

Plasma Turbulence of Non-Specular Trail Plasmas as Measured by a High Power Large Aperture Radar

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High Power, Large Aperture (HPLA) Radars have been used to characterize the plasmas formed as meteoroids ablate in Earth's atmosphere. These plasmas are referred to as heads, which are the plasmas surrounding the meteoroids, and trails, which are plasmas behind the meteoroids. A particular subset of the trails is nonspecular trails, which are detected when the radar beam is quasi-perpendicular to the magnetic field. These returns are thought to be the reflection from field aligned irregularities (FAIs) that form due to the onset of turbulence in the meteor trail. In this paper, we present nonspecular trails detected by the Advanced Research Project Agency (ARPA) Long-range Tracking and Identification Radar (ALTAIR). These data include dual frequency, dual polarized, and high range resolution in-phase (I) and quadrature (Q) returns with additional azimuth and elevation data derived from the monopulse system. In order to describe the properties of the plasma turbulence, we first present turbulence onset times for the nonspecular trails and make comparisons to nonspecular trail models. Second, we describe the evolution process of the nonspecular turbulence using a calculated ambipolar diffusion coefficient. Our results, in conjunction with an analysis of the diffusion perpendicular and parallel to the magnetic field, demonstrate that the ambipolar diffusion coefficient is not a sufficient description of the diffusion processes of the turbulence in nonspecular trails and that other influences must be considered when calculating the diffusion coefficients of nonspecular trails.
