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Effects of nonlinear wave growth on radiation belt particle fluxes

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In parallel with the emergence of the new science of space weather,there has been a resurgence of interest in radiation belt research in the last decade. Highly energetic electrons,which are typically generated in the outer radiation zone during geomagnetic storms,can cause serious malfunctions of orbiting satellites. Consequently,understanding the generation and dynamics of radiation belt particle fluxes has become a key feature of current space physics research. In this study we derive new relativistic formulae for the limiting electron flux for a general planetary radiation belt at a given L-shell.We compare the theoretical results on the trapped flux with observed energetic electron fluxes at Earth. We then incorporate the effects of nonlinear wave growth into the calculation of the limiting flux. Using model wave equations,we estimate nonlinear wave growth rates for a range of input parameters. We find that inclusion of nonlinear wave growth effects in specifying the wave power gain can significantly modify the limiting flux. Exact quantification of the effects of nonlinear wave growth on the limiting particle flux requires accurate information on the length scales for both linear and nonlinear convective wave growth. Unfortunately such data are not currently available from either experimental observations or computer simulations.

Keywords: radiation belts, nonlinear wave growth, stably trapped particle flux