

METEORIC HEAD ECHOES: THEORETICAL PRODUCTION  
RATES AND REQUIRED LEVELS FOR DETECTION

ReVelle, D.O.

Los Alamos National Laboratory

Small and generally quite high velocity meteoroids interacting with the upper and middle atmosphere lose their initial kinetic energy by producing heat, light, ionization, dissociation, diffuse waves, ablation and fragmentation debris, etc. The instantaneous and remnant ionization produced can be readily detected by both classical and large aperture radar systems. It has been a long standing problem that the instantaneous part of the ionization is difficult to interpret theoretically even though the standard range time plots available from classical meteor radars have consistently shown that the slope of the electromagnetic signal return is from a moving ball target whose velocity is consistent with the instantaneous meteor velocity. Recently, Janches and ReVelle (2005) have developed a set of single-body meteor entry relations to theoretically predict the instantaneous ionization levels (neglecting recombination effects at lower atmospheric heights where the atmospheric densities are much larger) as well as the prediction of the levels required for ground-based detections of this ionization. It was determined that the predicted detection threshold is a function of the depth of penetration of the meteors with smaller values required at progressively higher end heights. In order to achieve this required level an assumption had to be made regarding the absolute level of ionization in the gas cap volume in front of the meteor. We have attempted to bound this problem by assuming that the required level of ionization in the gas cap should fall between the synoptic, naturally occurring values prevailing in the ambient undisturbed atmospheric column (at the corresponding D, E or F region heights) and an upper limit produced by the intense meteor-atmosphere interaction and assumed to correspond to a 0.10 percent ionization level. Surprisingly, naturally occurring, ionospheric background levels were found sufficient to determine the required level of ionization necessary at quite large Knudsen numbers for ground-based radar detection of the instantaneous ionization levels produced theoretically. In this talk we will examine these predictions in more depth to try to better understand the full implications of these new predictions.

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1. (a) Douglas ReVelle  
P.O. Box 1663, MS D401  
Earth and Environmental Science  
Los Alamos National Laboratory  
Los Alamos, NM  
87545 USA  
revelle@lanl.gov  
(b) 505-667-1256  
(c) 505-665-3415
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3. (a)
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