Nonlinearly driven second harmonics of Alfvén cascades

H. Smith[1], B. N. Breizman[2], M. Lisak[1] and D. Anderson[1]
[1] *Dept. of Radio and Space Science, Chalmers University of Technology, SE-412 96 Göteborg, Sweden*
[2] *Institute for Fusion Studies, University of Texas at Austin, Austin, Texas 78712, USA*

Alfvén Cascades (ACs) have been observed in tokamaks in reversed shear operation, and have been theoretically explained as energetic particle or toroidicity induced shear Alfvén eigenmodes localised around the minimum q surface, [1]. In recent experiments in Alcator C-Mod, [2], measurements of density fluctuations with Phase Contrast Imaging through the plasma core show a second harmonic of the basic AC perturbation. The present work describes, assuming low β, the second harmonic perturbation as driven by the first harmonic eigenmode through quadratic terms in the shear Alfvén wave equation. These quadratic terms vanish in a homogeneous straight magnetic field, but they can be important in the tokamak geometry. The fact that the double frequency generated by the quadratic terms is close to the double mode number branch of the Alfvén continuum results in a resonant enhancement of the second harmonic perturbation, which compensates for the smallness of the quadratic terms. Possible interpretations of the observed relative amplitudes of the first and second harmonics are also discussed.

[1] B. N. Breizman, H. L. Berk and M. S. Pekker, Phys. Plasmas **10**, 3649 (2003).
[2] J. A. Snipes *et al.*, 31st EPS Conference on Plasma Phys. London, 2004 ECA **28G**, P-2.165 (2004).