LOCALIZATION AND FUSION MODELING IN PLASMA PHYSICS. PART I: MATH FRAMEWORK FOR NON-EQUILIBRIUM HIERARCHIES

Antonina N. Fedorova and Michael G. Zeitlin

IPME RAS, Russian Academy of Sciences
V.O. Bolshoj pr., 61
199178, St. Petersburg, Russia
http://www.ipme.ru/zeitlin.html
http://www.ipme.nw.ru/zeitlin.html

ABSTRACT

A fast and efficient numerical-analytical approach is proposed for description of complex behaviour in non-equilibrium ensembles in the BBGKY framework. We construct the multiscale representation for hierarchy of partition functions by means of the variational approach and multiresolution decomposition. Numerical modeling shows the creation of various internal structures from fundamental localized (eigen)modes. These patterns determine the behavior of plasma. The localized pattern (waveleton) is a model for energy confinement state (fusion) in plasma.

"A magnetically confined plasma cannot be in thermodinamical equilibrium"
Unknown author ... Folklore

1. GENERAL INTRODUCTION

It is well known that fusion problem in plasma physics could be solved neither experimentally nor theoretically during last fifty years. At the same time, during this long period other areas of physics and engineering demonstrated vast growth, on the level of both theoretical understanding and practical smart realizability. We can only mention an unprecedented level of theoretical understanding in Quantum Field Theory and String Physics, as the top of this mountain, and solid state electronics penetrating in real life together with personal computers and a lot of related things. It should be mentioned that the former thing demanded and created a fantastic level of theoretical models and new beautiful mathematics while the latter depended only on the state of the art of engineers from Intel and other high-tech firms who created, e.g., the processor Pentium by means of the multiplication table (almost) only. Unfortunately, although plasma physics, as a whole, was a key source of the so called Soliton Theory (beginning with numerical modeling by M. Kruskal and N. Zabusky),

Current Trends in International Fusion Research - Proceedings of the Sixth Symposium
Edited by Emilio Panarella and Roger Raman. NRC Research Press, National Research Council of Canada, Ottawa, ON K1A 0R6 Canada, 2009.