Highlights of Astronomy, Volume 15
XXVIIth IAU General Assembly, August 2009
Ian F Corbett, ed.

doi:10.1017/S1743921310009841

Application of the Rayleigh-Ritz variational technique for coronal loop oscillations

Narges Fathalian[1], Hossein Safari[2] and Sadollah Nasiri[1,2]

[1]Institute for Advanced Studies in Basic Sciences, P. O. Box 45195-1159, Zanjan, Iran
[2]Department of Physics, Zanjan University, P. O. Box 45195-313, Zanjan, Iran

Abstract. We studied the fast kink modes of a cylindrical model of coronal loops, in coronal conditions, stratified density and low-β plasma. The mode frequencies and profiles are calculated.

Keywords. Sun: corona, Sun:oscillations

1. Introduction

Several theoretical models have been developed to explore the nature and propagation of waves of coronal loops in 1-D models. Here, a Rayleigh-Ritz variational method developed for the oscillations of 2-D coronal loop model.

2. Overview

The MHD equations in the matrix representation reduces as (see e.g., Sobouti 1981 and Hasan & Sobouti 1987).

$$\mathbf{WZ} = \mathbf{SZE}, \tag{2.1}$$

where E is a diagonal matrix whose elements are the eigenvalues ω_l and $\mathbf{Z}$ is the matrix of the expansion coefficients. The elements of $\mathbf{W}$ and $\mathbf{S}$ are determined from the equations of motions. We adapt a Rayleigh-Ritz procedure and approximate the linear series in Eq. (2.1) by a finite number of terms, say n. The matrix blocks S_{ls} and $W_{ls}; l, s = 1, 2, 3$ become $n \times n$ matrices.

3. Results

Our numerical results show that: a) for unstratified loop, as expected, ω_n is proportional to its mode number (i.e., $\omega_n \approx n\omega_1$). b) for stratified loops, all the fundamental, first, second, and the third overtone kink ($m = 1$) frequencies increases with increasing stratified density scale height. For typical loop lengths, $100 - 400$Mm, the density scale heights fall in the range of $13 - 108$Mm. These results are in agreement with Verwichte *et al.* (2004), McEwan *et al.* (2006), and Safari *et al.* (2007). The application of variational method in real model of coronal loop are implementing in our group.

References

Hasan, S. S. & Sobouti, Y. 1987, *MNRAS*, 228, 427
McEwan, M., Donnelly, G. R., Díaz, A. J., & Roberts, B. 2006, *A&A*, 460, 893
Safari, H., Nasiri, S., & Sobouti Y. 2007, *A&A*, 470, 1111
Sobouti, Y. 1981, *A&A*, 100, 319
Verwichte, E., Nakariakov, V. M., Ofman, L., & DeLuca, E. E. 2004, *Sol. Phys.*, 223, 77