Journal of Space Exploration

Opinion| Vol 11 Iss 5

ISSN: 2319-9822

Modulational Interaction in Dusty Plasma from Meteoroid Wakes

Martin Rosado*

Editorial Office, Journal of Space Exploration, United Kingdom

***Corresponding author:** Martin Rosado, Editorial Office, Journal of Space Exploration, United Kingdom, Email: rosado.m@gmail.com

Received: May 5, 2022, Manuscript No TSSE-22-72538; **Editor assigned:** May 7, 2022, PreQC No. TSSE -22-72538 (PQ); **Reviewed:** May 16, 2022, QC No. TSSE -22-72538 (Q); **Revised:** May 18, 2022, Manuscript No. TSSE -22-72538 (R); **Published date:** May 28, 2022, DOI: 10.37532/2319-9822.2022.11 (5).217

Introduction

The dust acoustic mode, which occurs at altitudes of 80 km to 120 km and is a linear stage of modulational interaction, may cause electromagnetic waves in meteoroid wakes to become modulational unstable. We take into account the characteristics of meteoroid wakes at various heights in the ionosphere. It is demonstrated that the charge of meteoric dust particles produces the necessary conditions for the development of dust acoustic waves. The modulational instability of the electromagnetic waves from the meteoric path stimulates dust acoustic disturbances. Neutrals' impact on the evolution of modulational interaction is taken into consideration. In comparison to the Earth's ionosphere, meteoric wakes have a larger concentration of neutrals. At altitudes of 80 km to 90 km, the formation of modulation instability is reduced by collisions between neutrals and dust but is unaffected by inelastic collisions of neutrals with electrons and ions. The appearance of low-frequency noise during the passage of meteoric bodies in a frequency range typical of dust acoustic waves can be explained by the modulational instability of electromagnetic waves. It is demonstrated that for typical temperatures and particle concentrations in meteoroid wakes, the modulation instability has time to develop. There are presented equations for the charging of dust atoms in meteoroid wakes. Due to strong emission currents from the dust particles' surfaces, it has been discovered that the dust is positively charged both during the day and at night. When meteoroids enter the atmosphere, the ionospheric atoms collide with the meteoric body, causing meteoric matter to break apart, melt, and evaporate. High-velocity collisions between meteoric matter molecules and atmospheric air molecules can ionize and excite both meteoric and atmospheric atoms. These processes produce a meteoric trail made up of molecules, ionized atoms, and vaporized meteoric materials as well as fractured meteoric body pieces, molecules, and molecules of atmospheric gases. The shimmering streaks of meteoroid vapor are meteors.

There are many phenomena connected to the movement of meteoric bodies, including electromagnetic and auditory effects. Noises that have been recorded in a broad frequency range up to 12 kHz can be heard as meteors pass overhead. It is crucial for the operation of these systems and the prevention of their failures that radar systems, radio telescopes, geolocation tools, and rocket-passing tests are not affected by the physical phenomena and effects resulting from the passage of meteors. Bright bolide passage, the moments following it, and meteor showers all produced sounds. Electrophonic sounds, which are abnormally heard concurrently with the meteor passage, are unquestionably connected to electromagnetic phenomena. There were preconditions for the development of a theory of electromagnetic wave modulation from meteor passage in the Earth's atmosphere in the scientific literature, including assumptions on the relationship between low-frequency noise from meteor passage and the modulation of a high-frequency electromagnetic wave by low-frequency waves. Dust acoustic waves often occur in the low-frequency region, at frequencies up to 60 Hz, and activities connected to charged dust particles can result in these oscillations. Therefore, this mechanism might account for the low-frequency oscillations observed during meteorite passage.

Citation: Rosado. M., Modulational Interaction in Dusty Plasma from Meteoroid Wakes. J Space Explor. 2022;11(5).217.

Early data suggested that low-frequency disturbances only produced spectacular meteors, but later data revealed that they also accompanied the passage of minor meteoric bodies. Data on oscillations from meteor showers like the Perseids showed that there are sounds at low frequencies in the range of 10 Hz to 300 Hz and an enhanced electric field observed in a broad range from 5 Hz to 12.6 kHz even in the absence of major meteoroids. Currently, experiments are being actively undertaken on the recording of noise caused by meteoric body passage. Oscillations were observed throughout sufficiently broad frequency ranges, including 0 Hz to 10 Hz, 40 Hz to 100 Hz, and 0 Hz to 250 Hz. The concentration of neutrals in meteoroid wakes is an order of magnitude higher than that at the comparable ionospheric altitude, while the concentration of dust is many orders of magnitude higher than that in the Earth's ionosphere. Due to a high frequency of dust impacts with neutrals, modulational instability is suppressed at various altitudes. We identify the altitudes at which the emergence of electromagnetic waves with modulational instability linked to the dust acoustic mode in meteoric wakes is possible. For collisions of dust with neutrals and inelastic collisions of electrons and plasma ions with neutrals, dusty plasma processes in meteoroid wake and the associated possibility of modulational instability of electromagnetic waves for various altitudes of the meteoroid passage in the Earth's ionosphere were not previously taken into consideration. This makes the situation both novel and significant.

The propagation of the meteor path and dusty plasma processes in the Earth's ionosphere are both taken into consideration. Low-frequency noise caused by meteoroids passing through the atmosphere is explained by the modulational instability of electromagnetic waves linked to the dust acoustic mode. Conditions are set up for the occurrence of dust acoustic waves as a result of the charging of dust particles of meteoric substance produced by the meteoric body's fragmentation and the particles' acquisition of electric charges. The formation of modulational instability of electromagnetic waves from a meteoroid in the frequency range corresponding to dust acoustic waves is described as having the potential to excite dust acoustic disturbances. Calculated are the growth rates at which low-frequency dust acoustic disturbances become modulational excited. This study examines the scenario when the electromagnetic wave's length is significantly smaller than the meteoroid wake's breadth. In this situation, the modulational interaction description method can be applied. At altitudes of 100 km to 120 km, modulational instability can arise for typical meteoroid wake characteristics; at altitudes of 80 km to 90 km, modulational instability is prevented by dust collisions with neutrals. It is observed that the fragmentation of the meteoric body is what causes the dust to form in the meteoroid's wake. Mechanisms for the charging of dust particles in meteoroid wakes under the influence of emission currents and surrounding plasma's electron and ion currents are outlined. For submicron dust particles, the typical charge numbers are estimated.