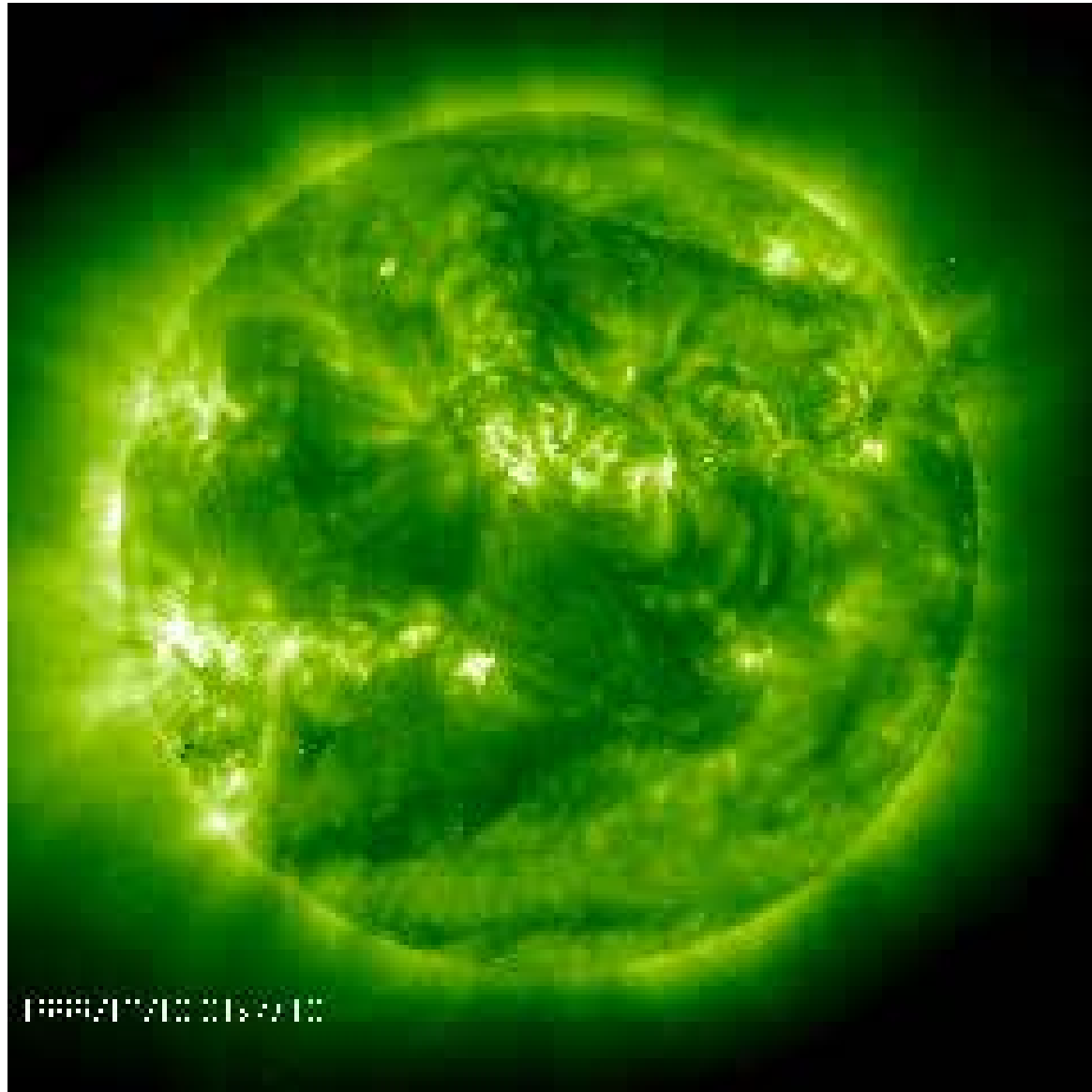# Improving atmosphere models and synthetic spectra

**F. Thévenin, L. Bigot, P. de Laverny, A. Recio-Blanco
& Marcs collaboration**

Kurucz, MARCS

- 1D ETL
- → not the same Sun

- Main differences : MLT, Opacities

- → not the same stellar atmospheres

- Differences are small but exist

# Are we able to reproduce the Sun?

- More or less.

- Depending on the resolution (asymmetry) and on the wavelength range :

- problems with micro and macroturbulence
- problems with atomic data?
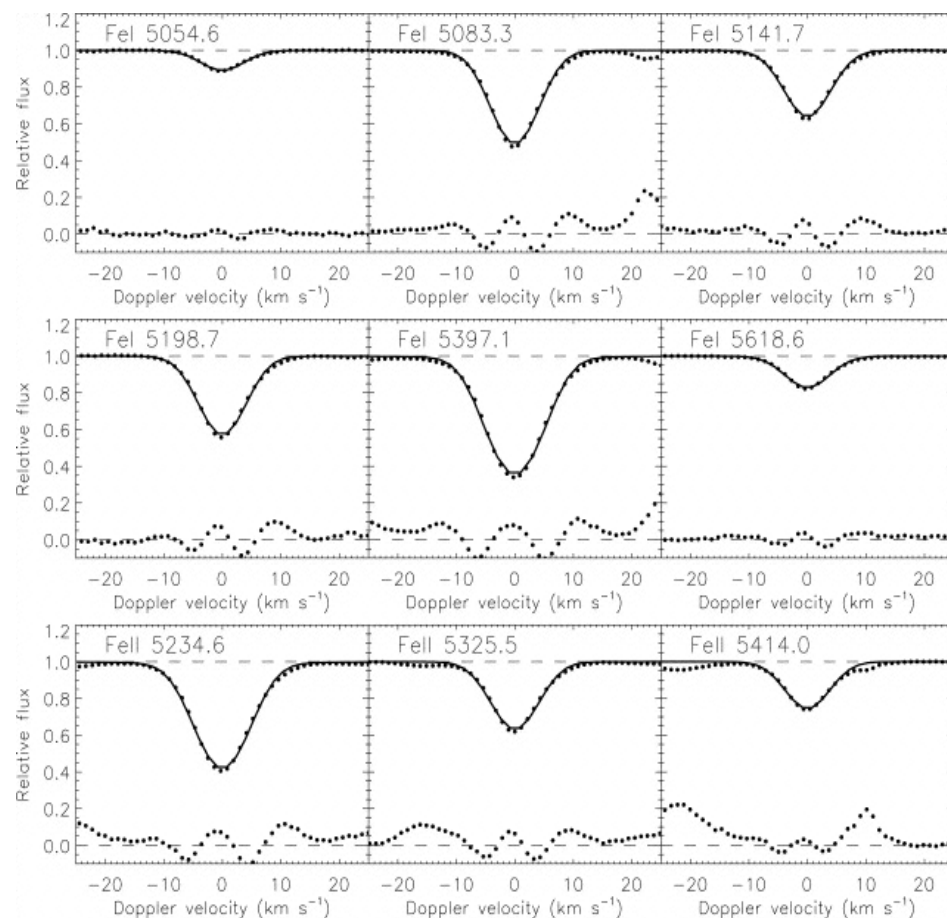
More input physics

- ETL → NETL: construction of atoms

- 1D line transfer → 3D

- Coupling with hydrodynamic: to generate the micro and macroturbulence

Asplund Nordlünd
# Allende Prieto et al.

Sun
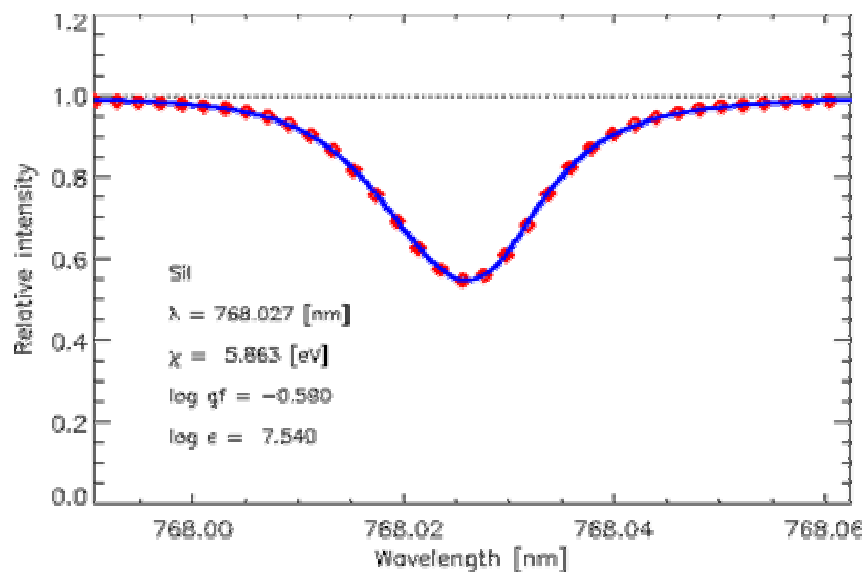
Procyon

log gf on the Sun or from laboratory

- # Borrero et al., 2002 and 2003 in A&A

- **Figure 2:** Comparison of oscillator strengths determined by Gurtovenko & Kostik (1981, 1982; **top**) and Thévenin (1989, 1990; **bottom**) with laboratory measurements from Oxford and Hannover for 80 Fe I lines in the visible part of the spectrum. In both cases, less than 50% of the lines are reproduced within the uncertainties of laboratory measurements
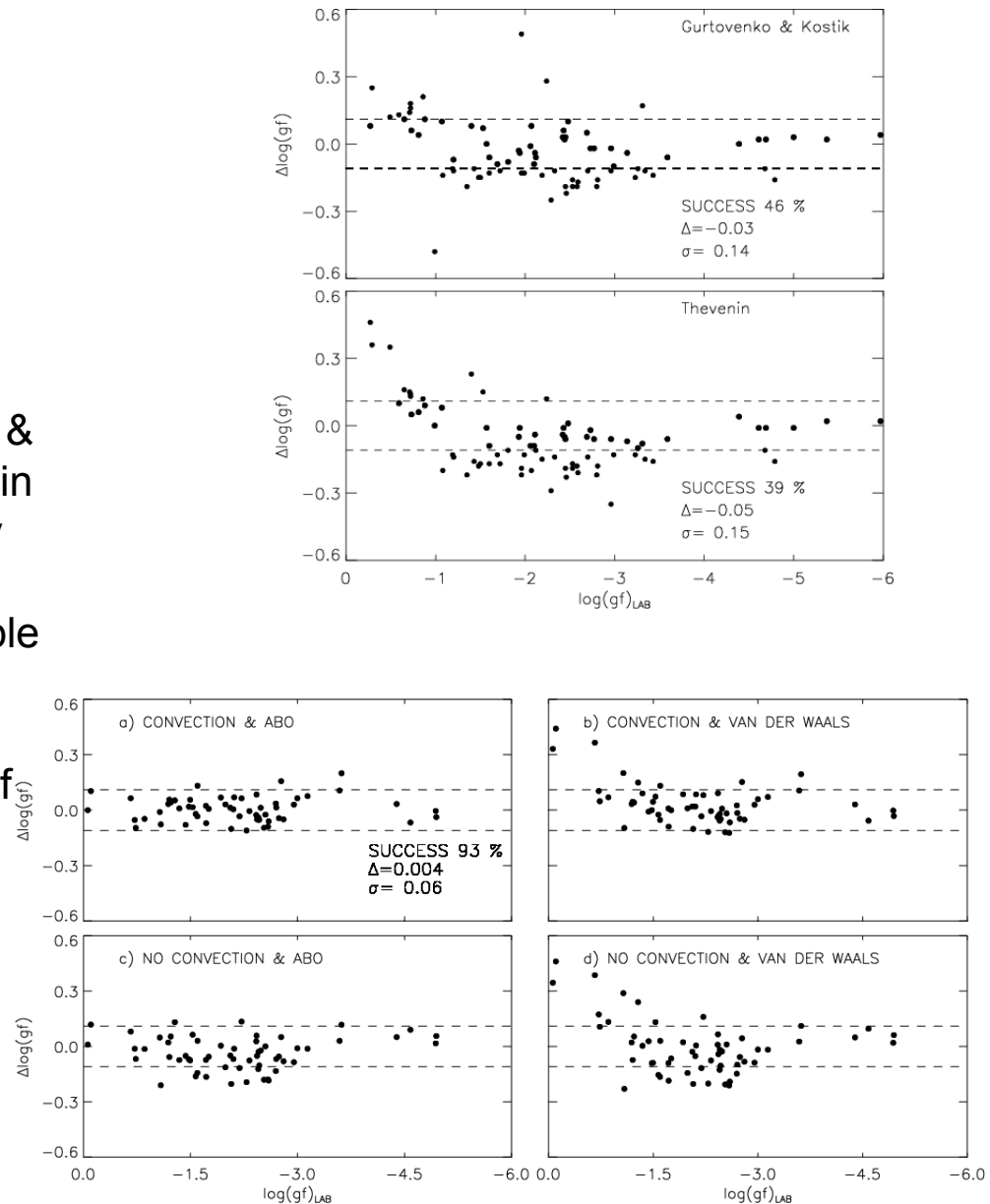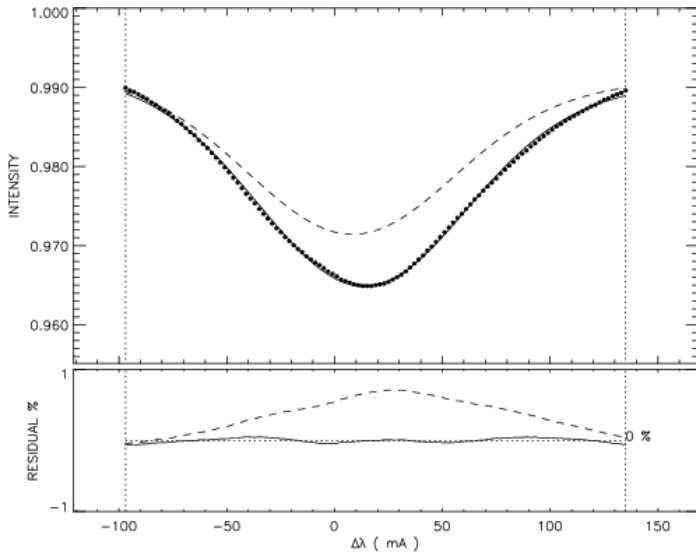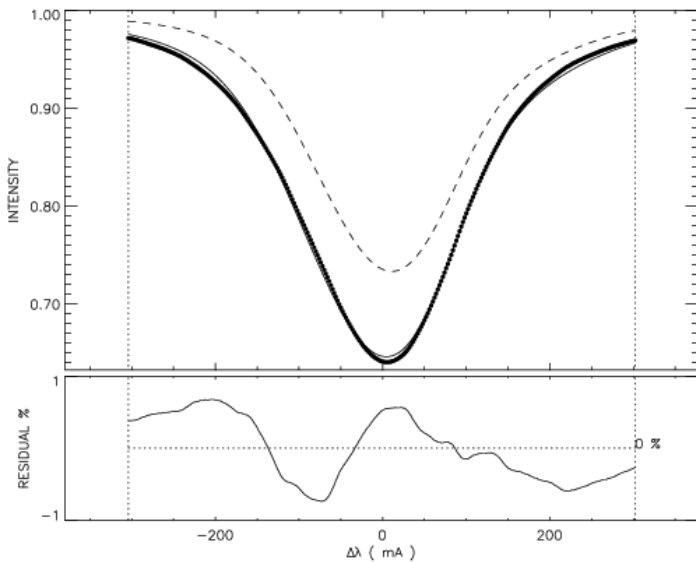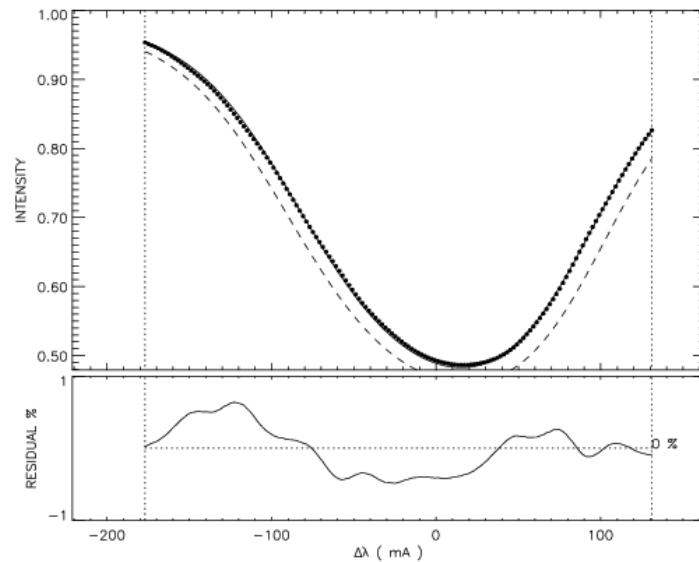
Initial Atomic Data | Inversion Results

Element: TI 1
$\lambda_0 = 10034.491$
loggf (KUR) = −2.227

SR=3255 $\Delta\lambda_0 = 5.40$ mA
Cont.Corr=−1.1 % loggf =−2.102
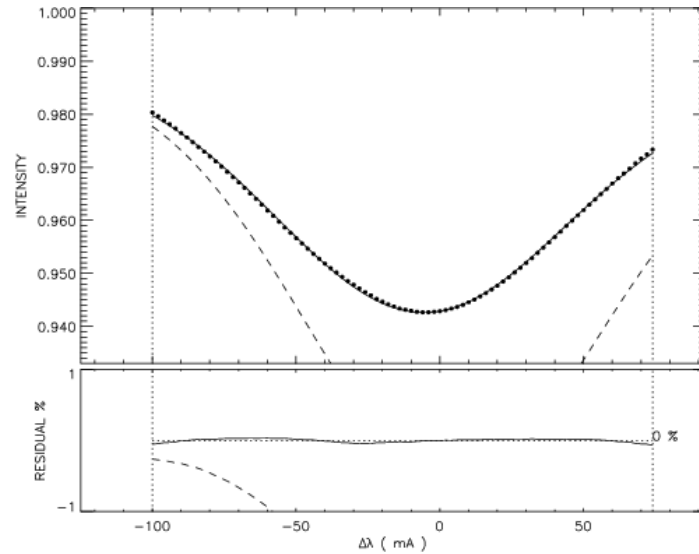
Initial Atomic Data | Inversion Results

Element: CR 1
$\lambda_0 = 10510.024$
loggf (KUR) = −1.558

SR=4079 $\Delta\lambda_0 = -10.$ mA
Cont.Corr=−1.2 % loggf =−1.809

Initial Atomic Data | Inversion Results

Element: SI 1
$\lambda_0 = 10784.562$
loggf (KUR) = −0.910

SR=225 $\Delta\lambda_0 = -10.$ mA
Cont.Corr=−0.058 % loggf =−0.593

Initial Atomic Data | Inversion Results

Element: FE 1
$\lambda_0 = 11422.323$
loggf (KUR) = −2.700

SR=308 $\Delta\lambda_0 = -1.9$ mA
Cont.Corr=−1.2 % loggf =−2.887

Fel 6978.85 (loggf=−2.484)

Fel 6271.27 (loggf=−2.703)

loggf=−2.509
χ=0.462

(Thevenin)
loggf=−2.41
χ=1.394

(Thevenin)
loggf=−2.85
χ=1.231

loggf=−2.712
χ=0.156

Δλ(mA)

Δλ(mA)

$\log(gf)_{FURNACE} - \log(gf)_{THEVENIN}$

$\log(gf)_{FURNACE} - \log(gf)_{THIS-WORK}$
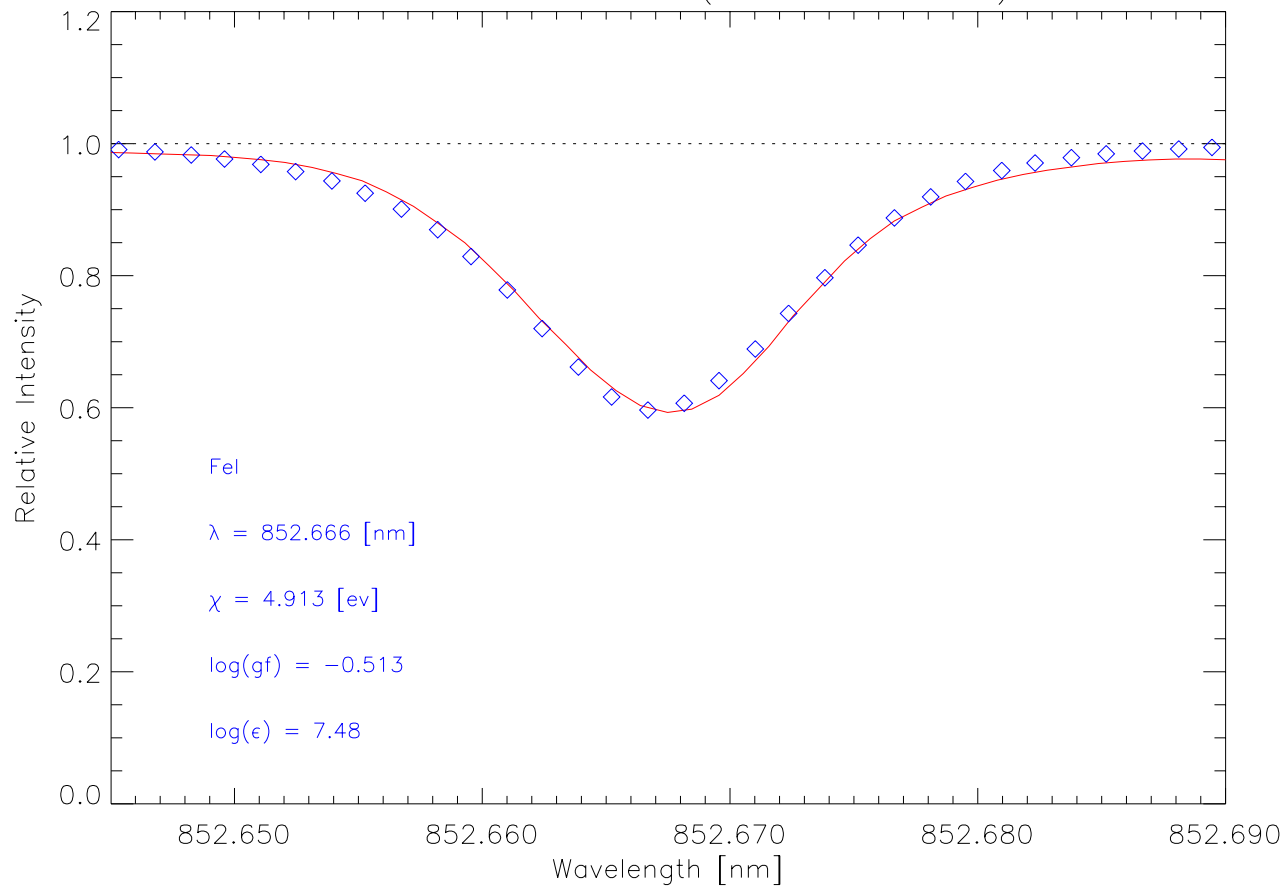
$\log(gf)_{FURNACE}$
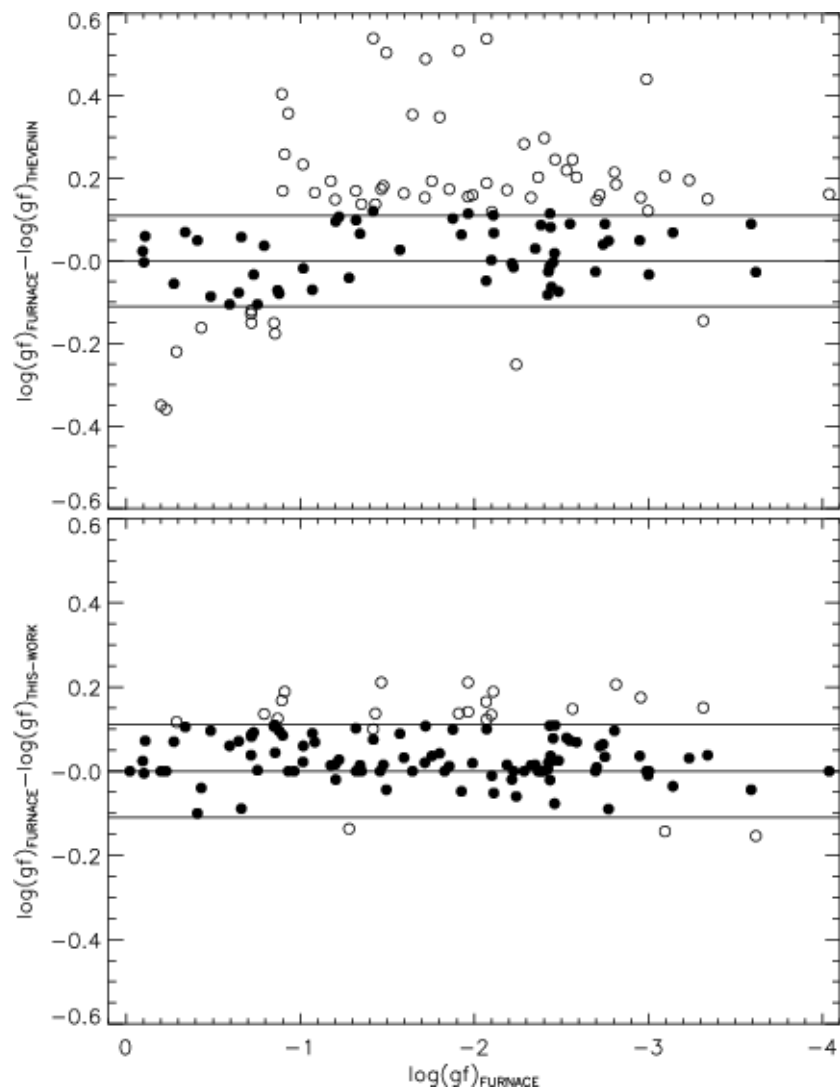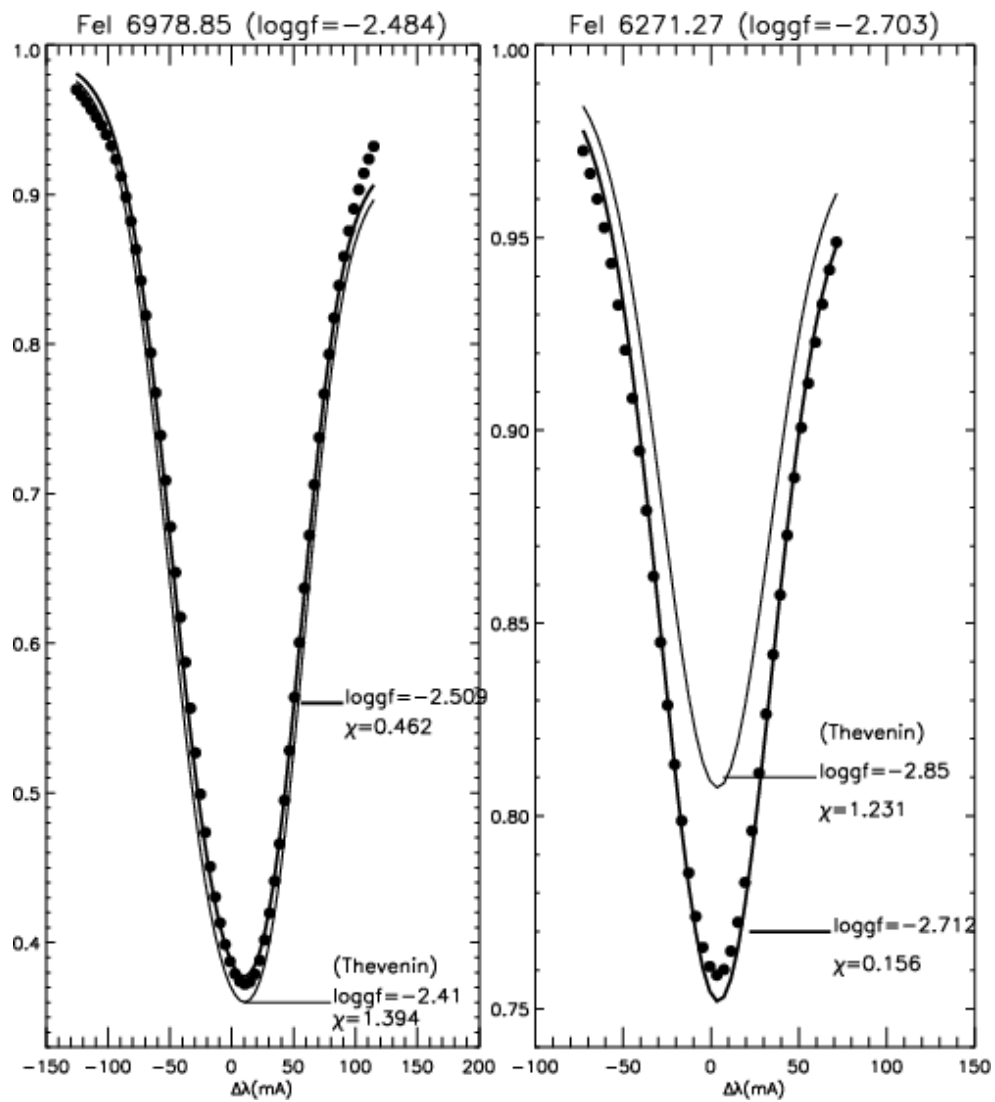
Bigot & Nordlünd

Solar snapshot

+

Line transfer
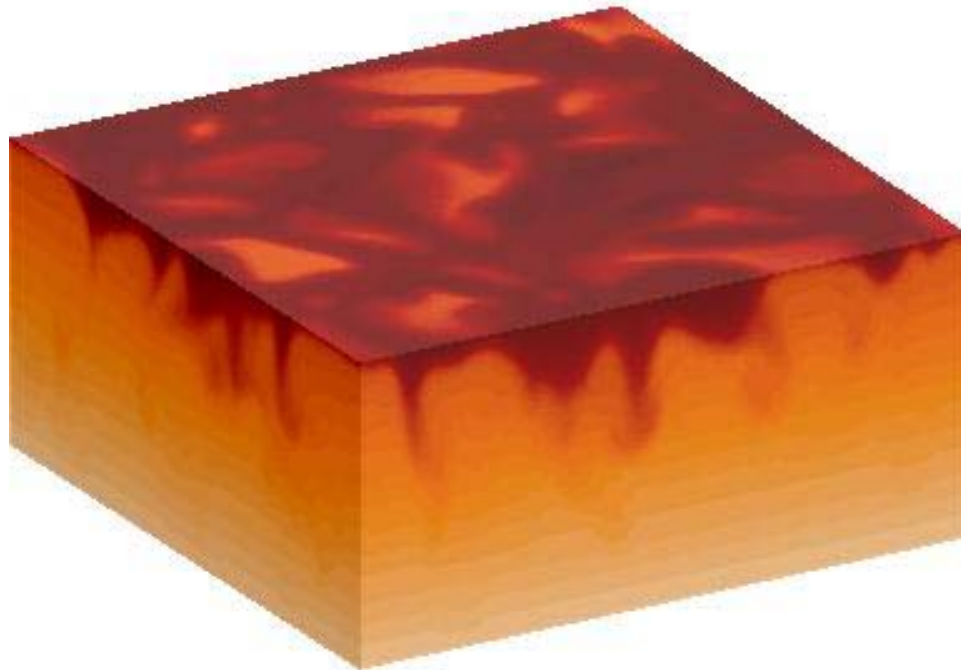
Adjusting the line parameters (Edvardsson gf-values)
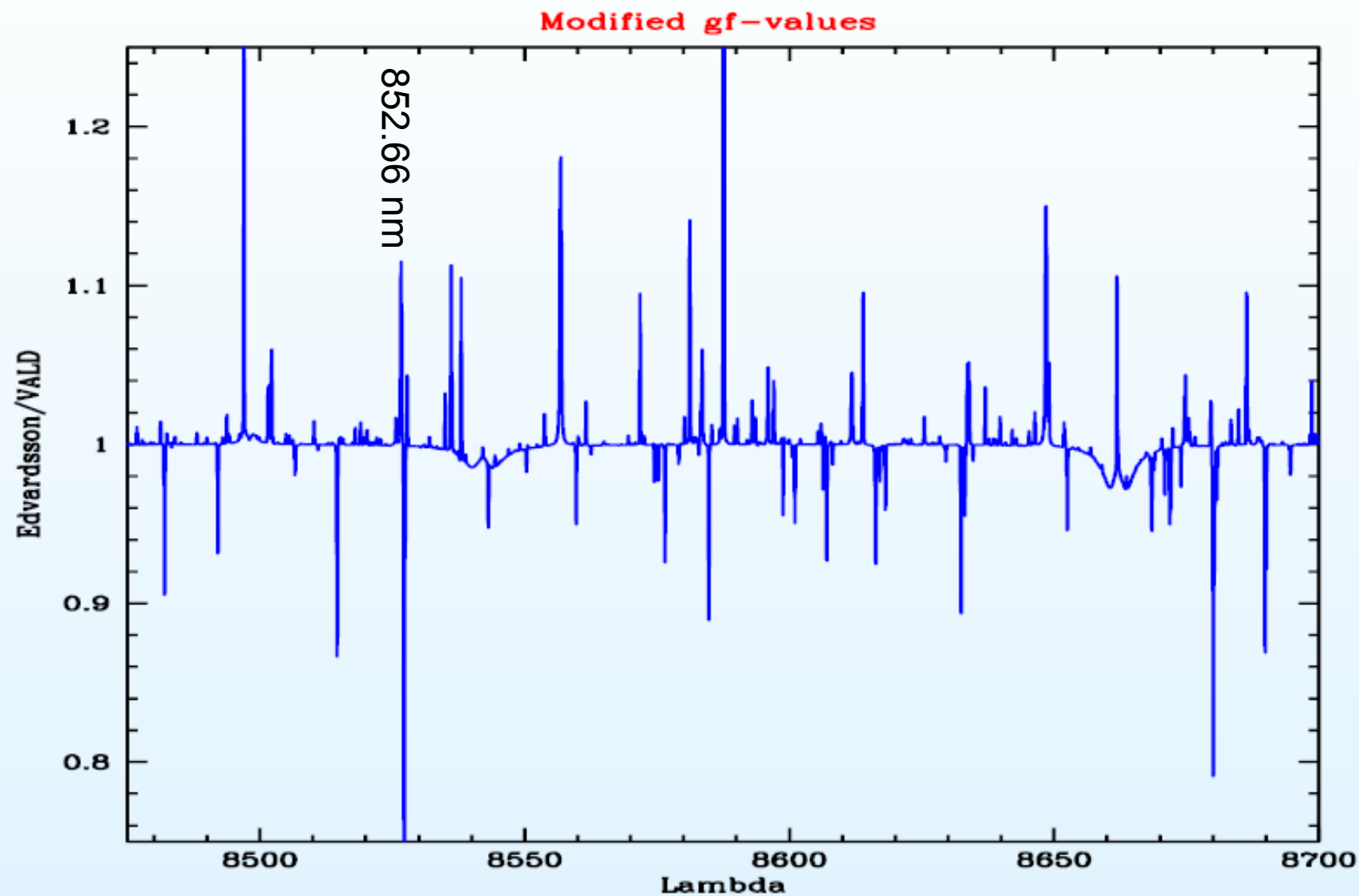
3D LTE solar model (125 x 125 x 82)

FeI

λ = 852.666 [nm]

χ = 4.913 [ev]

log(gf) = −0.513

log(ϵ) = 7.48

For A type star, Bigot & Nordlünd
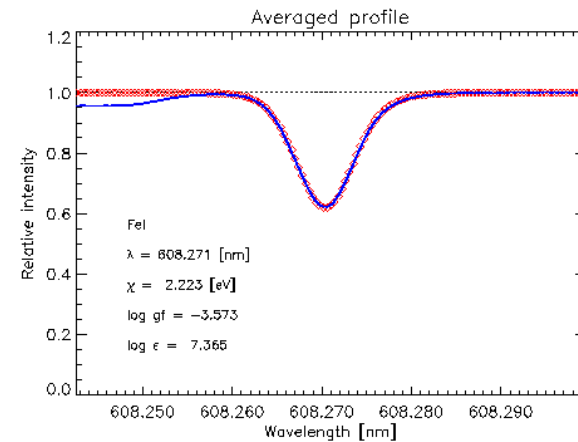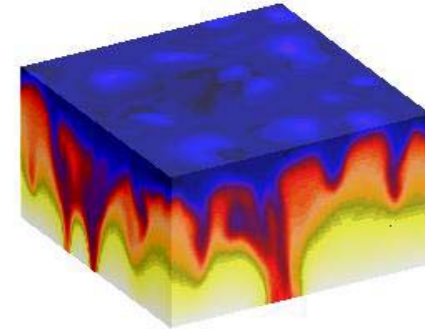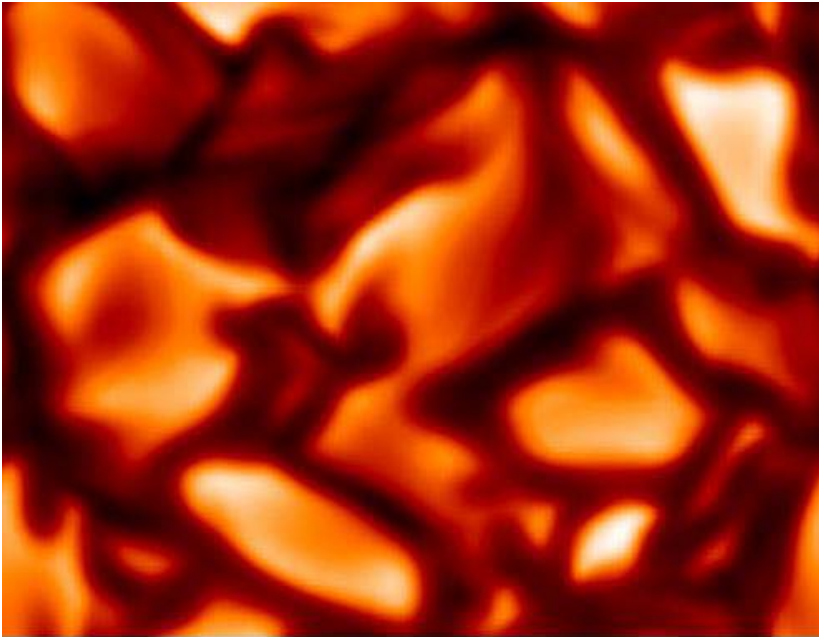
Several years for

1) Check all lines one by one.

2) Improve the codes for faster computations

3) NLTE – 3D on the Sun, mainly for strong lines
-    Construct best atoms, levels + atomic data
-    Solve the problem of H-collisions
-    Ion exchange : H- + ions
-    improve the van Regemorter formula for forbiden lines.

Group CESAM

- Morel P.
- Goupil M.J.
- Lebreton Y.
- Piau L.
- Pichon B.
- Thevenin F.

Joint meeting : RVS + Photometry ?

Next year ?