Forbidden and Unexpected Transitions in Atomic Ions

Jiguang Li[†], Tomas Brage[†], Jon Grumer[†], Per Jönsson[‡], Yang Yang[¶], Wenxian Li[¶], Zejie Fei[¶], Martin Andersson[¶], Roger Hutton[¶], Yaming Zou[¶]

[†] Department of Physics, Lund University, S-221 00 Lund, Sweden

[‡] Group for Materials Science and Applied Mathematics, Malmö University, S-205 06 Malmö, Sweden

[¶] Institute of Modern Physics, Fudan University, 200433 Shanghai, China

Forbidden transitions originate from higher order contributions to the transition operator, in the form of non E1 operators, but could be modeled using the dominating part of the wave function of the atomic ion. Unexpected transitions, on the other hand, we define as decay induced by small perturbations in the ion and therefore a smaller contribution to the atomic wave function. The historical example of an unexpected transition is intercombination lines that are induced by magnetic interactions including the electronic spin. The accurate prediction of properties of unexpected transitions requires a detailed and involved modeling of the ion and is therefore a true challenge to atomic structure theory. Forbidden transitions are basically fairly straight forward and will therefore open up for attempts to spectroscopic accuracy in prediction of lifetimes and wavelengths.

In this poster we describe two different projects. One describes forbidden-line spectroscopy of tungsten ions belonging to the silver- [1,2], cadmium- [3] and rhodium-like [4] isoelectronic sequences. For each of these sequences we have compared calculated results, based on using the GRASP2K [5] computer package, with experimental results, based on spectroscopic work done at the Shanghai permanent magnet Electron Beam Ion Trap [6]. Through the comparison of these two results we emphasized that the such effects as electron correlations involving core electrons, which are usually considered as small corrections in highly charged ions and thus neglected, play important roles in physical quantities concerned.

The second project discusses what could be labeled as e new generation of unexpected transitions and we show examples of GRASP2K-calculations for transitions induced by the hyperfine interaction and by external magnetic fields. These unexpected lines are potential candidates for diagnostics of plasma states, like the density and the strength of magnetic fields, in both terrestrial and astrophysical plasmas [7,8]. Systematic investigations are currently being performed on the Ne-like [9] and Ar-like [10] isoelectronic sequences from both theoretical and experimental sides. Additionally, we stress that it is necessary to take into account these unexpected lines in the analysis of plasma spectra.

References:

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