

Interactive comment on “Evidence of the Nonstationarity of the Terrestrial Bow Shock from Multi-Spacecraft Observations: Methodology, Results and Quantitative Comparison with PIC Simulations” by Christian Mazelle and Bertrand Lembege

Anonymous Referee #1

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The manuscript describes an in-depth, solid analysis of the Terrestrial supercritical, quasi-perpendicular (Qperp) shock substructures (foot, ramp and overshoot) from in-situ, multi-spacecraft magnetic field and plasma measurements. The analysis is based on a new, detailed methodology which is applied to 96 Earth shock crossings by the Cluster spacecraft. The study shows that the ramp thickness is at least of the order of a few electron inertial lengths, but also, that the depth of the foot region is highly variable with maximum values in agreement with previous theoretical studies. Finally, these

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results are discussed in the context of previous works and compared with advanced, PIC simulations. In particular, the latter show that the ramp depth is not appreciably sensitive to the shock reformation phase, while, as expected, the foot depth varies dramatically on a similar timescale. This is the first time a clear methodology to identify and measure the extent of these regions is put together in a coherent and meticulous fashion. This will surely be gladly received in the shock community who will hopefully use this work as a reference. But additionally, the paper presents new, relevant results on the size of the Qperp substructures at the Earth. For those reasons, I find the manuscript suitable for publication in Annales Geophysicae.

There are only a few, minor shortcomings that should be addressed.

First, the text is sometimes hard to follow and this is not desirable in a manuscript that could also be used as a tutorial. The authors may find useful doing a more careful proofreading. Finally, the manuscript displays a fair amount of typos, cross-out words and a few confusing sentences that should be addressed.

Line 14: Most statistics clearly evidence that the ramp (please reconsider the use of the verb evidence)

Line 21: 'A comparison with..'

Lines 20-25: List of results a, b, c or i. ii and iii

Line 28: Confusing, please rephrase.

Line 191: 'as close as possible'

Line 195: 'or it is not satisfactory'

Line 197: finest? => shortest? Smallest? Thinnest?

Line 300: n_0 is a vector (bold)

Line 635: Newbury

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Line 900: Paschmann

Line 989: nonstationarity

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