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The generation of nonlinear Electric Field Bursts in the outer radiation belt through the parametric decay of whistler waves

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Huge numbers of different non-linear structures (double layers, electron holes, non-linear whistlers, etc. referred to as Time Domain Structures - TDS) have been observed by the electric field experiment on the Van Allen Probes. They often emerge on the forward edges of the wave structures and form chains. A large part of the observed non-linear structures are associated with whistler waves. The parametric interaction of two VLF whistler waves propagating in opposite directions and an electron acoustic wave is studied analytically as well as experimentally, using Van Allen Probe data. The resulting electron acoustic wave is considered to be the source for generation of electron scale TDS. The measured three waves are in a good agreement with an assumption of their parametric interaction: f1=f2+f3 and k1=k2+k3. The bi-coherence analysis shows the non-linear nature of the observed electron-acoustic waves as well as the whistler wave and electron acoustic wave phase connection. The estimated decay instability increment shows that the three wave interaction process can develop in a characteristic time smaller than 1 second, thus the process is rapid enough to explain the observations This induced parametric interaction can be one of the mechanisms for quasi-periodic Time Domain Structure generation in the outer Van Allen radiation belt.