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Meteor studies applying incoherent scatter radar instruments

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Meteors appear in the ionosphere during the entry of solid particles, so-called meteoroids, from interplanetary space. Meteors are observed by the partial ionization of meteoroid and atmospheric material that is generated during the entry of the solid particles. The ionization is associated with optical emission (optical meteors) and it reflects radio waves (radio meteors).

The radar backscattering is sensitive to objects that are too small to be detected optically and the sensitivity for observing radio meteors varies with the radio frequency used for the observation. Incoherent scatter radar facilities detect in majority sporadic meteors by their head echoes that originate directly from the surrounding of the entering meteoroid, hence providing the opportunity for detailed studies of meteor phenomena on small scales. Meteors are typically observed at 120 km to 80 km altitudes where the mean free path of atmospheric neutral particles changes from meters to millimeters. The phased-array incoherent scatter radars that are currently under development, such as the planned EISCAT_3D system in northern Scandinavia, will further improve the spatial and time resolution of radar observations, will allow simultaneous measurements of the meteors and of the parameters of the surrounding ionosphere and will possibly allow observing the formation of meteoric smoke particles associated with meteors.

In this presentation we consider the possibilities for measurements with the future EISCAT 3D as a new path of studying the physics of meteor phenomena with high accuracy.