

The Calculation

The goal here is to compute different realizations of the CHIANTI atomic data for use in interpreting observed density sensitive line ratios. The calculations so far are simply proof of concept to illustrate the procedure and provide example data files.

Variables in the HDF5 Files

CHIANTI_PERTURB_SPL1 : The magnitude of the perturbation applied to the collision strengths for transitions that connect to the levels in the ground configuration. The perturbations are normally distributed with a mean of zero and a standard deviation given by CHIANTI_PERTURB_SPL1. The other perturbations are similar.

CHIANTI_PERTURB_SPL2: The magnitude of the perturbation applied to the collision strengths for transitions that connect to the levels other than those in the ground configuration.

CHIANTI_PERTURB_AVAL: The magnitude of the perturbation applied to the A values (decay rates).

ioneq_file: The name of the CHIANTI ionization equilibrium file.

logt: The log temperature array.

logt: The log density array.

logt_max: The peak in the ionization fraction for this ion.

nsim: The number of realizations of the atomic data.

wavelength: The wavelength for each line of interest. Note that all transitions within 0.1 Angstroms of this wavelength will be included in the emissivity. Only a single wavelength for each line is given here.

transition: A list of all of the transitions that are included in the emissivity. The transitions are listed using the CHIANTI level numbers. For example, for O VIII 18.969 there are three transitions close in wavelength:

```
ion = o_8
this wave = 18.969
nearby transiions = 3
  index      wave      dwave      emiss
    15  18.9671   0.0019   3.48e-09
    16  18.9723   0.0033   1.39e-12
    17  18.9726   0.0036   2.18e-09
transitions = 1-4 / 1-2 / 1-3
```

emissivity: The emissivity as a function of logn at logt_max for each of the transitions of interest. The organization of the array will depend on the language being used to read the file (column-major vs row-major).

emissivity_t: The emissivity as a function of logt and logn for each of the transitions of interest. This is used for investigating the temperature sensitivity of the density ratios.

time_stamp: The IDL system time when the routine was run.

text: Some text describing the included transitions.

Reading the HDF Files in R

To read HDF5 files in R you need to download and compile `rhdf5`. This is done within R using

```
source("http://bioconductor.org/biocLite.R")
biocLite("rhdf5")
```

Once that is done you read the variables using statements such as

```
library("rhdf5")
fname <- "fe_13.monte_carlo.h5"
emissivity <- h5read(fname, 'emissivity')
logn <- h5read(fname, 'logn')
wavelength <- h5read(fname, 'wavelength')

see test_chianti_mc.R for more details.
```

Reading the HDF Files in Python

Use the `h5py` package, which is included in the Anaconda distribution of python. Converting to numpy arrays is also useful. See `test_chianti_mc.py` for more details.

```
import h5py
import numpy as np
file = 'o_8.monte_carlo.h5'
mc = h5py.File(file, 'r')
emissivity = np.array(mc['emissivity'])
logn = np.array(mc['logn'])
wavelength = np.array(mc['wavelength'])
```

Reading the HDF Files in IDL

Here is some pseudocode for reading a file in IDL:

```
file = 'o_8.monte_carlo.h5'
file_id = h5f_open(file)
dset_id = h5d_open(file_id, 'emissivity')
emissivity = h5d_read(dset_id)
h5d_close, dset_id
```