Field–mapping and initial experiments in the Compact Toroidal Hybrid (CTH) Experiment.

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The Compact Toroidal Hybrid (CTH) is a low-aspect ratio torsatron with adjustable vacuum rotational transform and shear that operates with ohmic plasma current to investigate the equilibrium and stability of current-carrying helical plasmas. Equilibrium reconstruction of experimental stellarator plasmas for optimization of stability and transport has become more important in recent years because of the finite levels of pressure-driven currents now achieved in high β helical plasmas, and also because the NCSX and QPS stellarators will make use of bootstrap and/or driven plasma current to generate a non-negligible fraction of the plasma rotational transform. A new computational scheme to reconstruct equilibrium flux surfaces in stellarators (V3FIT) is under development,[1] and will be tested in CTH with external and internal magnetic diagnostics in strongly current-driven plasmas. Moreover, issues of current-driven MHD instability and the potential for disruptions in stellarators are also of paramount interest in such hybrid configurations. In this regard, CTH will investigate the onset of resistive and ideal current-driven instabilities in magnetic equilibria in which key parameters (global shear, vertical elongation, vacuum rotational transform, fraction of current-driven rotational transform) are varied in order to assess the potential for passive disruption control in current-carrying stellarators.

The CTH device is a five-field period, L = 2 torsatron (R_0 = 0.75 m; a_{Vessel} = 0.3 m) with toroidal field coils for control of the vacuum rotational transform, and three independent sets of poloidal field coils for equilibrium control, and an ohmic transformer to produce an expected maximum current of 50 kA. In addition, a set of 15 error-correction coils has been installed to minimize static islands in vacuum and plasma configurations, and may also be used to influence rotating islands. The minimum plasma aspect ratio in vacuum magnetic configurations is A_p = 4. The maximum magnetic field on axis is $B_o \leq 0.7$ T with zero supplementary toroidal field ($\iota(a) \cong 0.18$), though most initial work is carried out at B_o = 0.33 T to make use of 2nd harmonic ECH at 18 GHz.

ECH plasmas in CTH were first attained in Feb. 2005. Current efforts center on field-mapping and precision alignment of the multiple coil sets to achieve low aspect ratio vacuum configurations with minimal islands over a range of vacuum rotational transforms. Results of the field-mapping and the use of the flexible error-correction coil set will be presented.

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