AORSA full wave calculations of helicon waves in DIII-D and ITER

C. Lau[1, a)], E. F. Jaeger[2], N. Bertelli[3], L. A. Berry[2], D.L. Green[1], M. Murakami[1], J. M. Park[1], R. I. Pinsker[4], R. Prater[4]

[1]Oak Ridge National Laboratory, Oak Ridge, TN, USA
[2]XCEL Engineering, Inc., Oak Ridge, TN, USA
[3]Princeton Plasma Physics Laboratory, Princeton, NJ, USA
[4] General Atomics, San Diego, CA, USA

[a)]lauch@ornl.gov

Abstract: Helicon waves have been recently proposed as an off-axis current drive actuator for DIII-D, FNSF, and DEMO tokamaks. Previous ray tracing modeling using GENRAY predicts strong single pass absorption and current drive in the mid-radius on DIII-D in high beta tokamak discharges. The full wave code AORSA, which is valid to all order of Larmor radius and can resolve arbitrary ion cyclotron harmonics, has been used to validate the ray tracing technique. If the scrape-off-layer (SOL) is ignored in the modeling, AORSA agrees with GENRAY in both the amplitude and location of driven current for DIII-D and ITER cases. These models also show that helicon current drive can possibly be an efficient current drive actuator for ITER. Previous GENRAY analysis did not include the SOL. AORSA has also been used to extend the simulations to include the SOL, in order to estimate possible power losses of helicon waves in the SOL. AORSA calculations show that another mode can propagate in the SOL and lead to significant (~10-20%) SOL losses at high SOL densities. Optimizing the SOL density profile can reduce these SOL losses to a few percent.