



EGUsphere, referee comment RC1  
<https://doi.org/10.5194/egusphere-2022-704-RC1>, 2022  
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## **Comment on egusphere-2022-704**

Anonymous Referee #1

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Referee comment on "Solar wind magnetic holes can cross the bow shock and enter the magnetosheath" by Tomas Karlsson et al., EGU sphere,  
<https://doi.org/10.5194/egusphere-2022-704-RC1>, 2022

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This paper uses multipoint measurements to analyse solar wind magnetic holes crossing the terrestrial bow shock and entering into the magnetosheath. Data from the Cluster four-spacecraft constellation have been used to observe density holes upstream of the bow shock and also shortly after, downstream in the magnetosheath. The analysis of 26 such magnetic hole observations shows that the temporal scale size and the magnetic field rotation are very similar for the upstream and downstream observations. This is consistent with the interpretation that magnetic holes are of solar wind origin.

The analysis is careful, the results are original and the paper is well written. The paper should be accepted for publication after a minor revision.

### Specific Comments:

Magnetic holes are part of the "zoo" of several transient structures that have been observed upstream of the Earth's bow shock. These include: (i) hot flow anomalies, which are also characterised by a depressed magnetic field but are filled with hot plasma flowing in a direction significantly deflected from the solar wind velocity vector (e.g. Lucek et al., *J. Geophys. Res.*, doi:10.1029/2003JA010016, 2004); (ii) hot diamagnetic cavities, where the depressed magnetic field within the cavity is flanked by strong enhancements (e.g. Thomsen et al., *J. Geophys. Res.*, doi:10.1029/JA091iA03p02961, 1986); (iii) foreshock cavities, where temperature and pressure inside are only slightly greater than in the ambient solar wind (Sibeck et al., *J. Geophys. Res.*, doi:10.1029/2001JA007539, 2002); and (iv) solar wind density holes, characterised by a strong plasma density depletion within them, flanked by density overshoots and compressed magnetic field (Parks et al., *Phys. of Plasmas Lett.*, 13, 050701, 2006). What is missing from the present paper is putting magnetic holes into context and comparing them with these other transient upstream structures. This is particularly useful for their relationship with density holes, since as shown by Parks et al. (2006) density holes are accompanied by magnetic holes of nearly the same shape.

