Hybrid simulations on the energetics of CIR-related plasmas

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The particle energy in the interplanetary space is distributed in a range from tens of eV in a solar wind thermal component up to 10^{20} eV ultra-high-energy cosmic rays. The energetic components (including anomalous cosmic rays, ACRs) of the heliospheric origin are identified in a supra-thermal range (hundreds of keV to MeV), which fills the gap between the thermal solar wind plasmas and power-law cosmic ray particles. They are considered to be mainly accelerated by the interaction with shock waves. One major source of generating the shock in the heliosphere is the corotating interaction region (CIR), where the fast solar wind (˜700-800km/s) interacts with the slow wind (˜300-400km/s) ahead. A pair of shocks are formed at the boundaries of CIR during its propagation; the forward shock (FS) accelerates the slow wind, while the reverse shock (RS) decelerates the fast wind with sufficient heating. We perform one and two dimensional simulations using hybrid codes (particle ions and massless electrons) to investigate the kinetic processes occurring in the region around these CIR shocks. The difference of acceleration/heating properties for lower and higher energy components in FS and RS are elucidated in detail. One prominent feature in FS is the leakage of energetic particles in its upstream, indicating the FS weakening. This might be due to the finite volume of the fast solar wind which provides most energies to sustain the shock structure. On the other hand, the presence of magnetic holes (MHs), which are associated with the penetration of interplanetary Alfven waves through RS, dominantly affect the energetics in the region between RS and the streaming interface, where large pitch-angle scattering is taken place. Our future interest is how the acceleration process at the termination shock (accordingly, the profile of ACR spectrum) be modified under the presence of these CIR-shocked plasmas. In this context, the inclusion of pickup ions (PUIs) will also be investigated.