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REPORT ON TRIP TO CHALK RIVER, FEBRUARY 7-11, 1949

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M. E. Rose

The week, February 7 through 11, was spent by the writer at the National Research Laboratory at Chalk River, Ontario. February 7 and 8 were devoted to a discussion of the problem of internal conversion. Present at this meeting were Dr. W. H. Watson of the National Research Laboratory, Drs. B. A. Griffith, H. Gellman, and Gottlieb of the Computation Laboratory of the University of Toronto. The people from the University of Toronto had previously become interested in the problem at the request of Dr. Watson and have made some contributions to the calculation of K-shell internal conversion coefficients.

The preliminary part of the discussion was devoted to a description of the work done by the writer and co-workers on the K-shell internal conversion coefficients. It was agreed that this work together with supplementary calculations which will be done at the Harvard Computation Laboratory on the Mark I at the request of the writer will complete in a very satisfactory manner the entire problem of K-shell internal conversion coefficients.

Inasmuch as the value of the above mentioned work to experimentalists is greatly enhanced if the values of the internal conversion coefficients for the L-shell are also known, the primary subject of the remainder of the discussion was devoted to the question of procedures most suitable for obtaining the L-shell internal conversion coefficients. For these it is necessary to take into account the screening of the ejected electrons due to the presence of all the other atomic electrons. This effect of screening

could be omitted from the K-shell calculations because reliable estimates can be made which show that its omission cannot cause an error greater than 2% and for several reasons this represents a limit of accuracy of the calculations which have been undertaken.

After considerable discussion it was agreed that the only method available for calculation with screening would be first to calculate screened wave functions for the atomic electrons and then to obtain internal conversion coefficients from these by numerical integration. This conclusion was precisely the same as that reached at an informal discussion held in Oak Ridge during the previous week between Dr. G. Goertzel of New York University, Dr. B. Spinrad of Argonne National Laboratory, and the writer. However, inasmuch as the internal conversion coefficient is an extremely sensitive function of the parameters on which it depends viz: Z the nuclear charge, k the gamma-ray energy and ℓ giving the multiple order, it is necessary to calculate at least 1500 wave functions in order to obtain as much information about L-shell internal conversion coefficients as was obtained for the K-shell. Moreover it is fairly certain that such a project cannot be carried out on the Mark I, the machine which was used for the K-shell calculations.

In order to overcome this difficulty the following program was decided upon as a method of procedure: Calculations of the L-shell internal conversion coefficient would be made with and without screening for about 10 representative cases. These cases would be chosen to fit in with calculations of wave functions made by Mr. John Reitz of the University of Chicago. In a previous communication to the writer Mr. Reitz indicated a willingness to cooperate with us in the internal conversion coefficient calculations. Since he has already calculated wave functions with screening for a number of cases, the

comparison of conversion coefficients with and without screening would be made for those cases which Mr. Reitz has already studied. A letter has been sent to Mr. Reitz requesting his cooperation in making internal conversion coefficient calculations with his wave functions and suggesting that if he is unable to do this, that we would be willing to attempt such calculations if he should forward the pertinent numerical data. At the same time the group from the University of Toronto will perform the calculations without screening. From a comparison of these two sets of calculations it is hoped that one can evaluate, in a kind of empirical manner, suitable screening constants so that the remaining L-shell internal conversion calculations could be carried out in exactly the same manner as were the calculations for the K-shell. In this way we could make use of the Mark I and of the fact that this machine is more readily available to the A.E.C. laboratories.

It has also come to the writer's attention that Professor D. R. Hartree of Cambridge may be considering, or may even have instigated, a program of wave functions computations for relativistic screened atoms. If this is the case, the possibility exists that these wave functions may be used for the internal conversion calculations thus eliminating, so far as this laboratory is concerned, a major part of the job. A letter of inquiry has been addressed to Professor Hartree.