NONLINEAR PLASMA WAVES AT INJECTION FRONTS IN THE INNER MAGNETOSPHERE - A CENSUS

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On 2016-12-21, Van Allen Probe B observed a dispersionless electron injection event. The event shows clear evidence of electrons being impulsively transported from the plasmasheet into the closed drift paths of the inner magnetosphere over a 45-minute interval.

For this entire interval, the Electric Fields and Waves (EFW) instrument on the Van Allen Probes recorded high cadence (16,384 Samples/sec) electric and magnetic field time series data, with no gaps. These data enable an unbiased census of the plasma waves driven by this injection event, including the identification of each wave type, its properties, and its relation to the freshly injected electrons.

Analysis of this event yields four primary observations: [1] This injection event is composed of four distinct, but closely related, magnetic dipolarizations. [2] Each dipolarization drives a separate burst of wave activity, with a broad range of linear and nonlinear waves excited simultaneously. [3] Identified nonlinear waves include kinetic Alfven waves, electron phase space holes, nonlinear whistler-mode waves. Identified narrow-band waves include lower band and upper band whistler-mode chorus waves, and electron cyclotron harmonic waves. Some nonlinear wave types are conspicuously absent (electron-acoustic solitons, double layers). [4] The distributions of nonlinear wave properties constructed from this large interval of unbroken burst data are significantly different from those derived using amplitude-triggered burst data.

These observations provide insight into how electron transport, mediated by plasma injections, drives wave activity in the inner magnetosphere. They also help clarify 'typical' properties of some nonlinear waves (electron phase space holes and nonlinear whistler mode waves), constraining their impact on inner magnetospheric electron acceleration and transport.