Geophysical Research Abstracts, Vol. 9, 11241, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-11241

Laboratory Evidence of Helicity or Vortex Generation in an Electric Quadrupole: Simulation of Tornadoes with and without Lightning

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In many cases, tornadoes are accompanied or involved by lightning discharges and are thought to be composed of uncharged and charged components different from each other in terms of velocity, vorticity, helicity, and appearance (shape and luminosity). Their visible dark portion may correspond to uncharged tornadoes, while luminous or bright part may involve charged tornadoes with return strokes. Usually, uncharged tornadoes have been considered to be ascending hot streams of thermohydrodynamic origin. This is the conventional theory of tornadoes, based on hydrodynamics (HD) or thermohydrodynamics (THD) but does not consider electrical effects that are really significant in tornadic thunderstorms. It has been shown, however, that a new electrohydrodynamics (EHD) established and developed over the last more than two decades is applicable to tornadic thunderstorms with lightning.

This paper presents ‘Laboratory Simulation of Tornadoes with and without lightning by a Universal Electric-Cusp Type Plasma Reactor’ and in general confirms ’Evidence of Helicity or Vortex Generation in an Electric Quadrupole’. Although electric discharges by using this plasma reactor composed of two lead electrodes suspended above a copper plane has successfully demonstrated an electric cusp-mirror and reconnection model, a variety of features of an electric quadrupole have to be investigated experimentally in detail, for example by using this plasma reactor. First, in order to demonstrate helicity or vortex generation in an electric quadrupole, clean, precise experiments are required. Along this line, preliminary experiments of wind flow observations under the atmospheric pressure inside the reactor before and during electric discharges are reported. To be able to observe by the naked eye, a semispherical or

mesa-type lead with a thin bamboo needle or a bunch of incense sticks burned has been placed in a region of electric cusp on the copper plane and the movement of a smoke produced by brightness and/or electric discharge has been observed. Both cyclonic and anti-cyclonic helical flows have been confirmed from the movement of smokes by the naked eye. An electric cusp center without object forms a X-type and coincides with fluid vortex merging or breakdown point beyond which fluid vortex and electric field lines correspond to pendent funnels of tornadoes.

These observations by photos taken confirms the naked eye observations and are presented for the first time.

References

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