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# "PENETRATION OF THIN FILMS BY HYPERVELOCITY MICROPARTICLES"

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J. F. Friichtenicht

Prepared by
J. F. Friichtenicht
Manager, Meteoritics Dept.

D. B. Langmuir

Approved by
D. B. Langmuir
Director

PHYSICAL ELECTRONICS LABORATORY
Physical Research Division

TRW Systems
One Space Park, Redondo Beach, California

# PENETRATION OF THIN FILMS BY HYPERVELOCITY MICROPARTICLES

## I. INTRODUCTION

At least one type of micrometeoroid detector operates on the basis of light transmission through holes produced in otherwise opaque films by the impact of micrometeorites. The detector flown aboard the Explorer VII satellite by LaGow and Secretan[1] was of this type. In their device, the opaque film was placed between a light source and a photomultiplier tube, which measures the quantity of light transmitted through the film. A sudden increase in phototube current signals a meteoroid impact. The magnitude of the phototube current increase is proportional to the area of the hole in the film. For maximum benefit to be derived from the measurements, it is desirable to relate the current increase to the parameters of the impacting micrometeoroid.

Films typical of those used by LaGow and Secretan were calibrated using high-speed particles from the TRW Systems electrostatic hypervelocity accelerator.[2] A brief experimental program in support of these measurements was conducted and the results are given below. It should be pointed out that the results are equally applicable to the general area of hypervelocity impact phenomena.

## II. PROCEDURES AND RESULTS

The thin film, in the form of a strip about one inch wide by three inches long, was mounted in a test fixture attached to the end of the accelerator drift tube. The plane of the film was perpendicular to the axis of the particle beam. A detector[3] for the measurement of particle charge, velocity, mass, and trajectory was positioned immediately in front of the film holder. The film could be moved manually in a direction defined by the long axis of the film, thus exposing a number of separate and distinct target areas to the beam.

As many as ten areas could be utilized before the target was removed from the vacuum chamber. The film holder was carefully indexed and the observed impact sites were correlated with the trajectory information derived from the particle detector.

The targets were 0.00025 inch thick mylar films with a thin (about 0.1 micron) layer of vapor-deposited aluminum on the impact side. The diameter of the holes produced $D_H$ was measured with a screw micrometer eyepiece and a high power optical microscope. For these measurements, $D_H$ is defined as the diameter of that part of the crater transparent to light. In general, this diameter is smaller than the overall diameter of the disturbed area. Carbonyl iron spheres were used for all of the shots. The particle diameter $D_p$ was determined by the techniques described in Ref. 3.

The results are summarized in Fig. 1. The results show that the ratio of hole diameter to particle diameter increases slowly with velocity, but is relatively constant from about 5 or 6 km/sec and up. The scatter of the data points prohibits a reasonable estimate of the velocity dependence. The lack of precision arises from errors in the measurement of both of the quantities. Also, it is likely that the thickness of the film relative to the size of the particle plays an important role, but this has not been considered. It is clear, however, that the hole diameter is at most one or two times the particle diameter even at the highest impact velocities. More precise measurements are required to fully assess the situation.

vw

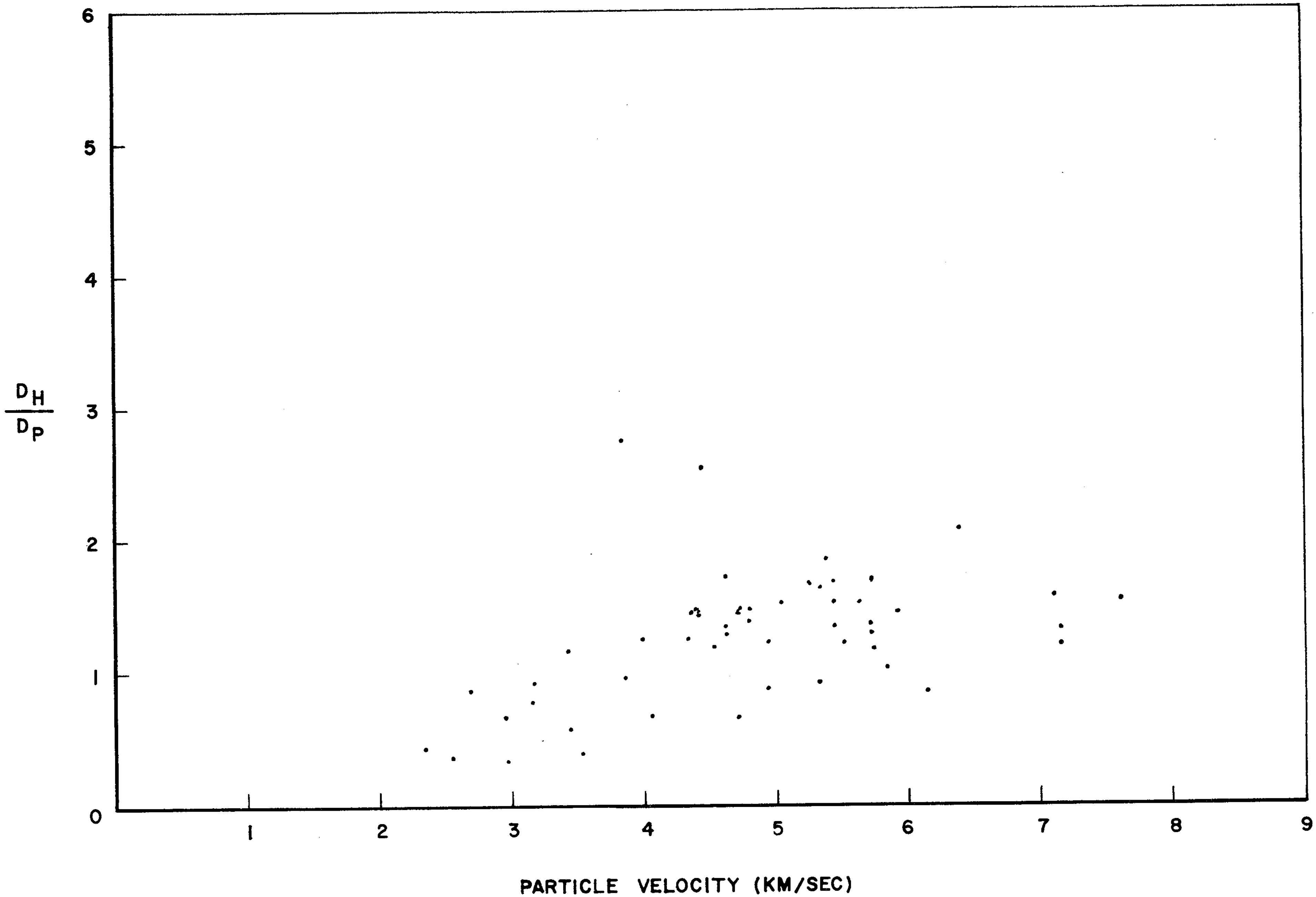


Figure 1. Relative hole diameter of holes produced in thin films by the impact of high speed particles as a function of velocity.

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