Global particle simulation of lower hybrid wave propagation and mode conversion in tokamaks

J. Bao[1, 2], Z. Lin[2], and A. Kuley[2]

[1]Fusion Simulation Center, Peking University, Beijing 100871, China

[2]Department of Physics and Astronomy, University of California, Irvine, California 92697, USA

Global particle simulations of the lower hybrid (LH) waves have been carried out by using the fully kinetic ion/ drift kinetic electron model with a realistic electron-to-ion mass ratio. Linear simulation of the propagation of a LH wave-packet in the toroidal geometry shows that the wave propagates faster in the high field side than the low field side, in agreement with a ray tracing calculation [1]. With LH waves propagating towards the plasma center from the edge, the poloidal spectrum of the wave-packet broadens and the central poloidal number increases (Figs.1a-1b). Furthermore, an electromagnetic fluid-kinetic model is introduced to study the accessibility of LH waves with low numerical noise, in which electron density is pushed forward by the continuity equation, and the kinetic markers are introduced for closure. The mode-conversions between slow and fast waves are observed in both cylinder and toroidal geometries, which are consistent with the theory (Fig. 1c). LH wave propagation with launching from high field side is also studied by using particle simulation model. The nonlinear simulation of LH wave current driven is also carried out with the electromagnetic model, in which nonlinear particle trapping effect is observed and the bounce frequency agrees with the theory.

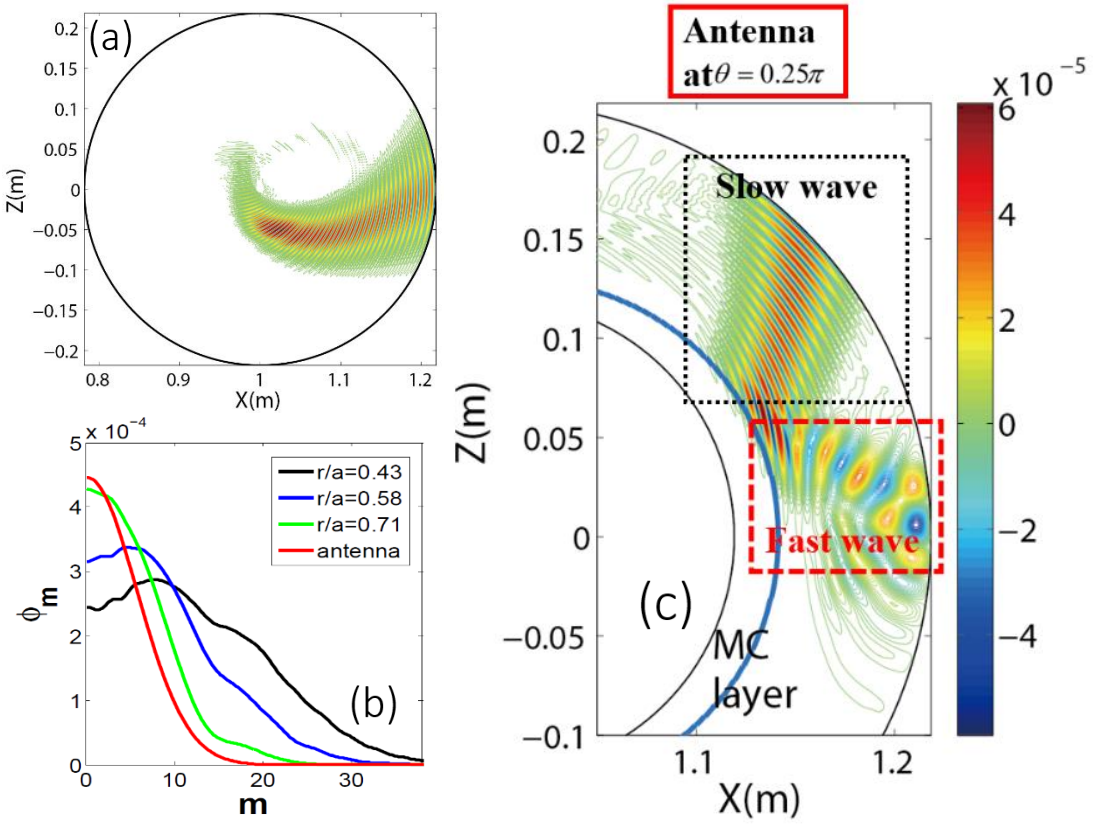

Figure 1. (a) LH wave propagation and (b) the corresponding poloidal spectrum profiles at different flux-surfaces. (c) Mode conversion between slow and fast waves in LH frequency range.

[1] J. Bao, *et al.* Plasma Phys. Control. Fusion **56,** 095020 (2014)