The instantaneous trail length of faint meteors

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The dustball model postulates that meteoroids are comprised of refractory grains embedded in a volatile matrix [1,2]. As the meteoroid descends in the atmosphere, the matrix ablates first, releasing grains that ablate individually. The meteor is expected to develop an instantaneous luminous trail, with a length dependent on the grain release rate, as well as the size distribution of grains. An example trail is given in Fig. 1, recorded on high-resolution, image-intensified video. Previous efforts to observe faint meteor (down to $+8$ magnitude) instantaneous trail lengths have yielded values up to 2000 m, but were hampered by low video resolution and signal-to-noise ratio [3,4]. Simultaneous observations of the instantaneous trail length and meteor light curve can yield information about the size distribution and density of grains comprising the meteoroid.

We discuss measurements of the lengths of faint meteor (dimmer than 0 magnitude, $m < 10^{-4}$ kg) instantaneous trails, captured in high resolution (< 5 m per pixel) intensified video by the Canadian Automated Meteor Observatory (CAMO) [5]. CAMO has been collecting meteor observations since April 2010, and a recent statistical analysis on events recorded between 2010 and 2014 has revealed that about 85 per cent show significant trails [6]. The goal of this project is to quantify instantaneous trail lengths with an objective and reliable method, such that the grain size distribution of the associated meteoroid may be determined with ablation models.

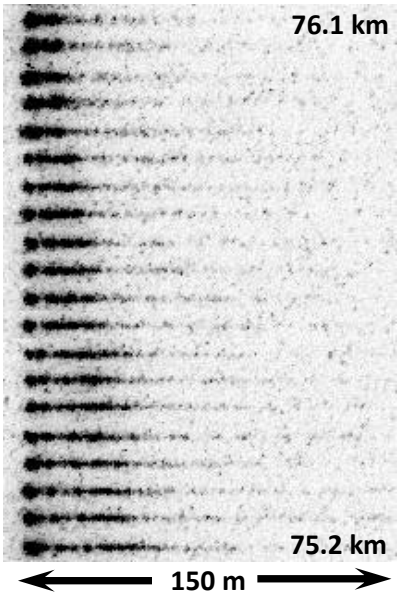

Figure 1: Snapshots of the instantaneous meteor trail observed on 2016-01-06 07:49:18 UTC with CAMO, at heights ranging from 76.1 to 75.2 km. The meteor had a peak absolute magnitude of $+3.1 \pm 0.2$. Snapshots are approximately every 10 ms and have inverted contrast for visibility. 150 m at the range of the meteoroid has been illustrated at the bottom.

References

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