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Integration of the high- N hybrid scenario to a high performance pedestal, stable zero torque operation and a divertor solution

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DIII-D experiments have demonstrated the expansion of the high-betaN hybrid scenario to the high density levels necessary for radiating divertor operation, leading to pedestal enhancement, and showed how the choice of injected impurity impacts the effectiveness of a radiating mantle solution, as well as the impurity transport to the core and the divertor. The scenario was made robust to systematic changes in EC power deposition location and current drive magnitude or heating injection, and was extended to zero beam torque, where the plasmas are passively stable with and without EC power. Coupling a high-performance core to an acceptable heat flux divertor is a crucial step for ITER and any fusion reactor. This work presents results on all the necessary ingredients, implemented in the high betaN hybrid scenario: high density, on- and off-axis electron heating and current drive, pedestal enhancement, puff-and-pump and radiating mantle techniques and impurity transport. 2017 experiments confirmed ELITE simulations which predicted that a near double null configuration and reactor-relevant q_95>5.5 are required for the pedestal enhancement with density. The impact of impurities used for the radiating mantle on the core of the plasmas, as well as their transport in the edge and divertor will be discussed.

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