Analytic theory of shell models of turbulence

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In this poster I will review a theory of the shell models of turbulence, and in particular, the Sabra shell model. The purpose of the presentation is to present the current state of the research and show where our results refine previous numerical studies, or fill the gaps in understanding of certain phenomena. The poster will consists of two main parts.

The first part will concentrate on the classical theory of the deterministic model. We will discuss our results such as existence and uniqueness of solutions, the long-time behavior of the models and in particular the rigorous estimates on the number of degrees of the model in different regimes of parameters. We will emphasize the impact of such results on the numerical investigations and provide examples. Finally, we will conclude this part of the presentation with the discussion of the transition to chaos in the model, connecting our results to previous numerical studies.

The second part of the poster will describe the behavior of the shell models in the limit of vanishing viscosity. I will present results on the existence, uniqueness and regularity of solutions to the inviscid shell models. In particular, I will discuss the possibility of the blow-up in those models in some regimes of parameters and the existence of regular unique solutions in other regimes. In this context I will discuss dissipation anomaly phenomena, validity of the Onsager's conjecture, etc. in the shell models of turbulence.

This is a joint work with my advisor Prof. E. S. Titi (University of California Irvine and Weizmann Institute of Science), and Prof. P. Constantin (University Chicago).

References

[1] P. Constantin, B. Levant, E. S. Titi, *Analytic study of the shell model of turbulence*, Physica D, **219** (2006), 120-141.

[2] P. Constantin, B. Levant, E. S. Titi, *A note on the regularity of inviscid shell models of turbulence*, Phys. Rev. E, to appear.

[3] P. Constantin, B. Levant, E. S. Titi, *Sharp lower bounds for the dimension of the global attractor of the Sabra shell model of turbulence*, J. Stat. Phys., submitted.

[4] P. Constantin, B. Levant, E. S. Titi, *Remarks on the zeroth law of turbulence in different models*, in preparation.

[5] B. Levant, E. S. Titi, *Tight estimates on the dimension of the inertial manifold and critical dimension in shell models of turbulence*, in preparation.