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Interactive comment on "Wave activity in front of high-β Earth bow shocks" *by* Anatoli A. Petrukovich et al.

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Reply to Referee #2 The paper is devoted to analysis of high-β shocks. The subject is timely, there are no many studies of such shocks. The problem of the paper that analysis has not been done. The manuscript leaves the impression that the study has only begun. There paper does not arrive to any conclusions. There is attempt to convert temporal measurements to spatial one and, therefore, relate the nice figures to shock physics (eg ion motion).

We are grateful to the reviewer for the attentive reading. We cannot agree, that the paper does not reach any conclusion. We determine the time scales of the shock transition, dominating frequency for the highest-amplitude magnetic variations, their

polarization and estimate the spatial scale. There is no definite conclusion on the wave mode, but this is because linearly polarized waves not allow to determine reliably the wave vector direction. Besides that, there was a large amount of hidden work for initial data selection, since these are relatively rare shocks, almost never described before. We selected all crossings, suitable for multipoint analysis, at least in principle (out of almost 20 years of Cluster observations). Yes, about other shock types a lot more is known and results are more quantitative. However, this was achieved after tens of publications and thousands of crossings studied. It is not unexpected to achieve not so high level of details in this very first publication using very rare events. The paper was initially written in a very concise manner to avoid discussion of secondary phenomenological features. However, this may result in a somewhat misleading presentation. Now the description is substantially extended. We added more details on the sample crossings, review generality of results for the whole statistics and discuss comparison with other publications. More specific replies are below.

Corrections in the text: the manuscript is extended by almost 50% and improved. In Sec 1 and 2 changes are marked by bold. Sections 3 and 4 (data examples and discussion) are rewritten almost completely. The full analysis of Event #2 (similar to that for Event #1) is given. Description on Event #3 is significantly extended, including a new note on substantial variability of background magnetic field. Summary on statistics of events is added. In total 3 figures and 1 table are added in the main text and 2 figures in Supplement.

It is not clear what is called "waves".

The terms are corrected and streamlined in the whole text. Now we use "magnetic variations" as more neutral term. "Waves" indeed assume some repeating spatial structure.

The choice of a model normal against other methods is not justified.

We add comparison with other methods of normal calculation. They actually provide

the same results in Events #1 and #2. In Event #3 with very low magnetic field, its direction varies and coplanarity approach cannot be applied. We also discuss some possible implications.

It is now even said what is ”full resolution” of the magnetic field measurements. Are readers supposed to know that?

“Full resolution” was adopted from the name of the data set in Cluster Science archive. For these events it is about 20 Hz sampling (now mentioned in the text).

Except statistics of high-β occurrence and nice magnetic profiles (the third one seems to be a typical quasi-parallel shock), there is no new physics in the paper.

We do not agree. We determine also frequency, polarization of dominating high-amplitude variations and estimate it spatial scale. Some methods to calculate wave propagation direction are also tested, but proved not applicable. We also make initial suppositions about wave mode. (More detailed reply is above in the beginning)

(the third one seems to be a typical quasi-parallel shock)

Though there is no clear ramp (jump of magnetic field) in Event 3, the transition is quite localized in several tens of seconds and has very laminar gradual change in ion moments. “Typical” quasi-parallel shock (e.g. Burgess et al. and earlier references therein) has a prolonged transition up to several Earth radii long with patchy ion dynamics. The detected profile is very similar in time scales for all studied crossings and could be also observed for reforming oblique (Lefebvre et al 2009) or supercritical quasi-perpendicular shocks. Text added: This issue is now also discussed in more detail.

finally, the new revised paper is in supplement for reference

Please also note the supplement to this comment:
https://www.ann-geophys-discuss.net/angeo-2018-110/angeo-2018-110-AC2-

supplement.pdf

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