



Contribution ID: 216

Type: Poster

CHIANTI version 11 - advanced ionization equilibrium models: density and charge transfer effects

CHIANTI is the most widely-used database in solar physics, and in some cases is the reference dataset for other databases in astrophysics. We present here a significant update to the modelling. CHIANTI has, up until now, used the coronal approximation to calculate ion balances. This is only suitable in the more tenuous, high temperature solar corona. New effects have been added to the models to make them more appropriate for the solar transition region, where densities are higher and temperatures cooler. This includes density effects on ionisation and recombination rates. Also, charge transfer, which occurs during collisions between atoms and ions, has been included in CHIANTI for the first time. We present an example run of the new models by creating a synthetic spectrum for an active region using differential emission measure modelling. Line intensities are enhanced by factors of 2-5 in certain cases compared to the previous modelling. We compare the results with observations from HRTS and find excellent agreement for transition region lines. The results resolve some long-standing discrepancies in predicting emission for the Si IV lines observed by IRIS, as well as for C IV and N V.

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Session Classification: Coffee break and poster session 2

Track Classification: Diagnostic tools and numerical methods in solar physics