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Effects of pressure anisotropy on the geometry of magnetic flux rope

Wai-Leong Teh[1]
[1]Space Science Centre, Institute of Climate Change, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia
e-mail (speaker): waileong.teh@gmail.com

A newly developed steady, two-dimensional (2D), magnetohydrostatic reconstruction associated with plasma pressure anisotropy is presented. This new reconstruction method is applied to a small-scale magnetic flux rope in the magnetosheath observed by the Magnetospheric Multiscale mission. The flux rope was mostly occupied entirely by the pressure anisotropy of $p_\perp > p_\parallel$. By comparing the 2D magnetic field map from the reconstruction with the isotropic pressure (see Figure 1b), results for $p_\perp > p_\parallel$ show that the width of the flux rope is reduced, leading to a small aspect ratio of the flux rope and that the circular field line is contracted (see Figure 1a). Additionally, an experiment was conducted for $p_\parallel > p_\perp$ by exchanging $p_\parallel$ and $p_\perp$ of the flux rope. The effects of $p_\parallel > p_\perp$ are found to be opposite to that of $p_\perp > p_\parallel$. This finding may have implications for charged particle acceleration within magnetic flux ropes/islands in the anisotropic plasmas.

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References
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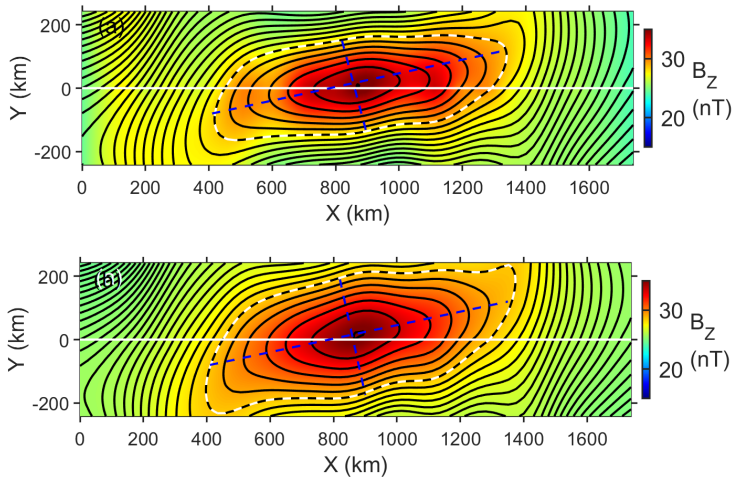

Figure 1. Reconstructed magnetic field maps for (a) $p_\perp > p_\parallel$ and (b) isotropic pressure. The circular dashed line is used to calculate the aspect ratio (width/length) of the flux rope.