Mini Workshop on

# VERTEX ALGEBRAS, W-ALGEBRAS AND RELATED STRUCTURES

September 23-24 2021, Department of Mathematics Guido Castelnuovo, Sapienza Università di Roma

Aula di Consiglio



Speakers:

Drazen Adamovic (University of Zagreb) Daniele Brilli (Sapienza Università di Roma) Alessandro D'Andrea (Sapienza Università di Roma) Alberto De Sole (Sapienza Università di Roma) Fabio Gavarini (Università di Roma Tor Vergata) Pierluigi Moseneder Frajria (Politecnico di Milano)

## Program

Thursday, September 23

15-16 Adamovic On semisimplicity of category KL\_k for affine vertex superalgebras

16-16.30 coffee break

16.30-17.30 Brilli Pseudoalgebraic structures for the exceptional Lie superalgebra E(5,10)

17.30-18.30 Moseneder Conformal embeddings in affine vertex superalgebras

Friday, September 24

9.30-10.30 De Sole Vertex algebra and Poisson vertex algebra cohomology

10.30-11.30 Gavarini: Real forms of complex Lie superalgebras and supergroups

11.30 -12 coffee break

12-13 D'Andrea: Irreducible representations of Lie Pseudoalgebras

**Organization:** Paolo Papi (Sapienza Università di Roma)

## Abstracts

### On semisimplicity of category KL\_k for affine vertex superalgebras

A level k is called collapsing if the simple affine W-algebra at level k associated with simple Lie (super)algebra is isomorphic to its affine vertex subalgebra. In a long term project with V. Kac, P. Moseneder-Frajria, P. Papi and O. Perse, we introduced the notion of collapsing level and studied some application to the representation theory of affine vertex algebras. Collapsing levels also have appeared in other recent research on vertex tensor categories and associated varieties of vertex algebras.

In this talk, we present results from the new paper with P. Moseneder-Frajria and P. Papi on the semi-simplicity of the Kazhdan-Lusztig category KL\_k of affine vertex superalgebras at collapsing and some other levels. We discuss some examples when KL\_k has indecomposable highest weight modules which lead to a construction of new non-semisimple vertex categories.

#### Pseudoalgebraic structures for the exceptional Lie superalgebra E(5,10)

The language of Lie pseudoalgebras is useful in giving finite description of infinite-dimensional Lie algebras and has proved to be a valuable tool in algebra and representation theory. In this talk we show how these techniques can be possibly generalized to the "super" setting by applying them to the exceptional linearly compact Lie superalgebra E(5,10).

#### Conformal embeddings in affine vertex superalgebras

We will discuss the conformal embeddings between basic classical Lie superalgebras with emphasis on the case of the embedding of the even part in the whole Lie superalgebra. We classify such embeddings and in many relevant cases, we compute the decomposition of the affine vertex algebra of the ambient Lie superalgebra as a module for the affine vertex algebra of the embedded subalgebra. The main tool is a fusion rules argument that proves to be very powerful. Joint work with D. Adamovi´c, P. Papi, O. Per`se.

#### Vertex algebra and Poisson vertex algebra cohomology

We review cohomology theories corresponding to the chiral and classical operads. The first one is the cohomology theory of vertex algebras, while the second one is the classical cohomology of Poisson vertex algebras (PVA).

Using a spectral sequence relating them, we are able to compute the cohomology of vertex algebras in many interesting cases. We then describe a unified approach to integrability through vanishing of the first cohomology, which is applicable to both classical and quantum systems of Hamiltonian PDEs.

### Real forms of complex Lie superalgebras and supergroups

The notion of "real structure" for Lie superalgebras can be given in two ways: standard (direct generalization of the classical notion) and graded. The naif notion of "real form", however, only makes sense in the standard case. In a joint work with Rita Fioresi, we prove that a functorial formulation of "real structures" allow to achieve a uniform notion of "real form", in functorial language, for both the standard and the graded case; moreover, this approach and its outcomes also make sense or Lie supergroups as well. We also introduce a suitable, generalized notion of "compact real form", for both Lie superalgebras and Lie supergroups.

At the end of the talk, I will also present some existence results for simple contragredient Lie superalgebras and their associated connected simply connected supergroups.

### Irreducible representations of Lie Pseudoalgebras

*I will present the classification of finite irreducible representations of all finite simple Lie pseudoalgebras, with a special focus on the recently solved cases of primitive type H and nonprimitive pseudoalgebras.* 

#### Con il contributo di

Progetto di Ateneo 2020: Representation Theory and Applications