Radio-wave Scattering by Meteors and the Dependence on Meteor Trail Structure

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1. Extended Abstract

Meteor studies by radar have had a long history, dating back to the 1950's and even prior to that time. For many years the dominant type of radars used were those that reflected in a specular manner from the ionized trail formed by the meteoroid. This required that the meteor entry trajectory was orientated in such a way that mirror like reflection from the trail produced a signal at the receiver. For monostatic systems, this meant that the trail was aligned perpendicular to the path from the meteor trail to the radio antennas. Both backscatter systems and forward scatter systems were used.

These types of studies made the simplest possible assumptions about the nature of the reflecting trail. It was assumed that the trails were cylindrical conductors of finite length following the meteor head. Lengths could be typically 5 or more km long, requiring most studies to use Fresnel scatter theory rather than Fraunhofer. The theory of this process was developed in the years up to 2000 (e.g. [1] and references there-in).

In more recent years, other forms of meteor scatter have been investigated, both experimentally and theoretically, including head-echo scatter and so-called non-specular processes [2,3]. As the measurements become more complex, the need has arisen to use more sophisticated models for the structure of the meteor trial, beyond a simple cylinder. An example is shown in Fig.. 1, but even this simple figure does not cover all of the available subtleties associated with a typical trail.

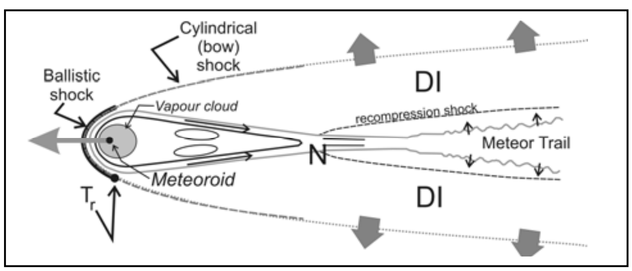

Figure 1. One proposed model for trail structure for a strong meteor [4].

In this paper, we review the current state of knowledge concerning meteor trail structure, and consider the impact of this more detailed information on various types of radar scatter. Important features include the nature of the head and the associated vapour cloud, various shock fronts subsequently produced, and flow characteristics that lead to the initial radius of the trail.

2. References

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