# LINEAR PLASMA EXPERIMENT FOR NON-LINEAR MICROWAVE INTERACTION EXPERIMENTS

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As a non-linear medium, plasma can exhibit diverse dynamics when excited by multiple EM waves. Electromagnetic waves are vital to the introduction of energy in laser plasma interactions and the heating of magnetically confined fusion reactors. In laser plasma applications Raman coupling via a Langmuir oscillation or Brillouin scattering mediated by ion-acoustic waves are of interest. Signals with normalised intensities approaching those used in some recent laser plasma interactions can be generated using powerful and flexible microwave amplifiers, interacting in relatively tenuous, cool and accessible plasma. Other multi-wave interactions are interesting for magnetic confinement fusion plasmas, for example beat-wave interactions between two microwave signals coupling to cyclotron motion of the ions and electrons or the lower hybrid oscillations may be useful in heating the plasmas or for driving currents.

A linear plasma experiment is being built to test such multifrequency microwave interaction in plasma, based on prior research on geophysical cyclotron wave emission and propagation [1,2]. The main section of the plasma will be magnetised at up to 0.05T, with the plasma created by an RF helicon source to generate a dense, large, cool plasma with a high ionisation fraction. A range of frequency-flexible sources will provide microwave beams to enable multi-wave coupling experiments. The paper will present progress on this apparatus and experiments.

The authors gratefully acknowledge support from the EPSRC, MBDA UK Ltd and TMD Technologies Ltd.

[1] Ronald K., Speirs D.C., McConville S.L., Phelps A.D.R., Robertson C.W., Whyte C.G., He W., Gillespie K.M., Cross A.W., Bingham R., 2008, Phys. Plasmas, 15, art.056503

[2] Speirs, D.C., Bingham, R., Cairns, R.A., Vorgul, I., Kellett, B.J., Phelps, A.D.R., Ronald, K, 2014, Phys. Rev. Lett., 113, art 155002