



Open questions of the role of pre-onset streamers in substorm expansion

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It is well accepted that auroral breakup maps close to the transition region between dipolar and stretched magnetotail field lines. It is also well established that auroral streamers appear poleward of the breakup arc, at least in some circumstances. Nishimura et al. [2010] and Lyons et al. [2010] have papers describing a scenario (hereafter referred to as the NLS) in which new plasma intrusion by plasma depleted flux tubes triggers auroral substorm onset. A series of papers since then has expanded this work (Lyons et al., 2010, 2011, 2012; Nishimura et al. 2011, 2012, 2013) to include polar cap patches and ionospheric flow near the open/closed boundary. In addition, it has been suggested that the substorm current wedge (SCW) does not form in response to the initial breakup, but is a consequence of magnetotail flows occurring well after (up to 10 minutes) onset. Despite the preponderance of events purporting to relate pre-onset streamers to auroral onset, the causal connection between white light streamers and onset is still an open question. In addition, the new studies directly contradict the previously established relationship of the SCW to the initial breakup. In this paper, we discuss these controversies, and show how multipoint measurements in space, especially by THEMIS, and on ground, including all-sky imagers, radar, and ground data, can be used to resolve the controversy.