On the formation and origin of substorm growth phase/onset auroral arcs inferred from conjugate space-ground observations

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Magnetotail processes and structures related to substorm growth phase/onset auroral arcs remain poorly understood mostly due to the lack of adequate observations. In this study we make a comparison between ground-based optical measurements of the premidnight growth phase/onset arcs at subauroral latitudes and magnetically conjugate measurements made by the Active Magnetosphere and Planetary Electrodynamics Response Experiment (AMPERE) at ˜780 km in altitude and by the Van Allen Probe-B spacecraft crossing L values of ˜5.0-5.6 in the premidnight inner tail region. The conjugate observations offer a unique opportunity to examine the detailed features of the arc location relative to large-scale Birkeland currents and of the magnetospheric counterpart. The observations strongly suggest that the premidnight arc is connected to highly localized pressure gradients embedded in the near-tail R2 source region via a local upward FAC.