Review report on "Proton Plasma Asymmetries between the Convective-Electric-Field Hemispheres of Venus' Dayside Magnetosheath" by Sebastián Rojas Mata et al.

In this work, the authors investigate plasma asymmetries in the Venusian magnetosheath. Using data from the Venus Express mission, they calculate mean values for proton density, velocity, temperature and magnetic field magnitude normalized to their solar wind counterparts. The authors take in hand a novel technique in order to calculate the plasma parameters, which later are organized according to the electric convective field. The main results do not show important asymmetries, but a secondary asymmetry on the velocity components leads to the second part of the paper where only the possible velocity asymmetries are studied. The final results are then compared with Mars and the comet 67P.

Major comments:
This reviewer finds a thoughtful analysis of the calculation of the moments, the choice of coordinate system, and the way the asymmetries are calculated for the observations. The authors claim that the clear asymmetries they found are for the proton density and the magnetic field strength with respect to the +E and -E hemispheres. This is not entirely true as the density shows very little asymmetry, while the magnetic field strength does not at all. So Conclusion 1 needs to be adjusted.

What follows from there, is an effort to look for an asymmetry showing an important dependence on the convective electric field which is translated in a possible relationship between the Larmor radius and the velocity components. However, the comparison is forced after imposing several constrictions. The authors do mention that comparing with the Mars case is not possible and they move on to compare with simulations. These last show a partial match with the observational results from the manuscript. Then comes the comparison between Venus and the comet 67P is a major concern. As a direct comparison is not possible, the authors impose one assumption after another to their own results to be able to compare with the 67P. The physical meaning of such a comparison would lack veracity. In this sense, Conclusions 2 and 3 are dubious.

The comparison with other non-magnetized bodies is not straightforward, even the authors are aware of it as expressed in the manuscript. I would suggest leaving out this section to a future work when a more direct comparison without too many assumptions could be done by the authors, which is -I believe- not the main point of this work and requires more work.

I have a few questions/comments on the first part of the manuscript, which is valuable material and I would recommend for publication after minor revisions.

Other comments/questions:
1. The data spatial coverage is limited for high latitudes and yet the authors calculated the asymmetries for the range 0-90°. Wouldn't it be better to leave out the regions with poor coverage using some criteria from the beginning? Perhaps something related to the time the spacecraft was in that region or a threshold in the number of measurements required to consider those angles.

2. Limited IMA field of view issue: did the authors take into account only full 3D distributions to calculate the plasma moments or did they also consider distributions with partial angular coverage? In the second case, how do the authors deal with the lack of physical meaning for partial distributions?

3. (Line 65) In the documentation for the IMA-MAG database it reads "*All solar wind (SW) parameters are medians calculated from IMA scans and MAG data not included in the file. These medians are assigned as the upstream SW conditions for each orbit (hence entries repeat for the same orbit).*"
The SW conditions change during each orbit, and the inbound leg of the orbit is unlikely to be preceded by the same SW conditions as the outbound leg. If one considers two data points, one closer to the shock in the inbound leg and the other closer to the shock in the outbound leg, it does not make sense to consider the same set of upstream SW conditions for both points (either upstream inbound or upstream outbound). One point should be associated with the closest SW region mapped by the spacecraft. So could you clarify which SW conditions are considered for an orbit: upstream inbound leg or upstream outbound leg? How do you choose which to use? If the exact same upstream SW conditions are taken no matter where the measurement point is, what is the effect of such a selection on the calculated asymmetries?

4. (Line 109) "*The perpendicular and parallel temperatures exhibit the clearest symmetry between hemispheres (both overall and as a function of latitude).*"
In Figure 1, the asymmetries for Tpar and Tperp are clear; however, the parameter asymmetry in Figure 2 is visible for Tperp, but that is not true for Tparallel. Why is it so?

5. (Line 134) If an artifact effect, shouldn't it be also shown in the third quartile and for all data?

6. (Line 195) So the asymmetry for large Larmor radius is related to the fact that ions are picked-up more easily in that direction than in others? But, I would expect for this to happen far from the planet as r_L is large, therefore the asymmetry will be very hard to observe close to the planet.