

Recent Developments on the 110 GHz Electron Cyclotron Heating Installation on the DIII-D Tokamak*

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The 110 GHz electron cyclotron system on the DIII-D tokamak is receiving significant improvements to its capabilities. Chief among these is the addition of the fifth and sixth 1 MW class gyrotrons, increasing the power available for auxiliary heating and current drive by nearly 60%. A new fully articulating dual launcher has been installed for high speed scans. A new feedback system linking the DIII-D plasma control system (PCS) with the ECH cathode voltage waveform generators permits real-time control of plasma properties such as electron temperature.

The commissioning of the fifth and sixth gyrotrons will complete the upgrade to 6 gyrotrons begun four years ago. Three of these tubes are from Communications and Power Industries (CPI). They use CVD diamond rf output windows to obtain high power with long pulse capability. The rf beams from these tubes are nearly Gaussian, and require fewer correction optics to couple to the HE_{1,1} mode in the circular waveguide.

The new dual launcher allows for two axis independent steering for each waveguide. The mirrors can currently be moved at up to 100 degrees per second. The system is being further developed to allow for scanning during shots.

The feedback system linking the DIII-D PCS with the ECH cathode voltage waveform generators takes advantage of the external amplitude modulation input on the generators. The signal from the PCS is conditioned so that it will modulate the ECH preprogrammed waveform within acceptable gyrotron operating limits. The PCS can use a variety of plasma monitors to generate its signal, such as electron cyclotron emission or Mirnov probes. The feedback system has been demonstrated to control the core electron temperature development during the early phase of a plasma discharge.

The new capabilities should further enhance the role of ECH in tokamak plasma control and lead to a new set of experiments.

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