Atomic Data for Modeling the Fe K-Lines in High-Density Astrophysical Plasma Environments: Radiative, Auger and Photoionization Processes

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Iron X-ray K-lines emitted by black hole accretion disks play an important role in astrophysics. Indeed, they have observed widths and shifts that imply an origin very close to the central black hole [1]. They can give information about the effects of special and general relativity in the emitting region. Moreover, some important properties of the black hole itself, such as its spin, can be inferred by modeling the distortion of the Fe K emission profile [2]. Plasma conditions in accretion disks are thought to be characterized by electronic densities as high as 10^{22} cm^{-3} [3]. Such conditions may affect the atomic processes corresponding to the ionic species present in the plasma. However, atomic data used in the standard programs to model astrophysical X-ray spectra are computed assuming an isolated ion approximation. Therefore, this shortcoming is thought to be the major reason for the inconsistencies observed in the results [4].

The main goal of the present work is to estimate the effects of high-density plasma environment on the atomic processes involving the K-vacancy states in iron ions. For this purpose, relativistic atomic structure calculations have been carried out using the multiconfiguration Dirac-Fock (MCDF) method, in which a time averaged Debye-Hückel potential has been considered, using the GRASP92 [5] and of the RATIP [6] codes. In this contribution, we present some results concerning the influence of plasma environment on the radiative, Auger and photoionization processes in highly-charged iron ions.

References

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