

LABORATORY STUDIES OF SPRITES IN GAS MIXTURES REPRESENTING THE VENUSIAN AND JOVIAN ATMOSPHERES

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Terrestrial lightning is sometimes accompanied by TLEs, prominently sprites, above the thunderclouds, which are clearly visible from space. Lightning was observed in several planetary atmospheres, while its existence on other planets is still an open question. It is reasonable to assume that where there is lightning, sprites will appear. Computation of the electrical field above the cloud layers of various planets suggests this is possible. Several space missions are in preparation for the investigation of lightning, sprites and other atmospheric phenomena on Venus, Jupiter, and other planets. In order to observe planetary sprites, it would be useful to investigate what kind of light emission is to be expected. This is addressed by observing streamer discharges in a laboratory setting.

We report on measurements of streamers in two types of gas mixtures, CO_2/N_2 and H_2/He , that correspond to the Venusian and the Jovian atmospheres, respectively. We confirm the existence of similarity laws in the two gas mixtures. Similarity laws allow for the extrapolation of laboratory findings to sprite occurrence altitudes. An estimation of the streamer velocity is obtained, in both gas mixtures it is around $1\text{-}2\cdot 10^5$ m/sec, similar to streamer velocity in the terrestrial atmosphere. Measurements of the spectrum produced by the streamer and glow phases of the electrical breakdown are measured for the first time. We find that the spectrum of the streamer discharge is significantly different from the spectrum of the arc discharge for these gas mixtures.

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