1 | 1a,5a, ,14,11 | 656.3 | + 17.5 ±0.4 | 208 |
| HD 101501 | 5.390 | +0.83 | G8 V | −0.070 ± 0.134 | NSV 05291 | S | M | 2.3 ± 0.8 | 1a,6b, 9,14,11 | 681.4 | − 5.0 ±0.4 | 138 |
| HD 113226 | 2.917 | +1.08 | G8 IIIab | +0.041 ± 0.042 | NSV 06064 | S | L | ~2.5 | 1a,6a,10,14,11 | 656.4 | − 13.9 ±0.4 | 208 |
| HD 90125 | 6.419 | +1.14 | G9 V | | | | | | 4 , , , , | 656.3 | − 14.1 ±0.3 | 187 |
| HD 108225 | 5.117 | +1.09 | G9 III | −0.001 ± 0.052 | | C | L | 1.4 ± 1.2 | 1b,6n, 9,14,11 | 951.6 | − 4.9 ±0.4 | 158 |
| HD 136442 | 6.452 | +1.27 | K0 V | | | C | | | 4 , , 9, , | 715.4 | − 47.4 ±0.5 | 153 |
| HD 44391 | 7.823 | +1.61 | K0 Ib | +0.21 | | | | | 2b,5a, , , | 530.6 | − 13.7 ±0.4 | 150 |
| HD 102224 | 3.818 | +1.41 | K0.5 IIIb | −0.388 ± 0.048 | NSV 05319 | S | M | 1.1 ± 0.13 | 1b,6n,10,14,11 | 530.7 | − 9.2 ±0.4 | 231 |
| HD 218356 | 4.900 | +1.52 | K0.5 II | −0.20 / −0.15 | NSV 14429 | S | H | ~4 | 1b,5a, 9,14,11 | 716.6 | − 28.9 ±0.7 | 198 |
| HD 108381 | 4.466 | +1.32 | K1 III | +0.085 ± 0.045 | | | M | 1.6 ± 1.0 | 1b,6n, ,14,11 | 279.5 | + 4.1 ±0.4 | 195 |
| HD 94600 | 5.155 | +1.27 | K1 III | −0.187 ± 0.078 | | | | 1.3 ± 1.0 | 4 ,6n, , ,11 | 681.4 | − 22.1 ±0.4 | 187 |
| HD 81146 | 4.599 | +1.45 | K2 IIIb | −0.028 ± 0.058 | | | M | <1.9 | 1a,6a, ,14,11 | 279.4 | + 28.1 ±0.4 | 150 |
| HD 85503 | 4.013 | +1.48 | K2 IIIb | +0.243 ± 0.027 | | | M | ~2.4 | 1a,6a, ,14,11 | 563.5 | + 13.1 ±0.4 | 199 |
| HD 50877 | 4.041 | +2.13 | K2 Iab | −0.11 | $\phi^1$ CMa | M | M | ≤20 | 1a,8 , 9,14,11 | 570.4 | + 33.0 ±0.7 | 184 |
| HD 102328 | 5.398 | +1.51 | K2.5 IIIb | +0.223 ± 0.049 | | | M | 1.1 ± 1.0 | 1b,6n, ,14,11 | 563.5 | + 0.9 ±0.5 | 154 |
| HD 122064 | 6.611 | +1.22 | K3 V | | | | | | 4 , , , , | 955.5 | − 26.7 ±0.5 | 99 |
| HD 125560 | 4.981 | +1.47 | K3 III | +0.133 ± 0.053 | NSV 06631 | S | M | <1.0 | 4 ,6n,10,14,11 | 655.5 | − 8.0 ±0.6 | 261 |
| HD 150567 | 7.820 | +1.44 | K3 III | +0.34 | | | | | 3b,3b, , , | 592.6 | − 51.7 ±0.5 | 119 |
| HD 9138 | 4.995 | +1.63 | K3 III | −0.452 ± 0.060 | | | M | <1.0 | 1a,6a, ,14,13 | 563.3 | + 35.7 ±0.5 | 219 |
| HD 107325 | 5.643 | +1.28 | K3 III | +0.191 ± 0.093 | NSV 05559 | S | | <1.0 | 1b,6n,10, ,11 | 279.5 | − 17.1 ±0.6 | 169 |
| HD 131977 | 5.880 | +1.28 | K4 V | +0.016 ± 0.133 | | | H | ~1 | 1b,6b, ,14,11 | 655.5 | + 26.3 ±0.4 | 190 |
| HD 79354 | 5.457 | +1.90 | K4 III | | NSV 04427 | S | H | 3.0 ± 1.0 | 1a, , 9,14,11 | 279.3 | − 31.6 ±0.4 | 188 |
| HD 120539 | 5.075 | +1.70 | K4 III | −0.184 ± 0.064 | | | H | 2.0 ± 1.3 | 4 ,6n, ,14,11 | 655.5 | − 3.7 ±0.4 | 260 |
| HD 219978 | 6.985 | +2.77 | K4.5 Ib | −0.15 | NSV 14501 | S | | | 1b,7 , 9, , | 771.5 | − 24.6 ±0.5 | 246 |
| HD 237025 | 8.969 | +2.59 | K5-M0 II | | | | | | 2a, , , , | 919.3 | − 41.6 ±0.4 | 177 |
| HD 17709 | 4.735 | +1.86 | K5.5 III | −0.335 ± 0.089 | NSV 00963 | S | H | <15 | 1a,6a, 9,14,11 | 530.4 | + 14.9 ±0.4 | 221 |
| HD 80493 | 3.291 | +1.86 | K6 III | −0.191 ± 0.200 | NSV 04456 | S | M | | 1a,6a,10,14, | 656.4 | + 40.0 ±0.4 | 205 |
| HD 95578 | 4.912 | +1.93 | M0 III | −0.23 | NSV 05099 | S | H | <20 | 1a,5a, 9,14,11 | 593.5 | − 12.9 ±0.4 | 189 |
| HD 100029 | 3.987 | +1.94 | M0 III | | NSV 05231 | S | H | | 1b, , 9,14, | 279.4 | + 8.8 ±0.4 | 197 |
| BD +56.595 | 8.409 | +2.54 | M0 Iab | Per OB1 | V 439 Per | L | | | 2a, , 9, , | 563.3 | − 41.8 ±0.6 | 173 |
| BD +63.2073 | 10.408 | +3.38 | M0 Ib | | | | | | 2a, , , , | 797.5 | − 38.7 ±0.6 | 105 |
| HD 102212 | 4.209 | +1.79 | M1 III | | NSV 05318 | S | H | | 1b, , 9,14, | 656.4 | + 50.5 ±0.4 | 263 |
| HD 35601 | 7.567 | +2.70 | M1.5 Iab-Ib | −0.24 | V 362 Aur | S | | | 2a,5a, 9, , | 563.4 | − 5.0 ±0.8 | 241 |
| HD 14330 | 8.210 | +2.49 | M1 Iab | Per OB1 | FZ Per | S | | | 2a, , 9, , | 542.3 | − 41.2 ±0.6 | 147 |
| HD 117675 | 4.897 | +1.92 | M2.5 III | | NSV 06297 | S | H | | 1b, , 9,14, | 955.5 | + 17.5 ±0.3 | 117 |
| HD 202380 | 6.887 | +2.82 | M2 Ib | +0.07 | NSV 13609 | M | | | 1b,5a, 9, , | 594.6 | − 15.6 ±0.4 | 202 |
| HD 13136 | 7.994 | +2.71 | M2 Iab-Ib | Per OB1 | | | | | 1a, , , , | 531.4 | − 39.4 ±0.4 | 246 |
| HD 36389 | 4.639 | +2.44 | M2 Iab-Ib | +0.11 | CE Tau | M | M | | 1a,5a, 9,14, | 563.5 | + 23.1 ±0.5 | 256 |
| HD 217906 | 2.654 | +1.96 | M2.5 II-III | −0.11 | $\beta$ Peg | S | H | | 1b,5a, 9,14, | 716.6 | + 6.4 ±0.7 | 205 |
| HD 120933 | 4.940 | +1.94 | M3- III | +0.50 | AW CVn | S | H | 5.1 ± 1.0 | 1b,5a, 9,14,11 | 569.5 | − 43.0 ±0.5 | 218 |
| HD 76827 | 4.942 | +1.82 | M3 III | | NSV 04344 | S | H | | 1a, , 9,14, | 279.3 | + 5.6 ±0.4 | 168 |
| HD 84335 | 5.311 | +1.87 | M3 III | | CS UMa | S | | | 1a, , 9, , | 655.3 | + 8.6 ±0.3 | 294 |
| HD 236871 | 8.854 | +2.65 | M3 Iab-Ib | | V774 Cas | M | | | 2a, , 9, , | 951.4 | − 44.3 ±0.6 | 134 |
| BD +60.2613 | 9.120 | +3.28 | M3 Ia | | PZ Cas | L | | | 1b, , 9, , | 797.5 | − 47.8 ±0.8 | 192 |
| HD 112300 | 3.577 | +1.80 | M3+ III | −0.09 / −0.16 | NSV 06026 | S | M | | 1b,5a, 9,14, | 951.6 | − 21.3 ±0.4 | 186 |
| HD 101153 | 5.487 | +1.76 | M4 III | −0.08 | $\omega$ Vir | S | | | 4 ,5a, 9, , | 951.6 | + 7.2 ±0.6 | 193 |
| HD 11401 | 8.140 | +2.31 | M4 III | | NSV 00647 | S | | | 2a, ,10, , | 797.5 | + 3.7 ±0.6 | 173 |
| BD +56.512 | 9.705 | +2.11 | M4 Ib | Per OB1 | BU Per | L | | | 2a, , 9, , | 531.5 | − 35.7 ±0.5 | 222 |
| HD 12401 | 8.053 | +2.42 | M4 Ib | Per OB1 | XX Per | M | | | 2a, , 9, , | 951.3 | − 22.8 ±1.0 | 160 |
| BD +62.207 | 9.618 | +3.25 | M4 Ia | | HZ Cas | L | | | 2a, , 9, , | 797.5 | − 53.5 ±0.8 | 166 |
| HD 123657 | 5.394 | +1.74 | M4.5 III | −0.03 | BY Boo | S | M | | 1b,5a, 9,14, | 955.5 | − 36.8 ±0.4 | 257 |
| HD 76830 | 6.518 | +1.80 | M4.5 III | | NSV 04332 | S | | | 1a, , 9, , | 951.5 | + 21.7 ±0.5 | 287 |
| HD 130144 | 6.021 | +1.54 | M5 IIIab | | NSV 06796 | L | | | 4 , , 9, , | 715.4 | − 23.8 ±0.6 | 413 |
| HD 55690 | 8.341 | +1.94 | M5+ III | | NSV 03466 | M | | | 1a, ,10, , | 951.4 | − 11.7 ±0.4 | 130 |
| HD 94705 | 6.116 | +1.46 | M5.5 III | | VY Leo | M | M | | 1a, , 9,14, | 951.5 | − 8.5 ±0.5 | 282 |
| HD 148783 | 5.047 | +1.52 | M6- III | −0.06 / +0.02 | g Her | L | M | | 1b,5a, 9,14, | 951.7 | + 0.2 ±0.6 | 277 |
| HD 18191 | 5.951 | +1.47 | M6- III | | RZ Ari | M | | | 1a, , 9, , | 951.3 | + 47.1 ±0.6 | 311 |
| HD 25725 | 8.745 | +1.63 | M7+ II | | V Eri | L | | | 1a, , 9, , | 951.3 | + 6.4 ±1.1 | 315 |