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P1.1078 Enhanced accessibility and absorption of helicon and lower hybrid waves in tokamak plasmas via n|| upshift from poloidal inhomogeneity

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Two high-power systems for non-inductive current drive in the mid-radius region with waves in the lower hybrid range of frequencies (LHRF) are under construction for the DIII-D tokamak. One system will launch fast waves at 0.48 GHz ('helicons') from a 30-element traveling wave antenna of the comb-line type mounted above the mid-plane on the outboard side of the torus, while the other system will launch slow waves at 4.6 GHz from a grill mounted near the midplane on the high-field side of the torus. In each case, the aim is to couple ~1 MW of power to DIII-D plasmas at a launched value of the parallel index of refraction of approximately n|| 3. The reason for requiring this relatively high value of n||, with its consequent challenge for efficient coupling, is to obtain accessibility to the core plasma at high density in the low toroidal field of DIII-D (BT(0)<2.2 T) for the 4.6 GHz slow wave, while in the case of the 0.48 GHz helicon, a value of n|| at least this high is needed to yield strong first-pass Landau damping at attainable electron pressures in DIII-D. Analysis with the ray-tracing code GENRAY verifies that the evolution of n|| along the ray is decisively affected by poloidal inhomogeneity for both the slow lower hybrid wave [1] and for the fast wave in the lower hybrid range of frequencies [2]. We show that this similarity in behavior can be traced to the essentially geometric origin of the effect, and that the propagation properties of the two modes in simple geometries are qualitatively similar in this frequency range. The consequences for wave accessibility to the core and the location of strong damping are analyzed for the conditions of the upcoming DIII-D experiments. We quantify the degree of sensitivity of the deposition location to variations in the plasma equilibrium. The highpower helicon experiments will commence in 2020, while the installation of the equipment for the high-field-side launch lower hybrid experiment is scheduled to occur between the 2020 and 2021 campaigns. Progress on hardware construction and installation will be reported.

[1] P.T. Bonoli and E. Ott, Phys. Fluids 25, 359 (1982) [2] D.L. Grekov, V.E. D'Yakov and K.N. Stepanov, Nucl. Fusion 23, 1402 (1983)

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