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Double $KK$ excited states in highly charged sulphur

P. Amaro*, J. P. Marques†, P. Indelicato§, T. K. Mukherjee#,
J. K. SahaII, L. C. Tribedi†, J. P. Santos*2

* Laboratório de Instrumentação, Engenharia Biomédica e Física da Radiação (LIBPhys-UNL), Departamento de Física, Faculdade de Ciências e Tecnologia, FCT, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
† BioISI - Biosystems & Integrative Sciences Institute, Faculdade de Ciências da Universidade de Lisboa, Campo Grande, C8, 1749-016 Lisboa, Portugal
§ Laboratoire Kastler Brossel, École Normale Supérieure, CNRS, Université P. et M. Curie – Paris 6, Case 74; 4, place Jussieu, 75252 Paris CEDEX 05, France
# Narula Institute of Technology, Agarpara, Kolkata-700109, India
II Indian Association for the Cultivation of Science, Jadavpur, Kolkata-700032, India
& Department of Nuclear and Atomic Physics, Tata Institute of Fundamental Research, Colaba, Mumbai 400005, India

Synopsis Calculation of energies and radiative decays was performed for several highly charge states of sulphur in order to identify experimental lines associated to double excited $KK$ atomic states.

Double $KK$ excited states have several important applications in astrophysics as well as in plasma diagnostics [1, 2]. Besides its applicability, the fundamental interest of dominance of fluorescence over autoionization decay for some $KK$ excited states has attract much attention, both from theoreticians and experimentalists [3, 4]. Recently, it was observed the $2p3d(1D^0) \rightarrow 1s3d(3D^0)$ in helium with sufficient accuracy to distinguish from the H-like $K_\alpha$ line, showing an enhanced fluorescence rate compared to the one assuming standard selection rules [5]. In this work, we continue the investigation of $KK$ excited states for sulphur by performing a systematic identification of experimental lines, which includes both single $K$ and double $KK$ excited states. The relativistic calculations were made within the MCDF approach using the general relativistic MCDF code (MDFGME) [6]. Experimental measurements were performed at the Pelletron accelerator facility in TIFR Mumbai.

In these preliminary calculations, all transition energies and probabilities were computed in a monoconfiguration approach. Almost all possible combinations of excitations for $K_\alpha$, $K_\beta$ and $K_\gamma$ transitions of He through Be charge states were considered. The positions of the experimental lines are displayed in Fig. 1 along with the decay rates of the computed transitions. Transitions from $KK$ excited states were also considered in both He- and Li-like states. It can be observed in Fig. 1 that all experimental lines lines are unambiguously identified, with the exception of one line next to the He-like $K_\alpha$ line. Lines near the H-like $K_\alpha$ line can only be associated to the $KK$ excited states of He or Li charge states. A precise identification can be done by calculating the respective autoionization rate.

Figure 1. Comparison of obtained theoretical lines with experimental lines.

Referências


1E-mail: pdamaro@fct.unl.pt
2E-mail: jps@fct.unl.pt