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P3.016 A high power helicon antenna for the DIII-D tokamak and its electromagnetic aspects

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A comb-line antenna to demonstrate efficient off-axis non-inductive current drive from the absorption of toroidally directed very high harmonic fast waves is being designed and built for DIII-D [1].
The antenna consists of a toroidal array of 30 modules, each 5 cm wide by 21 cm tall, so that the array spans 1.5 m on outer wall just above the tokamak midplane.
This antenna will be fed with 1 MW of RF power at 476 MHz [2] by a coaxial feedthrough that transitions to a stripline feed inside the vacuum vessel which divides the input RF power evenly and at the proper phases into the four inputs of the end modules of the antenna. COMSOL was used to optimize the RF performance of the stripline and the RF coupling into and between the modules by varying their geometry and spacing. Multipactor phenomena is being analyzed using the SPARK3D code, which predicts it occurring in the stripline and the modules, motivating changes to the surface properties of the materials used and the RF power levels and toroidal magnetic field at which the antenna can be operated.
In addition, the forces are computed due to the currents induced in the striplines, modules, and their support systems by plasma disruptions. The current magnitudes and directions are plotted so it is possible to identify the locations where the largest current is perpendicular to the toroidal magnetic field. By modifying the antenna support geometry, it is possible to optimize the currents to minimize the resultant forces and torques on the whole antenna system.

[1] R. Prater, et al., Nucl. Fusion 54, 083024 (2014).
[2] A. Nagy et al., Fusion Science and Technology 72, 623-627(2017)
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