Determination of Prominence Plasma β from the Dynamics of Rising Plumes

Observations by the Hinode satellite have shed new light onto the dynamics of rising plumes, dark in chromospheric lines, in quiescent prominences that propagate from large ($\sim 10\,\mathrm{Mm}$) bubbles that form at the base of the prominences. These plumes are created by the Rayleigh-Taylor instability and present a very interesting opportunity to study Magnetohydrodynamic (MHD) phenomena in quiescent prominences. However, obstacles still remain in our effort to study prominences and the dynamics they display.

One of the biggest issues is that of the magnetic field strength, which is not easily measurable in prominences. To tackle this problem, we developed a new method that can be used to determine a prominence's plasma β (the ratio of the gas pressure to the magnetic pressure) when rising plumes are observed. Using the classic fluid dynamic solution for flow around a circular cylinder with appropriate MHD and compressibility corrections, the compression of the prominence material can be estimated. After successfully confirmation through simulations; this method was applied to a prominence giving an estimate of the plasma β as $\beta = 0.47 \pm 0.079$ to 1.13 ± 0.080 for the range $\gamma = 1.4$ - 1.7. Using this method it may be possible to estimate the plasma β of observed prominences, therefore helping our understanding of a prominence's dynamics in terms of MHD phenomena.

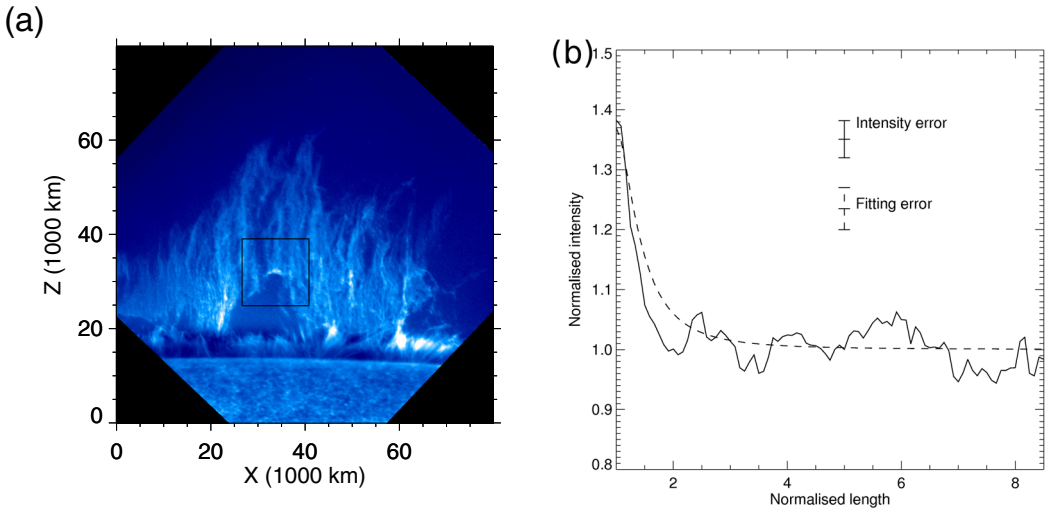

図: (a) A prominence with a plume (in the black box). The intensity increase at the head of the plume can be clearly seen. (b) The change of intensity with height at the head of the plume. Solid line shows the observed intensity and dashed line shows the result from the model.

Reference:

Hillier, A., Hillier, R., & Tripathi, D. 2012, ApJ, 761, 106.

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