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P1.1080 DIII-D high field side lower hybrid current drive: experiment overview

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http://ocs.ciemat.es/EPS2019ABS/pdf/P1.1080.pdf

High field side lower hybrid current drive (HFS LHCD) has potential to provide efficient off-axis current drive consistent with advanced tokamak (AT) scenarios via improved wave accessibility and penetration.[1] Due to the quiescent HFS scrape off layer, HFS LHCD has potentially dramatically reduced plasma material interaction (PMI) issues and improved coupling.[1] DIII-D AT discharges provide an opportunity to validate HFS RF wave physics and LHCD physics models and to demonstrate PMI and coupling challenges are mitigated.
In DIII-D AT discharges, HFS launch below mid-plane allows LH waves to penetrate and single pass damp in region rho~0.6-0.8 with driven current up to 140 kA/MW coupled sufficient for current profile control. In addition, an optimized discharge based on QH-mode has been identified where up to 250 kA/MW coupled is predicted.
To accommodate a HFS coupler in DIII-D, the center post tile thickness is planned to be increased by 2.5 cm while keeping the divertor floor height unmodified. Within this physical envelope, a compact coupler where the expected power density is ~32 MW/m^2 has been designed using a cold plasma model load in COMSOL. The coupler distributes power poloidally utilizing a traveling wave, 4-way splitter and a six way multi-junction to split and set the wave spectrum.[2] For the coupler and in-vessel waveguide, copper cannot be utilized as structural material due to the 380℃ machine bake (anneals copper) and disruption loads. The primary material options include copper plated Inconel, copper plated stainless and GRCop-84(Cu-8%Cr-4%Nb)[3]. To facilitate assembly, an RF/vacuum flange has been have designed and tested. The latest simulations, design and system status will be presented.

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[2] A. Seltzman et al., "A High Field Side Multijunction Launcher with Aperture Impedance Matching for Lower Hybrid Current Drive in DIII-D Advanced Tokamak Plasmas," Nucl. Fusion (submitted 2018).
[3] D. L. Ellis, "GRCop-84: A High-Temperature Copper Alloy for High-Heat-Flux Applications," Vols. NASA/TM - 2005-213566, 2005.

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