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Substorm-related near-Earth reconnection surge: Combining telescopic and microscopic views.

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A strong ∼10 min-long surge of the lobe reconnection was observed in the middle of a substorm near the reconnection separatrix on the tailward side of near-Earth neutral line by MMS spacecraft. This intense reconnection event, with average reconnection rate of 2-4 mV/m, was accompanied simultaneously by substorm current wedge formation and fast poleward expansion of auroral bulge-related westward electrojet in the conjugate ionosphere. Particle observations during meridional crossing of POES spacecraft above the expanding bulge confirmed both the concurrent strong particle acceleration and the dipolarized character of newly-formed magnetic field lines inside of the bulge. Globally the observed average reconnection rate (<Ey> ∼2-3 mV/m) was sufficient to produce the observed magnetic flux increase in the bulge associated to the fast poleward expansion (about 6o CGLat in ∼5min). Being in the southern lobe near the tailward reconnection separatrix, the MMS spacecraft observed the short-duration earthward electron beams providing the local Hall current, tailward-propagating Alfven wave bursts (with Poynting flux up to 0.1 mW/m2), and large-amplitude E-field spikes (e-holes and LHD waves); they all were observed in association with the passage of localized PSBL bulges of the reconnection exhaust, possibly formed due to the enhancements of the reconnection rate. This unprecedented combination of conjugate observations allows us to confirm directly the important global consequences of intense near-Earth reconnection event, which were suggested (e.g., in the NENL substorm scenario) but could not be previously observed alltogether in the same event.