

The Confirmation Of High-Altitude Radar Meteors Observed With The Jicamarca 50MHz Array Radar

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There have been several optical observations of high-altitude meteors reported over the years. For instance, Olech et al. (A. Olech et al., *A&A*, 557, A89, 2013) recently reported a large Orionid fireball which was observed with the Polish Fireball Network of video and Photographic cameras. The fireball was captured at a beginning height of 168.4 ± 0.6 km and a terminal height of 69.4 ± 0.6 km. The radar meteor community, however, has remained skeptical with regard to the results of high-altitude meteors observed with High-Power, Large-Aperture (HPLA) radars. Antenna side-lobe contamination is placed in the center of this issue as the commonly raised objection. In order to confirm the existence of high-altitude radar meteors (HARM), we present here two nicely recorded high-altitude meteor head echoes whose beginning heights were 170 km and 140 km respectively. They were observed from our April 15, 2010 meteor observations using the Jicamarca Radio Observatory (JRO) main 50 MHz radar array antenna system. These two head echoes have significantly distinguishable SNR patterns and high Doppler velocities. An interferometric technique was employed to locate these meteor events via matching their SNRs with the JRO antenna radiation pattern (J. L. Chau et al., *Ann. Geophys.*, 26(8), 2333-2343, 2008). To resolve the antenna side-lobe ambiguity issue, we demonstrate here the beam width and distant side-lobe properties for these observations. The sensitivity was so low that seeing meteor-zone meteors via the side-lobes was unlikely. For example, no satellites were detected in the side-lobes in this experiment. In addition, a flare-related trail-echo of one of these two events further locates the meteor head echo within the antenna main lobe as it is consistent with $\mathbf{k \perp B}$ scattering (A. Malhotra et al., *JGR*, 112, A12303, 2007).