Hydrodynamic Analog for Electromagnetic Structures of Sprites

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Abstract

Since the discovery by Franz [1], sprites have now been observed over thunderstorms all over the world. The first columniform sprites (c-sprites) reported were vertical columns of light which may extend about from 76 to 87 km and probably less than 1 km in diameter [2]. Upon using the hydrodynamic analog we can derive some families of stationary Beltrami field-like solutions from the free Maxwell equations in vacuum.

The Beltrami condition [3], a representation of the alignment of a vorticity with its flow, describes the simplest and perhaps the most fundamental equilibrium state in the system of vortex dynamics. These stationary electromagnetic fields are helical and/or column-like once they are represented in a suitable frame of reference. Possible dendritic and jelly-fish-like patterns of sprites are demonstrated.

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Figure : Possible sprite- and column-like electromagnetic field.

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