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REGULARITIES IN THE DISTRIBUTION OF OSCILLATOR STRENGTHS OF LINES IN SPECTRA OF GROUP II ATOMS: BeI, MgI, AND CaI

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Abstract—Regularities in the distribution of oscillator strengths of lines in spectra of II group atoms of the periodic table of elements BeI, MgI, and CaI are established. It is established that the linear dependence described the oscillator strengths of transitions, for which the principal quantum numbers of the upper and lower states are simultaneously changed by unity. For BeI, MgI, and CaI atoms 98 linear dependencies having a high correlation coefficient (as a rule $R > 0.99$) were established. It is shown the influence configuration interaction on being linear dependencies. © 1997 Elsevier Science Ltd. All rights reserved

1. INTRODUCTION

In Refs. 1 and 2 regularities in the dependence of oscillator strengths of spectral lines (f_{ik}) on the change in principal quantum numbers of the lower and upper levels in spectra of alkali metal atoms and their isoelectronic ions were established. It was shown that when transitions are written in the form $(n_i + j)l$–$(n_i + j + m)l'$, where l and l' are orbital quantum numbers of the lower and upper levels, respectively: $(n_i + j)$ and $(n_i + j + m)$ are principal quantum numbers with n_i = constant, $j = 0, 1, 2, 3, \ldots$, $m = 0, 1, 2, 3, \ldots$, a linear dependence of the f_{ik} values on j at given n_i and m is observed:

$$f_{ik}^{\text{app}} = A(m)\cdot j + B(m) \tag{1}$$

The aim of this paper is to analyze these regularities for II group atoms of the periodic table of elements: BeI, MgI and CaI. It is interesting to study these elements because, as distinct from atomic systems considered in Refs. 1 and 2, two electrons in the outer shell of II group atoms led to formation of doubly excited states. These states may perturb the levels of one-electron configurations and affect regularities. Atomic parameters of MgI and CaI are particularly important in astrophysics for modeling processes in stellar atmospheres, because the relative content of these elements in stars is considerably large.

2. REGULARITIES

The analysis was based on the comparatively wide set of data[3] where the f_{ik} values were calculated in the Coulomb approximation by Bates–Damgaard method[4] modified in Ref. 5. At lack or absence of some f_{ik} values, the data[6] were partially used. In Ref. 3, the results of calculations are given as numbers $lg(g_i f_{ik})$, and for triplet levels the $lg(g_i f_{ik})$, values are given for individual multiplet components. Therefore the f_{ik} values were preliminary found, and for the triplet level system the averaging over lower and upper multiplets was carried out.

Let us consider at first regularities for the MgI atom.

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