β-Induced Alfvén Eigenmodes Destabilized by Energetic Electrons in a Tokamak Plasma

W. Chen,* X. T. Ding, Q. W. Yang, Yi Liu, X. Q. Ji, Y. P. Zhang, J. Zhou, G. L. Yuan, H. J. Sun, W. Li, Y. Zhou, Y. Huang, J. Q. Dong, B. B. Feng, X. M. Song, Z. B. Shi, Z. T. Liu, X. Y. Song, L. C. Li, X. R. Duan, Y. Liu, and HL-2A team

Southwestern Institute of Physics, P.O. Box 432 Chengdu 610041, China

(Received 10 June 2010; published 26 October 2010)

The β-induced Alfvén eigenmode (BAE) excited by energetic electrons has been identified for the first time both in the Ohmic and electron cyclotron resonance heating plasma in HL-2A. The features of the instability, including its frequency, mode number, and propagation direction, can be observed by magnetic pickup probes. The mode frequency is comparable to that of the continuum accumulation point of the lowest frequency gap induced by the shear Alfvén continuous spectrum due to finite β effect, and it is proportional to Alfvén velocity at thermal ion β held constant. The experimental results show that the BAE is related not only with the population of the energetic electrons, but also their energy and pitch angles. The results indicate that the barely circulating and deeply trapped electrons play an important role in the mode excitation.

DOI: 10.1103/PhysRevLett.105.185004 PACS numbers: 52.35.Bj, 52.55.Pi