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Relativistic electron's butterfly pitch angle distribution modulated by localized background magnetic field perturbation driven by hot ring current ions

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Dayside modulated relativistic electron's butterfly pitch angle distributions (PADs) from 200 keV to 2.6 MeV was observed by Van Allen Probe-B at L = 5.3 on November 15, 2013. They were associated with localized magnetic dip driven by hot ring current ion (60-100 keV protons and 60-200 keV oxygen) injections. We reproduce the electron's butterfly PADs at satellite's location using test particle simulation. The simulation results illustrate that negative radial flux gradient contributes primarily to the formation of the modulated electron's butterfly PADs through inward transport due to the inductive electric field, while deceleration due to the inductive electric field and pitch angle change make in part contribution. We suggest that localized magnetic field perturbation, which is a frequent phenomenon in the magnetosphere during magnetic disturbances, is of great importance for creating electron's butterfly PADs in the Earth's radiation belts.