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A FORTRAN SUBROUTINE FOR CALCULATING THE  
RANGE-ENERGY RELATION OF CHARGED  
PARTICLES IN CHEMICAL ELEMENTS

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A FORTRAN SUBROUTINE FOR CALCULATING THE  
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W. Peter Trower

September 3, 1964

A FORTRAN Subroutine for Calculating the  
Range-Energy Relation of Charged  
Particles in Chemical Elements<sup>o</sup>

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A problem inseparable from any experimental particle physics is that of determining the energy loss of a charged particle as it passes through matter. We have constructed a computer program to easily give useful and accurate solutions to this problem. The program is constructed basically to evaluate the Bethe-Bloch equation for all charged particles except electrons and positrons. At low energies shell corrections are applied. At high energies density-effect corrections are applied. Since the Bethe-Bloch equation yields the differential energy loss of the particle in MeV/cm, we can obtain the range of the particle by direct integration, using low-energy proton experimental ranges to initiate the integration. The range of a particle is given as a function of energy or momentum in terms of three units: centimeters, gram-centimeters<sup>2</sup>, and moles of electrons/centimeters<sup>2</sup>. This calculation is made for any homogeneous target material that is a chemical element. Using the results of element calculations, we can readily compute the energy loss and range in chemical compounds and mixtures.<sup>1</sup>

The results of representative calculations have been checked with experimental results and have been found to be in good agreement. Figure 1 displays both calculated and experimental range results for protons in copper in the energy interval of 1 MeV to 100 BeV.<sup>2</sup>



The user must specify the charge of the target atom, the charge and mass of the particle, and the energy range of his interest. He may, in addition, specify the atomic number, mean ionization potential, and density of the target material if he wishes to override the internally stored data of the program with that of his choice.

This program is available in deck form from the author. A full writeup, which includes a listing of the source program as well as fixed data, has been prepared.<sup>3</sup>

FOOTNOTES AND REFERENCES

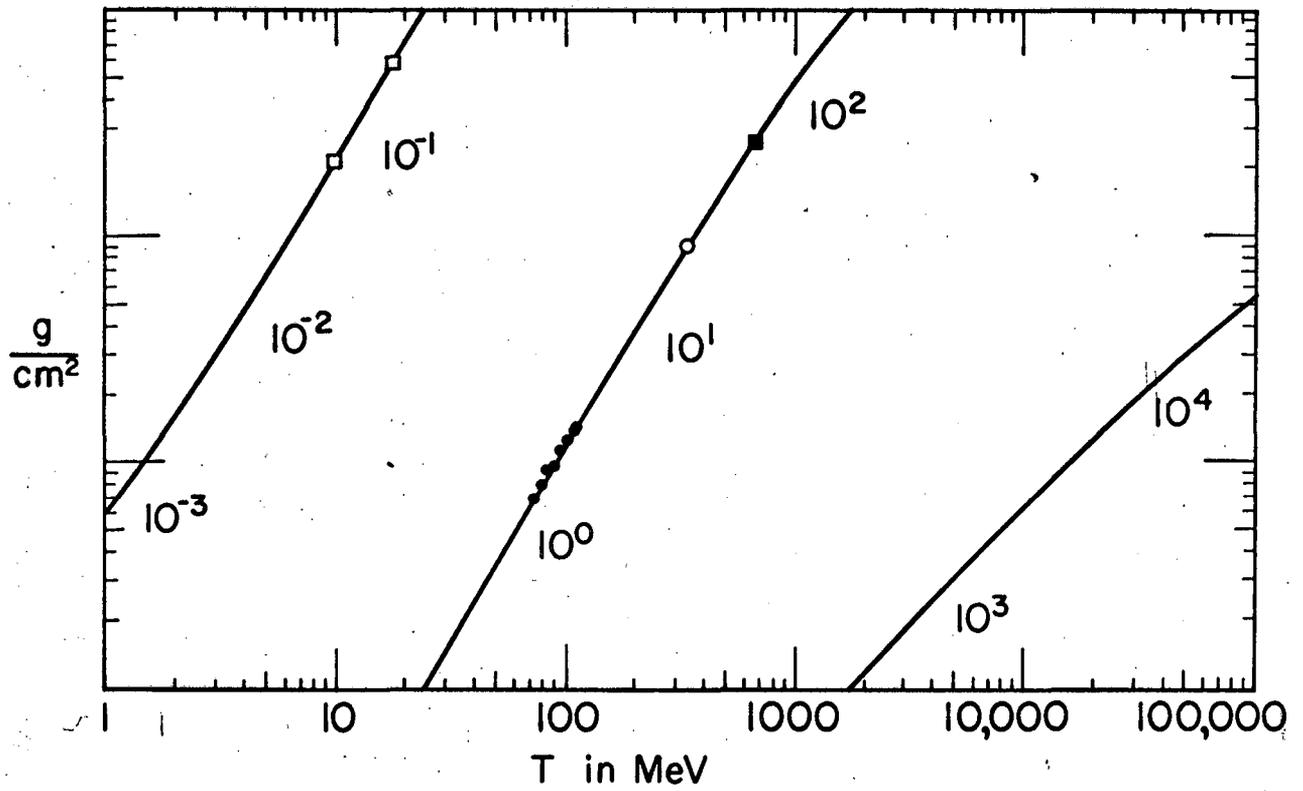
\* Work performed under the auspices of the U. S. Atomic Energy Commission.

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FIGURE CAPTION

Fig. 1. Graph of proton range in copper generated by program RANGE (I=322 eV). Points plotted according to data of: Bloembergen and Van Heerden (Ref. 2b) (●); Bichsel (Ref. 2a) (□); Mather and Segre (Ref. 2c) (○); and Zrelov and Stoletov (Ref. 2d) (■).  
—————: Calculated from RANGE (I=322 eV).



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Fig. 1.

