the rest energy. This is the only way in which these spectra can be fitted into a Fermi type theory.

However, these linear combinations of interactions predict much smaller K-capture probabilities than are observed, and too strong an energy variation of lifetime for ordinary decay, so that neither is likely to be the dominating term in the majority of nuclei. If they do appear, it is probably in combination with another interaction term of the ordinary type, which latter must then be screened out by a selection rule in Cu^{64}. Further development of the question must await low energy experiments on other elements, to determine whether or not the Cu^{64} behavior is anomalous.

In any case, it is clear that the low energy spectra of Cu^{61} force us to a choice of two severely restricted interaction forms, and the incompatibility of these interactions with other nuclear data indicates the important role of the low energy end of the spectrum in the investigation of the nature of β-decay.

[1] J. Backus, Phys. Rev. **68**, 59 (1945).
[2] A. W. Tyler, Phys. Rev. **56**, 125 (1939).
[3] M. Fierz, Zeits. f. Physik **104**, 553 (1937).

Preliminary Investigation of Spark Discharges along Shock Waves

E. E. HACKMAN
Rouss Physical Laboratory, University of Virginia, Charlottesville, Virgina
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FOLLOWING is an outline of methods used and results of preliminary investigations on spark discharges in the vicinity of shock waves formed in an air stream moving at supersonic velocities.

Air was discharged through a 2″ nozzle into the open at Mach numbers in the range of approximately 1.2–1.9. A metal rod $\frac{3}{8}$″ diameter was supported in the air stream generally longitudinally along the axis of symmetrical flow, with its conical point at distances of $\frac{1}{2}$″ to 4″ from the face of the nozzle. In some cases the rod was displaced outward from the center (axial) position. The rod was negatively charged to a potential of approximately 10^5 volts by the usual method (Marx circuit) for recurrent sparking, discharging through the air stream to the nozzle face. In series with the high potential side of the circuit a spark gap was inserted to provide a light source for shadowgraph photographs. A representative photograph is shown in Fig. 1. As will be noted, the positions of the principal equipment are recorded together with the main spark discharge and the principal shock waves, in profile, of the air stream from the nozzle. Figure 2 is a sketch of the significant features.

FIG. 1. View of spark discharge along shock cone. A-nozzle; B-rod (negatively charged); C-path of discharge from rod to nozzle; D-shock waves; E-direction of air stream.

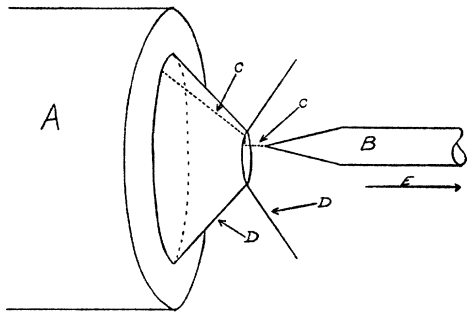

FIG. 2. View of spark discharge along shock cone. A-nozzle; B-rod (negatively charged); C-path of discharge from rod to nozzle; D-shock waves; E-direction of air stream.

Of primary interest, as observed both visually and photographically, is the path of the main discharge. It will be noted that it proceeds generally directly ahead into the air stream, meeting the nozzle shock cone, and thence along the cone to the nozzle. In this instance the rod was displaced vertically approximately 0.15 inch to obtain a profile view.

The foregoing phenomena were observed in numerous cases for various nozzle Mach numbers, in the range indicated above, and for varying distances of the point of the rod from the nozzle. The geometrical path varied as the position of the rod was shifted with respect to the shock cone.

Further investigations are intended to explore in greater detail the observed phenomena with a view in part to determining the local conditions along the path of the discharge, and the conditions favoring such a path.

A Relation between Characteristic Bond Constants and Electronegativities of the Bonded Atoms

WALTER GORDY
Department of Physics, Duke University, Durham, North Carolina
February 1, 1946

THE relation,

$$k = 1.67N(x_A x_B/d_{AB}^2)^{\frac{3}{4}} + 0.30,$$

where k is the bond-stretching force constant in dynes/cm $\times 10^{-5}$, N the bond order, d_{AB} the bond length in Angstroms, and x_A and x_B are the electronegativities of the bonded atoms A and B according to the Pauling scale,[1] has been found to hold rather accurately for a large number of diatomic and simple polyatomic molecules in their

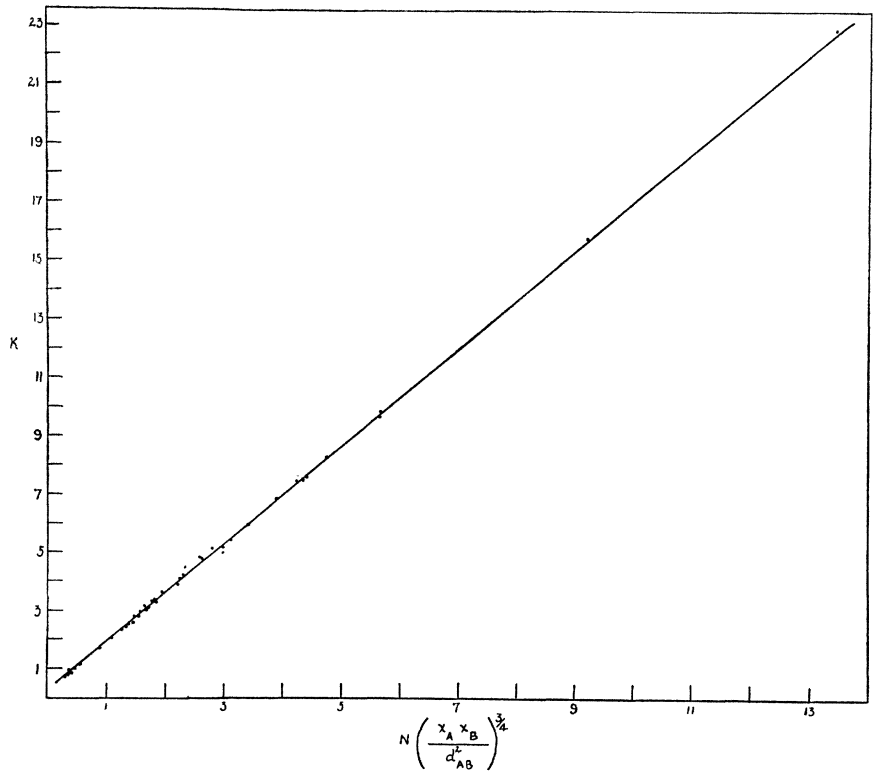

FIG. 1. Plot of bond-stretching force constant k against $N(x_Ax_B/d_{AB}^2)^{\frac{3}{4}}$ for: AsH_3; BH of B_2H_6; BeO; Br_2; CBr of CH_3Br; CC bonds of C_2H_2, C_2H_4, C_2H_6, CH_3CCH, C_6H_6; CCl of CH_3Cl; CF of CH_3F; CH_4; CN of CH_3NH_2 and of HCN; CO of CH_3OH and of H_2CO; CS of C_2H_6S and of CS_2; CSe of C_2H_6Se; Cl_2; GeH_4; HBr; HCl; HF; HI; IBr; ICl; I_2; KBr; KCl; KI; NaBr; NaCl; NaI; N_2; NH_3; H_2O; OF_2; OCl_2; PH_3; H_2S; H_2Se; SS of H_2S_2; SiH_4.

Values for all bond constants and electronegativities and the sources from which they were obtained will be listed in a later publication.

ground states. Figure 1 shows k plotted as a function of $(x_Ax_B/d_{AB}^2)^{\frac{3}{4}}$ for the bonds listed.

When the same atom is involved in more than one of the bonds included, the electronegativity value given for it by Pauling was adjusted to give the best over-all fit with the relation. This adjustment merely required the extension of the values to an additional place as it was not found necessary in any instance to alter the last significant figure given by Pauling. This is remarkable as Pauling's values were determined in a completely different manner, from the extra ionic resonance energies of bonds having partial ionic character.

Identical bonds in different molecules are not repeated in the figure. The several CC bonds included all have different bond orders. The orders used for them are those recently determined by Mulliken, Rieke, and Brown[2] from the molecular orbital theory. The resulting good agreement of the CC bonds supports their rather surprising predictions that the usual CC "single" bond in hydrocarbons has appreciable double bond character, and that the usual CC "double" bond has appreciable triple bond character.

The above relation does not apply to bonds containing atoms with unsatisfied valencies, to diatomic molecules in which both atoms have +1 valence, nor to polyatomic molecules in which there is appreciable interaction between the non-bonded atoms. Certain classes of them may, however, be fitted to the more general relation,

$$k = aN(x_Ax_B/d_{AB}^2)^{\frac{3}{4}} + b,$$

by a suitable choice of the parameters a and b.

A more detailed treatment of the relation with some of its applications will appear elsewhere.

[1] L. Pauling, *The Nature of the Chemical Bond* (Cornell University Press, Ithaca, New York, 1939), p. 64.
[2] R. S. Mulliken, C. A. Rieke, and W. G. Brown, J. Am. Chem. Soc. 63, 41 (1941).

A Calculus of Finite Precision—A Correction

BENJAMIN LIEBOWITZ
350 Fifth Avenue, New York, New York
January 7, 1946

IN my paper on "A Calculus of Finite Precision,"[1] I introduced the concept of kinematical probability and with its aid derived from purely classical considerations Schroedinger's equation for stationary states, or at least something very much the same as Schroedinger's equation both in form and meaning. The assumptions underlying that derivation are: