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First joint meeting Brazil – Italy in mathematics

SESSION 26 "GEOMETRIC STRUCTURES, LIE THEORY AND APPLICATIONS"

IMPA, 1–2 September 2016

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THURSDAY 1/9

9.45 - 10.30: MARCOS JARDIM, U Estadual de Campinas

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Geometric structure of the nested Hilbert scheme of points

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The nested Hilbert scheme of points on surfaces has been studied from the algebraic geometric points of view, and it is known to be connected and smooth in some cases. We study the geometry of such cases, showing that they admit a closed holomorphic 2-form which is generically non-degenerate.

10.30 - 11.15: LETTERIO GATTO, Politecnico di Torino

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Integrals on Grassmannians of lines

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Let $G(r, n)$ be the complex Grassmann variety parametrizing r-dimensional subspaces of $\mathbb{C}^n$. By an integral on $G(r, n)$ one usually means the degree of a product of Chern classes of the universal quotient bundles $\mathcal{Q}$ over it. The most popular is $\int_{G(r,n)} c_1(\mathcal{Q})^{r(n-r)} \cap [G(r, n)]$, which coincides with the Plücker degree of $G(r, n)$. Within the framework of Gaudin models and representation theory of the Lie algebra $\mathfrak{sl}_2(\mathbb{C})$, basing on previous work with Varchenko [SV] about critical points of the generating function of the Wronski map, I. Scherbak proves in [Sch] a formula computing arbitrary integrals on $G(2, n + 2)$. A purely algebraic proof of Scherbak's result will be offered in the talk by exploiting the fact that the Chern polynomial $c_t(\mathcal{Q})$ defines a Hasse-Schmidt derivation on a Grassmann algebra, in the sense of [GS]. In addition, if time permits, we shall briefly discuss i) the fact, observed by Santiago, that the generating function of the degrees of the Grassmannian $G(2, n)$ of lines in $\mathbb{P}^{n-1}$ can be expressed in terms of modified Bessel functions of the first kind and ii) the relationship of the subject with the combinatorics of the so called Catalan traffic [N,S].

[GS] L.Gatto, P.Salehyan, *Hasse-Schmidt Derivations on Grassmann Algebras*, Impa Monographs n. 4, Springer, 2016

[N] H.Niederhausen, *Catalan Traffic at the Beach*, Electr. J. Comb. 9, (R33) (2002), 1–17.

[S] T.Santiago, *"Catalan traffic" and integrals on the Grassmannian of lines*, Discr. Math. 308 (2008), 148–152.

[Sch] I.Scherbak, *Gaudin Models and the generating function of the Wronski map*, Geometry and topology of Caustics, 2002, Banach Center Publications, vol. 62, 2002, 249–262.

[SV] I.Scherbak, A.Varchenko, *Critical points of functions, $\mathfrak{sl}_2$ representations, and Fuchsian differential equations with only univalued solutions*, Mosc. Math. J. 3 (2003), no. 2, 621–645.

11.15 - 12.00: LUIGI VERDIANI, U Firenze

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Smoothness of cohomogeneity one metrics and obstructions to nonnegative curvature.

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Compact simply connected Riemannian manifolds with an isometric action of a compact Lie group that has an hypersurface orbit (cohomogeneity-one manifolds) are classified up to dimension seven. Among the, except for two families, parametrised by an integer, in dimension 7, the ones that admit invariant metrics of nonnegative sectional curvature are classified. We show that nonnegative curvature is obstructed on the manifolds that belong to one of these families. In order to prove it we develop a method, of independent interest, for describing smooth invariant metrics on cohomogeneity one manifolds.

17.30 - 18.15: PAOLO PICCIONE, U de São Paulo

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Infinitely many solutions to the Yamabe problem on noncompact manifolds

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I will discuss the existence of infinitely many complete metrics with constant positive scalar curvature on prescribed conformal classes on certain noncompact product manifolds. These include products of closed manifolds with constant positive scalar curvature and simply-connected symmetric spaces of noncompact or Euclidean type; in particular, $S^m \times \mathbb{R}^d$ and $S^m \times \mathcal{H}^d$. As a consequence, one obtains infinitely many periodic solutions to the singular Yamabe problem on $S^m \setminus S^k$, for all $0 \leq k < (m - 2)/2$. I will also show that all Bieberbach groups are periods of bifurcating branches of solutions to the Yamabe problem on $S^m \times \mathbb{R}^d$. This is a joint work with R. Bettiol, UPenn.

18.15 - 19.00: HENRIQUE SÁ EARP, U Estadual de Campinas

Gauge theory on Milnor links

We show Milnor's links of certain isolated hypersurface singularities admit a natural cocalibrated G_2-structure and a Yang-Mills instanton moduli space bearing a promising relationship to the Donaldson-Thomas construction for Calabi-Yau 3-folds.

FRIDAY 2/9

9.45 - 10.30: MAURIZIO PARTON, U Chieti-Pescara

Locally conformally Kähler geometry

Abstract tbc.

10.30 - 11.15: GIOVANNI BAZZONI, Philipps-Universität Marburg

A zoo of symplectic, complex and non-Kähler manifolds

It is well known that a Kähler manifold has an underlying symplectic structure. Forty years ago Thurston provided the first example of a compact symplectic manifold that admits no Kähler metrics. Giving examples of these manifolds is hampered by a twofold problem. On the one hand, constructing compact symplectic manifolds is a challenging task: among the available techniques, we mention the symplectic blow-up of Gromov and McDuff, the symplectic connected sum of Gompf and the asymptotically holomorphic theory of Donaldson. A slightly more difficult problem is to construct manifolds which, although not Kähler, are at the same time symplectic *and* complex. On the other hand, one needs to know whether the existence of a Kähler structure influences the underlying smooth manifold, and how. The Hard Lefschetz property and the formality of the rational homotopy type answer this second problem.

The talk surveys examples of manifolds which are complex and symplectic and do not carry a Kähler metric, emphasizing the role played by the fundamental group. The only example missing in this bestiary is that of a six-dimensional simply connected, compact, symplectic and complex manifold which admits no Kähler metrics. Based on the preprint [BFM], we complete the picture by constructing such missing exemplar.

[BFM] G.Bazzoni, M.Fernández and V.Muñoz, *A 6-dimensional simply connected complex and symplectic manifold with no Kähler metric*, `http://arxiv.org/abs/1410.6045`

11.15 - 12.00: DANIELE ANGELLA, U Firenze

Cohomological and metric properties of non-Kähler manifolds

We study cohomological properties of compact non-Kähler manifolds, and we investigate the existence of special metrics. For example, we can consider the existence of Hermitian metrics in a conformal class with the property of having constant scalar curvature with respect to the Chern connection. (Note that the Chern Ricci form defines a class in Bott-Chern cohomology.) The problem can be solved at least in the case of non-negative Kodaira dimension.

14.30 - 15.15: CLAUDIO GORODSKI, U de São Paulo

The curvature of orbit spaces

Let a compact Lie group act by isometries on the unit sphere. The space of orbits X is an Alexandrov space of curvature at least 1 and diameter at most π with respect to the natural quotient metric. The following question of K. Grove has been investigated by several authors and remains widely open in general: *How small can the diameter of X be?* In this talk, we discuss the closely related problem: *How curved can X be?* (Joint work with A. Lytchak (Köln).)

15.45-16.30: ANDREW CLARKE, U Federal do Rio de Janeiro

The modified K-energy and complex deformation

A theorem of Mabuchi, following Donaldson in the cscK case, says that if a Kähler class admits an extremal Kähler metric, then the modified K-energy is bounded below on that class and takes its minimum value on that extremal metric. If one deforms the complex structure the new manifold can in principle lose the extremal metric. We show however that under small appropriate deformations the modified K-energy does remain bounded.