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Creating Hybrid Plasmas With Off-Axis ECCD for Radiating Divertor Studies in DIII-D[1] C.C. PETTY, J.R. FERRON, T.C. LUCE, T.H. OSBORNE, T.W. PETRIE, General Atomics - San Diego, F. TURCO, Columbia U., C.T. HOLCOMB, LLNL, K.E. THOME, ORAU — A long duration, high density, high power hybrid scenario has been developed for use in radiative divertor studies in DIII-D. Using 11.2 MW of co-NBI power and 3.4 MW of ECCD, with a total injected energy of up to 56 MJ, high performance hybrid plasmas with $\beta_N = 3.7$ and $H_{98y2} = 1.5$ were created. The hybrid plasmas were fully non-inductive at densities of $n \approx 4.2\ 10^{19}\ m^{-3}$ with central ECCD, but the EC deposition needed to be moved to $\rho = 0.45$ to avoid the right-hand cutoff when the density was raised to $n \approx 5.8\ 10^{19}\ m^{-3}$ for radiative divertor studies. Although moving the EC deposition to $\rho = 0.45$ had the effect of dropping τ_E by 10%, the energy confinement time increased with higher density like $\tau_E \propto n^{0.4}$, allowing high beta to be maintained. While the plasma current profile displays the usual self-organizing properties of hybrids – an anomalously broad profile with $q_{min} > 1$ – local current drive can still have a measurable effect on stability, either positively or negatively. For example, hybrid discharges with radial ECH deposited at $\rho = 0.45$ proved to be more robustly stable to n = 1 modes (can be either a 1/1 or 2/1 mode) than similar discharges with co-ECCD at the same location. Interestingly, the large 1/1 mode had almost no effect on energy confinement but strongly degraded particle confinement; thus this mode needed to be suppressed to achieve the high pedestal densities required for radiative divertor studies.

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