Workshop on Higher Spin Gauge Theories

26 – 28 April 2017, UMONS

Abstracts

X. Bekaert: *Unitarity of mixed-symmetry gauge fields on de Sitter spacetime*

A dictionary between all unitary irreducible representations of the algebra so(1,d+1) and the corresponding massive or (partially) massless fields on (d+1)-dimensional de Sitter spacetime is presented, together with their characters.

D. Francia: *On the cubic interactions of Maxwell-like higher spins*

Maxwell-like Lagrangians provide a simplified setting for higher-spin massless particles, in the sense that the same action can be used to describe cubic interactions for the different possible unitary spectra encoded in symmetric Lorentz tensors. The key technical advantage lies in the possibility of avoiding altogether the introduction of traces. In this framework, in particular, we build off-shell cubic vertices for metric-like higher spins in (A)dS backgrounds.

S. Fredenhagen: *On asymptotic W-symmetries in 3d higher-spin gauge theories*

I will review the structure of W-algebras that arise as asymptotic symmetries in higher-spin gauge theories on AdS3, with a particular emphasis on the relation between different gauges (highest weight gauge, u-gauge, diagonal gauge) leading to different realisations of the W-algebra (W-basis, U-basis, free field realisation). Whereas the W-basis is the most natural one from the conformal field theory point of view, the free field realisation (and the U-basis connected to it via the Miura transform) seems the ideal starting point to discuss quantisation.

M. Grigoriev: *Fefferman-Graham construction and higher-spin fields*

I briefly review the Fefferman-Graham ambient metric construction and discuss its higher-spin extension.

C. Heissenberg: *Higher-Spin Asymptotic Symmetries and Soft Theorems*

Inspired by recent developments on the link between asymptotic symmetries and soft theorems in gravity and QED, we study the large gauge transformations of massless higher-spin fields in D=4 Minkowski spacetime. Upon imposing suitable fall-off conditions, providing higher-spin counterparts of the Bondi gauge for asymptotically flat gravitational systems, we observe the existence of an infinite-dimensional asymptotic symmetry algebra.
The corresponding Ward identities for higher-spin supertranslations allow one to derive Weinberg's factorization theorem for amplitudes involving soft particles of spin greater than two.
The connection between BMS symmetry and Weinberg's soft graviton theorem is also briefly revisited, and in particular we show how to obtain the latter without assuming a priori that the equivalence principle holds.

C. Iazeolla: *4D higher-spin black holes with nonlinear scalar field fluctuations: more on Vasiliev vs. Fronsdal*

I will show the basic features of the new exact solutions of the 4D Vasiliev equations that superpose nonlinear scalar field fluctuations and higher-spin black holes, and comment on the possible implications they have on the understanding of black-holes in higher-spin gravity and of the non-localities of the theory, as well as on the comparison between the perturbative expansion of the Vasiliev equations with the construction of nonlinear correction to the Fronsdal equations via the Noether method.

P. Kessel: *Higher Spin and Locality*

In this talk, I will review various papers on the degree of locality in higher-spin theories. I will try to summarize the relevant results achieved over the last years and discuss some open questions. This will hopefully be useful for the following discussion session.

S. Lal: *Quantum Corrections to Stringy HS Holography*

We review one-loop tests of the Higher-spin/CFT dualities and describe extensions of such computations to various more `stringy' theories such as the bulk dual of free SU(N) Yang-Mills, and finally type IIB strings in AdS(5) x S(5). We also describe new techniques which make such computations possible. These computations are independent of supersymmetry, though we observe interesting simplifications which occur only for maximal supersymmetry. This is somewhat in contrast to the usual situation in higher-spin theories where supersymmetry does not lead to any obvious simplifications. The talk will be based on work in collaboration with Jinbeom Bae and Euihun Joung (chiefly arXiv:1603.05387 arXiv:1607.07651, and arXiv:1701.01507).

A. Leonard: *On twisted self-duality conditions*

We show that the equations of motion for (free) integer higher spin gauge fields can be formulated as twisted self-duality conditions on the higher spin curvatures of the spin-s field and its dual. We focus on the case of four spacetime dimensions, but formulate our results in a manner applicable to higher spacetime dimensions. The twisted self-duality conditions are redundant and we exhibit a non-redundant subset of conditions, which have the remarkable property to involve only first-order derivatives with respect to time. This non-redundant subset equates the electric field of the spin-s field (which we define) to the magnetic field of its dual (which we also define), and vice versa. The non-redundant subset of twisted self-duality conditions involve the purely spatial components of the spin-s field and its dual, and also the components of the fields with one zero index. One can get rid of these gauge components by taking the curl of the equations, which does not change their physical content. In this form, the twisted self-duality conditions can be derived from a variational principle that involves prepotentials, which are the higher spin generalizations of the prepotentials previously found in the spins 2 and 3 cases. The prepotentials have again the intriguing feature of possessing both higher spin diffeomorphism invariance and higher spin conformal geometry. The tools introduced in an earlier paper for handling higher spin conformal geometry turn out to be crucial for streamlining the analysis. In four spacetime dimensions where the electric and magnetic fields are tensor fields of the same type, the twisted self-duality conditions enjoy an SO(2) electric-magnetic invariance. We explicitly show that this symmetry is an "off-shell symmetry" (i.e., a symmetry of the action and not just of the equations of motion). Remarks on the extension to higher dimensions are given.

K. Mkrtchyan: *Amplitudes from vertices in 4d*

We make an explicit link between the cubic interactions of off-shell fields and the on-shell three-point amplitudes in four dimensions. Both the cubic interactions and the on-shell three-point amplitudes had been independently classified in the literature, but their relation has not been made explicit.

D. Ponomarev: *On higher-spin theories in flat space*

For a long time it is known that interactions of massless higher-spin fields in flat space are problematic. It turns out that at least some of these problems can be avoided if one abandons manifest Lorentz covariance inherent to approaches where higher-spin fields are represented by Lorentz tensors. On the contrary, in the light-cone deformation procedure Lorentz covariance is not manifest, being controlled manually order by order. Remarkably, this allows to construct additional consistent interactions already at the cubic order. Among these additional interactions one finds the minimal coupling of higher-spin fields to gravity, which is, moreover, universal. Also, based on earlier results of Metsaev, we propose a complete chiral higher spin theory, which features only cubic interactions. I will also discuss some other developments in this direction.

R. Rahaman: *The Uniqueness of Hypergravity*

We show, under some reasonable assumptions, that the only consistent theory of a higher-spin fermion interacting with General Relativity in three-dimensional flat space is the hypergravity theory of Aragone and Deser. We also investigate the consequences of including a cosmological term and matter coupling.

E. Skvortsov: *Formal higher-spin theories*

Higher-spin theories as free differential algebras lead to interesting algebraic structures that result from deformation quantization and formality theorems. We show that any higher-spin theory is defined by two data: higher-spin algebra and Hochschild cocycle of this algebra, which also gives full description of the fluctuations over any higher-spin flat background. It is shown that there are no obstructions at higher orders. Moreover, higher orders can be systematically generated once a resolution of the Hochschild complex is given, with Vasiliev equations being particular examples of this construction. Various examples of formal higher-spin theories are decoded and some new are constructed.

M. Valenzuela: *Higher spin matrix models*

We construct a variation of Vasiliev's higher spin gravity which can be interpreted as a matrix model.
This result suggests that higher spin gravity actually describes a sector of M-theory.

Yu. M. Zinoviev: *Infinite spin fields in 3d and beyond*

We give explicit realization for the infinite (continuous) spin bosonic and fermionic fields in d=3. For this we use previously constructed frame-like gauge invariant description for massive bosonic and fermionic fields with arbitrary spins and take the limit where spin goes to infinity while mass goes to zero. We also give explicit form for the supertransformations leaving the sum of such bosonic and fermionic Lagrangians invariant. Generalizations to the higher dimensions are also briefly discussed.