• From Copacabana:
You can use the bus line 125 (Jardim Botânico) from Avenida Princesa Isabel or Rua Barata Ribeiro and get off at the final stop. You should then walk uphill to Estrada Dona Castorina; IMPA is on the right hand side.

Since the 125 bus is somewhat infrequent, it is usually faster to follow a different route. Take the 572 or 584 bus and get off on Rua Jardim Botânico at the stop near ABBR and the “Pão de Açúcar” supermarket. Then, walk to Rua Lopes Quintas (which crosses Rua Jardim Botânico), go to the bus stop near the newsstand, take a 409 or 125 bus and get off at the final stop. From then on, follow the instructions at the end of the previous paragraph.

• From Ipanema and Leblon
You can use the bus line 125 (to Jardim Botânico) from Rua Prudente de Moraes (Ipanema), Avenida General San Martin (Leblon), or Avenida Bartolomeu Mitre (Leblon) and get off at the final stop. You should then walk uphill to Estrada Dona Castorina; IMPA is on the right hand side.

Since the 125 bus is somewhat infrequent, it is usually faster to follow a different route. Take the 572, 512 or 584 bus and get off on Rua Jardim Botânico at the stop near ABBR and the “Pão de Açúcar” supermarket. Then, walk to Rua Lopes Quintas (which crosses Rua Jardim Botânico), go to the bus stop near the newsstand, take a 409 or 125 bus and get off at the final stop. From then on, follow the instructions at the end of the previous paragraph.

• From Flamengo, Botafogo and Humaitá
You can use the bus line 409 (Sans Pena – Horto) from Praia do Flamengo (Flamengo Beach), Praia de Botafogo (Botafogo Beach) or Rua Humaitá, and get off at the final stop. Then walk uphill to Estrada Dona Castorina; IMPA is on theright hand side.

Welcome to the

International Symposium on Differential Geometry

In honor of Marcos Dajczer on his 60th birthday

IMPA, Rio de Janeiro, August 17 – 21, 2009

The symposium, promoted by IMPA and the Millennium Institute, will be held at IMPA, Rio de Janeiro, during the week August 17-21, 2009. All lectures will be delivered by speakers invited by the Scientific Committee. Some areas in Differential Geometry focused by the conference will be Lie groups and algebras and their representations, minimal and CMC surfaces, geodesic flows, isometric and conformal immersions, symmetric spaces, compact manifolds with positive sectional curvature and Morse theory.

The conference has been approved for grants from several Brazilian agencies and the National Science Foundation.

Organizing Committee

Fernando Coda, IMPA
Guillermo A. Lobos, UFSCar
Luis Florit , IMPA
Walcy Santos, UFRJ

Scientific Committee

Blaine Lawson, SUNYSB
Gudlaugur Thorbergsson, Uni-Koeln
Jeff Cheeger, CIMS-NYU
Luis Florit, IMPA
Manfredo P. do Carmo, IMPA
Paolo Piccione, USP
Ruy Tojeiro, UFSCar
Wolfgang Ziller, UPENN

Speakers

L. Alías
F. Codá
T. Colding
E. Garcia-Rio
M. Ghomi
C. Gorodski
J. Lauret
J. Lira
B. Meeks
C. Olmos
G. Paternain
P. Piccione
H. Rosenberg
L. San Martin
N. Sesum
R. Tojeiro
B. Wilking
J. Wolf
W. Ziller

Social Activities

Monday 17 - 05:15 PM
Opening ceremony and Cocktail

Thursday 20 – 08:00 PM
Dinner

Information

1. Registration Fee

Foreign and Brazilian Participants	R$ 150.00
Foreign and Brazilian Students	R$ 50.00

2. Contact

Estrada Dona Castorina, 110 - Jardim Botânico
22460-320 Rio de Janeiro, RJ
Tel: (21) 2529-5008/ 2529-5018 e 2529-5277
Fax: (21) 2529-5019
E-mail: isdg2009@gmail.com

WELCOME TO IMPA!

1) Computational Facilities:

The participants can use the computers on the Hall of the 2nd floor

- The login is impa2009
- The password is castorina110

We also have wireless (WIFI) connection. The ESSID of the network is *impa-wl* and the password is *impacastorina*.

2) Location of IMPA:

IMPA is located near the Botanical Garden in the city of Rio de Janeiro, Brazil.
The address is:
Estrada Dona Castorina, 110 – CEP: 22460-320 Rio de Janeiro, RJ – Brasil.

However, many cab drivers may need the following instructions which we reproduce in Portuguese:

HORTO, POR FAVOR: Vou para o IMPA na
ESTRADA DONA CASTORINA, 110
NO FINAL da rua PACHECO LEÃO à DIREITA DEPOIS do PONTO
FINAL da LINHA DE ONIBUS 409.

3) Public Transportation:

How to get to IMPA:

The easiest and most cost effective (timewise) way to get to IMPA is by cab as described above. However, if you prefer to use public transportation see the next paragraph.

Posters

Ari J. Aiol and **Carmen V. Mathias**
Title: Parabolic graphs of CMC in H^3 with boundary data satisfying the bounded slope condition

Alma L. Albujer - Alicante – Spain, and **Luis J. Alías** - Murcia - Spain
Title: Global and local geometry of maximal surfaces in Lorentzian product spaces

Antonio Carlos Asperti - USP
Title: Alguns resultados recentes sobre hipersuperfícies mínimas em uma forma espacial de dimensão quatro

Rosa Maria dos Santos Barreiro Chaves - USP
Title: O Problema de Björling para superfícies de tipo tempo no espaço de Lorentz-Minkowski

Lino Grama - Unicamp
Title: Equigeodesics on flag manifolds

Guillermo A. Lobos – UFSCar, **Márcio F. Da Silva** – UFABC, and **V. Ramos Batista** - UFABC
Title: Minimal Surfaces with only Horizontal Symmetries

Guillermo Lobos Villagra - UFSCar e **Maxwell Mariano**
Title: Subvariedades pseudo-paralelas anti-invariantes de contacto normal em variedades de Kenmotsu"

Alexandre Lymberopoulos - ESEG
Title: A Classification of ruled and Weingarten hypersurfaces in spcae forms

Fernando Manfio - USP
Title: Rigidity isometric of surfaces in 3-dimensional homogeneous Lorentzian manifolds

Pedro Morais - Universidade da Beira Interior – Portugal
Title: Isometric rigidity in codimension two

Frank Morgan - Williams College
Title: Manifolds with Density and Perelman's Proof of Poincaré

Alcibiades Rigas - Unicamp
Title: Suspension of Cartan inclusions with $K > 0$

Program at a glance

Hour	Monday 17	Tuesday 18	Wednesday 19	Thursday 20	Friday 21
8:30 - 9:30	Registration				
9:30 - 10:30	T. Colding	L. Alias	W. Ziller	L. San Martin	E. Garcia-Rio
10:30 -11:00	Coffee	Coffee	Coffee	Coffee	Coffee
11:00 - 12:00	C. Gorodski	M. Ghomi	J. Lauret 10:45 - 11:45	B. Meeks	J. Lira
12:00 - 14:30	Lunch	Lunch	N. Sesum 11:45 - 12:45	Lunch	Lunch
14:30 - 15:30	R. Tojeiro	C. Olmos	Free	P. Piccione	J. Wolf
15:30 - 16:00	Coffee	Coffee		Coffee	Coffee
16:00 - 17:00	G. Paternain	H. Rosenberg		F. Coda	B. Wilking
	Opening ceremony Cocktail			Dinner (Tba)	

Abstracts

L. Alías - Universidad de Murcia

Geometric Applications of the Generalized Omori-Yau Maximum Principle

Following the terminology introduced by Pigola, Rigoli and Setti in [5], the Omori-Yau maximum principle is said to hold on an n-dimensional Riemannian manifold Σ if, for any smooth function $u \in \mathcal{C}^\infty(\Sigma)$ with $u^* = \sup_\Sigma u < +\infty$ there exists a sequence of points $\{p_k\}_{k\in\mathbb{N}}$ in Σ with the properties: (i) $u(p_k) > u^* - \frac{1}{k}$, (ii) $|\nabla u(p_k)| < \frac{1}{k}$, and (iii) $\Delta u(p_k) < \frac{1}{k}$. In this sense, the classical result given by Omori [4] and Yau [6] states that the Omori-Yau maximum principle holds on every complete Riemannian manifold with Ricci curvature bounded from below. More generally, as shown by Pigola, Rigoli and Setti [5], a sufficiently controlled decay of the radial Ricci curvature of the form $\mathrm{Ric}_\Sigma(\nabla\varrho, \nabla\varrho) \geq -C^2 G(\varrho)$, where ϱ is the distance function on Σ to a fixed point, C is a positive constant, and $G : [0, +\infty) \to \mathbb{R}$ is a smooth function satisfying (i) $G(0) > 0$, (ii) $G'(t) \geq 0$, (iii) $\int_0^{+\infty} 1/\sqrt{G(t)} = +\infty$, and (iv) $\limsup_{t\to+\infty} tG(\sqrt{t})/G(t) < +\infty$, suffices to imply the validity of the Omori-Yau maximum principle. On the other hand, as observed also in [5], the validity of the Omori-Yau maximum principle on Σ does not depend on curvature bounds as much as one would expect. For instance, the Omori-Yau maximum principle holds on every Riemannian manifold admitting a non-negative C^2 function φ satisfying the following requirements: (i) $\varphi(p) \to +\infty$ as $p \to \infty$; (ii) there exists $A > 0$ such that $|\nabla\varphi| \leq A\sqrt{\varphi}$ off a compact set; and (iii) there exists $B > 0$ such that $\Delta\varphi \leq B\sqrt{\varphi}\sqrt{G(\sqrt{\varphi})}$ off a compact set, where G is as above.

In this lecture we will introduce some geometric applications of the generalized Omori-Yau maximum principle to the study of hypersurfaces with constant mean curvature both in Riemannian and Lorentzian ambient spaces. The results in this lecture are part of our recent research work developed jointly with Bessa and Dajczer [1], Hurtado and Palmer [3] and García-Martínez [2].

References

[1] L.J. Alías, G.P. Bessa and M. Dajczer, *The mean curvature of cylindrically bounded submanifolds*, to appear in Math. Ann.

[2] L.J. Alías and S.C. García-Martínez, *On the scalar curvature of constant mean curvature hypersurfaces in space forms*, preprint 2009.

[3] L.J. Alías, A. Hurtado and V. Palmer, *Geometric analysis of Lorentzian distance function on spacelike hypersurfaces* to appear in Trans. Amer. Math. Soc.

[4] H. Omori, *Isometric immersions of Riemannian manifolds*, J. Math. Soc. Japan, **19** (1967), 205-214.

[5] S. Pigola, M. Rigoli and A.G. Setti, *Maximum principles on Riemannian manifolds and applications*, Memoirs Amer. Math. Soc. **822** (2005).

[6] S.T. Yau, *Harmonic function on complete Riemannian manifolds*, Commun. Pure Appl. Math., **28** (1975), 201-228.

the Kaehler case. I will also indicate that a similar approach gives Harnack inequalities including Brendle's generalization of Hamilton's Harnack inequality to nonnegative complex curvature.

The second part of the talk will be a report of joint work with Christoph Böhm. We study manifolds satisfying $\scal\ge \sqrt{2(n-1)(n-2)} \|R_W\|$, where R_W denotes the Weyl curvature. We will show that the condition is invariant in dimensions above 12 and classify the corresponding compact Ricci solitons. The condition is invariant under surgery of codimension > $n/2+1$.

J. Wolf - University of California at Berkeley

The Geometry of Complex Manifolds Related to Group Representation Theory

Resumo/Abstract:

Complex manifolds and CR manifolds can be used to construct representations of real semisimple Lie groups. Analysis of their compact subvarieties leads to the spectrum along maximal compact subgroups and has promise of saying something about analytic continuation of discrete series and other series. I'll describe the underlying geometry and indicate how it provides the setting for this representation theory.

W. Ziller - University of Pennsylvania

Manifolds with Positive Sectional Curvature

Resumo/Abstract:

Manifolds with positive sectional curvature have been studied intensely since the beginning of global Riemannian geometry. But examples are still rather limited. We will discuss some recent developments giving rise to new examples.

R. Tojeiro - Universidade Federal de São Carlos

Genuine deformations of submanifolds

Resumo/Abstract:

The isometric (conformal) deformation problem for a given Euclidean submanifold $f\colon M^n \to \mathbb{R}^{n+p}$ with dimension n and codimension p and a given positive integer q is to describe all possible isometric (conformal) deformations $\hat{f}\colon M^n \to \mathbb{R}^{n+q}$ of f, that is, all immersions $\hat{f}\colon M^n \to \mathbb{R}^{n+q}$ whose induced metric coincides with (is conformal to) that induced by f. A satisfactory answer to the local version of the problem in both isometric and conformal settings is known only in the case $p = 1 = q$, and goes back almost a century to the works of Sbrana and Cartan.

In higher codimensions, the problem becomes much harder. A basic observation is that a submanifold of a (conformally or isometrically) deformable one has also that property. This has led M. Dajczer and L. Florit to introduce the notion of a *genuine* isometric deformation of a submanifold. That an isometric deformation is genuine means that the submanifold can not be included into a submanifold of higher dimension in such a way that the deformation of the former is induced by a deformation of the latter. They proved that an Euclidean submanifold together with a genuine deformation of it in low (but not necessarily equal) codimensions must be mutually ruled, and they obtained a sharp estimate for the dimension of the rulings.

Our aim in this talk is threefold. First, to give an overview of the topic, in which M. Dajczer has played a leadership role over the last decades. Then, to discuss in more detail the concept of genuine isometric deformations of submanifolds and the aforementioned results by M. Dajczer and L. Florit. Finally, to report on recent work with L. Florit, in which we extend the notion of a genuine deformation of a submanifold to the conformal setting, and describe the geometric structure of a submanifold together with a genuine conformal deformation of it. We explain the unifying character of that result by showing how it implies some knew and old conformal rigidity theorems.

B. Wilking - University of Munster

Sharp Estimates for the Ricci Flow

Resumo/Abstract:

I will show that each orbit of the adjoint representation of the complex group $SO(n,C)$ gives rise to a Ricci flow invariant curvature condition. The proof is very simple, short and conceptional and the obtained conditions include all previously known invariant nonnegativity conditions, e.g, nonnegative isotropic curvature, nonnegative complex curvature, two nonnegative curvature operator... There an analogue for

F. Codá - Instituto de Matemática Pura e Aplicada

Deforming Three-manifolds with Positive Scalar Curvature

Resumo/Abstract:

We have recently been able to prove that the moduli space of metrics with positive scalar curvature of an orientable compact 3-manifold is path-connected. The proof uses the Ricci flow with surgery, the conformal method, and the connected sum construction of Gromov and Lawson. The work of Perelman on Hamilton's Ricci flow is fundamental. In this talk we will explain the proof of this result and give some applications to General Relativity.

T. Colding - New York University

Singularities of mean curvature flow

Resumo/Abstract:

In this talk we will discuss generic singularities of mean curvature flow. Specifically, generic singularities will be classified in all dimensions, compactness results of general singularities in Euclidean three-space will be proven, and the notion of a mean curvature flow starting at a generic surface discussed.

E. Garcia-Rio – Universidade de Santiago de Compostela

Osserman manifolds

Resumo/Abstract:

A pseudo-Riemannian manifold (M,g) is said to be Osserman if the(possibly complex) eigenvalues of the Jacobi operators are constant on the unit pseudo-sphere bundles $S^\pm (M)$. Any isotropic pseudo-Riemannian manifold is Osserman but the converse is not true. The purpose of this lecture is to present an overview on the topic with some recent contributions resulting in a complete description of four-dimensional Osserman metrics. The higher dimensional situation presents additional difficulties to be pointed out during the lecture.

M. Ghomi - Georgia Institute of Technology

Four-vertex theorems in Riemannian surfaces

Resumo/Abstract:

One of the earliest results in global differential geometry is atheorem of Kneser which states that any simple closed curve in the plane has (at least) four vertices, i.e., local extrema of geodesic curvature. In this talk we discuss analogues of this result in other Riemannian surfaces. In particular we show that any metric of constant curvature on a compact surface with boundary induces four vertices on the boundary if and only if the surface is a topological disk. Furthermore we show that the simply connected space forms are the only complete Riemannian surfaces in which every simple closed curve has four vertices.

C. Gorodski - Universidade de São Paulo

Homogeneous isoparametric submanifolds of type An in Hilbert spaces

Resumo/Abstract:

In finite dimensions, a submanifold of Euclidean space is called *isoparametric* if: (a) its normal bundle is flat; and (b) the shape operators along any parallel normal vector field are conjugate. It follows from theorems of Dadok and Palais-Terng that every homogeneous isoparametric submanifold of Euclidean space is a principal orbit of the isotropy representation of a symmetric space.

In infinite dimensions, one works in the category of proper Fredholm submanifolds in Hilbert space and defines such a submanifold to be isoparametric if it satisfies conditions (a) and (b) above. Terng has constructed very interesting examples of homogeneous isoparametric submanifolds in Hilbert space, principal orbits of the so called $P(G,H)$-actions, which are essentially isotropy representations of affine Kac-Moody symmetric spaces.

In this talk, we will explain our proof that every every homogeneous isoparametric submanifold of type $\tilde{A}_n$ in a Hilbert space is a principal orbits of a $P(G,H)$-action.

Joint work with Ernst Heintze (Augsburg).

H. Rosenberg - Paris VII / IMPA

The geometry of surfaces in 3-dimensional homogeneous spaces

Resumo/Abstract:

I will discuss surfaces in the 3-dimensional homogeneous spaces SxR, HxR, Berger spheres, Heisenberg space, PSL(2,R)-tilda, and Sol(3). Here, S and H are the sphere and hyperbolic plane of curvature one and minus one respectively. I describe some examples and theorems depending on the mean, intrinsic or extrinsic curvature of the surface.

L. San Martin - UNICAMP – IMECC

Invariant almost Hermitian structures on flag manifolds

Resumo/Abstract:

Let G be a complex semi-simple Lie group and form its maximal flag manifold F = G/P = U/T where P is a minimal parabolic (Borel) subgroup, U a compact real form and T a maximal torus of U. We describe U-invariant almost Hermitian structures on F with emphasis on the (1,2)-symplectic structures (also called quasi-Kähler). These structures are naturally related to the affine Weyl groups and to their alcoves. A special form for them, involving abelian ideals of a Borel subalgebra, is derived.

N. Sesum - University of Pennsylvania

On complete gradient shrinking Ricci solitons

Resumo/Abstract:

In this joint work with Ovidiu Munteanu, we prove some integral estimates for complete gradient shrinking Ricci solitons and use them to give a classification of those in a locally conformally flat case. We also show that in the Kähler case all harmonic functions on such solitons have to be constants which implies some things about the structure of a manifold.

G. Paternain - University of Cambridge

On the stability condition in Symplectic Topology

Resumo/Abstract:

A 2-form ω on an odd-dimensional manifold is called a Hamiltonian structure if it is closed and maximally non-degenerate (i.e. has a 1-dimensional kernel). The Hamiltonian structure is said to be stable if there is an additional 1-form λ such that any non-zero vector v in the kernel of ω annihilates $d\lambda$ but $\lambda(v) \neq 0$. If $d\lambda = \omega$ we have a contact structure. The stability condition plays an crucial role in the compactness results in Symplectic field theory and Rabinowitz Floer homology and it is important to know if the stability condition persists under small perturbations. In this lecture I will try to explain an example showing that this is not the case. The manifold in question is the sphere bundle of a closed hyperbolic 3-manifold and the Hamiltonian structure comes from the special additional invariant 2-form that the geodesic flow possesses. The proof of non-openess relies on a suitable use of the so-called Kanai connection and has a strong differential-geometric flavour. This is joint work with Kai Cieliebak and Urs Frauenfelder.

P. Piccione - USP Instituto de Matemática e Estatística

Bifurcation of Constant Mean Curvature Tori in Euclidean Spheres

Resumo/Abstract:

We use equivariant bifurcation theory to show the existence of infinite sequences isometric embeddings of tori with constant mean curvature in Euclidean spheres that are not isometrically congruent to the CMC Clifford tori, and accumulating at some CMC Clifford torus. (Joint work with L. Alias)

J. Lauret - Universidad Nacional de Córdoba

Homogeneous Ricci flows and Solitons

Resumo/Abstract:

In the spirit of the DeTurck's trick, we shall describe an ODE for a curve of Lie brackets which is equivalent in a natural and specific sense to the Ricci flow starting at any homogeneous Riemannian manifold, but which has proved to be much more friendly, at least in some particular cases (as, for instance, nilmanifolds). Indeed, it is easy to prove from this perspective (already considered by Guzhvina and Payne) that for any simply connected nilmanifold all the solutions to the Ricci flow are type-III, and even with a constant which only depends on the dimension. Certain convergence results have also been obtained for nilmanifolds by using this approach.

Concerning Ricci solitons, we will define algebraic solitons on homogeneous spaces by generalizing the concept of nilsoliton and give an idea of the proof of the following: any example of an algebraic soliton which is not a solvmanifold would give rise to a counterexample to the long standing Alekseevskii's conjecture on Einstein homogeneous manifolds of negative scalar curvature.

J. Lira - Universidade Federal do Ceará

Conformal Killing graphs with prescribed mean curvature

Resumo/Abstract:

I will discuss the existence and uniqueness of graphs with prescribed mean curvature function over a bounded domain in Riemannian manifolds endowed with a conformal Killing vector field. The domain is contained in a hypersurface in the integrable orthogonal distribution and the graph is a hypersurface transversal to the flow lines of the field. This is joint work with Marcos Dajczer.

B. Meeks - Univ. of Massachusetts at Amherst

The local and global geometry of embedded minimal and CMC surfaces in 3-manifolds.

Resumo/Abstract:

I will give a survey of some of the exciting progress in the classical theory of surfaces M in 3-manifolds with constant mean curvature H greater than or equal to zero; we call such a surface an H-surface. The talk will cover the following topics:

1. The classification of properly embedded genus 0 minimal surfaces in R^3. (joint with Perez and Ros)

2. The theorem that for any $c>0$, there exists a constant $K=K(c)$ such that for $H>c$, and any compact embedded H-disk D in R^3 (joint with Tinaglia):

(a) the intrinsic distance from points of D to its boundary is less than K.
(b) the norm of the second fundamental form of D is less than K for any points of D of intrinsic distance at least c from the the boundary of D is less than K.
(c) item 2(b) works for any compact embedded H-disk ($H>c$) in any complete homogeneous 3-manifold with absolute sectional curvature less than 1 for the same K.

3. For $c>0$, there exists a constant K such that for any complete embedded H-surface M with injectivity radius greater than $c>0$ in a Riemannian 3-manifold with absolute sectional curvature <1 has the norm of its second fundamental form less than K. (joint with Tinaglia):

(a) Complete embedded finite topology H-surfaces in R^3 have positive injectivity radius and are properly embedded with bounded curvature.
(b) Complete embedded simply connected H-surfaces in R^3 are spheres, planes and helicoids; complete embedded H-annuli are catenoids and Delaunay surfaces.
(c) Complete embedded simply connected and annular H-surfaces in H^3 with H less than or equal to 1 are spheres and horospheres, catenoids and Hsiang surfaces of revolution; the key fact here is that complete + connected implies proper.

3. Classification of the conformal structure and asymptotic behavior of complete injective H-annuli $f:S^1 \times [0,1) \to R^3$; there is a 2-parameter family of different structures for $H=0$. (joint with Perez when $H=0$)

4. Solution of the classical proper Calabi-Yau problem for arbitrary topology (even with disjoint limit sets for distinct ends!!). (joint with Ferrer and Martin)

C. Olmos - Universidade Nacional de Cordoba – Famaf

Submanifolds and Berger-type theorems

Resumo/Abstract:

The normal holonomy of a submanifold of a space form, turns out to be even simpler than Riemannian holonomy. This has interesting consequences not only in submanifold geometry, but also in Riemannian geometry. In fact, the Berger holonomy theorem depends strongly on the fact that the normal holonomy has a very special form. In this talk we would like to draw the attention on some results, similar to that of Berger, in the context of submanifold or Riemannian geometry (that also depend on the special form of the normal holonomy and that can be proven by geometric methods). Finally, we will discuss some applications of the so-called "Skew-torsion holonomy theorem" to naturally reductive spaces, which in particular explains the inextendibility of isotropy irreducible spaces (in the sense of Wolf and Wang-Ziller).