UiT the Arctic University of Norway
15 Nov 2018

BFS-TFS one-day seminar

Geometry and Relativity

Organizer: Boris Kruglikov (UiT)

Schedule:

09:25-09:30. Welcome.

Morning Session Teknologibygget Aud 2.017

09:30-10:15. Harvey Reall (Cambridge) The strong cosmic censorship conjecture
10:20-11:05. Irina Markina (Bergen) Sub-Lorentzian geometry on the Heisenberg group
11:10-11:55. Sigbjørn Hervik (Stavanger) Spaces with identical polynomial curvature invariants

12:00-13:00. Lunch break.

Afternoon Session Teknologibygget Aud 1.017

13:00-13:45. Alena Pravdova (Prague) Kundt spacetimes in theories of gravity
13:50-14:20. Eivind Schneider (Tromsø) Differential Invariants of Kundt waves

14:20-14:40. Coffee break

14:40-15:10. Lode Wylleman (Stavanger) Type I/G tensors in Lorentzian geometry
15:15-16:00. Øyvind Grøn (Oslo) Nash theory of gravity

16:00-17:00. Pizza and discussions.

Arrival Tromsø 14.11, preferably before 19:00.
Departure Tromsø 15.11, preferably after 18:00.

Partisipants:

- Matthew Terje Aadne (Stavanger)
- Sven Bokn (Bergen)
- Eivind Dahl (Stavanger)
- Øyvind Grøn (Oslo)
- Sigbjørn Hervik (Stavanger)
- Boris Kruglikov (Tromsø)
- Andreu Llabres (Tromsø)
- Luis Marin (Bergen)
- Irina Markina (Bergen)
- David McNutt (Stavanger)
- Anders Samuelsen Nordli (Tromsø)
- Ben David Normann (Stavanger)
- Anna Escofet Pacreu (Tromsø)
- Vojtech Pravda (Prague)
- Alena Pravdova (Prague)
- Harvey Reall (Cambridge)
- Eivind Schneider (Tromsø)
- Jonatan Stava (Bergen)
- Dennis The (Tromsø)
- Lode Wylleman (Stavanger)

Øyvind Grøn (University of Oslo & OsloMet)

Nash theory of gravity

Abstract: John Nash worked the last ten years of his life on a theory extending Einstein's general theory of relativity. The Nash theory has never been completed. He only worked it out for empty space, but there exist some suggestions for how energy-momentum can be included into the theory. I will present the Nash theory, some solutions of it, and some tentative suggestions for further developments. Maybe the most interesting aspect of the theory is that it seems to make dark energy unnecessary.

Sigbjørn Hervik (University of Stavanger)

Spaces with identical polynomial curvature invariants

Abstract: We will discuss pseudo-Riemannian spaces having identical curvature invariants. The fundamental question we will ask is: To what extent are pseudo-Riemannian spaces uniquely characterized by their polynomial curvature invariants? So if two spaces have identical invariants, when can we say that they are diffeomorphic? And, in the case they are not diffeomorphic, what can we say about their properties?

Irina Markina (University of Bergen)

Sub-Riemannian versus Sub-Lorentzian geometry on the Heisenberg group

Abstract: In the talk we describe the sub-Lorentzian structure on the Heisenberg group and compare sub-Lorentzian geodesics with sub-Riemannian ones. We discuss the fundamental solutions of the sub-Laplacian and ultrahyperbolic operators, associated with these non-holonomic distributions and left invariant vector fields. At the end we discuss topological peculiarities of sub-Lorentzian manifolds comparing to the sub-Riemannian case.

Alena Pravdova (Czech Academy of Sciences)

Kundt spacetimes in theories of gravity

Abstract: Kundt spacetimes represent a well-known class of exact solutions to classical four-dimensional general relativity. In recent years, there has been a number of works pointing out particular geometric properties of various subsets of Kundt spacetimes, extending Kundt spacetimes to higher dimensions and clarifying their role in various generalized theories of gravity. We will summarize some of these results, discussing VSI (spacetimes with vanishing curvature invariants), universal spacetimes and almost universal spacetimes.
It can also be shown that all spherically symmetric static spacetimes (including some black hole solutions, e.g. Schwarzschild solution) are conformal to Kundt. For some generalized theories of gravity, such as quadratic gravity, this leads to a considerable simplification of the gravitational field equations. We will thus also discuss new black holes solutions in quadratic gravity obtained using conformal-to-Kundt ansatz.

Harvey Reall (University of Cambridge)

The strong cosmic censorship conjecture

Abstract: The strong cosmic censorship conjecture in General Relativity asserts that the future is predictable from initial data. Some black holes admit inner “Cauchy” horizons for which spacetime beyond the horizon is not predictable from initial data describing the universe before the black hole formed, in apparent violation of the conjecture. However, such Cauchy horizons are believed to be unstable and so it is believed that this behaviour is non-generic. I will review the status of this conjecture and describe recent work on strong cosmic censorship with a positive cosmological constant.

Eivind Schneider (UiT the Arctic University of Norway)

Differential invariants of Kundt waves

Abstract: Kundt waves are special pure radiation spacetimes admitting a non-twisting, non-expanding null congruence. Let G denote the Lie pseudogroup of diffeomorphisms preserving metrics of this form. We give a complete description of the algebra of scalar differential G-invariants for such metrics, and discuss how the invariants can be used to distinguish and classify Kundt waves. Joint work with Boris Kruglikov and David McNutt.

Lode Wylleman (University of Stavanger)

Type I/G tensors in Lorentzian geometry

Abstract: Classification of tensors in Lorentzian geometry is an important tool for describing spacetime physics. Within the null alignment (boost weight) classification scheme by Milson et al, a tensor has been said to be of type I/G if no null directions exist along which the boost order is at most zero. For most kinds of tensors (e.g. Weyl-like tensors) this is the generic situation; however, the type I/G property has remained elusive, certainly in higher than four dimensions. In this talk I will prove that any type I/G tensor allows for a unique timelike direction that minimizes super-energy density or, equivalently, relative to which the super-Poynting vector vanishes. The result will be put into perspective and consequences will be discussed.