

# Scientific Programm

## SCHEDULE

	Monday	Tuesday	Wednesday	Thursday
9h00-9h30	Wellcome & registration	<a href="#">A. Roncoroni</a>	<a href="#">B. Devyver</a>	
9h30-10h30	<a href="#">A. Malchioldi</a>	<a href="#">A. Mondino</a>	<a href="#">K.-T. Sturm</a>	<a href="#">A. El Sahili</a>
10h30-11h00	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11h00-12h00	<a href="#">M. Simon</a>	<a href="#">A. Deruelle</a>	<a href="#">N. Nadirashvili</a>	<a href="#">F. Luo</a>
12h00-14h00	<i>lunch</i>	<i>lunch</i>	<i>lunch</i>	<i>lunch</i>
14h00-15H00	<a href="#">F. Schulze</a>	<a href="#">H. Auvray</a>		<a href="#">M. van den Berg</a>
15h00-15h30	<a href="#">A. Wehbe</a>	<a href="#">B. Premoselli</a>		<a href="#">A. Suleymanova</a>
15h30-16h00	Coffee Break	Coffee Break		Coffee Break
16h00-17h00	<a href="#">G. Pipoli</a>	<a href="#">V. Guedj</a>		<a href="#">H. Matthiessen</a>

	Friday
9h00-10h00	<a href="#">B. Colbois</a>
10h00-10h20	Coffee Break
10h20-11h20	<a href="#">R. Petrides</a>
12h00-13h00	<i>lunch</i>

### Social Events

- Sunday evening: Buffet at the Gulf stream' s Hotel
- Exursion to the Batz's island: Wednesday afternoon
- Conference dinner: Wednesday night

### ABSTRACTS

#### Monday

- **Andrea Malchioldi, Pisa:** ◀

*On the Sobolev quotient in CR geometry*

**Abstract:** We consider a class of three-dimensional CR manifolds which are modelled on the Heisenberg group. We prove positivity of the mass under the condition that the Webster curvature is positive

and that the manifold is embeddable. We apply this result to the CR Yamabe problem, and we discuss the properties of Sobolev-type quotients, giving some counterexamples for Rossi spheres. This is joint work with J.H.Cheng and P.Yang.

- **Miles Simon, Magdeburg:** ◀

*Integral estimates for Ricci flow in four dimensions*

**Abstract:** We prove some integral estimates for Ricci flows on compact manifolds in four dimensions which hold for any solution. We explain some consequences of these estimates if one further assumes that the scalar curvature is bounded up to the singular time.

- **Felix Schulze, London:** ◀

*Optimal isoperimetric inequalities for surfaces in Hadamard-Cartan manifolds via mean curvature flow*

**Abstract:** Let  $(M^n, g)$  be simply connected, complete, with non-positive sectional curvatures, and  $\Sigma$  an orientable, closed 2-dimensional surface in  $M^n$ . Let  $S$  be an area minimising 3-current such that  $\partial S = \Sigma$ . We use a weak mean curvature flow, obtained via an elliptic regularization scheme, starting from  $\Sigma$  to show that  $S$  satisfies the optimal Euclidean isoperimetric inequality:

$$|S| \leq 1/(6\sqrt{\pi})|\Sigma|^{3/2}.$$

The proof follows from an almost monotonicity of a suitable isoperimetric difference along the approximating flows in one dimension higher.

- **Ali Wehbe, Beyrouth:** ◀

*Stabilization of coupled wave equations under geometric conditions*

**Abstract:** The purpose of this note is to investigate the stabilization of system of two wave equations coupled by velocities with only one localized damping. We expand the results obtained by Alabau et al. (ESAIM 2017) in the case that the damping term is linear, the main novelty of this paper is that the waves are not assumed to be propagate with equal speeds and the coupling coefficient is not assumed to be positive and small. We distinguish two situations. The first one is when the waves propagate at the same speed. In this case, under geometric conditions on the coupling and the damping regions, we establish an exponential energy decay estimate for usual initial data. On the contrary, we first show that our system is not uniformly stable. Next, under the same geometric conditions, we establish a polynomial energy decay in 1 for smooth initial t data. Finally, in one space dimension, using the real part of the asymptotic expansion of eigenvalues of the system, we prove that the obtained polynomial decay estimate is optimal.

- **Giuseppe Pipoli, Grenoble:** ◀

*Inverse mean curvature flow in complex hyperbolic space*

**Abstract:** We consider the evolution by inverse mean curvature flow of a closed, mean convex and star-shaped hypersurface in the complex hyperbolic space. We prove that the flow is defined for any positive time, the evolving hypersurface stays star-shaped and mean convex. Moreover the induced metric converges, after rescaling, to a conformal multiple of the standard sub-Riemannian metric on the sphere. Finally we show that there exists a family of examples such that the Webster curvature of this sub-Riemannian limit is not constant.

Tuesday

- **Alberto Roncoroni, Pavia:** ◀

*A Serrin-Weinberger Symmetry result on model manifolds*

**Abstract:** The starting point is the classical "Serrin symmetry result" for the overdetermined boundary value problem related to the equation  $\Delta u = 1$ . The original technique used by Serrin to prove this result is the so-called "moving planes method" which is a refinement of the famous "reflection principle" invented by Alexandrov. In this talk, I focus on the more analytic approach by Weinberger which is based on integration by parts, the Bochner formula and the Cauchy-Schwarz inequality; in particular, I extend this argument to prove a Euclidean symmetry result for model manifolds of non-negative Ricci curvature with a suitable assumption between the solution and the geometry of the model.

- **Andrea Mondino, Warwick:** ◀

*Some smooth applications of non-smooth Ricci curvature lower bounds*

**Abstract:** After a brief introduction to the synthetic notions of Ricci curvature lower bounds in terms of optimal transportation, due to Lott-Sturm-Villani, I will discuss some applications to smooth Riemannian manifolds. These include: rigidity and stability of Levy-Gromov inequality, an almost euclidean isoperimetric inequality motivated by the celebrated Perelman's Pseudo-Locality Theorem for Ricci flow, and some geometric properties of quotients of smooth manifolds having Ricci curvature bounded below.

- **Alix Deruelle, Paris 6:** ◀

*Expanders of the harmonic map flow*

**Abstract:** This is a joint work with Tobias Lamm. Expanding self-similarities of a given evolution equation create an ambiguity in the continuation of the flow after it reached a first singularity. In this talk, we investigate the possibility of smoothing out any map from the  $n$ -sphere,  $n > 1$ , to any closed Riemannian manifold, that is homotopic

to a constant by a self-similarity of the harmonic map flow. To do so, in the spirit of Chen-Struwe, we introduce a one-parameter family of Ginzburg-Landau equations that exhibit the same homogeneity and once the existence of expanders for this family is granted, we pass to the limit. We also study the singular set of such solutions as well as the uniqueness issue.

- **Hugues Auvray, Orsay:** ◀

*Bergman kernels on punctured Riemann surfaces*

**Abstract:** In a joint work with X. Ma (Paris 7) and G. Marinescu (Cologne), we obtain refined asymptotics for Bergman kernels computed from singular data on Riemann surfaces. More precisely, we work on the complement of a finite set of points, seen as singularities, on a compact Riemann surface, that we endow with a metric extending Poincaré's cusp metric around the singularities. As for the polarization line bundle, it comes equipped with a positively curved Hermitian metric, whose curvature is the base metric near the singularities. I shall thus explain how an advanced description of the model geometry (given by Poincaré's metric on the punctured unit disc), and localization techniques in the spirit of Bismut-Lebeau in a weighted analysis context, allow us to describe the Bergman kernels attached to these punctured Riemann surfaces, up to their singularities. If time allows, I shall also mention an arithmetic interpretation of these results, in terms of modular forms.

- **Bruno Premoselli, Bruxelles:** ◀

*TBA*

**Abstract:**

- **Vincent Guedj, Toulouse:** ◀

*Geometry and topology of the space of Kähler metrics on singular varieties*

**Abstract:** Let  $Y$  be a compact Kähler normal space. We study metric properties of the space of Kähler metrics in a fixed Kähler class using Mabuchi geodesics. We extend several results by Calabi, Chen, Darvas and Tian previously established when the underlying space is smooth. As an application we analytically characterize the existence of Kähler-Einstein metrics on  $\mathbb{Q}$ -Fano varieties. This is a joint work with E. Di Nezza.

Wednesday

- **Baptiste Devyver, Haifa:** ◀

*Index of free boundary minimal surfaces in  $\mathbb{B}^3$*

**Abstract:** We consider free boundary minimal surfaces in the unit ball  $\mathbb{B}^3$  of  $\mathbb{R}^3$ . Recent works by A. Fraser and R. Schoen have triggered

a renewed interest in these; one of their main results is that for any integer  $k \geq 1$ , there exists a free boundary minimal surface in  $\mathbb{B}^3$  of genus 0, with  $k$  boundary components. For  $k = 2$ , the surface in question is particularly simple, being a piece of (rescaled) catenoid called the *critical catenoid*. We will present a result stating that the critical catenoid has minimal Morse index among all non-flat free boundary minimal surfaces in  $\mathbb{B}^3$ , and, if time allows, state some related open problems. Parts of this work have been obtained in collaboration with A. Fraser.

- **Karl-Theodor Sturm, Bonn:** ◀

*Synthetic upper Ricci bounds and rigidity of metric cones.*

- **Nikolai Nadirashvili, Marseille:** ◀

*Isoperimetric inequalities for spectrum of Laplacian on surfaces*

**Abstract:** We discuss isoperimetric inequalities for higher eigenvalues of the Laplace-Beltrami operator on surfaces.

Thursday

- **Amine El Sahili, Beyrouth:** ◀

*Les mathématiques discrètes au Liban*

**Abstract:** Les mathématiques discrètes au Liban ont été toujours des sous titres intrinsèques dans tout ce qui est mathématiques finies ou informatique théorique. En 2005 un premier cours en théorie des graphes (considérée comme titre prépondérant dans les mathématiques discrètes moderne) a été indépendamment inséré dans le cursus universitaire à l'Université Libanaise, déclenchant une activité d'enseignement et de recherche en croissance continue depuis lors. Nous présentons dans cet exposé ce parcours scientifique, les résultats et la situation acquise après dix ans de travail, et nous soulignons en particulier notre projet de recherche qui a fait le lien entre les mathématiques discrètes de l'Université Libanaise et la géométrie de l'université de Brest.

- **Feng Luo, Rutgers:** ◀

*Discrete conformal geometry of polyhedral surfaces*

**Abstract:** We discuss some of the recent work on discrete conformal geometry of polyhedral surfaces. The relationship among discrete conformal geometry, the work of Thurston and Alexandrov on convex surfaces in hyperbolic 3-space, and the Koebe circle domain conjecture will be addressed. We also show that the discrete uniformization maps converge to the conformal maps. This is a joint work with D. Gu, J. Sun, and T. Wu.

- **Michiel van den Berg, Bristol:** ◀

*Spectral bounds for the torsion function and torsional rigidity*

**Abstract:** Let  $\Omega$  be an open set in  $\mathbb{R}^m$  with finite measure  $|\Omega|$ , and let  $v_\Omega$  be the torsion function for  $\Omega$ : the solution of  $-\Delta v = 1$ ,  $v \in H_0^1(\Omega)$ . Let  $\lambda(\Omega)$  denote the bottom of the spectrum of the Dirichlet Laplacian acting in  $L^2(\Omega)$ . It is shown that the bound  $\|v_\Omega\|_{L^\infty(\Omega)}\lambda(\Omega) \geq 1$  is sharp: for any  $\epsilon > 0$  we construct an open, bounded and connected set  $\Omega_\epsilon \subset \mathbb{R}^m$  such that  $\|v_{\Omega_\epsilon}\|_{L^\infty(\Omega_\epsilon)}\lambda(\Omega_\epsilon) < 1 + \epsilon$ . It is shown that an upper bound for the torsional rigidity in terms of  $|\Omega|$  and  $\lambda(\Omega)$ , going back to Pólya and Szegő, is sharp (joint work with V. Ferone, C. Nitsch, C. Trombetti). I will also discuss some open problems.

- **Asilya Suleymanova, Bonn:** ◀

*On spectral geometry of manifolds with conic singularities.*

**Abstract:** In this talk we consider the heat kernel of the Laplace-Beltrami operator on a Riemannian manifold. On any closed smooth Riemannian manifold the heat trace expansion gives some geometrical information such as dimension, volume and total scalar curvature of the manifold. On a manifold with conic singularities we derive a detailed asymptotic expansion of the heat trace using the Singular Asymptotics Lemma of Jochen Brüning and Robert T. Seeley. Then we investigate how the terms in the expansion reflect the geometry of the manifold. Can one hear a singularity?

- **Henrik Matthiessen, Bonn:** ◀

*Existence of metrics maximizing the first eigenvalue on closed surfaces*

**Abstract:** We show that on each closed surface of fixed topological type, orientable or non-orientable, there is a metric, smooth away from finitely many conical singularities, that maximizes the first eigenvalue among all unit area metrics. The key new ingredients are several monotonicity results relating the corresponding maximal eigenvalues. This is joint work with Anna Siffert.

Friday

- **Bruno Colbois, Neuchatel:** ◀

*Lower bounds for the spectrum of the magnetic Laplacian.*

**Abstract:** I will discuss lower bounds for the first eigenvalue of the magnetic Laplacian of Euclidean planar domains with Neumann boundary conditions.

- **Romain Petrides, Paris 7:** ◀

*Min-Max construction for free boundary minimal disks.*

**Abstract:** We will discuss existence of minimal disks into a Riemannian manifold having a boundary lying on a specified embedded submanifold and that meet the submanifold orthogonally along the boundary. A general existence result has been obtained by A. Fraser. Her construction was inspired by Sacks-Uhlenbeck construction of minimal 2-spheres: the existence is obtained by a limit procedure for a perturbed energy functional whose critical points are called  $\alpha$ -harmonic maps. We will explain how it is possible to adapt ideas of Colding-Minicozzi. These ideas go back to the replacement method of Birkhoff for the existence of geodesics. This approach gives general energy identities that include bubbles. This is a joint work with P. Laurain.