Application from	**Siminos, Evangelos**
E-mail Address	siminos@gatech.edu
Job	Anniversary Research Lectureships - Physics / 2233
Application date	22/03/2012 20:00

Anniversary Research Lectureships

Do you fall into any of the categories described above?	Yes
Have you successfully completed a PhD?	Yes
Do you have three peer-reviewed outputs?	Yes

Personal details

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Post code	01187
Mobile phone number	
Home phone number	

Equal opportunities questionnaire

Age group	25 - 34
Gender	Male
Ethnicity	Other White Background
Country of legal nationality	Greece
Do you consider yourself to have a disability, as defined by the Disability Discrimination Act?	No

Current employment

Employer's name	Max Planck Institute for the Physics of Complex Systems
Job title	Guest Scientist (postdoc)
Start date	08/2011
End date / expected end date	08/2013
Current salary	31080 EUR
Notice period required / date available to start	three months / Sept. 2012

Application questions

If you would like to make a joint application, please specify the additional department.	
Please give details about your PhD. Detail should include your dates of study, title, examiners and awarding institution.	Dates of study: 6/2005-6/2009 Title: Recurrent spatio-temporal structures in presence of continuous symmetries Examination Committee: P. Cvitanovic (adviser) R. Grigoriev K. Wiesenfeld M. Schatz L. Dieci Awarding institution: Georgia Institute of Technology, Atlanta, GA, USA Description: My PhD thesis focused on the interplay between symmetry and nonlinear dynamics in spatially-extended systems with coherent structures. As an illustrative test case we use Kuramoto-Sivashinsky equation, a one-dimensional partial differential equation that exhibits turbulent behavior, and developed a geometrical, dynamical systems' description of its high-dimensional (in principle infinite dimensional) phase space. This sets the stage for a quantitative prediction of statistical averages with tools (such as trace formulas) that relate the spectrum of evolution operators to the spectrum of periodic orbits. However, when the dynamics admits a continuous symmetry and multiple traveling wave solutions are present, the geometric picture is often obscured by the presence of equivalence classes of solutions. To alleviate this difficulty, I worked on symmetry reduction for Lie groups acting on high-dimensional spaces, a problem for which classical Hilbert-basis approaches are not applicable. Our proposed solution is to use a geometrical approach based on Cartan's moving frames. This results to effective numerical schemes, but also to explicit invariant bases for symmetry reduction in higher-dimensional spaces. Application in the Kuramoto-Sivashinsky and complex Lorenz systems allowed an elucidation of the role unstable manifolds of certain traveling wave solutions play in organizing the global geometry.

Tell us about the research experience you have gained following the successful completion of your PhD.	July 2009- July 2011, Postdoctoral Fellow, CEA, DAM, DIF, Arpajon, France Stability of nonlinear electrostatic waves and stimulated Raman scattering saturation As a postdoc at CEA I've been studying kinetic effects in laser-plasma interaction problems. An issue of great interest to current inertial confinement fusion efforts is the stability of nonlinear electrostatic plasma waves, in particular the ones associated with stimulated Raman scattering. Standard numerical tools for stability calculations (such as projection onto a finite-dimensional basis) face fundamental difficulties due to the Hamiltonian structure, extreme range of scales and continuous linear spectrum in the Vlasov-Poisson system. These difficulties were resolved in our study using an operator-theoretic technique (spectral deformation), which establishes a formal connection to dissipative systems and suppresses non-essential scales. This formulation allows the determination of the unstable eigenmodes of a Vlasov equilibrium and illuminates the physical mechanism underlying the instability. Application of our method to establish a connection between instabilities of nonlinear electrostatic waves excited by laser-plasma interaction and the saturation of stimulated Raman scattering is an ongoing effort at CEA, as part of an ongoing PhD project. Relativistic solitary waves A parallel effort at CEA was the study of relativistic solitary waves in the interaction of ultra-intense laser pulses with under-dense plasmas. The motivation is that such structures can be used to transfer energy from a laser pulse to the plasma particles, therefore presenting potential as an acceleration mechanism. Mathematically, such solitary waves can be thought of as homoclinic and heteroclinic connections of a certain Hamiltonian dynamical system. My contribution was to deduce the existence and provide a classification of new families of solutions, using general geometrical arguments involving the symmetries of the system and the dimensionality of invariant subspaces. July 2011 to present, Postdoctoral Fellow, Max Planck Inst. for the Physics of Complex Systems Electron heating effect on self-induced transparency The effective increase of critical density associated to the interaction of relativistically intense laser pulses with (classically) overdense plasmas, known as self induced transparency (SIT), is a mechanism of great importance for laser-solid interaction. In the context of ion acceleration, for instance, SIT can prevent efficient ion radiation-pressure-acceleration. As a postdoc at the Max Planck Institute I've been studying SIT by means of analytical theory and particle-in-cell (PIC) simulations. Our main finding is that kinetic effects, such as collisionless heating of the electrons at the edge of the plasma, significantly increase the effective critical density. An understanding of this phenomenon is reached by a study of dynamical barriers (separatrices) for the motion of electrons in the field of the laser: electrons heated to relativistic velocities can acquire enough energy to cross separatices that would otherwise restrict their motion to be close to an equilibrium. In turn, the plasma loses stability and the pulse can propagate in an overdense plasma by expelling electrons towards the vacuum.

Outline your ideas for a programme of research at York. This should include a statement on the impact of your research, highlighting how this links with the relevant department's strategy.	One of the major milestones of the last decade in the physics of laser-plasma interactions was the advent of compact accelerators that exploit short, high-intensity laser pulses to accelerate particles (electrons and ions) in much higher energies than possible with conventional accelerators of comparable size. Although many different physical mechanisms that lead to high quality (small energy and angular spreads, sufficient charge) have been identified, a common feature shared by all successful schemes is the emergence of coherent motion in a complex and unstable medium. Understanding, and controlling, acceleration mechanisms thus depends on an understanding of the nonlinear interaction of coherent field structures (wakes, solitons, shock waves, to name a few) and the plasma particles. As an example, in laser wakefield acceleration both the interaction length along which electrons are accelerated in the wakefield of the laser, and the initial 'self-injection' of electrons into the wakefield have to be controlled so that a large fraction of the electrons is accelerated to approximately the same energy. Therefore, an understanding of dynamical barriers to particle transport, that is of separatrices in a generalized phase-space, is of utmost importance in developing new schemes for laser-driven particle accelerators. My research at York would be centered around exploring such coherent structures in the interaction of relativistically intense laser pulses with solid density targets. Recent particle-in-cell simulation results in the context of self-induced transparency (SIT) suggest a complex interplay between the acceleration of electrons by the electric field near the edge of the target, electron heating, and chaotic dynamics in the quasi-stationary field of the transmitted pulse. Surprisingly, within this disordered environment highly energetic electron beams can spontaneously form and retain a relatively small energy spread. My purpose is to understand, through a study of time-dependent separatrices in the electron phase-space, under what conditions do such beams form and whether they could be utilized in an acceleration scheme. Furthermore, for higher pulse intensities (but certainly within reach of the forthcoming experimental facilities) ion dynamics should play a role and their study could also lead to new schemes for laser-driven ion acceleration. Technically, such a project is demanding but within the expertise of the applicant. Establishing closer contact with experiments would require two-dimensional (in the space variables) simulations. Therefore, an extension of our particle-in-cell code (in collaboration with M. Grech of MPIPKS) to two dimensions will be the major computational task associated with this project. In order to detect time-depended separatrices in the electron phase-space, the applicant intents to use dynamical system's techniques developed for the tracking of such separatrices in fluid dynamics. The proposed research will fit well within the plasma physics group in the Physics Department, as many members are active in laser-plasma interactions, and particularly in theory and experiments involving solid targets. Ideally, it would spark interest in the experimental realization of such acceleration schemes in the laboratory. Therefore, the proposed research would not only diversify the research in the plasma physics group, but would also be likely to initiate collaborations within it.

Name your top three peer-reviewed outputs.	E. Siminos, D. Benisti and L. Gremillet, Stability of nonlinear Vlasov-Poisson equilibria through spectral deformation and Fourier-Hermite expansion, Phys. Rev. E 83, 056402 (2011) G. Sanchez-Arriaga, E. Siminos and E. Lefebvre, Relativistic solitary waves modulating long laser pulses in plasmas, Plasma Phys. Contr. Fusion 53, 045011 (2011) E. Siminos and P. Cvitanovic, Continuous symmetry reduction and return maps for high-dimensional flows, Physica D, 240, 187--198 (2011)
Give details of any independent grant income you have secured to date.	N/A
Describe your teaching experience to date. If you do not have any teaching experience, please outline how you would anticipate contributing to the teaching programme at York.	In fall 2008 I gave a series of three guest lectures for the advanced graduate course "Nonlinear Dynamics" in School of Physics, Georgia Tech, on the topic "Symmetry in dynamical systems". In the years 2003-2008 my Ph.D. studies at the School of Physics of Georgia Tech were supported by teaching assistantship. The undergraduate courses I was involved in include Physics I & II, Physics Laboratory I & II, Classical Mechanics I & II, Electromagnetism, Special Relativity, Quantum Mechanics I. The duties included recitation sessions (giving lectures on problem solving), preparing and teaching lab sessions, holding office hours, preparation and grading of homework and examinations.

Curriculum vitae

Curriculum vitae (CV)	cv_siminos.pdf

Additional information

Do you have any financial, business or other personal interests which may conflict with the duties of this post?	No
Are you related to, or in a close personal relationship with, any member of University staff in the appointing department?	No
If you answered yes to either of the questions above, please provide details.	
Where did you originally find out about this vacancy?	Word of mouth

First reference

Title	Professor
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Can we contact this referee prior to interview?	Yes

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Third reference

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Can we contact this referee prior to interview?	Yes

Criminal convictions

Do you have any unspent criminal convictions?	No
If you answered yes, please give details below.	