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Radiation belt electron acceleration during periods of low plasma density

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Electrons in the Van Allen radiation belts can have energies in excess of 7 MeV. We present a unique way of analyzing phase space density data which demonstrates that local acceleration is capable of heating electrons up to 7 MeV. The Van Allen Probes mission not only provided unique measurements of ultra-relativistic radiation belt electrons, but also simultaneous observations of plasma waves that allowed for the routine inference of total plasma number density. Based on long-term observations, we show that the underlying plasma density has a controlling effect over local acceleration to ultra-relativistic energies, which occurs only when the plasma number density drops down to very low values (~10 cm^{-3}). The VERB-2D model is used to simulate ultra-relativistic electron acceleration during an event which exhibits an extreme cold plasma depletion. The results show that a reduced electron plasma density allows chorus waves to efficiently resonate with electrons up to ultra-relativistic energies, producing enhancements from 100s of keV up to >7 MeV via local diffusive acceleration. We analyse statistically the observed chorus wave power during ultra-relativistic enhancement events, considering the contribution from both upper and lower band chorus waves. The PINE density model allows for the investigation of global magnetospheric density changes. We analyze the how the global cold plasma density changes during ultra-relativistic enhancement events and compare to in-situ point measurements of the plasma density.