High-resolution video observations and light curve analysis of faint meteors

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The Canadian Automated Meteor Observatory regularly observes faint meteors with both a wide-field camera and a narrow-field camera. The wide-field observation provides an orbit and light curve, while the narrow-field camera (which can resolve up to 3 meters per pixel) provides fragmentation observations: does the meteoroid fragment into a few large pieces, many small pieces, or not at all?

The combination of two-station light-curve observations, with the meteoroid orbit and morphology, were used to investigate the relationships between meteoroid strength, fragmentation, and light-curve shape. The observations were collected between April 2010 and May 2014.

Each meteor's light-curve shape was classified according to the F parameter (the ratio of the position of maximum brightness to the length of the light curve); the Tisserand parameter (with respect to Jupiter) indicated the origin of the meteoroid; and the observed narrow-field morphology was used to describe the fragmentation mode.

The majority of meteor light curves were found to be symmetric (mean F parameter 0.49), cometary by Tisserand parameter, and show continuous fragmentation (long trails). Dynamically asteroidal meteors were found to fragment as often as dynamically cometary meteoroids, which may be evidence for mixing in the early Solar System, or migration of meteoroids from cometary to asteroidal orbits.

It is often assumed that light-curve shape may be indicative of fragmentation behaviour, but we find that meteors that show little to no fragmentation (single body objects) present mostly symmetric light curves, refuting this idea. About 90 per cent of observed meteors show some form of fragmentation.