

Simultaneous UHF/VHF Radar and Optical Observations of Meteors at Arecibo

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430 MHz Ultra-High Frequency (UHF) and 47 MHz Very-High Frequency (VHF) radar observations of meteors were made at the Arecibo Observatory in Puerto Rico over a period of four days during 17-22 May 2012. These radar observations were made in conjunction with optical meteor observations. The volume observed by each of the radars and the optical imager overlapped, so that the same meteor could be detected by all three observation systems. We present the results of the analysis of this data. An automated analysis code identified over 8,000 meteors in the UHF radar data and over 200 meteors in the VHF radar data spanning the four nights of observation. 70 of these meteors were found to have been simultaneously detected by both the UHF and the VHF systems, and 19 of these were also observed optically.

Signal-to-noise ratio (SNR), range profiles, and line-of-sight velocity profiles for each meteor were obtained from the radar data. For the UHF radar data, the Doppler shift of the returned pulse was used to determine meteor line-of-sight velocity. For the VHF radar data, a pulse-to-pulse correlation function was used to determine the velocity. Given the ranges of the meteors, horizontal velocities were determined using the optical imager. By combining the horizontal and line-of-sight (i.e., vertical) velocity components from the optical imager and the radars, a three-dimensional velocity vector for the meteor can be determined. The intensity of the meteor in each of the observing systems can also be compared. In some cases, only part of the meteor light curve was observed, placing a lower limit on the optically-derived mass. Despite these outliers, the maximum SNR of each radar meteor was found to roughly correlate with the optically-derived mass of the meteor.