University of Craiova – Project in FP7- EURATOM-FUSION

Title of the project: **MODEL FOR EDGE PLASMA TURBULENCE**
Support documents: EFDA Task Agreement,
Code: WP08-09-TGS-01b-06/**MedC/PS** [AS-5]

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Responsable of the project: Prof. Dr. Steinbrecher Gyorgy

1. . SCOPE OF THE PROJECT

Study of the models of the edge plasma turbulence related to long-range correlations, intermittency edge transport barriers, core impurity transport with different dominant core turbulence. Previously developed stochastic models will be adapted to the study long-range correlations, self-similarity and intermittency.

2. . STAGE OF PROJECT

Experience acquired in solving stochastic differential equation, in the previous study of long range correlations in the particle transport, will be use d to model long-range correlations and multi-scale physics processes in edge plasma turbulence. These previous results on these random processes will be used to obtain new results on the characterization of the intermittent events and particle transport on the plasma boundary.

3. OBJECTIVES in 2009

Characterization of long-range correlations and multi-scale physics in L-mode plasmas and during edge improved confinement regimes.

Objective 1a: Long range correlations, influence on the impurity transport

Objective 1b: Long range correlations, reduced stochastic models.

4. WORK PROGRAM in 2009

Previous investigations (G. Steinbrecher, B. Weyssow, PRL 92, 125003, (2004)) on this subject was imposed by the necessity to elaborate reduced models for the edge transport, in particular to correlate experimentally observed evidence of the self-organized criticality on DIII-D Tokamak (T. L. Rhodes et all, Physics Letters A, 253, 181, (1999)), with the evidence of the multi-scale effects measured in DIII-D (M. Gilmore et all, P. O. P. 9, 1312, (2002)).

In the framework of the objective 1.a, a new mathematical method for the study of the particle transport in turbulent stochastic electrostatic field with long-range spatial correlation will be developed and applied to the study of the impurity transport. This method is an extension of our previous Hilbert space methods used in the study of the robustness of chaotic dynamical systems. These previous abstract results will be used to obtain rigorous numerical approximation methods and finally a C++ code. The expected result is the emergence of new numerical approximation method for particle transport.

In the framework of the objective 1b, our previous self-similar model of the edge plasma turbulence will be generalized. In the new model the overdamped approximation, used in the previous models, will be removed and will give a qualitative description of the effects of the long range correlations, self similarity, on particle transport and intermittency of the plasma edge turbulence. Two classes of partially soluble models will be studied. The first class is a one-dimensional non-linear and complex extension of our previous models. The second class of the models to be studied is higher dimensional and linear generalization of previous stochastic reduced model. In the framework of this class of higher dimensional linear models, the mechanism of the emergence of the long-range spatial correlations will be studied. These new models can be used to relate the existing data on long range correlations, self-similarity and intermittency and constitute a guide for the time consuming first principle edge plasma simulations.

5. SIGNIFICANCE OF RESULTS FOR JET and ITER

Long range correlations on the plasma boundary are related to the large fraction of particle and energy loss from the large tokamaks like ITER and JET. The mitigation of these unwanted effects require a best mathematical description of the role of long range correlations on the particle transport and intermittency The reduced models elaborated in this work allow a better choice of the strategies for the first principle numerical simulations and experiments, whose aim is the optimization of the operational regimes of large tokamaks.