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The link between substorm activity and the energy content of pulsating aurora

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Pulsating aurora are a common display of diffuse-like auroral patches that blink on and off with a variety of periods, sizes, and shapes. This type of aurora is caused by pitch-angle scattering of electrons from the outer Van Allen radiation belt via VLF waves. The energy range of pulsating aurora is much higher than discrete aurora - 10s keV up into the relativistic range. The widespread extent, energy, and source of pulsating aurora suggests they constitute a significant portion of the energy transferred from the magnetosphere to the ionosphere/atmosphere.

In this work, we investigate the energy of pulsating aurora and the drivers of the highest energy events. Simultaneous measurements of visible pulsating aurora from all sky imagers and co-located electron density profiles from the Poker Flat Incoherent Scatter Radar are shown from 55 pulsating aurora events. An inversion analysis is used to obtain the evolution of the energy spectra over time, and the relationship of that evolution to substorm activity. Our results indicate that substorm onset coincides with a harder energy spectrum for about the first 60-90 minutes following substorm onset. Additionally, substorm events with higher AE index correlate with a higher-energy content of pulsating aurora. An analysis of a typical case study shows the steps in this process. These results definitively link substorm injections to a higher level of energy transfer from the radiation belts to the ITM system.