Univerza v Mariboru

Fakulteta za naravoslovje in matematiko

ODDELEK ZA MATEMATIKO IN RAČUNALNIŠTVO

Vabilo

V okviru *Seminarja Oddelka za matematiko in računalništvo FNM UM* bo v sredo, 9. 4. 2014 ob 15.00 predaval

dr. Thanos Manos

iz Patrasa v Grčiji, trenutno sodelavec CAMTP Univerze v Mariboru.

Naslov predavanja je

The importance of being nonlinear: a survey on the role of chaos in quantum systems, galaxies and biological cells.

Povzetek predavanja je na naslednji stani.

Predavanje bo v predavalnici P1 na Gosposvetski 84 v Mariboru.

Vljudno vabljeni!

Predstojnik Oddelka za matematiko in računalništvo,

doc. dr. Andrej Taranenko

The importance of being nonlinear: a survey on the role of chaos in quantum systems, galaxies and biological cells

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Abstract.

Within the realm of physics there are nonlinear interactions playing a key role. In this talk I will review the effect of nonlinearity in three different cases, namely in galactic, quantum and cellular systems.

I will first give a brief introduction on what we call *classical chaos* in dynamical systems and more precisely in *Hamiltonian* (energy conservative) systems. The distinction between *chaotic* and *regular* motion becomes crucial when we are trying to build adequate and realistic models, in order to understand better the dynamical volution and formation (history) of the galaxies astronomers observe. In the case of *time-independent* galaxy models, i.e., constant model parameters, I will show: (a) how these parameters may enhance the global (in)stability, (b) how by combining different methods one can distinguish between "*strong chaotic motion*" and "*weak chaotic and regular*" [1] and (c) that by allowing the parameters to be *time-dependent*, a single orbit's motion can be much more complicated, interplaying between chaotic and regular behavior at different times [2], this is the typical case in N-body simulations [3].

In the second part of the talk, I will briefly discuss the basic concepts of what is called *quantum chaos* using as an example the *quantum kicked rotator*. The model's features of dynamical localization of chaotic eigenstates can be considered as a paradigm for other both time-periodic and time-independent (autonomous) fully chaotic or/and mixed type Hamilton systems. Some of the questions that arise in such models, are the following: (i) what distributions are adequate to describe in a global way the *localization length* of the systems eigenstates, from strongly localized to fully delocalized [4], (ii) what is the role of *anomalous diffusion*, which can arise for example by the presence of the so-called *accelerator modes*, in the localization properties [5] etc…

In the last part of the talk, I will focus on the *mathematical modeling of pancreatic β-cells*, which play a crucial role in diabetes [6]. Such models also incorporate nonlinear ordinary differential equations and I will present few preliminary results on the effort to construct a model which will be able to capture, describe and shed light on the dynamics linked to new experimental images and data.

References:

[1] Manos T & Athanassoula E, *Mon. Not. R. Astron. Soc.* **415** 629 (2011)
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[3] Manos T & Machado R, *Mon. Not. R. Astron. Soc.* **438** 2201 (2014)
[4] Manos T & Robnik M, *Phys. Rev. E* **87** 062905 (2013)
[5] Manos T & Robnik M, *Phys. Rev. E* **89** 022905 (2014)
[6] Fall C "*Computational Cell Biology*", Springer-Verlag New York, Inc. (2002)