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A FORTRAN PROGRAM FOR
CALCULATING KINEMATICAL AND DYNAMICAL QUANTITIES
OF PARTICLE INTERACTIONS AND DECAYS

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A FORTRAN Program for Calculating Kinematical and Dynamical Quantities of Particle Interactions and Decays*

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The application of special relativity to particle interactions is in general a straightforward but often tedious affair. This report describes a computer program that calculates relativistic kinematics and dynamics of particle interactions and allows the physicist a wide latitude in his choice of input variables and an extensive output that should cover most of his normal needs.

Symbolically the interaction for which this program KINE is constructed can be written as $1+2\rightarrow3+4$, where particle 2 is assumed to be at rest in the laboratory frame. The user specifies his problem by stating the masses of the particles in the reaction. Decays are specified by setting the mass of particle 2 equal to zero. For photoproduction the mass of particle 1 is set to zero. In three-dimensional space, each particle may be described by three variables (for example, P_x P_y P_z), making a total of nine variables for the reaction, since particle 2 is at rest. But in the reaction plane, each particle can be characterized by a pair of variables, so the number of variables is thus reduced to six. We further have three conservation equations, two in momentum and one in energy, and can arbitrarily specify the direction of particle 1, leaving only two variables that are necessary to specify this system. KINE has seven subroutines that allow the user to specify

the most useful combinations of two variables out of two of three pairs of particle variabl s: momentum or kinetic energy of 1 in the laboratory or in the center-of-mass frame, momentum or kinetic energy of 3 in either frame, and angle of 3 in either frame.

KINE essentially generates tables of kinematic and dynamic variables. Depending on the input, its output consists of the kinetic energies, momenta, and angles of particles 3 and 4 in both frames, as well as their η, β, and $\frac{d\Omega_{LAB}}{d\Omega_{c.m.}}$. In addition, the η, β, and γ of the center of mass; the relative velocity, phase space, and total opening angle of the final-state particles; and the threshold energy and momentum of the incident particle are calculated.

This program is available in deck form from the author and a full write-up has been prepared.[1]

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

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[1] W. P. Trower, FORTRAN Program KINE: Calculating Kinematical and Dynamical Quantities for Particle Interactions and Decays, Lawrence Radiation Laboratory Report UCRL-11650, September 1964 (unpublished).