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Comparison of the Zero Turbulence Manifold with results from the JET and MAST tokamaks

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Calculation of the threshold (the zero turbulence manifold) for subcritical turbulence in the presence of a toroidal sheared flow in the zero magnetic shear regime has revealed a strong dependence on the ratio of the magnetic safety factor q to the inverse aspect ratio epsilon; it is shown that the lower the value of this ratio, the higher the ion temperature gradient that can be reached, for example, in transport bifurcations. The theoretically calculated manifold is compared to results from the JET and MAST tokamaks; it is shown that the qualitative trends are remarkably similar between theory and experiment, and that in addition there is reasonable quantitative agreement in the predicted values of the temperature gradient. Experimental data also shows that at the highest values of the temperature gradient, the density fluctuation levels are lowest; the increase in temperature gradient may therefore be attributed to turbulence suppression. In summary, it is to be expected that a regime of low magnetic shear (i.e., flat safety factor profile), low safety factor and/or high inverse aspect ratio, and high toroidal flow shear will allow the highest temperature gradients to be achieved with a fixed level of heat input.