A new turbulent transition in a toroidal plasma

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We study the LH transition. This transition between a low confined turbulent state named L-mode and a higher quality confined state named H-mode has been observed since 1982 [1] in tokamaks. It is characterized by a drop of turbulent fluctuations which usually causes loss of confinement of the plasma. The understandig of this phenomenon is still incomplete [2]

We propose that the LH transition can be linked to a transition between two turbulent states in an axisymmetric flow. This transition was first observed numerically in a cylindric system [3] between two two-dimensional states with two (2D2C state) and three (2D3C state) velocity components, that we link to the H-mode and the L-mode respectively.

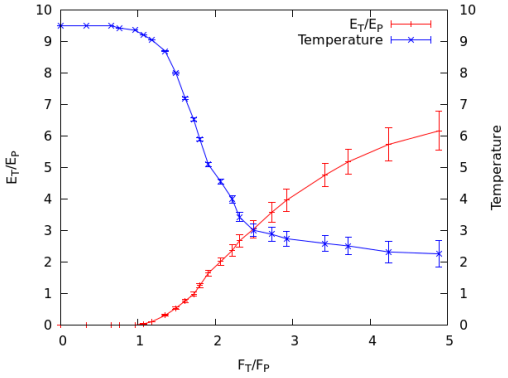

Figure 1: *Drop in temperature at the center of the tokamak section and growth in the E_T/E_P ratio by increasing toroidal-poloidal forcing ratio F_T/F_P.*

We performed direct numerical simulations with the code Nek5000 in toroidally axisymmetric geometry. A scalar field is added in order to study the confinement quality of the flow. We can show (Fig. 1) that an increase of toroidal fluctuating velocity induces both a loss of confinement of the scalar and an increase of the toroidal-polidal energy ratio E_T/E_P indicating a 2D3C state. We conclude that this simple model induces a transition which reproduces the key properties of the LH transition.

References

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