| Tuesday, 11th July 2023 | |
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| 9:30 – 10:20 | Boris Kruglikov (UiT the Arctic University of Norway)<br>*Dispersionless integrable systems and parabolic geometry in dimension 5*<br>Dispersionless integrability has been related to integrable background geometry via canonical structure on solutions for systems with quadratic characteristic variety (for instance, second order scalar PDEs). It turns out that the existence of dispersionless Lax pair implies the restriction that this variety is necessary degenerate if the number of independent variables exceeds four, consequently no convenient conformal metric can exist. It will be explained that the proper higher-dimensional analog is a compatible subconformal structure. This talk will be focused on dimension five, where the background geometry is still parabolic, and so the corresponding curvatures are given by the general theory of regular normal parabolic structures. The work is joint with Omid Makhmali, it was initiated within and supported by the GRIEG project SCREAM. |
| 10:25 – 10:55 | Josef Šilhan (Masaryk University)<br>*On normal conformal Killing fields*<br>We study the submaximal dimension of algebras of normal conformal Kiling fields on conformal manifolds (of any signature). This is closely related to the submaximal solution space of the conformal-to-Einstein operator. Further we discuss trajectories of conformal Killing fields. We specificaaly focus on the problem when all trajectories are conformal cirles or confomal loxodromas. |
| 10:55 – 11:30 | Coffee break |
| 11:30 – 12:20 | Joel Merker (Paris-Saclay University)<br>*Cartan-Enhanced Power Series Method of Equivalence*<br>To upgrade the naive approach through power series expanded at only one point, the talk will show how to import concepts and principles of Élie Cartan's G-structured method of equivalence, in Nurowski's spirit. Quite unexpectedly, basic linear representation theory happens to become of central use within highly nonlinear jet bundles. Two specific illustrations will be presented: Homogeneous models of 5D PDE systems under fiber- preserving transformations; Affinely homogeneous surfaces S^2 in R^4. Joint work(s) with Julien Heyd (Paris-Saclay University). |
| 12:25 – 12:55 | Iryna Yehorchenko (NAS of Ukraine)<br>*Equivalence classification for the general solutions of modified eikonal equations*<br>We construct general solutions of modified eikonal equations, being representatives of equivalence classes obtained in the process of symmetry classification of such equations. |
| 12:55 – 15:00 | Lunch break |
| 15:00 – 15:50 | Michael Eastwood (University of Adelaide)<br>*The Killing operator on Riemannian symmetric spaces*<br>As the name suggests, a symmetric space has plenty of symmetries and, locally, these constitute the kernel of the Killing operator. On the other hand, the range of the Killing operator is like a gauge-freedom in metric deformations and is often viewed as such in linearised relativity. The Killing operator in 3-space gives the strain tensor induced by a given displacement in linearised elasticity and, already in 1864, Saint-Venant constructed a second order linear operator (from strain to stress) that detected the strains arising from a displacement. In 1961, Calabi constructed a second order operator on the round sphere that detected the range of the Killing operator. He already asked about locally homogeneous metrics and lamented that 'the computations have been carried to a satisfactory degree of completion' only for constant curvature metrics. This talk will explain Calabi's operator (implicitly via parabolic differential operator) and we shall discover what happens for locally symmetric Riemannian metrics. This is joint work with Federico Costanza, Thomas Leistner, and Benjamin McMillan. |
| 15:55 – 16:45 | Thomas Leistner (University of Adelaide)<br>*The range of a connection and a Calabi operator for Lorentzian locally symmetric spaces*<br>On a semi-Riemannian manifold, the Killing operator maps a vector field to the Lie derivative of the metric along the vector field. The kernel of this operator consists of the Killing vector fields and, as infinitesimal isometries, they usually are at the centre of interest. In the talk, however, we focus on the range of the Killing operator. For spaces of constant sectional curvature, Calabi found a second order linear differential operator that provides exact local integrability conditions for the range of the Killing operator. We generalise this result by providing such a second order operator for indecomposable and, when possible, decomposable Lorentzian locally symmetric spaces. Our approach uses the prolongation of the Killing operator to a connection, which leads us to analyse the range of a connection on a vector bundle in general. We find a sufficient condition for local exactness in the complex that is given by the dividing the twisted de Rham sequence by the range of the curvature. This criterion is used to prove the local exactness of the Calabi operator for Lorentzian locally symmetric spaces when it holds, and identify the products for which it fails. This is joint work with Federico Costanza, Mike Eastwood, and Benjamin McMillan. See Mike's talk for analogous results for Riemannian locally symmetric spaces. |
| 18:00 – 19:30 | *Ask a Physicist* lecture: Aleksander Bogucki (University of Warsaw) & Paweł Nurowski (CFT PAS and Guangdong Technion)<br>*Acoustic decaphonic piano – its mathematics, physics and sound*<br>The hero of this lecture, the dekaphonic piano, is an acoustic concert hall instrument constructed on the demand of the world-famous jazz pianist Leszek Mozdzer. The piano is dekaphonic since it needs ten sounds only to play the entire octave, in contrast to the twelve sounds played in an octave by the usual piano. The new piano built by us has the ten-scale equal temperament musical tuning system, as opposed to the 12-scale equal temperament used by musicians in most Western music since the times of J. S. Bach.<br>The acoustic dekaphonic piano was designed by: Aleksander Bogucki, a physicist from the Institute of Experimental Physics of the University of Warsaw, Pawel Nurowski, a mathematician from the Center for Theoretical Physics of the Polish Academy of Sciences, Andrzej Wlodarczyk, a constructor and a restorer of historic pianos, and by Leszek Mozdzer - the initiator of the project. The keyboard layout is due to Ryszard Marianski, the frame by Roman Galinski, acoustics by Slawomir Rosa; regulation, intonation and tuning by Jan Grzyska and Miroslaw Mastalerz. As far as we know it is the first piano instrument of this kind in the world.<br>In this lecture, Aleksander Bogucki and Pawel Nurowski, the scientific designers of the piano, will explain technical difficulties, scientific obstacles, and esthetic issues, which they had to overcome to create an actual physical implementation of the instrument.<br>People without a musical education are most welcome to the lecture. All the relevant scientific information needed to understand the innovative nature of the instrument and the motivations for creating it will be explained. In particular, we will explain the mathematical principles of various musical tuning systems used in the history of Western music, so that after the lecture everybody shall know what is Pythagorian tuning, just intonation, equal temperament, and how the tuning system of our instrument is related to these classical notions. We will try to argue that mathematics prefers the tuning system employed in the dekaphonic piano. The sound of music played on an electronic piano using these various tuning systems will be presented and compared with each other during the lecture.<br>During the lecture, the physics of sound needed to understand the difficulties in creating a physical implementation of the instrument, will be explained and illustrated by several experiments designed by Aleksander Bogucki, Pawel Trautman and Andrzej Wlodarczyk.<br>The actual implementation of the dekaphonic piano, and live music played on the acoustic instrument, will be presented during a separate event, at a concert played by Leszek Mozdzer, which will be held in the Concert Hall Nowa Miodowa in Warsaw on Thursday, July 13, 2023, at 19:00. |