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Burn Control in Fusion Reactors via Isotopic Fuel Tailoring[1]
MARK D. BOYER, EUGENIO SCHUSTER, Lehigh University — The control of plasma density and temperature are among the most fundamental problems in fusion reactors and will be critical to the success of burning plasma experiments like ITER. Economic and technological constraints may require future commercial reactors to operate with low temperature, high-density plasma, for which the burn condition may be unstable. An active control system will be essential for stabilizing such operating points. In this work, a volume-averaged transport model for the energy and the densities of deuterium and tritium fuel ions, as well as the alpha particles, is used to synthesize a nonlinear feedback controller for stabilizing the burn condition. The controller makes use of ITER's planned isotopic fueling capability and controls the densities of these ions separately. The ability to modulate the DT fuel mix is exploited in order to reduce the fusion power during thermal excursions without the need for impurity injection. By moving the isotopic mix in the plasma away from the optimal 50:50 mix, the reaction rate is slowed and the alpha-particle heating is reduced to desired levels.

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