

# Unconventional views of stellar populations

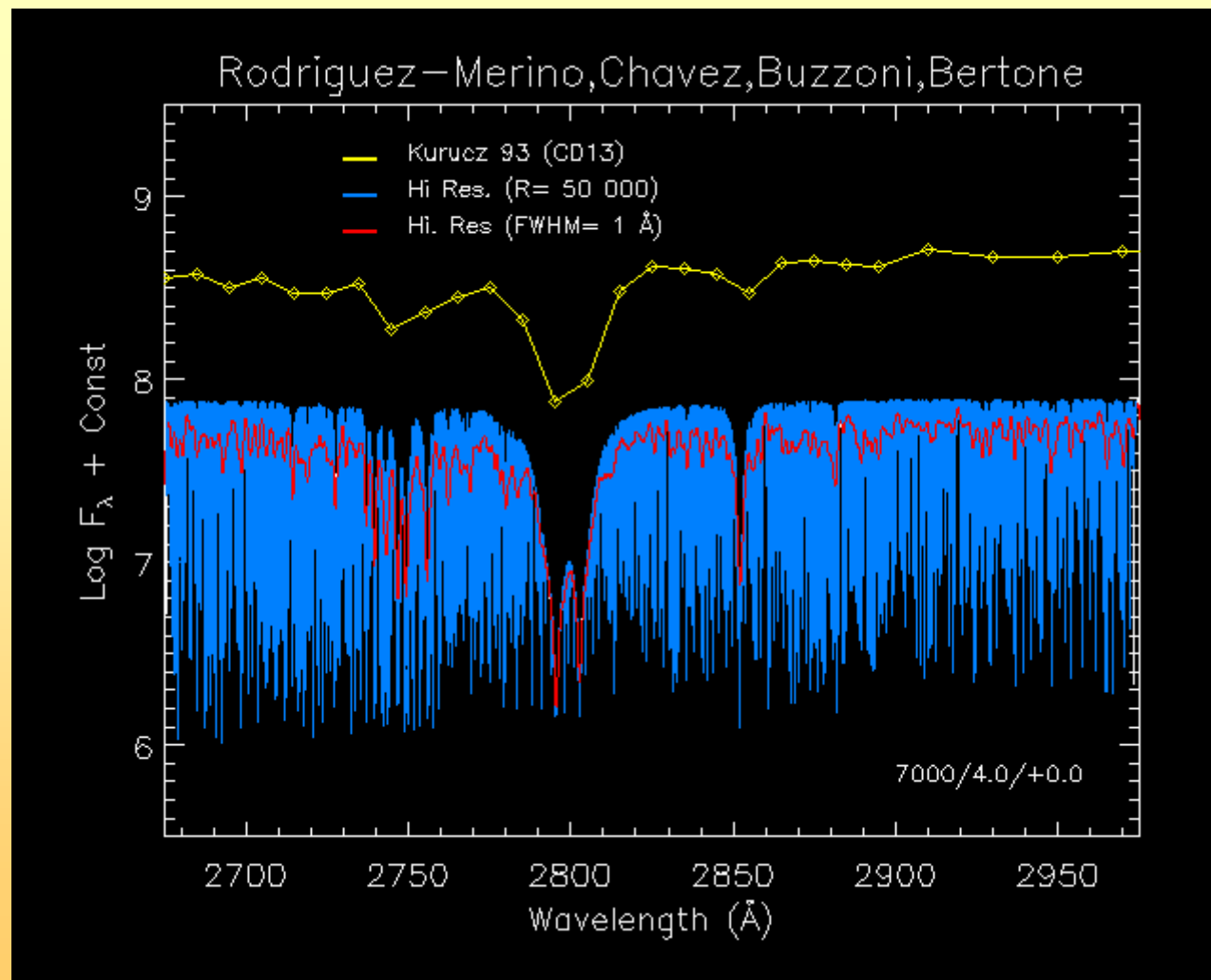
## Part III

### Open questions in high-resolution spectral synthesis

Alberto Buzzoni

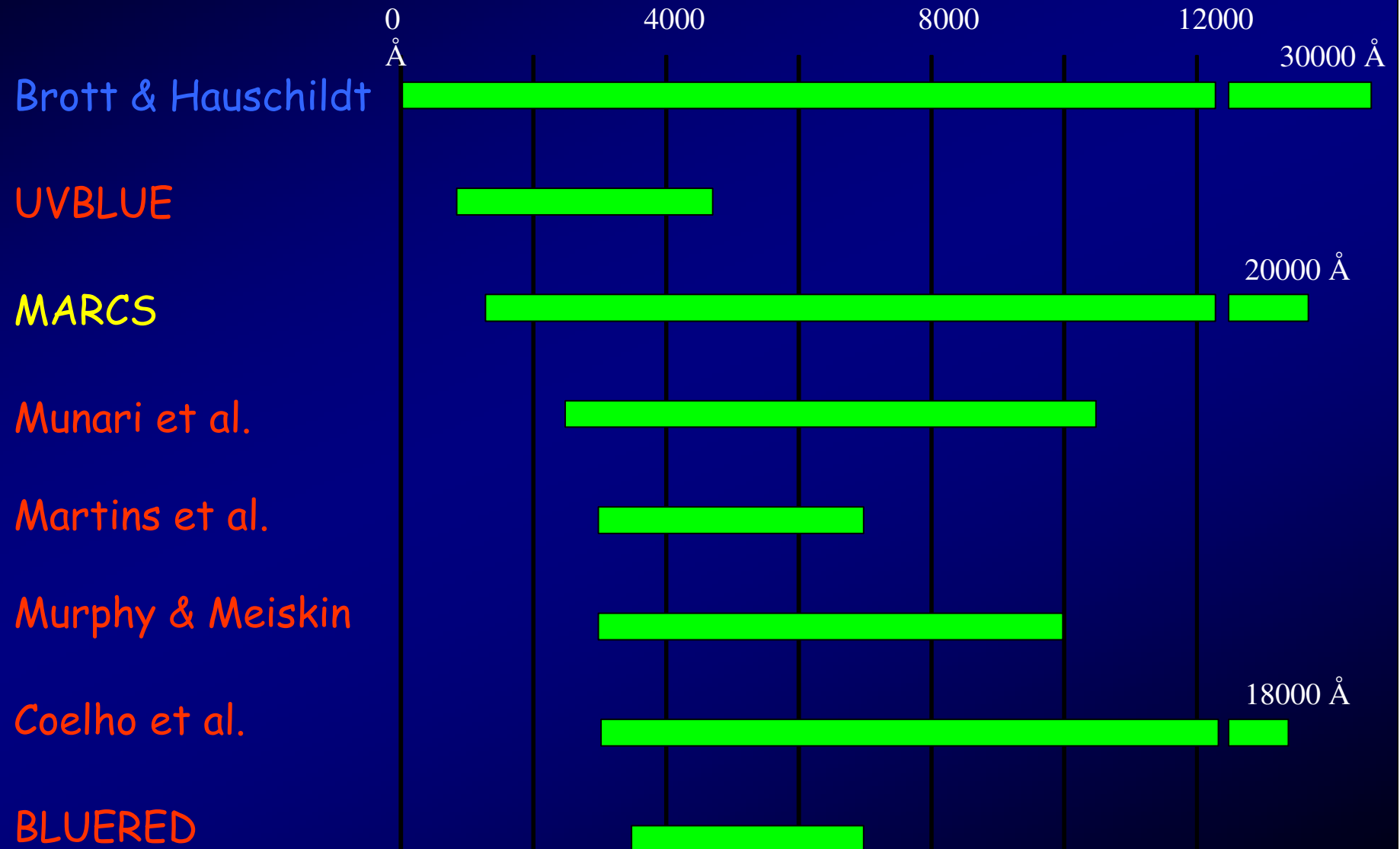
INAF - Oss. Astronomico di Bologna, Italy

# Toward high-resolution synthesis



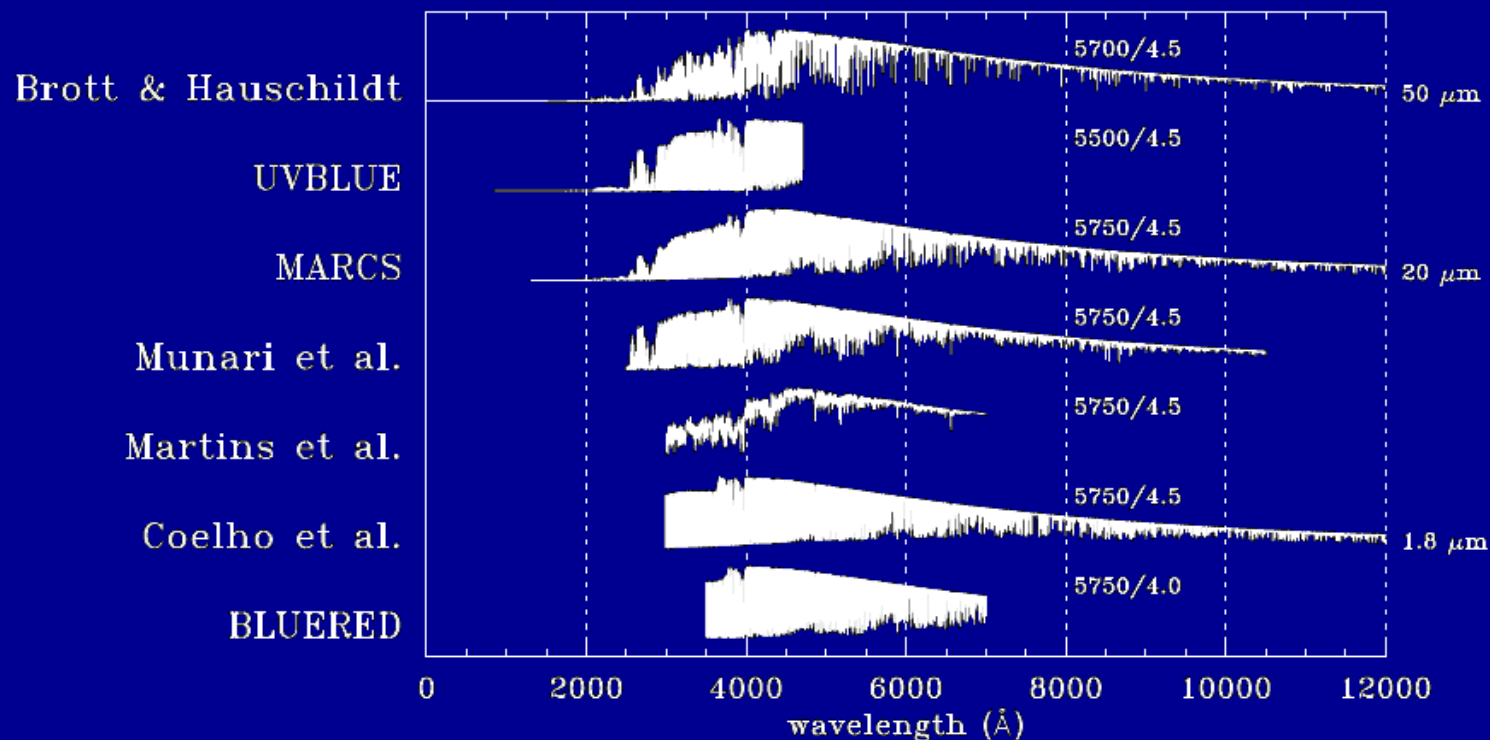
Rodriguez-Merino et al. (2005)

# Stellar libraries of high-res synthetic spectra



“Optical structure”  
+  
Synthetic spectrum  
=  
Model atmosphere

Library	Model Atmospheres	Spectrum Synthesis Codes
Brott	PHOENIX	PHOENIX
UVBLUE	ATLAS9 (old)	SYNTHE
MARCS	MARCS	MARCS
Munari	ATLAS9 (new)	SYNTHE
Coelho	ATLAS9 (new)	FANTOM
Martins	PHOENIX/ ATLAS9 (old)/ TLUSTY	PHOENIX/ SPECTRUM/ SYNSPEC
BLUERED	ATLAS9 (old)	SYNTHE



# The synthetic high-resolution library

	UV- Blue	BLUERED
$\lambda$ interval	850 $\rightarrow$ 4750 Å	3500 $\rightarrow$ 7000 Å
R =	50 000	500 000
Step	0.017 $\rightarrow$ 0.095 Å	0.007 $\rightarrow$ 0.014 Å
T <sub>eff</sub>	3000 $\rightarrow$ 50 000 K	4000 $\rightarrow$ 50 000 K
log g	0.0 $\rightarrow$ 5.0 dex	0.0 $\rightarrow$ 5.0 dex
[M/H]	-2.0 $\rightarrow$ +0.5	-3.0 $\rightarrow$ +0.3
No. spectra	1690	832

Rodríguez-Merino et al. 2005

Bertone et al. 2008

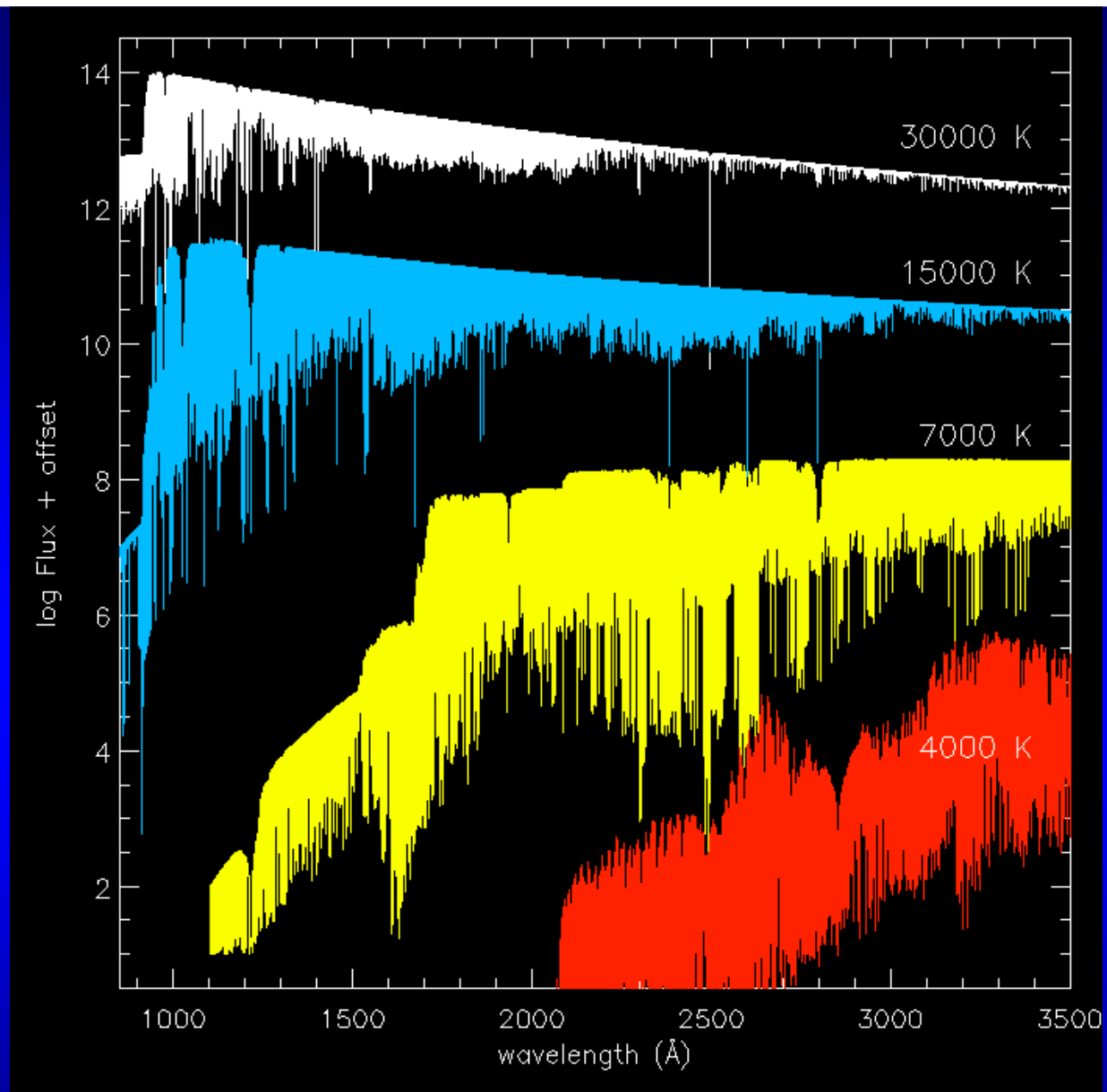
# Kurucz ATLAS9 model atmospheres

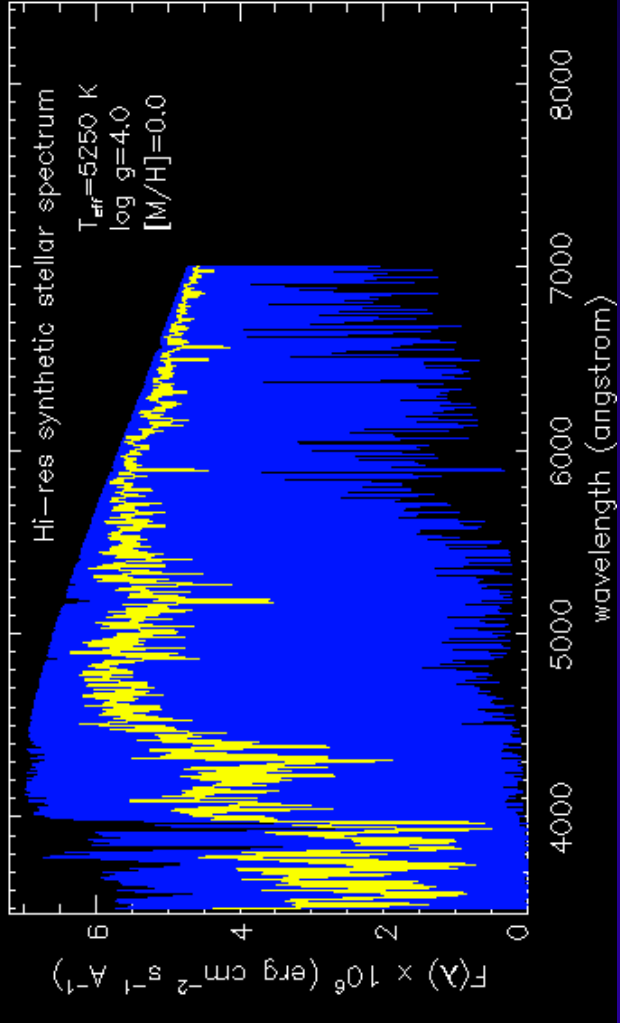
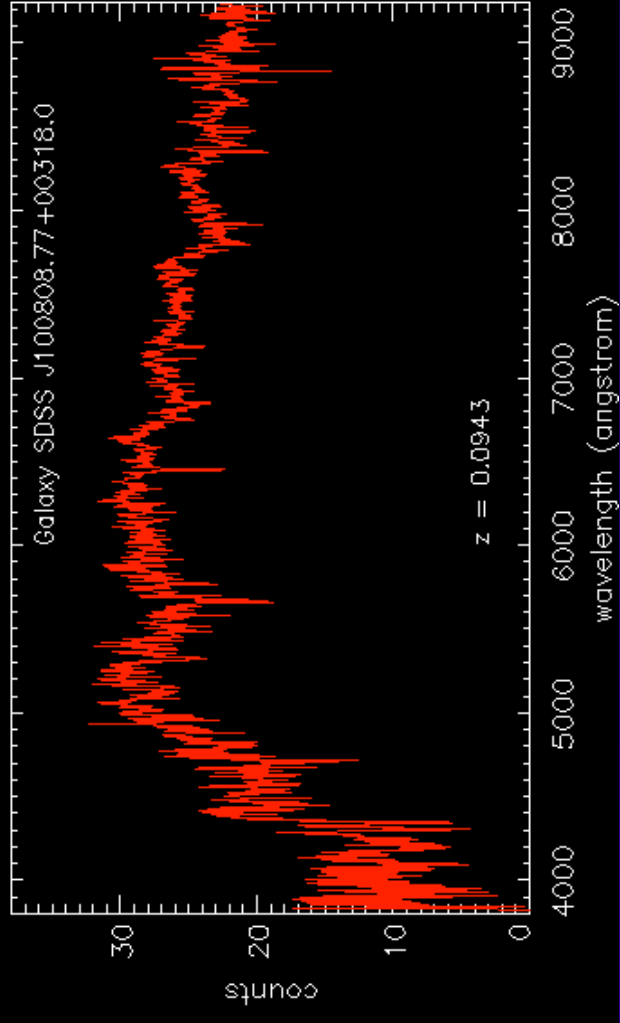
1. plane-parallel geometry;
2. steady state;
3. constant energy flux (radiative+convective);
4. hydrostatic equilibrium;
5. LTE;
6. homogeneous chemical composition;
7. 72 depth points;
8. 58 million absorption lines (ODF);
9. diatomic molecules.

Codes : ATLAS and SYNTHE

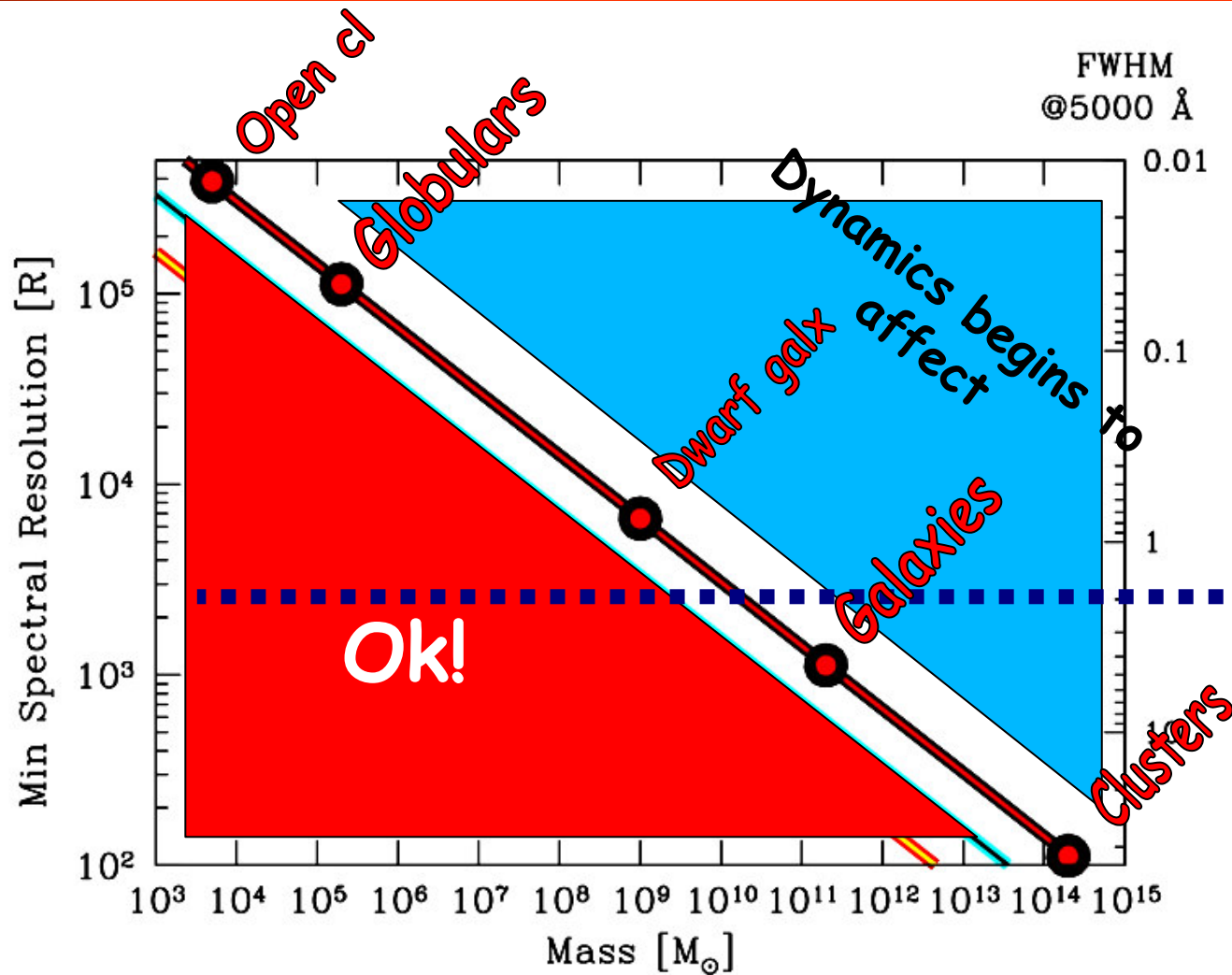
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# UV-Blue library





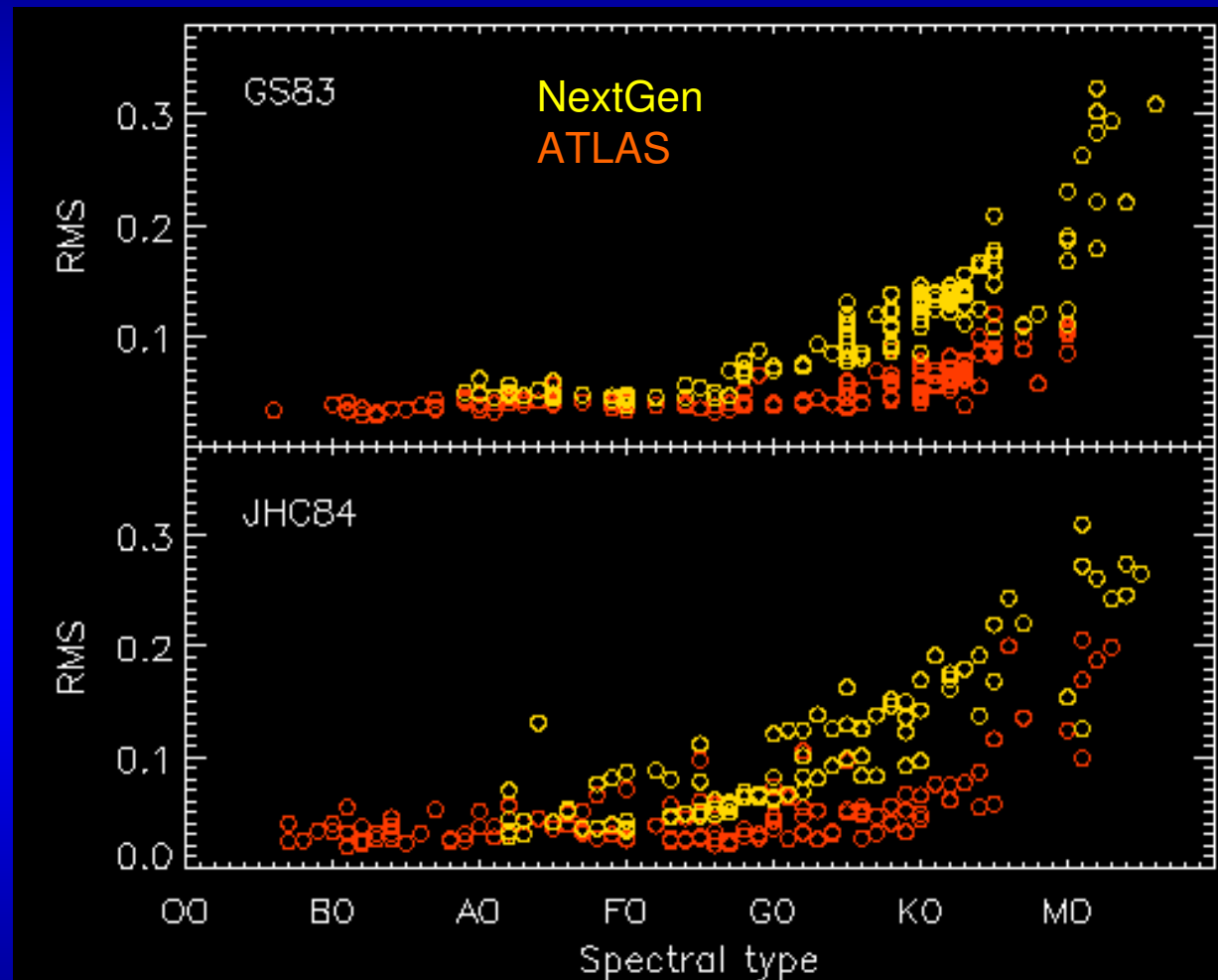
# High-res = more info?



Echelle

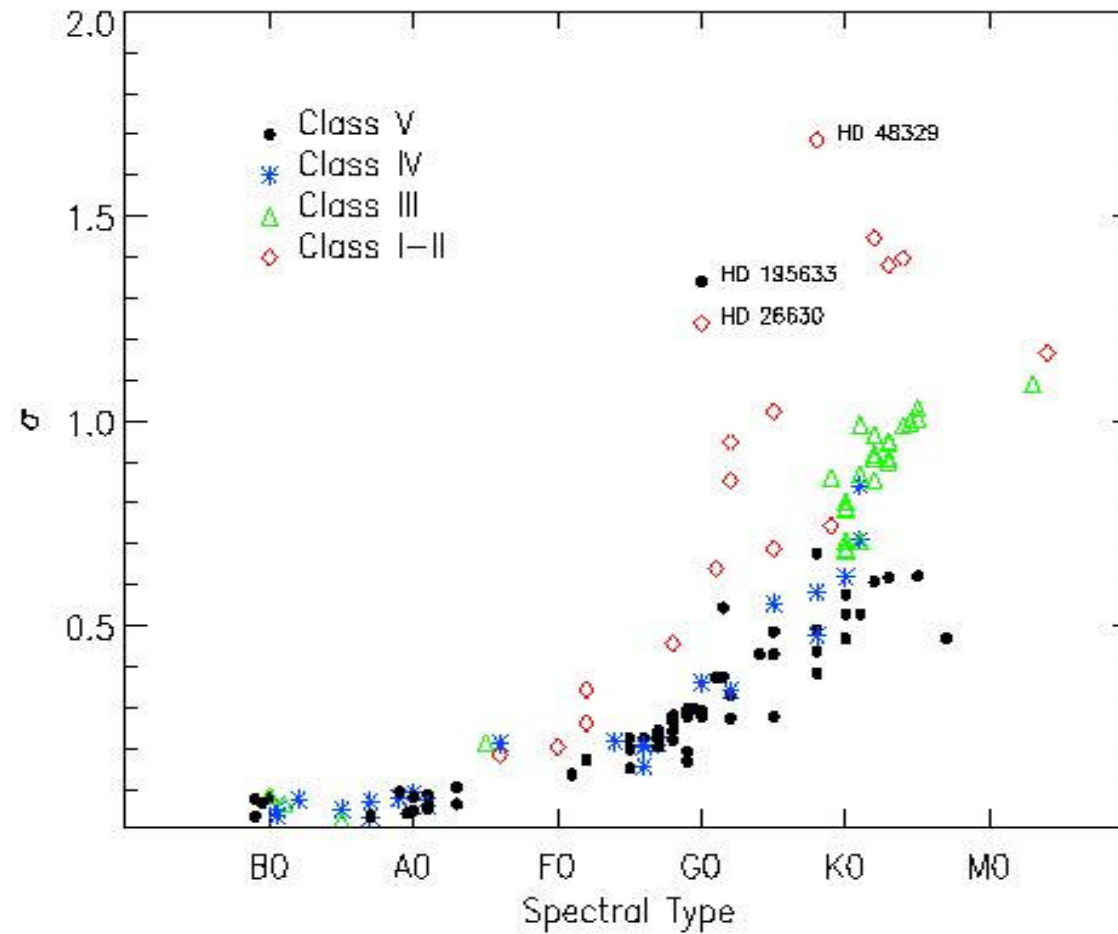
FOSC

# ATLAS vs. NextGen



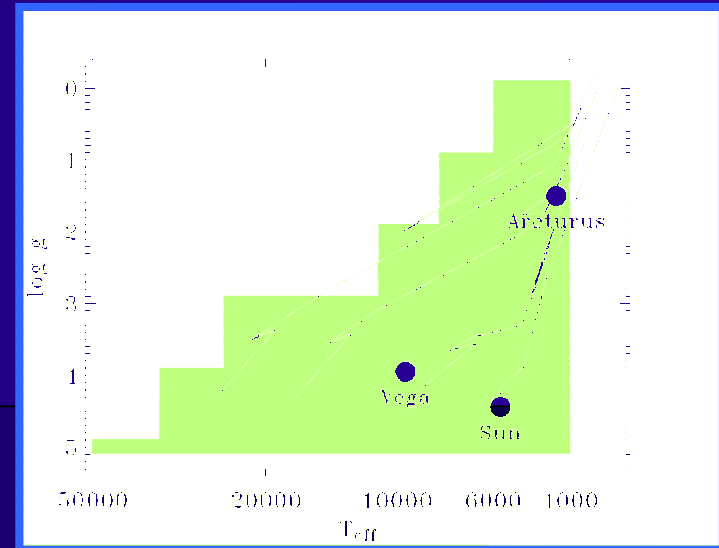
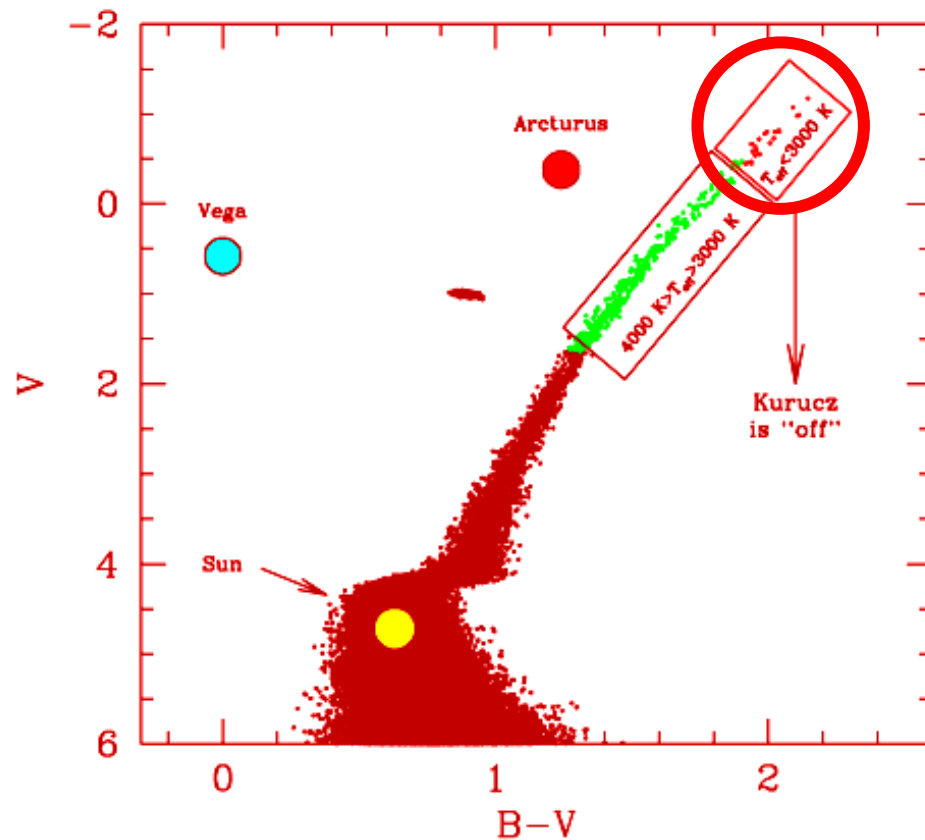
Bertone et al. (2004)

# Fitting the Ultraviolet

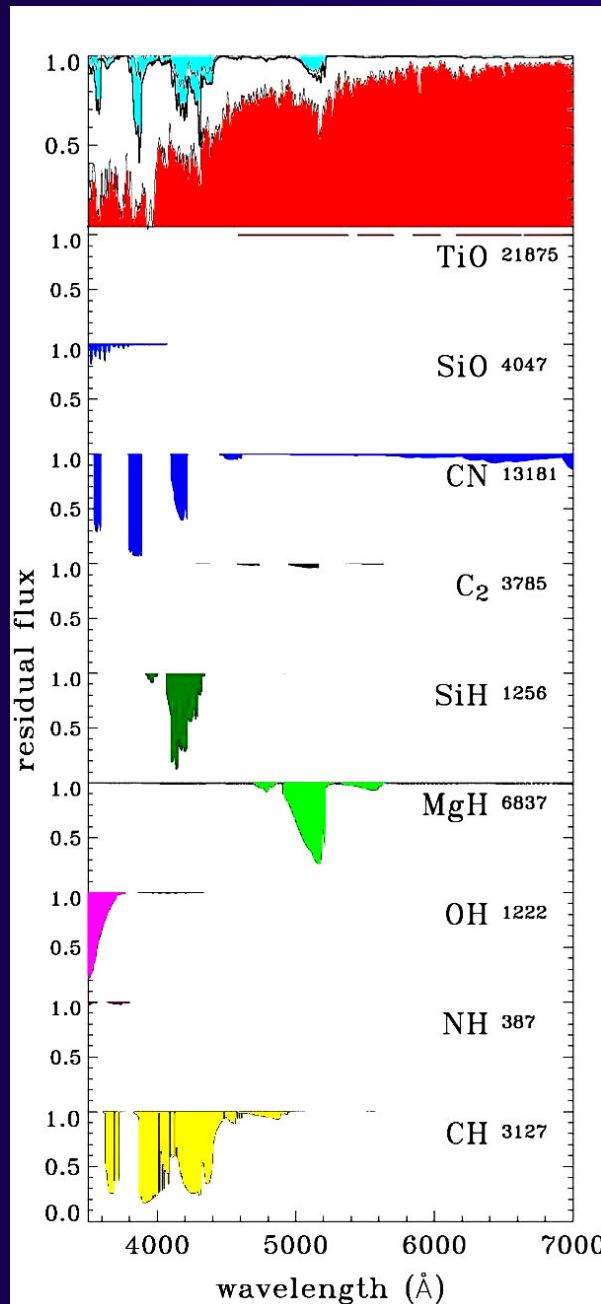


Rodriguez-Merino et al. (2005)

# Toward cooler temperatures



# Molecules!



$4000 > T_{\text{eff}} > 3000 \text{ K}$



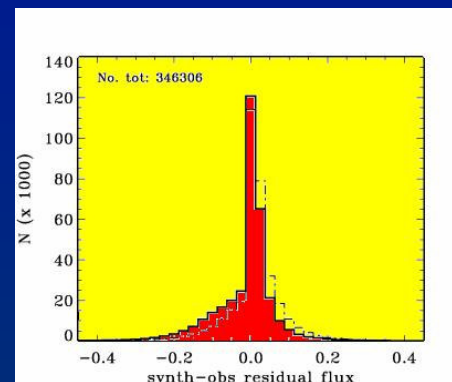
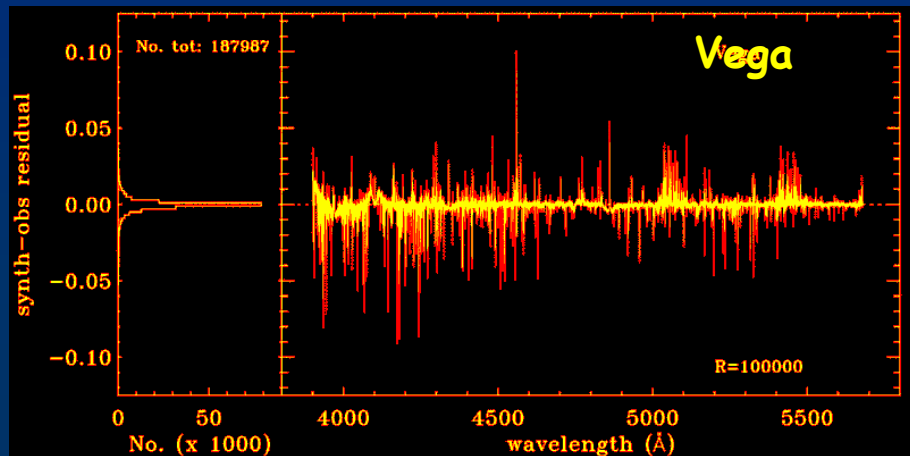
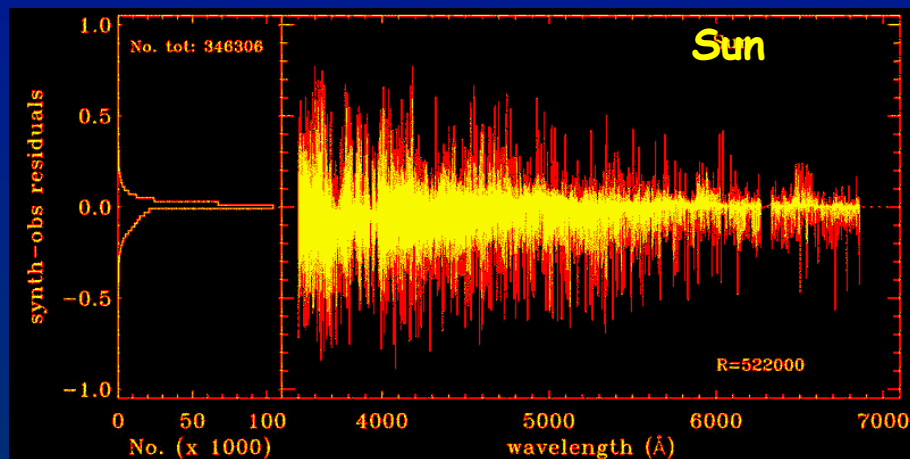
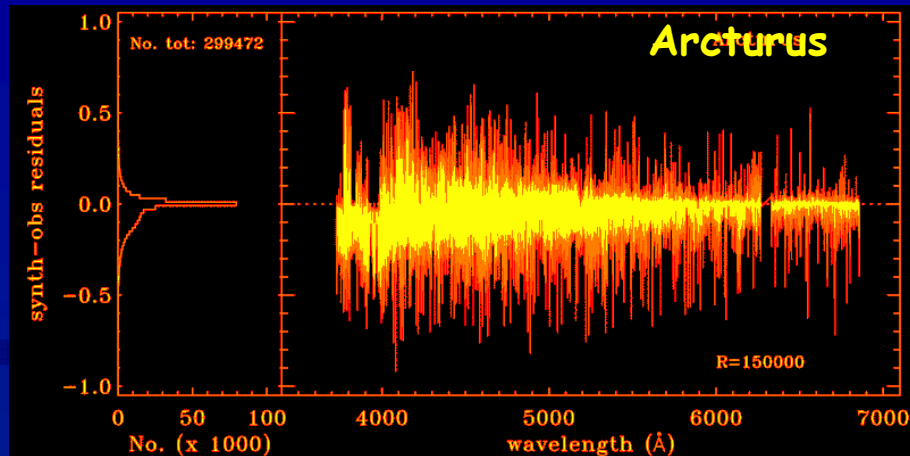
Diatomic molecules (i.e. TiO, SiO, CN, SiH, MgH, OH, CH....)

$3000 \text{ K} > T_{\text{eff}}$



Triatomic molecules (Water!)

# Template validation



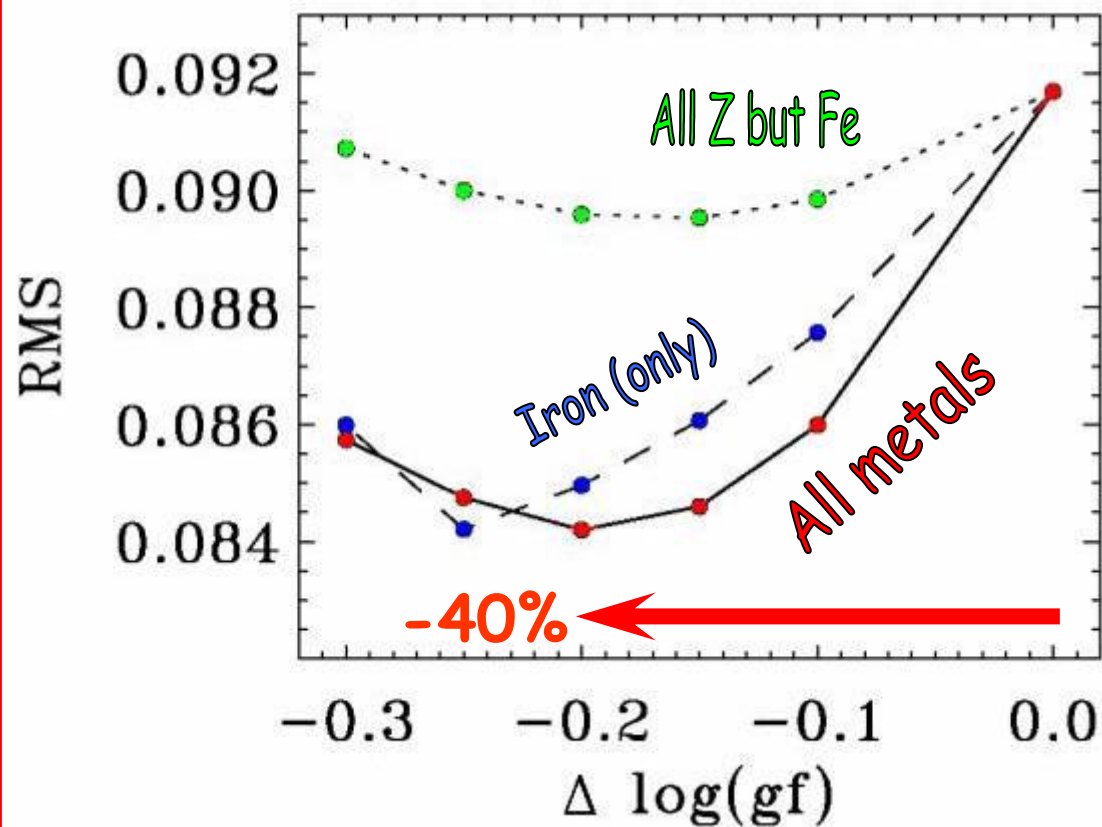
## skewness

Arcturus	-0.67
Sun	-1.04
Vega	-2.21

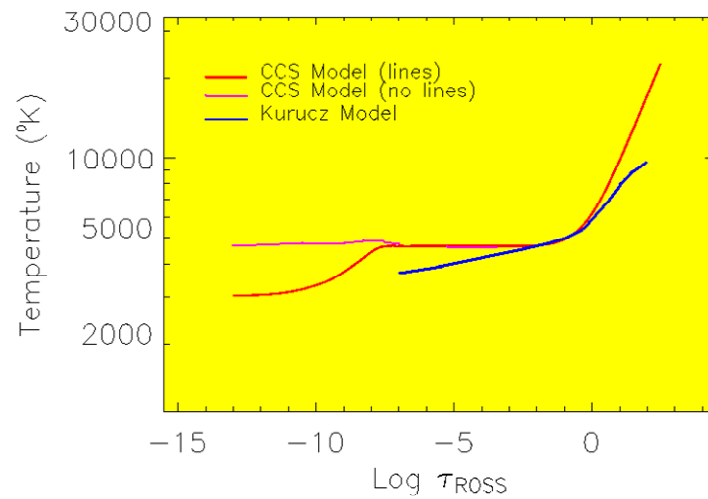
## $\sigma(\text{flux})$

R =	520k	150k	100k
Arcturus	...	0.108	0.056
Sun	0.092	0.079	0.045
Vega	...	...	0.007

## Lower Oscillator Strengths?

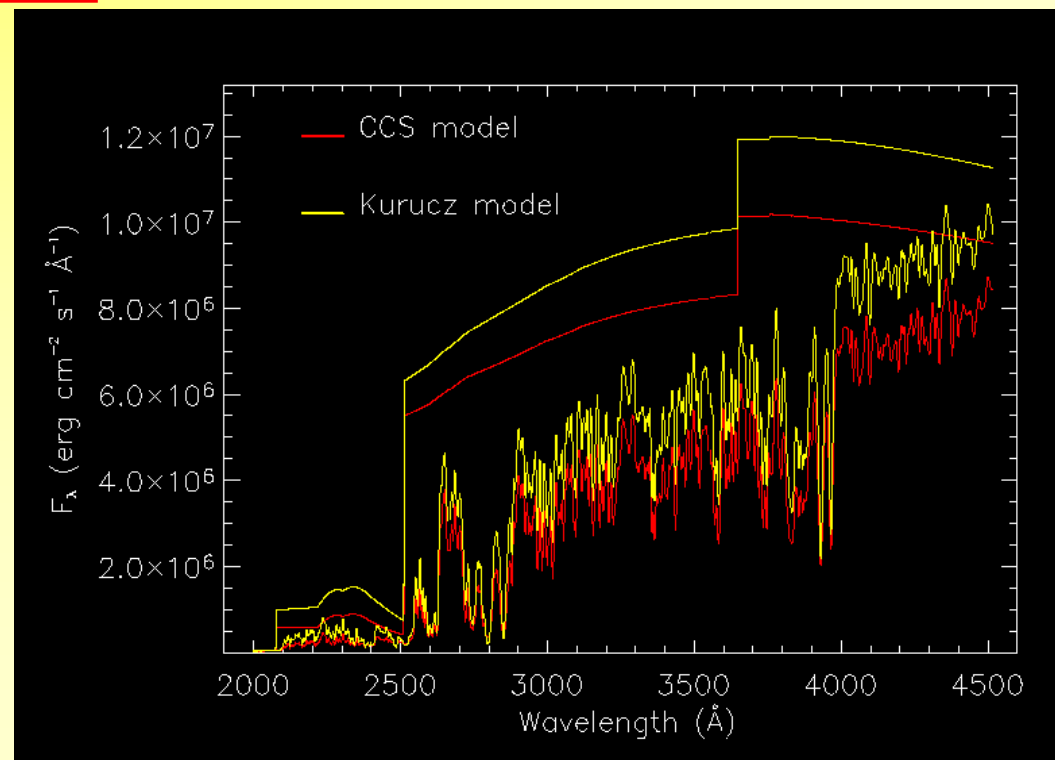


# Solar troubles



Rodriguez-Merino et al. (2008)

Cardona et al. (2002)



**The End (Part III)**