

Mathematical Work of Jorge Lauret

Jorge Lauret is a researcher of great power and broad interests who has made important contributions in various directions in Differential Geometry. Lauret was born in December 1969, he completed his undergraduate studies (Licenciatura) in Mathematics at FaMAF, Universidad Nacional de Córdoba in March 1994, and his PhD. in March 1998. He quickly showed his conditions for research and his ambition. After publishing some papers on homogeneous geometry, he worked on a problem that had been posed by A.Selberg in his paper on the trace formula (1956) as to whether commutative homogeneous spaces are necessarily symmetric. Lauret was able to produce many negative examples, by means of left invariant metrics on nilpotent H-type Lie groups. This work was published in *Bulletin London Math. Society* (1998). Soon afterwards he managed to construct many new Riemannian Gelfand pairs, by a construction using representations of compact Lie groups (*Transformation Groups*, 2000). These spaces attracted the attention of mathematicians such as E. Vinberg who wrote a long paper on the topic.

Lauret next important contribution was the construction of new Ricci solitons (*Math Annalen*, 2001), i.e. special solutions of the normalized Ricci flow. He showed by a variational approach that the Ricci soliton homogeneous nilmanifolds are precisely the critical points of a functional defined on a space which contains all the homogeneous nilmanifolds of a fixed dimension as a real algebraic set.

Another important topic in his research has been the study of the “optimal” left invariant Riemannian metric on a Lie group compatible with a given geometric structure (for instance symplectic, complex or hypercomplex). His main approach consists of varying Lie brackets rather than inner products and studying the moment map for the action of a reductive Lie group on the algebraic variety of all Lie algebras, and then using strong results from geometric invariant theory.

At this point he was awarded a Guggenheim fellowship to make a postdoc in Yale University, where he spent two years (2001-03). At this time his interest shifted to a question by S.Smale on the study of manifolds admitting Anosov diffeomorphisms. (It is conjectured that any such a manifold should be an infranilmanifold.) By means of nilpotent Lie algebras endowed with a rational structure he was able to produce a large family of examples, showing that the set of Anosov nilpotent Lie algebras is not classifiable, except in low dimensions (*J.Algebra* 2003, *Transactions AMS*, 2009).

In the last years Lauret has been working hard on the classification of homogeneous Einstein manifolds, writing several interesting papers. He has recently made a fundamental contribution, showing that the class of standard solvmanifolds studied by J. Heber (which admit a unique Einstein metric) is essentially the only such class ([ArXiv:math.DG/0703472](https://arxiv.org/abs/math/0703472)). This is a big step forward in the direction of the Alexeevskii conjecture that predicts the form of a general homogeneous non compact Einstein manifold (see A.Besse 1987, *Einstein manifolds*). In this paper Lauret introduces new ideas in the

subject, using as a main tool moment maps and an adaptation to the real case of a stratification introduced by Kirwan. On the other hand, he shows in another paper (ArXiv:math.DG/0602502, joint with C.Will) that this stratification is very useful in the study of Einstein solvmanifolds, by producing on the one hand, new existence results and also obstructions for a nilpotent Lie algebra to be the nilradical of an Einstein solvmanifold.

In the year 2007 Lauret has been awarded the Srinivasa Ramanujan Prize "in recognition of his outstanding contributions to differential geometry and group representations" Summing up I feel that Jorge Lauret is a young researcher of great strength, broad interests and high originality.