Fractional resonances between waves and energetic particles in tokamak plasmas

G.J. Kramer[1], L. Chen,[2,3] R.K. Fisher[4], W.W. Heidbrink[2],
R. Nazikian[1], D.C. Pace[4], and M.A. Van Zeeland[4]

[1]*Princeton Plasma Physics Laboratories,*
P.O. Box 451, Princeton,
New Jersey 08543
[2]*University of California-Irvine,*
Irvine, CA, USA,
[3]*Institute for Fusion Theory and Simulation,*
Zhejiang University, Hangzhou, China,
[4]*General Atomics, P.O. Box 85608,*
San Diego, California 92186, USA

Abstract

From numerical simulation and analytical modeling it is shown that fast ions can resonate with plasma waves at fractional values of the particle drift-orbit transit frequency when the plasma wave amplitude is sufficiently large. The fractional resonances, which are caused by a non-linear interaction between the particle orbit and the wave, give rise to an increased density of resonances in phase space which reduces the threshold for stochastic transport. The effects of the fractional resonances on spatial and energy transport are illustrated for energetic particle geodesic acoustic mode but they apply equally well to other types of MHD activity.