

# Exercise 3:

**LTE vs NLTE electron densities:  
the effect of collisions with electrons**

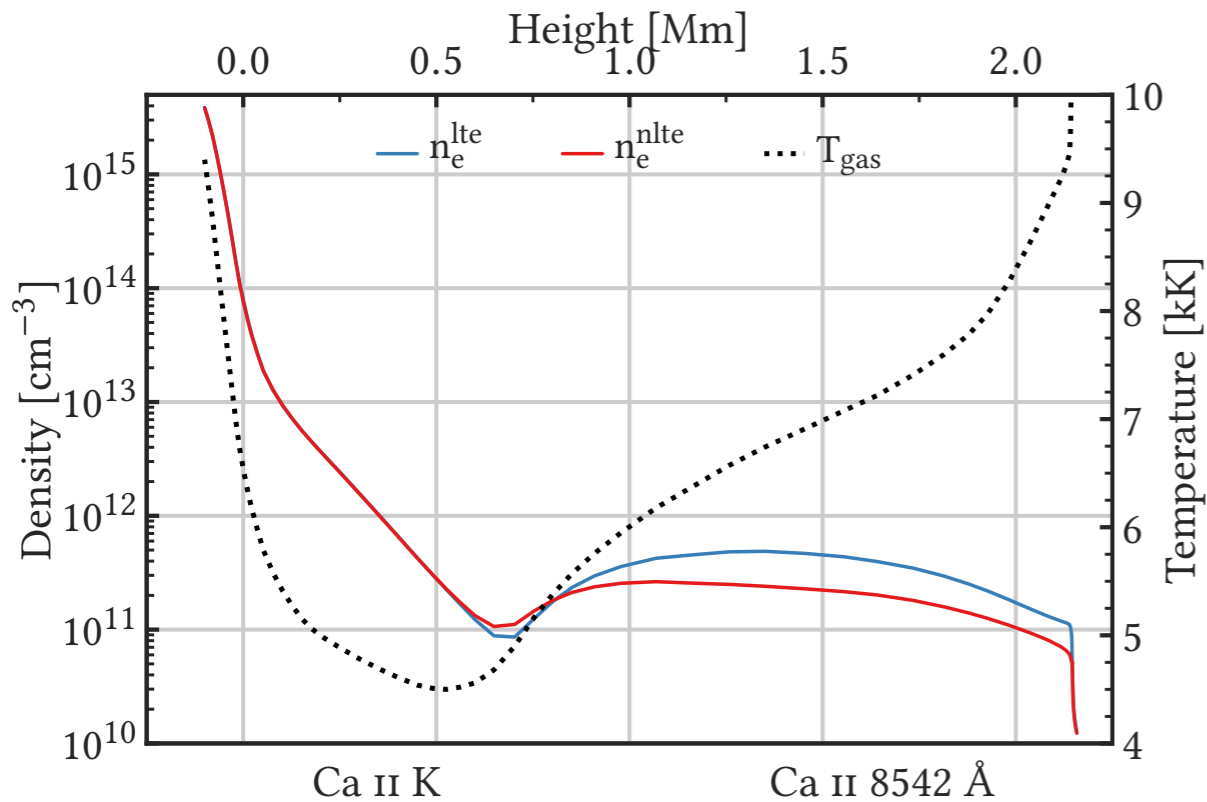


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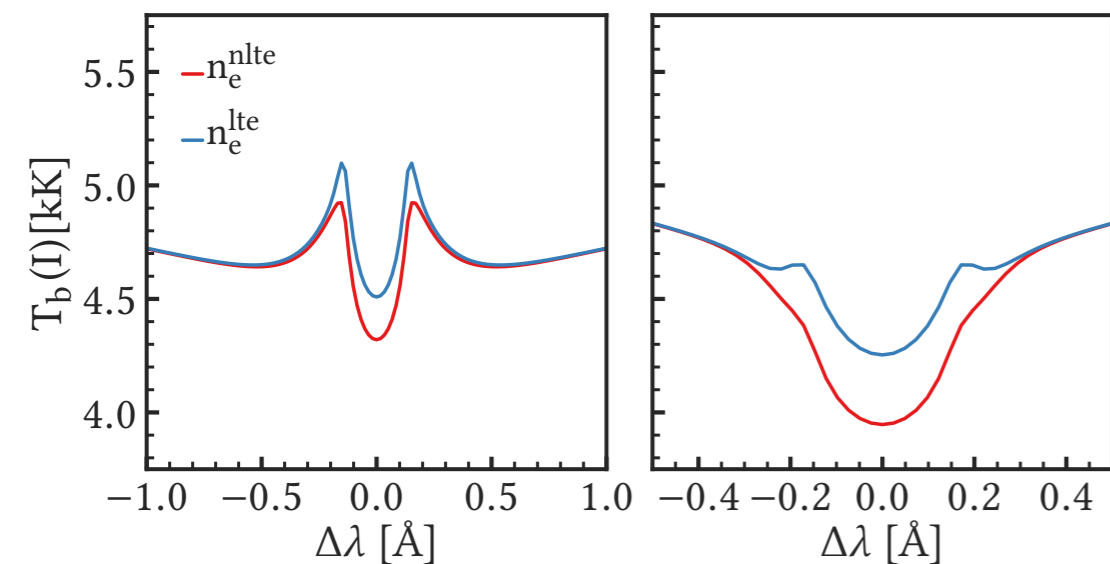
# NLTE electron densities

Most MHD codes and inversion codes assume a LTE EOS  $\longrightarrow n_e^{\text{LTE}}$

Electrons are the main source of collisions in the chromosphere: collisional rates can be wrong with LTE electron densities.



If  $n_e^{\text{NLTE}} < n_e^{\text{LTE}}$ , you will get less coupling to local conditions because



# NLTE electron densities

We will run the FALC model (which includes NLTE electron densities):

- With LTE  $n_e$
- With NLTE  $n_e$  (the ones included in the model)
- With NLTE  $n_e$  (computed by us with STiC, starting from the LTE solution)

Instructions:

1. LTE electrons — in input.cfg set:

- keep\_nne = 0 (this will recompute  $n_e^{\text{LTE}}$ )
- make sure that the hydrogen atom is PASSIVE in atoms.input
- set the output profiles to output\_profiles = synthetic\_neLTE.nc
- run STiC: mpiexec -n 2 ./STiC.x

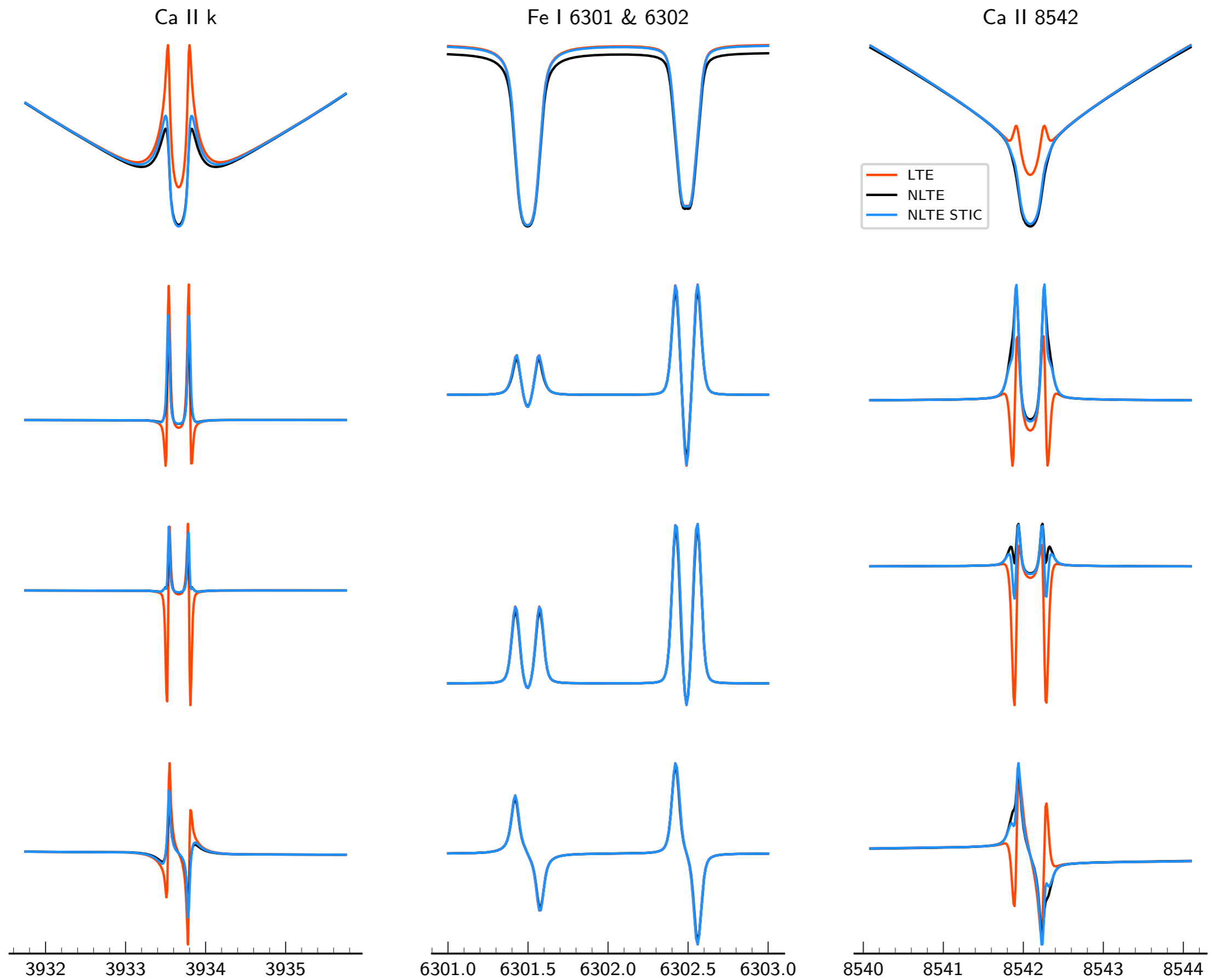
2. NLTE electrons (included in FALC) — in input.cfg set:

- keep\_nne = 1 (this will preserve the input  $n_e$ )
- make sure that the hydrogen atom is PASSIVE in atoms.input
- set the output profiles to output\_profiles = synthetic\_neLTE.nc
- run STiC

3. NLTE electrons (computed internally in STiC assuming NLTE hydrogen and charge conservation):

- keep\_nne = 0 (this will recompute  $n_e^{\text{LTE}}$ )
- make sure that the hydrogen atom is ACTIVE in atoms.input
- in keyword.input set SOLVE\_NE = ITERATION
- set the output profiles to output\_profiles = synthetic\_neLTE\_STIC.nc
- run STiC

# NLTE electron densities



# Summary

Electrons are the main source of collisions in the chromosphere.

Hydrogen is the main electron donor and its ionization balance is in NLTE.

The effect of assuming LTE  $n_e$  is that we can change the core intensity of chromospheric lines.