Characterization of the Mini-RFTF hydrogen helicon source

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Helicon plasma sources typically use radio frequency waves in the 1 to 50 MHz range and can produce high plasma densities with high ionization efficiency. However, their operation depends sensitively on the magnetic field geometry and strength, as well as the driving frequency, especially when light diatomic gases are used. The helicon source on Mini-RFTF at ORNL has been operated with both hydrogen and helium gas fill. The primary emphasis at the present is on hydrogen operation as the plasma source for a VASIMR engine. Diagnostics include a microwave interferometer, Langmuir probes, and a gridded energy analyzer. Results of hydrogen operation with a helical antenna at frequencies below and above the lower hybrid frequency will be presented and compared with theoretical predictions using the EMIR code, which allows for axial as well as radial variations in the plasma parameters. Experimental observations indicate that axial variations can strongly influence the operational range of the helicon, and the behavior is further complicated by non-linear power coupling to cavity modes that also depend on axial variations in the system.

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