

## ***Interactive comment on “Quasi-separatrix Layers Induced by Ballooning Instability in Near-Earth Magnetotail” by Ping Zhu et al.***

**Andrei Runov (Referee)**

arunov@igpp.ucla.edu

Received and published: 6 February 2019

The research paper by Ping Zhu et al. presents results of probing 3-D geometry of magnetotail reconnection by examining distribution and evolution of quasi-separatrix layers (QSL) in the MHD simulation output. The QSL analysis technique was developed to study magnetic structures in the solar corona. This method has also been used to study 3-D topology of the magnetic field in laboratory plasma experiments. According to my knowledge, it is the first attempt to apply the QSL analysis to simulated data of the magnetotail. The paper shows that the method, indeed, applicable and may be used for analysis of 3-D magnetic topology. The paper is well written, the presentation of results is clear. On this basis, the paper by Ping Zhu et al. is suitable for publication, basically, in its present form. Yet, a couple of points in Summary and Discussion needs

C1

clarification.

In line 19, page 7 the Authors stated: “... the reconstruction of the 3D QSL geometry may provide an alternative means for identifying the location and timing of 3D reconnection sites in magnetotail from both numerical simulations and satellite observations.” It is very interesting statement, and I would ask the Authors to comment possible applications of their methods to in-situ observations. If my understanding of the method is correct, the Jacobian transformation matrix and the norm should be defined within the entire region of space to calculate QSL. Am I correct? In the other words, the knowledge of the magnetic field lines connectivity is required. Obviously, it is not the case for single-point spacecraft measurements. May the requirement be fulfilled in a case of multi-point observations? Would 4-points observations (Cluster, MMS) be sufficient when the probe tetrahedron crosses the region of interest?

Later the Authors state: “Whereas the near-Earth magnetotail can become ballooning unstable under substorm conditions, the nonlinear evolution of ballooning instabilities, by themselves, may not lead to the near-explosive substorm onset.” This statement is somewhat out of context. Do the Authors mean that coupling between ballooning and reconnection is necessary for explosive-like process?

---

Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2019-2>, 2019.

C2