Biased-probe induced H-modes on the HBT-EP tokamak

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The insertion of a biased probe into a tokamak plasma has been used in the past to trigger edge transport barriers and to investigate the underlying physics [1]. The bias provides some external control of the plasma rotation and shear, and this may help elucidate the fundamental physics of these transport barriers.

Such externally induced edge transport barriers have recently been created in the HBT-EP tokamak. HBT-EP is a tokamak primarily dedicated to the study of MHD instabilities and their control, in particular feedback control of external kinks [see eg. Ref. 2-4]. The edge transport barriers on HBT-EP can be used to enhance the plasma pressure and pressure gradients, which allows studies and feedback of pressure driven MHD instabilities. The basic physics of these transport barriers is also studied, as will be discussed here.

The recent addition of several high resolution diagnostics to HBT-EP allows a detailed study of the induced edge transport barriers and other edge plasma phenomena. An array of four triple probes inserted into the plasma provides radially and temporally resolved measurements of plasma potential, density, and temperature. An array of 20 Hall probes [5], also inserted into the plasma, provides radially and temporally resolved measurements of the poloidal magnetic field, thus giving information about the local current density and local magnetic fluctuations in the outer region of the plasma. Using these and other diagnostics, a detailed study of the fundamental character of bias-induced edge transport barriers has been initiated. Comparisons with quantitative theories, such as the one developed by Guzdar et al. [6] will be performed. With this set of diagnostics, and the external control that a biased probe affords, it may be possible to determine a cause and effect relationship between the plasma turbulence, flow shear, and gradients in, eg., plasma temperature and density. We will report on our progress towards understanding this complex phenomenon using the above mentioned experimental tools.

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