Design of a microwave plasma source for electron heating and antenna testing*

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One of the major technical challenges for magnetic fusion is the interaction of the plasma with internal components, such as an antenna, and with materials. Linear plasma-material interaction test stands can benefit from additional electron heating of the high-density source plasma to increase the total plasma heat flux bombarding the target to better simulate fusion reactor conditions (10-20 MW/m^2). A microwave-based plasma experiment has begun at ORNL to study electron heating of over-dense plasmas and to provide a plasma environment for antenna testing. The experimental apparatus consists of a central vacuum chamber with two high-field magnets (~1 Tesla) on either side. The plasma is generated by high-field launched whistler waves at 18 GHz to create a moderate-density plasma ($n_e \sim 10^{18}/m^3$) in the central chamber. Electron heating of the over-dense plasma can be provided by either whistler waves or electron Bernstein waves at 6 GHz. The results of these experiments will provide a physics basis for future experiments for heating at higher densities. In addition, a mockup rf-antenna, designed to operate at 40-50 MHz, is being constructed to study the interaction of the plasma with the near-fields of the antenna. The antenna will be placed in the central vacuum chamber, which will act as an rf test facility. The results of initial plasma operation and mockup antenna status will be presented.

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