Higher Algebras and Lie-infinity Homotopy Theory

Organisers:

- Vladimir Dotsenko (Trinity College Dublin, Ireland)
- Norbert Poncin (University of Luxembourg, Grand-Duchy of Luxembourg)

Venue: Mathematics Research Unit, University of Luxembourg

Dates: June 25-28, 2013

Description: Homotopy invariant notions of algebraic and geometric objects have been receiving more and more attention in the past years, with many new ideas providing a fruitful interplay between, for instance, homotopical algebra for algebras and operads, higher Lie algebroids, and theory of higher categories. The goal of this workshop is to explore some recent progress in these areas. In addition to research reports, the workshop will include a mini-course on Lie-infinity methods in rational homotopy theory, a recurring topic implicitly present at the core of all these areas.

Speakers:

- Ruggero Bandiera (Università degli Studi di Roma "La Sapienza", Italy)
- Alexander Berglund (Stockholms Universitet, Sweden)
- Urtzi Buijs (Université Catholique de Louvain, Belgium)
- Marco Manetti (Università degli Studi di Roma "La Sapienza", Italy)
- Sergei Merkulov (Université du Luxembourg, Luxembourg)
- Aniceto Murillo (Universidad de Málaga, Spain)
- Behrang Noohi (Queen Mary University of London, UK)
- Urs Schreiber (Radboud Universiteit Nijmegen, The Netherlands)
- Sergey Shadrin (Universiteit van Amsterdam, The Netherlands)
- Kyosuke Uchino (Freelance, Tokyo, Japan)
- Luca Vitagliano (Università degli Studi di Salerno, Italy)
- Nathalie Wahl (Københavns Universitet, Denmark)
- Chenchang Zhu (Georg-August-Universität Göttingen, Germany)

List of registered participants

1. Mourad Ammar (Sfax, Tunisia)
2. Sergey Arkhipov (Aarhus, Denmark)
3. Ruggero Bandiera (Rome, Italy)
4. Abhishek Banerjee (Paris, France)
5. Alexander Berglund (Stockholm, Sweden)
6. Giuseppe Bonavolontà (Luxembourg, Luxembourg)
7. Urtzi Buijs (Louvain, Belgium)
8. David Carchedi (Bonn, Germany)
9. Andrea Cesaro (Lille, France)
10. Tiffany Covolo (Luxembourg, Luxembourg)
11. Malte Dehling (Göttingen, Germany)
12. Vladimir Dotsenko (Dublin, Ireland)
13. Martin Doubek (Prague, Czech Republic)
14. Katarzyna Grabowska (Warsaw, Poland)
15. Janusz Grabowski (Warsaw, Poland)
16. Casper Guldberg (Copenhagen, Denmark)
17. John Huerta (Lisbon, Portugal)
18. Noriaki Ikeda (Kyoto, Japan)
19. Benoit Jubin (Luxembourg, Luxembourg)
20. David Khudaverdyan (Luxembourg, Luxembourg)
21. Camille Laurent-Gengoux (Metz, France)
22. Sylvain Lavau (Lyon, France)
23. Jerry Lodder (Las Cruces, New Mexico, USA)
24. My Ismail Mamouni (Rabat, Morocco)
25. Marco Manetti (Rome, Italy)
26. Sergei Merkulov (Luxembourg, Luxembourg)
27. Aniceto Murillo (Malaga, Spain)
28. Behrang Noohi (London, UK)
29. Arthur Parzygnat (New York, USA)
30. Norbert Poncin (Luxembourg, Luxembourg)
31. Peter Roenne (Luxembourg, Luxembourg)
32. Jean-Marc Schlenker (Luxembourg, Luxembourg)
33. Martin Schlichenmaier (Luxembourg, Luxembourg)
34. Urs Schreiber (Nijmegen, The Netherlands)
35. Sergey Shadrin (Amsterdam, The Netherlands)
36. Yunhe Sheng (Changchun, China)
37. Paul Arnaud Songhafouo Tsopméné (Louvain, Belgium)
38. Kyosuke Uchino (Tokyo, Japan)
39. Elizaveta Vishnyakova (Luxembourg, Luxembourg)
40. Luca Vitagliano (Salerno, Italy)
41. Michael Völkl (Regensburg, Germany)
42. Nathalie Wahl (Copenhagen, Denmark)
43. Derek Wise (Erlangen, Germany)
44. Xiaomeng Xu (Geneva, Switzerland)

45. Sinan Yalin (Lille, France)
46. Marco Zambon (Madrid, Spain)
47. Tao Zhang (Göttingen, Germany)
48. Chenchang Zhu (Göttingen, Germany)

Group photo, 27/06/2013

Titles and abstracts

Alexander Berglund: mini-course *Lie-infinity algebras in rational homotopy theory*

Lecture 1: L-infinity algebra basics.
Lecture 2: The Sullivan-de Rham algebra and minimal models.
Lecture 3: The nerve of an L-infinity algebra.
Lecture 4: Application: rational homotopy theory of mapping spaces.

Ruggero Bandiera: *Formality of weak Lie algebras in Kähler geometry*

We construct a family of L-infinity structures on the suspension of a graded pre-Lie algebra and prove they are all homotopy abelian. Among the examples we recover the L-infinity structure introduced by Kapranov on the suspended Dolbeault complex of a Kähler manifold.

Urtzi Buijs: *Algebraic models of non connected spaces and homotopy theory of L-infinity algebras II*

We will describe how to realize a given L-infinity algebra as a non connected space, including as particular cases, some of the algebraic models of the talk by A. Murillo. We also show how to construct, given a non connected space, an L-infinity algebra whose realization has the same homotopy type as the original space. For it, the Lawrence-Sullivan construction of the interval will play an essential role.

Marco Manetti: *On deformations of coisotropic submanifolds*

We study the embedded deformations of a smooth coisotropic submanifold of a holomorphic Poisson manifold, by describing the controlling DGLA and the relation with the homotopy Lie algebroid of Cattaneo et al.

Moreover we show that if the Hodge to de Rham spectral sequence of the submanifold degenerate at E_1, then every first order deformation induced by the anchor map is unobstructed (joint work with R. Bandiera).

Sergei Merkulov: *Deformation quantization in infinite dimensions.*

We study a family of quasi-Poisson structures on an affine space which are Maurer-Cartan elements of some Lie-infinity deformation of the Schouten brackets. In finite dimensions this family can be identified with ordinary Poisson structures though an identification map is highly non-trivial (it depends on the choice of an associator). We show a simple explicit formula for quantization of quasi-Poisson structures using Kontsevich compactified configuration spaces and the standard homogeneous volume form on the circle.

Aniceto Murillo: *Algebraic models of non connected spaces and homotopy theory of L-infinity algebras I*

Classical rational homotopy theory relies in the equivalence of the usual homotopy category of simply connected, or more generally, nilpotent rational CW-complexes with the homotopy categories of commutative differential graded algebras and differential graded Lie algebras concentrated, roughly speaking, in positive degrees. Here, we show that considering the unbounded situation is also of interest when studying the rational homotopy type of non-connected spaces. This talk is the first part of a series of two lectures, the second one to be given by U. Buijs.

Behrang Noohi: *Integrating weak morphisms of Lie 2-algebras*

One of Lie's Main theorems states that for Lie groups G and H, with H simply-connected, every Lie algebra homomorphism Lie(H)→Lie(G) integrates to a smooth homomorphism H→G. We consider the same problem for Lie 2-groups G and H. We show that Lie's theorem holds whenever H is 2-connected. This leads us to conjecture that in the case of Lie n-groups the required condition for integrating a weak morphism Lie(H)→Lie(G) is n-connectivity of H.

Reference: http://dx.doi.org/10.1112/S0010437X1200067X.

Urs Schreiber: *Super L_∞ algebras and the Brane Bouquet*

What is called the "FDA method" in higher supergravity theory (going back to D'Auria and Fre) is secretly the treatment of super-L-infinity algebras via their dual Chevally-Eilenberg super-dg-algebras. In this talk I first introduce super L-infinity cohomology and homotopy fiber sequences of super-L-infinity algebras. Then I discuss the diagram of exceptional higher superextensions of the super-translation Lie algebra (super-spacetime) and show how this classifies the super-p-branes in string theory/M-theory together with their open brane intersection laws – a "brane bouquet" refinement of the traditional "brane scan". Finally I indicate how to each super-L-infinity algebra in the brane bouquet there is an associated higher WZW-type sigma model whose fields are tensor multiplets of sigma-model fields combined with higher gauge fields on the worldvolume.

This is joint work with Domenico Fiorenza and Hisham Sati.

For more details seehttp://ncatlab.org/schreiber/show/The+brane+bouquet

Sergey Shadrin: *Givental action as a homotopy gauge symmetry*

After a short introduction to the Givental group action on hypercommutative algebras, I'll explain how one can represent it as a gauge symmetry action on Maurer-Cartan elements of the homotopy Lie algebra encoding homotopy Batalin-Vilkovisky algebras. As a byproduct of this explanation, we'll see how one can extend it to the homotopy hypercommutative algebras that should form a proper framework for the chain level Gromov-Witten theory in genus 0.

A joint work with V. Dotsenko and B. Vallette.

Kyosuke Uchino: *Homotopy theory of derived bracket Leibniz algebras*

We will introduce a new type of algebra, Lie-Leibniz algebras, which is considered to be an abstraction of derived bracket construction of Kosmann-Schwarzbach (1996). This type algebra is closely related with a certain topological field theory of higher dimensions, in particular, Courant algebroids. We study the bar construction of Lie-

Leibniz algebras along the theory of operads and introduce the strong homotopy version of Lie-Leibniz algebras.

Article URL: http://arxiv.org/abs/1110.4188.

Luca Vitagliano: *Left/right representations of homotopy Lie-Rinehart algebras*

I propose a definition of left/right connection along a strong homotopy Lie-Rinehart algebra (in the sense of [Kjeseth 01]). This allows me to generalize simultaneously representations up to homotopy of Lie algebroids and actions of strong homotopy Lie algebras on graded manifolds. I also present homotopy versions of various results about representations of Lie-Rinehart algebras.

Nathalie Wahl: *Formal operations*

I'll introduce the concept of formal operations in homology theories such as Hochschild homology and give examples and computations.

Chenchang Zhu: *Lie n-groupoids and their action*

In this talk, we will introduce a suitable (higher) category of Lie n-groupoids (in general a n-groupoid object in a category with a suitable Grothendieck pretopology). Then we introduce a way to study their actions. Free and proper actions will give arise to principal bundles. This includes joint works with Du Li and Ralf Meyer, and with Henriques Bursztyn and Francesco Noseda.