Radar meteor head echo studies of the sporadic meteoroid complex

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Meteoroids roam through the solar system with orbits of all inclinations. The ones which cannot be associated to a certain meteor shower are termed sporadic meteoroids. Observing the sporadic meteoroid complex along the earth orbit, i.e., at different times of year with a ground based instrument, can be used to investigate its origin. This can give us answers about parent bodies and whether sporadic meteors are created and destroyed continuously or to some extent are decaying remains of dust released in the past. Visible streaks of light in the sky generated by meteoroids entering the terrestrial atmosphere are called meteors, as are radio reflections from the ionized plasma around or behind the meteoroids.

We use the 46.5 MHz Middle and Upper atmosphere (MU) radar to determine the absolute geocentric velocities of meteoroids from meteor head echoes. Head echoes are radio wave reflections from the plasma generated by the interaction of meteoroids with the atmosphere at about 70-140 km altitude. The echoes are characterized by being transient and Doppler-shifted. The received power is confined in range, as from a point source, and it moves with the line-of-sight velocity of the meteoroid. The high power, large aperture and low frequency of the MU radar enable a large number of meteor head echo observations, including echoes from small and slow meteoroids. A large number of detections is crucial for a reliable statistical study. We present preliminary result from meteor head echo experiments conducted with the MU radar during 2008 and April 2009. The results include meteoroid orbits for the detected particles as well as statistics on meteor rates detected from different apparent sporadic sources as the north and south apex, helion and antihelion sources, etc. We also present our future plan for the continuation of the above study, i.e., extending it to cover several seasons along the earth orbit for more detailed information on the sporadic meteoroid influx.

In earlier studies (e.g. Szasz et al., MNRAS 388, 2008), we have sampled the sporadic meteoroid complex at high latitudes, 68.9 N and 21.9 E, using a 930 MHz high power large aperture radar. However, less meteors are detected with high frequency, thus the lower frequency of the MU radar ensures a larger set of detections and hence a more reliable statistical study. It is also interesting to compare the results from high- and mid-latitudes in order to map latitudinal differences. The MU radar, located at 34.9 N and 136.1 E, is unique at mid-latitudes in the sense that it can be used for interferometric head echo meteor detections.