Hybrid simulations on the pickup ion acceleration in the CIR system

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Part of interstellar neutral atoms become ionized as penetrating into the heliosphere via charge-exchange or photoionization processes. These ionized particles, called as the interplanetary pickup ions (PUIs), can no more move straight, rather start gyrating around the interplanetary magnetic field. The motional electric field driven by the solar wind propagation accelerates the PUIs, where the maximum gyration velocity corresponds to that of the background bulk solar wind. The "pseudo"-thermal energy of PUIs is equivalent to the solar wind kinetic energy (keV range), which is typically one order of magnitude higher than the solar wind thermal energy (tens of eV range). Therefore, PUIs are considered to be one of the dominant source of the suprathermal particles in the heliosphere. PUIs are further accelerated by the shock wave, which is more efficient than in the case of thermal solar wind plasmas. This is because the standard shock acceleration theory requires the energy of particles to be high enough before experiencing the shock crossing. In the present study, we perform two-dimensional hybrid simulations to examine the characteristic of PUIs acceleration at the heliospheric shock structure, particularly focusing on a pair of shock at the boundaries of corotating interaction regions (CIRs). It is expected that multicomponent particles in the CIR system (fast/slow solar wind and corresponding PUIs) will show a wide variety of acceleration processes, which we will classify and investigate in detail.