HOW TO SIMULATE SPRITE DISCHARGES IN LABORATORY AND COMPUTER

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The huge sprite discharges at 40 to 90 km altitude have been recognized essentially as up-scaled versions of streamer discharges at standard temperature and pressure; streamers are now being investigated in the lab in depth. The predicted similarity laws between sprites and streamers were recently confirmed quantitatively in experiments [Briels et al., J. Phys. D: Appl. Phys. 41 (2008) 234008]. Air streamers show glowing dots at their growing ends in photographs with nanosecond resolution, and McHarg, Stenbaek-Nielsen and Kanmae [Geophys. Res. Lett. 34 (2007) L06804] have found the same glowing dots at the tips of sprite channels in high speed video imaging. This opens up the way to investigate sprites in the lab, e.g., their large variation of velocities and diameters in a given gas [Briels et al., J. Phys. D: Appl. Phys. 41 (2008) 234004], the attraction or repulsion of streamer channels [Luque et al., Phys. Rev. Lett. 101 (2008) 075005; Nijdam et al., J. Phys. D: Appl. Phys. 42 (2009) 045201], or sprites in the atmospheres of other planets [current work with Dubrovin, Yair, Nijdam, van Veldhuizen]. However, the altitude structure of the atmosphere cannot be realized in the lab, but only in the computer. Important are the high ionization below the ionosphere, and the variation of air density over the height of the sprite. The role of the lower ionosphere in creating sprite halo and sprite has been studied in recent simulations [Luque, Ebert, under review].

Sprite discharges

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