Program for **one-day seminar on Geometry, Analysis, and PDE**

Date: Monday, October 22, 2018,

Place: UiB, Auditorium B in VilVite center, (Thormøhlens gate 51
Id of the seminar: 18h-FIC001-2)

The seminar is one of the activities in the framework of BFS project and will be financed by this project.

We start at 09.00 at VilVite center, (Thormøhlens gate 51), near room B with morning coffee and then continue with the following topics.

09.30-10.30 Vinh Nguyen, Ecole Polytechnique, France (tien-vinh.nguyen@polytechnique.edu)

Title: Dynamics of strongly interacting 2-solitons for dispersive equations.
Abstract: The theory of linear dispersive equations predicts that waves should spread out and disperse over time. However, it is a remarkable phenomenon, observed both in theory and practice, that once there are nonlinear effects, many nonlinear dispersive equations (for example: NLS, gKdV, coupled NLS,...) admit special "compact" solutions, called solitary wave or solitons, whose shape does not change in time. A multi-soliton is a solution, which is close to a superposition of several solitons. The problem we address is the one of the dynamics of relative distance for 2-solitary wave solutions. In particular, we are interested in the construction of strongly interacting regimes, where the interaction between solitons changes the behavior. Then, from the construction, we discuss the similarity and the difference of the dynamics between the integrable case, known before by scattering theory and the nonintegrable case.

10.30–11.30 Mats Ehrnstrom, Professor, NTNU, Norway
(mats.ehrnstrom@ntnu.no)

Title: Enhanced existence time of solutions to the fractional Korteweg--de~Vries equation
Abstract: We consider the fractional Korteweg—de Vries equation u_t + u u_x - |D|^α u_x = 0 in the range of -1<α<1, α≠ 0. Using basic Fourier techniques in combination with the modified energy method we extend the existence time of classical solutions with initial data of size ε from 1/ε to a time scale of 1/ε^2. This analysis, which is carried out in Sobolev space H^N(\mathbb{R}), N≥ 3, answers positively a question posed by Linares, Pilod and Saut. This is joint work with Yuexun Wang, NTNU.

11.30–12.30 Andrea Santi, Associate Professor, University of Bologna, Italy,
(asanti.math@gmail.com)

Title: Killing superalgebras and their uses.
Abstract: I will report on joint works with J. Figueroa-O'Farrill and P. de Medeiros on the algebraic structure of Lie superalgebras generated by Killing spinors. I will explain that any such Killing superalgebra is an appropriate deformation of a subalgebra of the Poincaré superalgebra and discuss applications to the classification of highly supersymmetric backgrounds of d = 11 supergravity and the determination of the geometries admitting rigidly supersymmetric field theories in dimensions d = 4 and d = 6.

In particular, we will see that preserving more than half the supersymmetry implies the field equations of d = 11 supergravity. I will also elucidate the role played in this approach by a certain Spencer cohomology group, which in all cases defines the relevant notion of Killing spinor.

12.30-13.30 Lunch

13.30-14.30 Erlend Grong, Postdoc, UiB and University of Paris Sud, Norway-France, (grongpost@gmail.com, Erlend.Grong@uib.no)

Title: Geometric comparison theorems for hypoelliptic operators.
Abstract: We study hypoelliptic second order differential operators that are not elliptic, but satisfy the strong Hörmander condition. Just as elliptic operators correspond to a Riemannian geometric structure, such hypoelliptic operators correspond to a sub-Riemannian geometric structure. One can consider sub-Riemannian manifolds as the limit of Riemannian manifolds where the length of vectors in a certain subbundle go to infinity. Unfortunately, this limit will make the Ricci curvature become unbounded. Hence, we loose important results in the process, such as the Laplace comparison theorem.

We will show how to recover a comparison theorem for certain cases. We will consider sub-Riemannian manifolds that appear as limits of totally geodesic foliations. In particular, we will focus on Sasakian manifolds, 3-Sasakian and H-type. The results we obtain allows us to determine global properties of our manifold, such as compactness and diameter bound, from just partial properties of its curvature.

This result is a joint work with Fabrice Baudoin, Kazumasa Kuwada and Anton Thalmaier. ArXiv: https://arxiv.org/pdf/1706.08489.pdf

14.30-15.30 Boris Kruglikov, Professor, UiT, Norway, (boris.kruglikov@uit.no)

Title: *Tanaka theory and step two nilpotent Lie algebras.*
Abstract: Sub-Riemannian structures are rigid in the sense of Gromov, meaning they have finite-dimensional automorphism groups. Even more, they are prolongation rigid (in the sense adapted in the work by Dennis The and myself), i.e., their Tanaka prolongation (majorizing the Lie algebra of symmetries) has trivial positive part. It turns out that the same is true for other distributions, associated to Riemannian metrics on bracket generating distributions, e.g., for H- and J-type algebras and their pseudo-analogs. In the talk I will detail on these

and related topics. Most of the results are from the joint paper with Irina Markina, Alexander Vasiliev and Mauricio Godoy Molina.

15.30-16.30 Sergiy Neshveyev, Professor, UiO, Norway
(sergeyn@math.uio.no)

Title: Random walks and classification of quantum groups of Lie type.
Abstract: Quantum groups are generalizations of groups introduced by Drinfeld, Jimbo and Woronowicz around 30 years ago. The most famous examples are obtained by deforming compact semisimple Lie groups. In the talk I will explain how ideas of probability theory and amenability can be used to classify a large class of such deformations.