A HIGH POWER EXPERIMENTAL TRAVELING WAVE ANTENNA FOR FAST WAVE HEATING AND CURRENT DRIVE IN DIII–D*

D.A. Phelps, H. Ikezi, and C.P. Moeller
General Atomics, San Diego, California 92186-9784

A traveling wave antenna structure for tokamaks is a phased array of poloidally resonant elements wherein a wave is launched from one end only, propagates toroidally along the array within certain filter-like passbands specified by the coupling between elements and damps due to ohmic loss and absorption in the plasma.[1] Recently, low power traveling wave antenna (TWA) experiments in DIII–D utilized external coupling circuits for achieving efficient plasma absorption, while maintaining good impedance matching and phase stability.[2] In this paper, theory and computer simulation models validated by the low power experiments are used to conversion of the present antennas in DIII–D to high power TWAs. For minimum ohmic loss and ease of connection near the tokamak, the first harmonic passband in the relevant 60–120 MHz frequency range, along with direct inductive (versus mutual, capacitive, or other) coupling is selected. To match to the TWA, maintain phase and minimize rf voltage on the inductors, our modeling predicts that (1) external coupling between elements should be near the input/output taps, (2) for a coupling inductive reactance of 2–5 times the characteristic impedance of the element-coaxial cavities, the desired 15%–20% TWA bandwidths[2] are accessible, (3) tunable coaxial shorts terminating each element-coaxial cavity can establish the desired phase and match, and (4) a traveling wave recirculator[1] can increase the coupling efficiency to plasma..

[1]C.P. Moeller, et al., RF Conf. on Heating and Current Drive, Brussels (1992); also 10th Conf. on RF Power in Plasmas, Boston, MA (1993).
[2]D.A. Phelps, et al., 11th Conf. on RF Power in Plasmas, Palm Springs, CA (1995).

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Typed Name: D.A. Phelps

Institution/Company General Atomics

Address P.O. Box 85608

City, Province, State/Postal Code
San Diego, California 92186-9784

Country USA

Phone: (619) 455-2385

Fax: 619 455-2838

E-mail: phelpsd@gav.gat.com

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H. Ikezi C.P. Moeller

D.A. Phelps
General Atomics
P.O. Box 85608
San Diego, CA 9
(619) 455-2385

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