Strong electron acceleration by the vortex-induced reconnection: Full particle simulations

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We have performed two-dimensional full particle (EM-PIC) simulations to investigate the non-linear coupling between magnetic reconnection (RX) and MHD-sale Kelvin-Helmholtz (KH) vortex. RX has been considered as one of the most important particle acceleration mechanisms in space and a number of particle simulations have actually shown that the strong electron acceleration is caused by RX. On the other hand, recent two-fluid simulations have shown that the non-linear coupling between RX and KH vortex is easy to occur at the magnetic and velocity boundary layer such as the planet's magnetospheric boundary. Thus, in this study, using full particle simulations we compare the simple RX case with the vortex-induced RX case regarding the electron acceleration. In the vortex-induced RX case, the strong magnetic shear and the strong velocity shear coexist at the boundary. As a result, we found that the vortex-induced RX produces the notably stronger acceleration of electrons than the simple RX case. This is because in the vortex-induced RX case the RX rate is higher than that in the simple RX case and thus the RX electric field is stronger than that in the simple RX case. In addition, in the vortex-induced RX case, the convection electric field, which is stronger than the RX electric field, further accelerate non-thermal electrons first accelerated by the RX electric field. This new result may apply to not only the vortex rolled at the plane's magnetospheric boundary but also other turbulent plasma phenomena in space.