Van Allen Probes observations of drift-bounce resonance and energy transfer between energetic protons and poloidal Pc4 wave

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Poloidal Pc4 wave and proton flux oscillation due to the drift-bounce resonance are observed in the inner magnetosphere on the dayside near the magnetic equator by the Van Allen Probes spacecraft on 2 March 2014. The flux modulation is observed in the energy range of 67.0 keV to 268.8 keV with the same frequency of poloidal Pc4 wave. We estimate the resonant energy to be ˜120 keV for pitch angle of 20-40 degrees or 140-160 degrees, and 170-180 keV for pitch angle of 40-60 degrees or 120-140 degrees. The drift-bounce resonance theory gives the resonant energy of 110-120 keV, which is consistent with the observation for small pitch angle, but slightly higher than the observation for large pitch angle. We consider that this discrepancy of the resonant energy is due to the drift shell splitting. In order to examine the direction of energy flow between protons and the wave, we calculate the sign of the gradient of proton phase space density (df/dW) in both outbound and inbound paths. Results showed positive gradient in both paths, which means that the energy is transferred from the protons to the wave. During the appearance of poloidal Pc4 wave, the Dst∗index shows a sudden increase of ˜6.7 nT. We estimate the total energy loss of the ring current from the recovery of the Dst∗index and the variation of proton flux by the drift-bounce resonance. The estimated energy loss is almost comparable for both cases. Therefore, we suggest that the energy transfer from the ring current protons to the wave via the drift-bounce resonance cause the increase of Dst∗index.