Radiative and collisional parameters in doubly-ionized iron group elements

Vanessa Fivet[1], Pascal Quinet[1,2] and Manuel A. Bautista[3]

[1]*Astrophysique et Spectroscopie, Université de Mons – UMONS, B-7000 Mons, Belgium*
[2]*IPNAS, Université de Liège, B-4000 Liège, Belgium*
[3]*Department of Physics, Western Michigan University, Kalamazoo, MI 49008, USA*
vanessa.fivet@umons.ac.be

Accurate and reliable atomic data for lowly-ionized Fe-peak species (Sc, Ti, V, Cr, Mn, Fe, Co and Ni) are of paramount importance for the analysis of the high resolution astrophysical spectra currently available. The third spectra of several iron group elements have been observed in different galactic sources like Herbig-Haro objects in the Orion Nebula [1] and the Weigelt blob of Eta Carinae [2]. However, forbidden transitions between low-lying metastable levels of doubly-ionized iron-peak ions have been very little investigated so far and atomic data for those lines remain sparse or non existent.

We carried out a systematic study of the electronic structure of doubly-ionized iron-peak elements. The magnetic dipole (M1) and electric quadrupole (E2) transition probabilities were computed using the pseudo-relativistic Hartree-Fock (HFR) code of Cowan [3] and the central Thomas-Fermi-Dirac potential approximation implemented in AUTOSTRUCTURE [4]. This multi-platform approach allows for consistency checks and intercomparison and has proven very successful in the study of the complex Fe-peak species in which many different effects contribute.

We also present preliminary electron-impact collision strengths computed using the LS R-matrix code (RMATRX) [5].

References:

[1] A. Mesa-Delgado *et al.*, MNRAS **395**, 855 (2009).

[2] T. Zethson *et al.*, A&A **540**, A133 (2012).

[3] R. D. Cowan, *The Theory of Atomic Structure and Spectra*, Univ. California Press, Berkeley (1981).

[4] N.R. Badnell, J. Phys. B: At. Mol. Phys **30**, 1 (1997).

[5] K.A. Berrington *et al.*, Comp. Phys. Comm. **92**, 290 (1995).