The authors applied 2D test particle simulations based on field profiles from PIC simulations to understand how a quasi-perpendicular curved shock reflects ions. The authors tested various parameters using a self-consistent field model and a stationary field model that expands in time. The authors determine how electric field, θ_{BN}, and non-stationarity affect the reflection process. Although shocks are one of the fundamental particle accelerators throughout the universe, how shocks reflect ions is still poorly understood. This work provides many detailed results that can significantly improve our understanding. I would like to recommend the paper for publication providing that my concerns below are addressed.

About main conclusions:

I agree with the authors that E_l plays an important role in reflecting ions, but I doubt whether the parallel component of E_l can accelerate ions. E_l causes a potential change across the shock. I agree that E_l causes energy change for ions and electrons that cross the shock as stated in line 330 "this component works to decelerate incoming ions and to accelerate electrons to the downstream region". For reflected ions that do not cross the shock, however, there is no potential change before and after the reflection. I believe that the role of E_l is to build up a potential wall to prevent low energy ions from crossing downstream, right?

The authors claim that $\boldsymbol{E_t} \times \boldsymbol{B}$ drift due to convective electric field is very important. I cannot agree with this statement without mentioning the frame of reference. What about $\boldsymbol{E_t} \times \boldsymbol{B}$ drift in the shock normal incidence frame, the de Hoffmann-Teller frame, or the spacecraft rest frame when observing an earthward IP shock? For example, in the HT frame without $\boldsymbol{E_t}$, the drift in the solar wind rest frame corresponds to the motion of shock surface along the tangential direction. Therefore, as $\boldsymbol{E_t} \times \boldsymbol{B}$ drift is frame dependent, it is important to mention the frame of reference when discussing its role.

Other than $\boldsymbol{E_t} \times \boldsymbol{B}$ drift, there is also grad-B drift. In the shock normal incidence frame, the direction of grad-B drift is along $\boldsymbol{E_t}$ resulting in energy increase, i.e., shock drift acceleration. In the solar wind rest frame, such mechanism can cause velocity increase $d\boldsymbol{V} = 2\boldsymbol{V_n} + 2\boldsymbol{V_{HT}}$ (where $\boldsymbol{V_n}$ is local shock normal velocity in the solar wind rest frame). As B has z component, the grad-B drift direction has XY component. Based on shock drift acceleration model, larger θ_{BN} results in larger energy increase indicating longer drift distance, which is consistent with Figure 4. Therefore, can grad-B drift at least partially affect $\theta_{BN}^{exit} - \theta_{BN}^{hit}$ as a function of θ_{BN}?

I agree with the authors about the impact of θ_{BN}. However, in the simulation configuration, different θ_{BN} causes different M_A (from 5 to 3). M_A is also an important factor that can affect BI%. I think the effect of varying M_A needs to be mentioned when discussing the impact of θ_{BN}.

BI% shows burst and drops to 0 periodically in the HE model. I am wondering whether some parameters at the shock front may vary in a similar way, such as the strength of electric field and the gradient of magnetic field.

Other issues:

In Figure 1, there are upstream structures like SLAMS, foreshock cavities, and ULF waves in the FCE model (panel 2b) whereas there is nothing upstream in the HE model (panel 1b). Would upstream structures play a role and cause differences between two models? For example, they may reflect ions back downstream and decrease BI%.

In line 181, I am confused by the term "multi-bounces process". Is this diffusive shock acceleration? Is this "multi-bounces" between the shock surface and upstream structures? Or is this just at the shock surface within one ion gyroradius?

In lines 75-76, the induced electric field is generated by the solar wind. Does this mean that the PIC simulation is not in the solar wind rest frame? In line 126, the induced/convective electric field is due to the relative motion between the solar wind and the shock front. I think the convective electric field should be calculated using the local plasma bulk velocity, right? Or do the authors mean that the convective electric field is transformed from the shock rest frame ($-\boldsymbol{U} \times \boldsymbol{B}$) to the solar wind rest frame using the relative speed between the solar wind and the shock front? $\boldsymbol{E_t} \times \boldsymbol{B}$ is important, but it is unclear how $\boldsymbol{E_t}$ is obtained and difficult for me to check the direction of $\boldsymbol{E_t}$ and $\boldsymbol{E_t} \times \boldsymbol{B}$.

In line 192, $1\tau_{ci} \approx 4\tau_{ci}^{shock}$. Is τ_{ci} the value in the solar wind? If it is true, the field strength at the middle of the ramp is four times the solar wind field strength. I assume that the field strength at the middle of the ramp is smaller than the downstream field strength meaning that the field strength compression ratio is larger than 4, right?

The time variation of magnetic field of the shock profile can induce electric field. This component of electric field is not included in the HE model. Does this induced electric field play a role?

Figure 11 needs some more text in the conclusion section. For example, does $\vec{B}$ refer to magnetic field or magnetic mirror reflection? How the effect of EXB depends on θ_{BN} is not discussed in the conclusion section. Does black (white) mean longer (shorter) drift distance or stronger (weaker) effect on the reflection?

Wording problems:

Line 142, when BI% is first mentioned in the main text, I have to go back to the abstract to find its meaning.

I am confused by some terms. It is unclear whether "magnetic mirror reflection (Fast Fermi)", "specular reflection with the conservation of the magnetic moment", "Fermi type reflection", "Fermi type process", "mirror reflection or Fermi reflection", "Fermi type one acceleration process", "fast Fermi acceleration", and "shock drift acceleration" refer to the same process.

In section 2.2, the HE model is first introduced, so I expected to see the results from the HE model first instead of the FCE model in section 3. It may be better to be in the same order.

In line 77, although readers can find magnetic field configuration from the authors' previous papers, it would be better if the authors can simply add an "out-of-plane" symbol and an arrow in Figure 1 to indicate the IMF direction (and perhaps electric field direction at the shock front). Or the authors can at least refer to Figure 11.

In lines 214-215, there are two "in particular" in this sentence. I suggest replacing the second one with "especially".

In line 235, maybe it is better to revise it as "**Figure 7** shows very similar escaping angle distribution compared with Figure 4…"

In line 388, "the impact of the electrostatic field" should be "the impact of the **electric** field" as both components are discussed.

In line 405, impact -> Impact