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Determination of Prominence Plasma β from the Dynamics of Rising Plumes

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Prominences are one of the fundamental MHD structures relating to space weather. However, direct measurements of the prominence magnetic field is still difficult. Therefore, other mechanisms to determine the strength of the magnetic field are necessary. Using observations by the Hinode satellite of rising plumes, dark in chromospheric lines, in quiescent prominences that propagate from large (~ 10 Mm) bubbles that form at the base of the prominences, we present a new method that may be used to determine a prominence's plasma β when these rising plumes are observed. Using the classic fluid dynamic solution for flow around a circular cylinder with an MHD correction, the compression of the prominence material can be estimated. This has been successfully confirmed through simulations; application to a prominence gave 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 and providing a new method to determine the field strength of prominences.