

Acceleration of pickup H^+ , He^+ , and O^+ in the corotating interaction regions

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Pickup ions (PUIs), interstellar neutral particles ionized mainly by the charge exchange with solar wind plasmas, are considered to be the dominant source of anomalous cosmic rays (ACRs). Recent studies suggest that the heliospheric termination shock alone is not capable of accelerating primary PUIs up to the ACR energy range, an order of MeV. Among other mechanisms responsible for the PUI acceleration, we focus on the preacceleration process inside the heliosphere before the encounter with the termination shock. Corotating interaction regions (CIRs) are one of such a particle accelerator because their boundaries form the (forward and reverse) shocks. We perform two-dimensional hybrid simulations to investigate the PUI dynamics in association with CIRs. We have already shown that the hydrogen PUIs can gain energy over 250 keV. A periodic boundary in the present CIR model allows the successive CIRs, where the diffusive shock acceleration for PUIs can be attained between them. In the present study, we will pay additional attention to the behavior of other PUI species, helium and oxygen, which are also main ACR components. Detailed processes as well as efficiency of their acceleration are compared with those of hydrogen case. We will further unify the composite acceleration process during the CIR propagation.