Supergravity, G-structures and Killing superalgebras

BFS-TFS Guest Professor

Andrea Santi (University of Bologna)

Abstract.

The purpose of these lectures is to introduce d=11 supergravity and motivate the study of its supersymmetric backgrounds. I will discuss various geometric and Lie algebraic features of d=11 supergravity in the language of differential geometry, in particular the formulation in terms of Tanaka structures that I obtained in joint works with A. Spiro and A. Altomani. Tanaka structures are a striking generalization of the concept of G-structure introduced by N. Tanaka in the 1970s.

I will then discuss the construction of a Lie superalgebra generated from spinor fields satisfying a certain PDE and the homogeneity theorem, which states that supergravity backgrounds preserving more than half of the supersymmetry are homogeneous. Finally, I will report on recent work in collaboration with J. Figueroa-O'Farrill on the algebraic structure of this so-called Killing superalgebra and discuss applications to the classification of supersymmetric backgrounds. In particular, we will see that preserving more than half the supersymmetry implies the field equations of d=11 supergravity.

I will give all the relevant definitions along with plenty of examples. Here is a more detailed plan of the lectures:

1) Introduction to G-structures and Tanaka structures

   (Basic definitions and examples, symmetries of the integrable model, the automorphism group of a G-structure and Sternberg's Theorem, Tanaka structures and their automorphism groups)

2) Supergravity backgrounds (in d=11) and Tanaka structures

   (Backgrounds of eleven-dimensional supergravity, Tanaka structures modeled on supertranslation algebras, Howe's Theorem and reduction to G-structures)

3) Detour on Lie superalgebra theory

   (Basic definitions and examples, Kac's classification of simple Lie superalgebras, Lie superalgebras vs. Lie algebras, Poincaré superalgebras and maximal prolongations of supertranslation algebras)

4) Rudiments of Riemannian geometry and spin geometry

   (Killing vector fields and Killing transport, Killing algebras as filtered deformations, basics of spin geometry, parallel and Killing spinors, extended Killing algebras)

5) Spinorial aspects of d=11 supergravity

   (Supergravity Killing spinors, Killing superalgebras, maximally supersymmetric backgrounds, the homogeneity theorem)

6) Killing superalgebras and their uses

   (Killing supertransport, Killing superalgebras as filtered deformations, Spencer cohomology and Killing spinors equations, the reconstruction theorem for highly-supersymmetric backgrounds, finale on dimensions d=4 and d=6)

All lectures will happen at UiT
the Arctic University of Norway
Faculty of Science and Technology
Department of Mathematics and Statistics
Contact: Boris.Kruglikov@uit.no

25/09 Tue 11:30-13:30 TEKN 2.007
28/09 Fri 12:15-14:00 Realf A228
02/10 Tue 12:15-14:00 Realf A152
05/10 Fri 12:15-14:00 Realf A228
16/10 Tue 12:15-14:00 TEKN 1.018
19/10 Fri 12:15-14:00 Realf A228