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Strahl formation in the solar wind electrons: Particle-in-cell simulation

JUNGJOON, Seough[1*] ; NARIYUKI, Yasuhiro[2] ; YOON, Peter H.[3] ; SAITO, Shinji[4]

[1]Faculty of Human Development, University of Toyama / JSPS Postdoctoral Fellow, [2]Faculty of Human Development, University of Toyama, [3]IPST, University of Maryland / School of Space Research, Kyung Hee University, [4]Graduate School of Science, Nagoya University

The present study puts forth a possible explanation for the outstanding problem of the *strahl* formation in the solar wind electrons. Making use of the fact that in the collisionless limit the electron core-halo relative drift exists in the direction away from the Sun in such a way that the halo usually flow faster than the core, the present study carries out one-dimensional particle-in-cell simulation of whistler instability, assuming anisotropic core and drifting isotropic halo. The enhanced whistler waves driven by anisotropic core lead to the pitch angle scattering of drifting halo in an asymmetric way since the number of the drifting halo participating in the resonant interaction is different between the halos moving the sunward and anti-sunward directions. In this way, pitch angle scattering of the anti-sunward moving halo by the whistler waves propagating sunward is more efficient in phase space and leads to the energy transfer from the drift energy to the thermal energy of halo. During the saturation phase of whistler wave-halo particle resonant interaction, the remaining part of the anti-sunward moving halo, which is out of resonance with the whistler waves propagating sunward, turns out to be a field-aligned *strahl* in the electron velocity distribution.

Keywords: non-thermal solar wind electron velocity distributions, the magnetic-field-aligend strahl, whistler instability