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Electrical discharges in the upper atmosphere of the Earth and other planets of the Solar System

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In this contribution, we will present an overview of the kinetic and spectroscopic aspects of the research done in our group on atmospheric electricity in planetary atmospheres. In particular, we will describe our efforts towards the understanding of lightning-driven upper atmospheric electrical discharges in the Earth, the giant planets (Saturn and Jupiter) and on Venus where the existence of lightning is still nowadays controversial since no direct optical recording of lightning is yet available though there are a number of indirect (radio emissions) results suggesting that some kind of electrical atmospheric activity could exist in Venus.
In the case of the Earth, we will focus on the so called Transient Luminous Events (TLEs), which are a diversity of weakly ionized low temperature plasmas occurring in the upper atmosphere of the Earth between the thundercloud tops (15 km) and the lower ionosphere (95 km). These upper atmospheric plasmas were recorded for the first time 28 years ago (in the summer of 1989) and their occurrences are linked to the electrical (lightning) activity in the Earth troposphere (0 - 15 km). Our research tries to answer questions such as, what are the chemical and electrical impacts of TLEs in the Earth atmosphere What are the physical (kinetic and electrodynamic) mechanisms underlying the ignition of TLEs?. What are the key spectroscopic features of TLE optical emissions, how can they be detected and what can we learn by analyzing TLE optical spectra?.

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