ECH/EBW SYSTEMS FOR ST STARTUP AND CURRENT DRIVE

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Lower frequency (~15-30 GHz), high power microwave generation and transmission systems have been of interest for plasma initiation and non-inductive current drive during the startup phase of ST operation. Some success has been achieved with ECH/EBW startup experiments conducted on the MAST ST at Culham [1] and EBW heating experiments performed on the linear plasma Proto-MPEX [2] experiment at ORNL utilizing older 28 GHz gyrotrons. Medium power EBW systems have been proposed in the past for NSTX and more recently high power 28 GHz systems (~ 1 MW) have been proposed for NSTX-U [3]. Electron Bernstein Wave plasma modeling on these devices generally shows reasonable coupling efficiency for up to the second harmonic. Launcher beam optics analysis favor higher frequency for improved spot size. Waveguide transmission systems were developed using 88.9 mm corrugated aluminum waveguide components and associated compact launchers. Larger diameter waveguide prototypes of up to 114 mm diameter have been developed that could operate at both 28 GHz and a lower frequency such as 19 GHz depending on which frequency is of interest. Other Gyrotron hardware is available for experiments in the 28 -53 GHz range at power levels of 300-500 kw. Hardware options for various devices and test measurements and experimental results for existing EBW/ECH experiments will be discussed.

[1] Shevchenko, V., et al "Long Pulse EBW Start-up Experiments in MAST" Fusion Technology June 2015

[2] J. Rapp, et al, "The development of the Material Plasma Exposure eXperiment MPEX" Conference Proceedings IEEE SOFE 2015

[3] Taylor, G., et al, "A megawatt-level 28 GHz heating system for the National Spherical Torus Experiment Upgrade" EPS Conference Proceedings, December 2014