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Corotating drift resonant electrons in Saturn's radiation belt: theory and observational evidence

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Corotating drift resonant (CDR) electrons, of which the gradient and curvature drift could cancel the corotation around the Saturn, could get efficiently radial transported when exposed to the Saturnian global convective electric field. Such fast radial transport could lead to significant adiabatic acceleration and therefore supply for the electron radiation belt population. In this work, the nonlinear trapping nature of the corotating drift resonance is investigated. Electrons trapped inside the resonant island preform a banana-like orbit in the equatorial plane. We present an estimation of the trapping limit in L shell and energy for the resonant electrons with varying first adiabatic invariant, which could be directly compared to CASSINI observations. The estimation of the trapping period also indicates that trapped electrons takes times of more hours to close their orbit than the traveling electrons. The evolution in energy spectrogram driven by Saturn's convection and corotation has also been predicted by our test particle simulations. We suggest that the bifurcation of the 'zebra stripes' near the corotation drift resonant energy could be a diagnostic feature of the nonlinear CDR. Observations from MIMI/LEMMS with similar zebra stripes and the bifurcation have been found as predicted, proving that the electrons in Saturn's radiation belt are being transported radially by the convection and that corotating drift resonant could be a significant candidate for the plenishing of the Saturn's electron radiation belt.