

GEDYTO: GEOMETRICAL METHODS IN DYNAMICS AND TOPOLOGY: FINAL REPORT

Scientific summary and abstract

Place: Hanoi, Vietnam

Venue: [Hanoi National University of Education](#)

Dates: April 18-22, 2011

Organizers: [Viktor Ginzburg](#) (University of California at Santa Cruz)

[Eva Miranda](#) (Universitat Politècnica de Catalunya)

Do Duc Thai (Hanoi National University of Education)

[Nguyen Tien Zung](#) (Université de Toulouse)

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Scientific Summary:

The main topics for the conference are Geometry, Topology and Dynamical systems with a special emphasis on their symplectic aspects.

The conference GEDYTO: Geometrical methods in Dynamics and Topology is an international conference that wants to gather experts in Dynamics and Symplectic Topology to explore geometrical tools used in both disciplines. The conference wants to promote the exchange of ideas between these two close areas: Dynamical systems and Symplectic Topology.

This Conference has celebrated the 60th anniversary of the Hanoi National University of Education.

The conference started on Monday 18th and finished on Friday 22nd. There was an excursion to Halong-Bay for the weekend 23-24. Participants also had the afternoon of Wednesday free.

We had a total of 52 participants from 10 different nationalities. There were a total of 18 talks and two minicourses.

Description of the scientific content of and discussion at the event

We had a total of 18 speakers who contributed with 1-hour talks and two minicourses.

The minicourses were offered with the intention that students at the event (international and Vietnamese students) could benefit from the conference learning something from the scratch.

There were two minicourses (by Alain Chenciner and Nguyen Tien Zung) and 18 talks.

The list of international speakers was:

Marta Batoreo (UC Santa Cruz)

Marc Chaperon (Paris VII)

Alain Chenciner (IMCEE)

Jesus Gonzalo (Madrid)

Basak Gurel (Vanderbilt)

Mark Hamilton (Mount Allison)

Janko Latschev (Hamburg University)

Do Ngoc Diep (Hanoi)

Ricardo Perez Marco (Paris XIII)

Miguel Rodriguez-Olmos (Universitat Politecnica de Catalunya)

Dietmar Salamon (ETH-Zurich)

Romero Solha (Univesitat Politecnica de Catalunya)

Sheila Sandon (Nantes)

Michael Usher (University of Georgia)

Le Anh Vu (Hanoi)

Le Van Hong (Praha)

Vu The Khoi (Hanoi)

Dmitri Zaitsev (Trinity College)

The contents of the minicourses tried to provide basic tools for the study of dynamics of the n-body and for the study of entropy in dynamics and geometry. Professor Nguyen Tien Zung also explained also some applications of entropy to financial mathematics. The experience was very positive because students could perfectly follow those minicourses.

Here we include the abstracts:

Alain Chenciner (Observatoire de Paris-IMCCE): *"The Lagrange reduction of the N-body problem"*

Abstract :

In his fundamental "Essai sur le problème des trois corps" (Essay on the 3-body problem), Lagrange, well before Jacobi's "reduction of the node", carries out the first complete reduction of symetries in this problem. Discovering the so-called homographic motions (Euler had treated only the colinear case), he shows that these motions necessarily take place in a fixed plane, a result which is simple only for the

"relative equilibria". In order to understand the true nature of this reduction -- and of Lagrange's equations - it is necessary to consider the n-body problem in an euclidean space of arbitrary dimension. The actual dimension of the ambient space then appears as a constraint, namely the angular momentum bivector's degeneracy. I shall describe the results obtained in a joint paper with Alain Albouy published (in french !) in 1998. For a non homothetic homographic motion to exist, it is necessary that the motion takes place in an even dimensional space E. Two cases are possible: either the configuration is "central" (that is a critical point of the potential among configurations with a given moment of inertia) and the space E is endowed with an hermitian structure, or it is "balanced" (that is a critical point of the potential among configuration with a given inertia spectrum) and the motion is a new type, quasi-periodic, of relative equilibrium.

References:

J.L. Lagrange, Essai sur le problème des trois corps, Oeuvres volume 6, pages 229-324 (1772)

E. Betti, Sopra il moto di un sistema di un numero qualunque di punti che si attraggono o si

respingono tra di loro, Annali di Matematica s.2 t. 8, pages 301-311 (1877)

A. Wintner, The analytical foundations of Celestial Mechanics, Princeton University Press (1941)

A. Albouy & A. Chenciner, Le problème des n corps et les distances mutuelles, Inventiones mathematicae 131, pages 151-184 (1998)

A. Albouy, Mutual distances in Celestial Mechanics, Lectures at Nankai Institute, Tianjin, Chine, juin 2004

Nguyen Tien Zung (Toulouse) *"Entropy in Physics and Mathematics"*

Abstract :

In this minicourse, intended to be accessible also to undergraduate students, I'll try to explain various manifestations of the concept of entropy, including Shannon entropy in information theory (amount of information), Clausius-Boltzmann entropy in physics (laws of thermodynamics), Kolmogorov-Sinai entropy in dynamical systems (rate of information), entropy in geometry problems (e.g. isoperimetric inequalities), etc. In the last part of this minicourse I'll talk about my little results on the entropy of geometric structures, which generalizes the notion of geometric entropy of foliations introduced by Ghys--Langevin--Walczak.

The rest of the program consisted in one-hour talks. The two students who got financial support of CAST also contributed with one-hour talk.

Here is the list of speakers, titles and abstracts of the talks:

Marta Batoreo (UC Santa Cruz): **"On the Rigidity of the Maslov Index for Coisotropic Submanifolds of Rational Symplectic Manifolds"**

Abstract: A result of V. Ginzburg on the rigidity of the coisotropic Maslov index asserts that there exists a non-trivial loop (tangent to the characteristic foliation of a stable coisotropic submanifold of a symplectically aspherical manifold) with certain bounds on its Maslov index and area. This theorem also holds for some symplectic manifolds not necessarily symplectically aspherical. We shall state the theorem for the rational case and sketch its proof.

Marc Chaperon (Paris VII) **"Generalized Hopf bifurcations"**

Abstract: Following Thom's principle: "Always look for the organizing center of phenomena", I was able to prove a general "birth lemma" for families of dynamical systems at partially elliptic rest points; as noticed by Santiago Lpez de Medrano, it implies the birth of normally hyperbolic compact invariant manifolds diffeomorphic to all kinds of moment-angle manifolds in generic families; these manifolds can form a family of matrioshkas, providing for example a very simple model for the transition between two periodic regime

Alain Chenciner (Observatoire de Paris-IMCCE): **"The angular momentum of a relative equilibrium in dimensions higher than 3"** [abstract](#)

Jesus Gonzalo (Madrid), **"Flow dynamics and the existence of contact circles"**

Abstract: For flows tangent to plane fields in dimension 3 we define a twisting property, related to the Anosov property. We shall explain how this property gives a

simple geometric understanding of contact circles, which are pairs of contact structures discovered and studied by H. Geiges and the speaker. We shall mention open questions and challenges provided by this connection. For example one can use Seiberg-Witten to exhibit plane fields none of whose tangent flows satisfy the twisting property.

Basak Gurel (Vanderbilt) **"Conley conjecture for negative monotone symplectic manifolds"**

Abstract: The Conley conjecture, formulated by Conley in 1984, asserts the existence of infinitely many periodic orbits for Hamiltonian diffeomorphisms of tori and was established by Hingston in 2004. Of course, one can expect the conjecture to hold for a much broader class of closed manifolds and this is indeed the case. For instance, by now, it has been proved for all closed, symplectically aspherical manifolds and Calabi-Yau manifolds using symplectic topological methods. Most recently, jointly with Ginzburg, we establish the conjecture for negative monotone, closed symplectic manifolds.

In this talk, based on joint works with Ginzburg, we will examine the question of existence of infinitely many periodic orbits for Hamiltonian diffeomorphisms and outline a proof of the Conley conjecture in the negative monotone case.

Mark Hamilton (Mount Allison), **"Real and Kahler quantization of flag manifolds."**

Janko Latschev (Hamburg University) **"Algebraic torsion in contact manifolds"**

Abstract In this talk, I will report on recent joint work with Chris Wendl which uses the algebraic formalism of symplectic field theory to define a hierarchy of obstructions to symplectic filling of and exact symplectic cobordisms between given contact manifolds. I will also present 3-dimensional examples to show that these obstructions are non-trivial and distinct.

Do Ngoc Diep (Institute of Mathematics, VAST) **"Geometric Quantization of Fields Based on Geometric Langlands Correspondence"**

Abstract: We expose a new procedure of quantization of fields, based on the Geometric Langlands Correspondence. Starting from fields in the target space, we first reduce them to the case of fields on one-complex-variable target space, at the same time increasing the possible symmetry group G^L . Use the sigma model and momentum maps, we reduce the problem to a problem of quantization of trivial vector bundles with connection over the space dual to the Lie algebra of the symmetry group G^L . After that we quantize the vector bundles with connection over the coadjoint orbits of the symmetry group G^L . Use the electric-magnetic duality to pass to the Langlands dual Lie group G^\vee . Therefore, we have some affine Kac-Moody loop algebra of meromorphic functions with values in Lie algebra $\text{Lie}(G)$. Use the construction of Fock space representations to have representations of such affine loop algebra. And finally, we have the automorphic representations of the corresponding Langlands-dual Lie groups G^\vee .
<http://www.hindawi.com/journals/ijmms/2009/749631/>:

Ricardo Perez Marco (Paris XIII) **"Total integrability or general non-integrability in Hamiltonian Dynamics"**

Miguel Rodríguez-Olmos (Universitat Politècnica de Catalunya) **"Symmetric Hamiltonian bifurcations and isotropy"**

Abstract: We will use the bundle equations of Roberts et al for symmetric Hamiltonian systems in order to study some aspects of the stability and bifurcations of relative equilibria. It will be shown how the existence of continuous isotropy groups for the symmetry action can affect these properties with respect to the free case. Notably, we will discuss how these isotropy groups can induce bifurcations from a formally stable branch of relative equilibria. This is a joint work with J. Montaldi.

Dietmar Salamon (ETH-Zurich): ***"Uniqueness of symplectic structures."***

Sheila Sandon (Nantes) ***"On existence of translated points for contactomorphisms"***

Abstract: A point p in a contact manifold is called a translated point for a contactomorphism ϕ with respect to a fixed contact form if p and $\phi(p)$ belong to the same Reeb orbit and if the contact form is preserved at p . In my talk I will discuss the problem of existence of translated points, and its relation with the Arnold conjecture, the chord conjecture and the problem of leafwise coisotropic intersections. If I will have the time I will also explain how to use generating functions techniques to study this problem for contactomorphisms of the euclidean space, the sphere and the projective space.

Romero Solha (Univesitat Politecnica de Catalunya) ***"Foliated cohomology and geometric quantisation of integrable systems with singularities"***

Abstract: This talk shows an attempt to extend some results by Snyaticki, Guillemin and Sternberg in geometric quantisation considering regular fibrations as real polarisations to the singular setting. The real polarisations concerned here are given by integrable systems with nondegenerate singularities (in the Morse-Bott sense). And the definition of geometric quantisation used is the one suggested by Kostant; via higher cohomology groups. The case of nondegenerate singularities was obtained in dimension 2 by Hamilton and Miranda and the completely elliptic case was considered by Hamilton in any dimension. The approach is to combine previous results of Miranda and Presas on a Kunneth formula to reduce to the 2-dimensional case with an extension of the results of Rawnsley on the Kostant complex. This talk is based on joint work in progress with Eva Miranda.

Michael Usher (University of Georgia) **"Aperiodic symplectic manifolds"**

Abstract: We describe a general construction which, on a very diverse family of closed manifolds, gives rise to symplectic forms that admit autonomous Hamiltonian flows with no nontrivial periodic orbits. In particular, our family includes many of the classic examples of interesting symplectic four-manifolds with $b_+ > 1$. This contrasts with a result of Lu which, when combined with results from Taubes-Seiberg-Witten theory, shows that such symplectic forms can never exist on manifolds with $b_+ = 1$. All this suggests a number of open questions, some of which we will discuss.

Le Anh Vu (Hanoi): **" The Structure of Coadjoint Orbits (K-orbits) of a Class of Real Solvable Lie Groups"**

Abstract: The talk introduces the Kirillov's bilinear form and the symplectic structure on each K-orbit of an Lie group. We also introduce an overview of foliations formed by the family of maximal dimensional K-orbits (MD-foliations) of solvable real, simply connected Lie groups such that its K-orbits are either orbits of dimension zero or orbits with maximal dimensions (MD-groups). In addition, the talk gives analytical description or characterization Connes' C*-algebras of these foliations by KK-functors.

Le Van Hong (Praha) **"Smooth structures on stratified symplectic spaces"** [slides here](#)

Abstract. We introduce the notion of a smooth structure on a stratified symplectic space. We show that under a mild condition many properties of a symplectic manifold can be extended to a symplectic stratified space provided with a smooth Poisson structure, e.g. the existence and uniqueness of a Hamiltonian flow, the isomorphism between the Brylinski-Poisson homology and the de Rham homology, the existence of a Leftschetz decomposition on a symplectic stratified space.

Vu The Khoi, **"ON THE BURNS-EPSTEIN INVARIANTS OF SPHERICAL CR 3-MANIFOLDS"**

Abstract. Abstract: In this talk we present a method to compute the Burns- Epstein invariant of a spherical CR homology sphere, up to an integer, from its holonomy representation.

Dmitri Zaitsev (Trinity College) **"Dynamics of one-resonant biholomorphisms"**

Abstract: We construct a simple formal normal form for holomorphic diffeomorphisms in \mathbb{C}^n whose differentials have one-dimensional family of resonances in the first m eigenvalues, $m \leq n$ (but more resonances are allowed for other eigenvalues). Next, we provide invariants and give conditions for the existence of basins of attraction. Finally, we give applications and examples demonstrating the sharpness of our conditions. This is a joint work with Filippo Bracci.

Assessment of the results and impact of the event on the future direction of the field

Some of the talks were centered on classical dynamics (Chenciner, Miguel Rodríguez Olmos), others presented results in holomorphic Dynamics (Perez-Marco, Zaitsev, Vu The Khoi), some others were centered on recent developments in Symplectic and contact Topology (Gurel, Gonzalo, Batoreo, Usher, Lastshev). There were also some talks in general symplectic geometry (Salamon) and some more specific talks in geometric quantization or stratified spaces (Solha, Le Van Hong, Le Ahn Vu).

The fact that there were participants from different origins (either geographical or thematical) was a really positive experience.

There was an intense exchange of ideas of people from Symplectic Topology and people from Dynamics. The contribution of the ones who were “thematically” standing exactly on the middle (like Chaperon or Nguyen Tien Zung) was really important.

The local organization was really a key point for this success. The local organizer Do Duc Thai from the National University of Education made a remarkable effort in making this conference become a success. There were many activities envisaged for participants outside the conference site. There was the Puppets water show and the official dinner (which were offered for free to all participants). There was also a small excursion on Wednesday afternoon to the temple of Literature and a excursion on the weekend to Halong Bay. All this “outdoors” activities also contributed to the exchange of ideas among participants.

Also the fact that the two Ph.D students who were financed by the European Science foundation were making talks in this conference was really a positive idea because other international experts became interested in their work at this early stage of their career: Marta Batoreo is doing her Ph.D thesis on symplectic topology problems (under supervision of Viktor Ginzburg) and Romero Solha in geometric quantization and integrable systems (under supervision of Eva Miranda). The input of senior participants, in form of questions and additional comments after their talk was really a positive outcome of this conference.

The global assessment of this conference is so positive that we did even envisage the organization of a future conference like this one relating dynamical systems and Symplectic Topology.

Another positive outcome of this conference is that there will be a special issue of Acta Mathematica Vietnamica (<http://www.math.ac.vn/publications/acta/>) that will publish the proceedings of this conference.

The special editors of this journal will be:

Viktor Ginzburg
 Do Duc Thai
 Eva Miranda
 Nguyen Tien Zung.

All participants of the conference have been invited to contribute, either via Survey papers or original research papers.

All papers will be peer reviewed and the Deadline for submissions of contributions is December 30, 2011.

The idea of publishing this special issue is to foster international cooperation between Vietnam and the international community in this subject. Also to reinforce the impact factor of the journal Acta Mathematica Vietnamica.

There were also other starting points of cooperation between some speakers of the European Union (like Dimitry Zaisev) and Vietnamese students. The main local organizer Do Duc Thai has also started to establish contact with some Universities (Universitat Politècnica de Catalunya, Université de Paris XIII) to intensify the cooperation in this subject at the level of Ph.D studies and master courses.

Final programme of the meeting

This was the schedule of the conference:

Schedule:

Time	Monday	Tuesday	Wednesday	Thursday	Friday	Weekend-HalongBay
9:30-11	(Opening) Chenciner	Zung	Chenciner	Zung	Chenciner (1-hour talk)	EXCURSION TO HALONG BAY
Break						
11:30-12:30	Salamon	Gonzalo	Perez-Marco	Gurel	Zaitsev	
LUNCH						
14:00-15:00	Vu The Khoi	Latshev	FREE AFTERNOON	Hamilton	Rodriguez-Olmos	
15:00-16:00	Usher	Le Anh Vu		Le Van Hong	Solha	
Break						
16:30-17:30	Do Ngo Diep	Sandon		Batoreo	(Closing) Chaperon	

Colour's code: In orange: Minicourses (1 hour 30 minutes)
 In Turquoise-blue: 1-hour talks

Note: There will be a Banquet of Thursday's night.
On Friday talks will start at 10.00 am.

The titles and abstracts of the talks were included in the section [Description of the scientific content of and discussion at the event.](#)

Please ensure that the fields indicated in red are completed for each participant.

* Participant/Speaker/Convenor

** Dr/Professor/Mr/Mrs etc.

Status*	Title**	Firstname	Surname	Nationality	Date of Birth	Gender	Department	Institute	University	Organisation	Address	Postal Code	Town	Country	Telephone	Email	Web
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