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The External Kink Mode in Diverted and Limited Tokamaks[1]
A.D. TURNBULL, J.M. HANSON, F. TURCO, E.J. STRAIT, General Atomics, M.J. LANCTOT, LLNL — The disruptive instability in diverted tokamaks when the safety factor q at the 95% flux surface, q_{95}, is below 2.0 is shown to be a resistive kink. The mode is a counterpart to the ideal mode that explains the corresponding disruption in limited cross sections when q_a, the safety factor at the plasma boundary, lies just below a rational value m/n. Experimentally, the 2/1 kink instability is unstable for $q_a < 2$. However, for diverted plasmas, q_a is formally infinite and the ideal theory would predict stability. Yet, the disruptive limit occurs in practice when q_{95}, reaches 2. It is shown from numerical calculations in L-mode equilibria that a resistive kink mode is destabilized by the rapidly increasing resistivity at the plasma edge when $q_{95} < 2$, but $q_a >> 2$. The resistive kink behaves much like the ideal kink but the growth rates scale with a fractional power of the resistivity near the q = 2 surface; the exponent transitions smoothly between fractional values up to the ideal scaling. The model also explains an observed discrepancy in the limiter case where the onset actually occurs when q_a is slightly above 2.0.

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