

Reconstruction of magnetic field and plasma current using a stochastic optimization method



Figure 1 – Measurements of B and J fields from the four MMS spacecrafts



Figure 2 – Reconstructed B field projected into X-Z plane of Y=0 and J field into Y-Z plane of X=0 obtained by the new reconstruction model A new 3D reconstruction model for magnetic field (B) and plasma current (J) in the magnetosphere near a reconnection point has been developed to self-consistently and flexibly include both the measurements and physical constraints. The new model can effectively deal with the random errors in measurements and nonlinearities in physical constraints.

- How to translate discrete satellite measurements over a few tracks into a 3D visualization?
- The new reconstruction model fits the 3D smooth functions for the magnetic and plasma fields to the point-wise measurements from a constellation of satellites (Fig. 1) with a set of physical constraints.
- Using a stochastic optimization method called SPSA technique that automatically includes the random measurement errors, the physics-based smooth fields can be objectively reconstructed (Fig. 2).

Zhu, X. et al. (2022). Frontiers Astron. Space Sci. doi: 10.3389/fspas.2022.878403