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PREFACE: LOCALIZED EXCITATIONS IN NONLINEAR COMPLEX SYSTEMS (LENCOS'09)

This issue of Discrete and Continuous Dynamical Systems - Series S is a compilation of papers representing the current state-of-the-art on the field of localized excitations and their role in the dynamics of complex physical systems. During the last two decades, an impressive volume of theoretical and experimental work has been devoted to the existence, stability and dynamics of such coherent structures. They have been identified as critical components of numerous continuous and discrete dynamical systems and, depending on the context (and their particular form), they may be referred to as solitons, instantons, kinks, breathers, or quodons, among many others. We nowadays think of such localized nonlinear excitations as being ubiquitous in nature due to their experimental realization in many diverse systems including, but not limited to, optical fibers and waveguide arrays, photonic crystals, Bose-Einstein condensates, molecular crystals, quasi-one-dimensional solids, Josephson-junctions and arrays thereof, layered silicates, micromechanical cantilever arrays, uranium crystals, pendulum arrays, water waves, electrical transmission lines, ferromagnetic and antiferromagnetic materials, granular crystals and so on. Additionally, they are also conjectured to play an important role in denaturation transitions and bubble formation in DNA, protein folding, atom ejection and defect migration in crystals, low-temperature reconstructive transformations, and many others. The study of nonlinear localized excitations is a long-standing challenge for research in basic and applied science, as well as engineering, due to their importance in understanding and predicting phenomena arising in nonlinear and complex systems, but also due to their potential for the development and "design" of novel applications.

The "Localized Excitations in Nonlinear Complex Systems" (LENCOS'09) Conference was organized in order to link ideas of experimental and theoretical physicists, chemists, biologists, and applied mathematicians working in the broad field of nonlinear localized modes. This workshop aspires to be the beginning of a series of meetings in this field and a venue for interdisciplinary exchanges and the promotion of research in this multi-faceted and diverse thematic area. LENCOS was organized by the Nonlinear Physics Group of the University of Sevilla, which had also organized some previous relevant workshops, namely "Moving Breathers in Nonlinear Lattices" (2003), "Macroscopic Effects of Nonlinear Excitations" (2004), "New Horizons in Stochastic Complexity" (2004) and "Nonlinear excitations: theory and experiments" (2005). The LENCOS'09 Conference was attended by approximately 65 delegates from Europe, America and Asia. This was a vibrant mixture of senior and young researchers, which jump-started numerous productive interactions between different generations of researchers, different countries/continents and different sub-fields within this broad area.

As a very natural complement to the research excitement and scientific progress promoted by this workshop, we decided to prepare a special volume of research

papers associated with the broad theme of the conference, namely the study of nonlinear localized excitations and their applications within numerous different areas of science. A conscientious decision in that regard was to not limit the relevant submissions to merely the participants of the conference (although the majority of the articles came from there), but rather to advertise it more broadly and attract, accordingly, a richer mix of potential contributors and a wider representation of thematic interests. The resulting submissions were subjected to the standard refereeing policies and procedures of the journal and we would like to take this opportunity to thank all referees for their careful work and valuable time and effort. We also want to thank all authors both for submitting the relevant works, as well as for taking care of all remarks by the referees, and for respecting the imposed timelines. We sincerely hope that the resulting outcome will be one that will be of value to the nonlinear waves and localized modes' community and to both more junior, as well as to more seasoned researchers in the field.

We now present a brief overview of the different areas covered by the contributions to the Special Issue, placing them in some broad, over-arching categories:

Existence and interactions of traveling localized excitations: In the work of Aceves, Cisneros-Ake, and Minzoni supersonic waves in the Morse lattice are considered where a numerical analysis shows that solutions of small width evolve almost freely like the Toda shocks and a variational analysis demonstrates that the Peierls-Nabarro barrier induced by the lattice is canceled by the adjustment of the phase. Feckan and Rothos study the existence and bifurcation of traveling waves in the forced discrete nonlinear Schrödinger equation with polynomial type and bounded nonlinearities. Yulin and Champneys study the bifurcation of stationary and moving discrete breathers on a saturable discrete nonlinear Schrödinger equation with an asymmetry induced by an external pumping field. Alvarez *et al.* present a numerical examination of collisions of moving breathers traveling with different velocities in the Peyrard-Bishop model. Lastly, Cuevas *et al.* study the interstitial migration generated by the scattering with mobile discrete breathers in a Frenkel-Kontorova model.

Solitons in fluids: Ablowitz *et al.* give an overview of nonlinear wave theory and its applications to various topics, including pulses in mode-locked lasers, wave structures in hexagonal lattices, and a nonlocal formulation of water waves. On the other hand, Mercader *et al.* study the existence and stability of dissipative solitons in a horizontal layer containing a miscible mixture of two fluids heated from below.

Discrete nonlinear Schrödinger (DNLS) equation: In the contribution of Chong and Pelinovsky, the authors give a detailed variational approach towards the bifurcation of symmetric and asymmetric discrete breather solutions to the cubic-quintic DNLS equation. The work of Panayotaros considers systematically the existence, stability and bifurcations of states off the anti-continuum limit of vanishing coupling, in the setting of the discrete nonlinear Schrödinger lattice but with relatively few sites.

Fundamental aspects of the nonlinear Schrödinger (NLS) equation: In the manuscript by Usero dark solitary waves are identified and their properties are explored in the presence of nonlocal interactions, particularly ones of the Kac-Baker type. Belmonte-Beitia and Prytula analyze the existence of solitons in the case of generalized NLS equations. Finally, the work of Tsang *et al.* determines exact periodic and solitonic solutions to the one-dimensional Gross-Pitaevskii equation

with the pseudopotential in the form of a nonlinear lattice, induced by a spatially periodic modulation of the local nonlinearity.

Applications of NLS to optics and Bose-Einstein condensates (BECs): The manuscript of Aceves, Chung, *et al.* presents a study of supercontinuum generation in photonic crystal fibers in the framework of generalized NLS models, illustrating good agreement of their results with ones pertaining to real experiments. Diaz-Otero and Chamorro-Posada report results concerning the shape of the dispersion-management solitons and interactions between them, suggesting possibilities for an effective suppression of the intra-channel interactions between solitons. Gerdjikov, on the other hand, studies the properties of solitons in one-dimensional BECs with spin F in the context of multicomponent NLS equations. Finally, Kevrekidis and Frantzeskakis study single and multiple dark matter-wave solitons in atomic BECs at finite temperatures described by the dissipative Gross-Pitaevskii equation, which incorporates a phenomenological damping term.

Applications of localized excitations in biology: The work of Cruzeiro uses the VES (vibrational excited states) hypothesis to provide a new explanation for conformational changes in proteins, while Piazza and Sanejouand investigate how energy is redistributed across protein structures, following localized kicks, within the framework of a nonlinear network mode. Lastly, Ferreira *et al.* present numerical simulations of ionic currents along actin filaments performed in a zig-zag chain.

Localized excitations in crystals and mechanical arrays: Dou *et al.* present a one-dimensional model for the scattering of an incoming particle hitting the surface of a mica crystal, the transmission of energy through the crystal by a localized mode and the ejection of atoms at the incident or distant face. In the manuscript by Dubinko the mechanisms of recovery of the radiation damage, based on the radiation induced formation of quodons and their interaction with crystal defects such as voids and dislocations are considered. Russell and Eilbeck examine the tracks in crystals of muscovite of high energy charged particles together with quodons created by kinetic atomic scattering. Finally, Sato *et al.* present a method for realizing logic operations in a micromechanical cantilever array based on the timed application of a lattice disturbance to control the properties of the intrinsic localized modes.

Other nonlinear models: Cuenda *et al.* use the classical Bäcklund transformation along with the commutativity diagram to construct the wobbling kink solution for the sine-Gordon equation. Dobrowolski presents a geometric formulation that enables the consideration of the motion of kink-like excitations in the setting of curved Josephson junctions. In the work of Gaididei *et al.* the setting of asymmetrically coupled nonlinear elements is examined, with a view towards its potential applications e.g. in traffic flow and elsewhere; potential Hopf bifurcations and associated traveling wave dynamics are explored in the system. Finally, in the work of Dmitriev *et al.* the interaction of straight edge dislocation clusters with monochromatic sound waves is examined; furthermore, the possibility of excitation of gap discrete breathers within dislocation dipole chains is elucidated.

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