Radiative data of lowly-ionized iron-peak elements for transitions of astrophysical interest

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Accurate fine-structure atomic data for the Fe-peak elements (Sc, Ti, V, Cr, Mn, Fe, Co and Ni) are essential for interpreting astronomical spectra currently available. The lowly-ionized spectra of several iron group elements have been observed in nebular and stellar environments [1-2]. Yet, our present knowledge of their atomic structure is lagging behind the avalanche of high-quality spectra arising from these ions.

We present our systematic approach for studying the electronic structures and radiative rates of forbidden lines of doubly-ionized iron peak elements. The magnetic dipole (M1) and electric quadrupole (E2) transition probabilities are computed using the pseudo-relativistic Hartree-Fock (HFR) code of Cowan [3] and the central Thomas-Fermi-Dirac-Amaldi potential approximation implemented in AUTOSTRUCTURE [4] using a new method of optimization for the potential scaling parameters. The extensive sets of results obtained using these two theoretical approaches are then compared to the rare experimental and theoretical data available in the literature for these ions in order to assess the advantages and shortcomings of each method and provide astrophysicists with a comprehensive set of reliable radiative data.

References

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