Three-Dimensional Trajectories of 2016 Perseid Meteors Over West Japan Obtained Through Multi-Site Observations

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Meteors are the visible tracks of small grains that enter Earth's atmosphere from space. They collide with air molecules and create streaks of light in the upper atmosphere. The purpose of the present study was to determine the three-dimensional trajectory of such meteors, especially their altitude and velocity. In cooperation with three nearby observatories and research institutes in Okayama Prefecture, west Japan, I obtained a large amount of video/still image data for the 2016 Perseid meteor shower on four nights between August 11 and 14, 2016. I detected 546 meteors including 443 Perseids during the observation period. Two-point observational data were available for 28 meteors. I measured the altitude and azimuthal angles at the beginning and end of their trajectories, and calculated their three-dimensional position using the triangulation method. From the still images, the average altitudes at the beginning and end of their trajectories were determined to be 107 km and 91 km (±2.2 km), respectively, and the average path length was about 22 km. From the video images, an average geocentric velocity of 57 km/s (±11 km/s) was obtained. It was found that brighter meteors had longer paths and lower end points than fainter ones. However, the altitude of the beginning point was almost independent of the brightness or the angle of entry to the Earth's atmosphere. Consequently, it can be expected that the light emission process is determined by the structure of the atmosphere, and not by the mass or size of incoming grains. Therefore, by applying this method, meteors can be used as probes to investigate properties such as the gas density in the Earth's lower thermosphere, where neither satellites nor balloons can operate.

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