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Experimental study of reversed shear Alfvén eigenmodes during the current ramp in the Alcator C-Mod tokamak

E M Edlund[1], M Porkolab[2], G J Kramer[1], L Lin[3], Y Lin[2], N Tsujii[2] and S J Wukitch[2]

[1] Princeton Plasma Physics Laboratory, Princeton, NJ 08543, USA
[2] MIT Plasma Science and Fusion Center, Cambridge, MA 02139, USA
[3] University of California Los Angeles, Los Angeles, CA 90095, USA

E-mail: eedlund@pppl.gov

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Abstract
Experiments conducted in the Alcator C-Mod tokamak have explored the physics of reversed shear Alfvén eigenmodes (RSAEs) during the current ramp. The frequency evolution of the RSAEs during the current ramp provides a constraint on the evolution of $q_{\min}$, a result which is important in transport modeling and for comparison with other diagnostics which directly measure the magnetic field line structure. Additionally, a scaling of the RSAE minimum frequency with the sound speed is used to derive bounds on the adiabatic index, a measure of the plasma compressibility. This scaling places the adiabatic index at 1.40 ± 0.15 and supports the kinetic calculation of separate electron and ion compressibilities with an ion adiabatic index close to $7/4$.

(Some figures in this article are in colour only in the electronic version)

1. Introduction

Magnetized plasmas covering many orders of magnitude in size, from earth-bound devices such as the tokamak [1], to planetary aurora [2] and stellar systems [3] exhibit a type of electromagnetic oscillation known as the shear Alfvén wave [4]. In tokamaks, shear Alfvén waves can be destabilized by the radial gradient of the energetic ion pressure [1], which may arise from ion-cyclotron resonance heating (ICRH) [5], neutral beam heating [6] or fusion-born alphas [7]. Shear Alfvén waves have the potential to enhance the loss of energetic ions through resonant transport [8, 9], an important consideration for future burning plasma experiments. As a contribution to this larger field of transport studies, we comment here on a particular class of shear Alfvén waves known as the reversed shear Alfvén eigenmode (RSAE, also Alfvén cascade) and may be excited in tokamak plasmas during the current ramp

