Asymptotic symmetries and conservation laws from the point of view of BV cohomologies

Glenn Barnich

Universite Libre de Bruxelles

Abstract. In the first part, generalized symmetries and conservation laws in degenerate Lagrangian field theories are described through suitable cohomology classes of the Batalin-Vilkovisky formalism. In the second part, we discuss asymptotic symmetries in gravitational theories. More precisely, we first derive a historical precursor to the AdS/CFT correspondence, namely that the symmetry algebra of asymptotically anti-de-Sitter space-times in 3 dimensions consists of 2 commuting copies of the non-centrally extended Virasoro algebra. The central extension in the associated algebra of conserved charges is worked out. Analogous results in four dimensions are then briefly sketched.

Jet spaces and superfields

Alexei Kotov

University of Tromso

Abstract. In these lectures we will discuss the geometry of finite and infinite jet spaces (including prolongations of PDEs, and possibly differential invariants, pseudogroups and G-structures). In the second lecture the speaker will also tackle super jet formalism arising in Field Theory.

Minicourse: A fully intrinsic approach to local field theory via geometry/homology of PDEs

Luca Vitagliano

Universita' di Salerno

Abstract. Local differential calculus on the space of solutions of a PDE may be formulated geometrically and homologically on infinite jet space. Such formulation (essentially due to Vinogradov) is sometimes called secondary calculus (SC). By definition, SC applies to the shell of a field theory, the so called covariant phase space (CPS), yielding a fully intrinsic approach to it. I will review SC and its application to the description of the CPS.

Minicourse: Horizontal/characteristic cohomology of infinitely-prolonged systems of nonlinear-PDE: conceptual definition and computational approaches

Giovanni Moreno

Universita' di Salerno

Abstract. We will introduce J^∞ as the convenient geometrical setting where represent a system of nonlinear PDEs $\mathcal{E}$, since its chief geometrical structure, the infinite-order contact distribution $\mathcal{C}$, helps to identify the solutions of $\mathcal{E}$. Leaves of $\mathcal{E}$ are locally projectable on the manifold of independent variables (like space time in field theories), and all aspects of the differential calculus over J^∞ which are, in a sense, leaves-preserving, are accordingly called 'horizontal' (or 'characteristic'). In this mini-course I will briefly review the basic ingredients of horizontal calculus on $\mathcal{E}_\infty$, and then focus on the construction of its horizontal cohomology $\overline{H}$. I will explain why $\overline{H}$ plays a crucial role in lagrangian field theories, and present some examples of its computation

Tulczyjew triples in mechanics and field theory

Janusz Grabowski

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Abstract. The geometrical structure known as the Tulczyjew triple has proved to be very useful in describing mechanical systems, even those with singular Lagrangians or constrained. Starting with the standard Tulczyjew triple used in mechanics and explaining the formalisms of Lagrange and Hamilton in this language, their analogs for classical fields will be constructed. This picture of classical field theory is complete, containing not only the Lagrangian formalism and Euler-Lagrange equations but also the phase space, the phase dynamics, and the Hamiltonian formalism. Since the configuration space turns out to be an affine bundle, one has to use affine geometry. In particular, the two maps α and β that constitute the Tulczyjew triple are morphisms of the double structures of affine-vector bundles.

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Covariant weight system for knots from graded geometry

Jian Qiu

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Abstract. In this talk I shall discuss how to construct from a curved symplectic NQ-manifold (non-negatively graded manifold with a homological vector field) weight-systems for both knots and graph complexes. The main novelty is the application of Grothendieck connection to locally 'flatten' a curved manifold, while at the same time, keeping the result independent of any non-canonical choices, such as trivializations or connections. The result also finds its applications in field theory, especially in the background field method.