An alternative decay mode of inner shell vacancies in atoms is the radiative-Auger process in which the filling of the inner shell hole is accompanied by the simultaneous emission of a photon and the excitation of a second electron into a higher bound or continuum state of the atom. This decaying process will result in contributions to the spectrum of emitted x-rays which are seen in the lower energy side of the corresponding main x-ray emission line. The evidence of this effect is well established [1] and several models are found in the literature to describe the decaying process [2]. However, since the radiative-Auger process is much less intense than the single radiative process (x-ray emission), the radiative-Auger emission measurement requires a very accurate technique.

The radiative-Auger transitions can provide important contributions for the understanding of the electron correlation effects in atoms. In addition, the radiative-Auger effect needs to be considered in the precise measurements of x-ray emission rates in atoms following the filling of inner vacancies by outer shells electrons.

In the present work second order perturbation theory was used to calculate the K-MM radiative-Auger transition rate for Ca, Ti and Cr. The perturbing Hamiltonian was taken as the sum of the interaction between the atomic electrons and their interaction with the free radiation field. For the interaction between the atomic electrons and the free radiation field, only the dipole radiation term of the expansion of the electromagnetic field was considered.

As starting point we had considered an atom with one internal vacancy and without any photons in the radiation field as the initial configuration of the system. In the final configuration of the system, after a radiative-Auger transition, one electron from an outer shell fills the internal vacancy and another is promoted to a higher bound or continuum state of the atom and simultaneously is created one photon in the radiation field. The angular momentum factors were described in terms of Wigner 3-j and Racah 6-j symbols which select the allowed radiative-Auger transitions for a given initial state of the decaying atom. Screened hydrogenic wave functions were used to evaluate the radial matrix elements. Results are presented for transitions were the excited electron is promoted to a bound state with principal quantum number up to n =8 or to states in the continuum.

In the Figure 1 the calculated spectral distribution for K-MM radiative-Auger for Ca is compared with the experimental results of Budnar eta al.[3].

References