Simultaneous observation of faint meteors byradar head echo and high-sensitive video imageat Shigaraki MU observatory.

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Radar observation of meteor echoes has widely been applied for both atmospheric parameter measurement for aeronomy and meteor characteristics for meteor science. Two types of meteor echoes are used for the radar measurement; meteor trail echo and meteor head echo. The former is a strong Fresnel scattering from the ionized trail lasting for 0.1 to 1 second in usual case. The scattering is highly aspect sensitive and trails perpendicular to the radar boresite can be observed with significant intensity. Such trail echoes are used to derive wind velocity and temperature of the ambient atmosphere. On the other hand, radar head echo is the echo from an instantaneous high density plasma hear the meteoroid inpinges into the earth's atmospohere. From the observation of meteor head echo, information of the motion and the size of meteoroid can be obtained. The MU radar has been applied to meteor trail echo observation since 1989, and has been used for a precise wind and temperature measurement high resolution (1km altitude x 30 min time). On the other hand, orbit measurement of head echo by the MU radar has been started in 1998. By using SBL (sequential beam lobing) method, which has been developed for space debri observation, meteor orbit and velocities could be observed (Sato et al., 2000). In 2000, SBL method and interferometry method, by dividing the antena area into four groups, have been compared and the latter showed better precision in meteor orbit measurement (Nishimura et al., 2001). Nishimura et al. further investigated the relation of optical magnitude and radar echo power. They concluded that MU radar head echo mode can observe the meteor orbit with a precision of 0.5 degree for the meteors down to +15 magnitude.

This study is an extension of the research by Nishimura et al. (2001), emphasizing the time synchronized radar and video measurement, which has been newly established by the introduction of GPS time server. The optical video camera system with ICCD can record stars and meteors down to +11 and +10 of magnitudes, with a primary lens of f=85 mm F=1.2 or 1.4. In 2001, we have observed 86 simultaneous meteors by the radar and the video camera, and among them 25 meteors with a precise synchronization were closely investigated. We found that in most cases optical and radar intensity changes proportionally in time. However, the radar echo intensity sometimes decreases (or increases) quickly by more than 10 dB (or corresponding to 2.5 magnitude). Such transition seems to occur when the meteor brightness is less than 7 magnitude, i.e., in fairly dark region. To summarize, we suggest that there could be some variation of the radar scattering mechanism in faint (darker than +7 mag.) meteors and therefore special attension should be paid for the estimation of optical magnitude or meteor mass from weak radar meteor scatters such as recently observed with MST and IS radars.