

JUNIOR TRIMESTER PROGRAM
NEW TRENDS IN REPRESENTATION THEORY
HAUSDORFF RESEARCH INSTITUTE FOR MATHEMATICS
01.09.2020 – 18.12.2020

DANIEL LABARDINI-FRAGOSO
ALEXANDRA ZVONAREVA

Group: Cluster algebras and algebras from surfaces

Research areas: Cluster algebras, representation theory of quivers and associative algebras, combinatorics, geometry.

Group members: Severin Barmeier, İlke Çanakçı, Wassilij Gnedin, Martin Kalck, Maitreyee Kulkarni, Daniel Labardini-Fragoso, Ian Le, Jacob Matherne, Lang Mou, Kaveh Mousavand, Sebastian Opper, Jonathan Rachowicz, Matthew Pressland, Zhengfang Wang, Emine Yildirim, Alexandra Zvonareva.

During the Junior trimester program the following scientific events were co-organized:

WINTER SCHOOL

The Winter School *Connections between representation theory and geometry*, organized by Jenny August, Sondre Kvamme, Daniel Labardini-Fragoso and Alexandra Zvonareva, took place online on October 5–9, 12–16 and 19–23, 2020. With more than 100 participants, the school brought together experts on various connections between representation theory and geometry, who delivered introductory 3-lecture mini-courses aimed at young representation theorists:

- A mini-course *Introduction to A-infinity structures* by Bernhard Keller (Université de Paris, Paris 7);
- A mini-course *Introduction to Fukaya categories* by James Pascaleff (University of Illinois);
- A mini-course *A geometric model for the bounded derived category of a gentle algebra* by Sibylle Schroll (University of Leicester).

The mini-courses were complemented by a number of one hour long talks linking the topics and putting them in a broader mathematical perspective:

- *Skew-gentle algebras and surface orbifolds* by Claire Amiot (Institut Fourier, Grenoble, France);
- *Perverse sheaves and schobers on Riemann surfaces* by Tobias Dyckerhoff (Universität Hamburg);
- *From Hall algebras to legendrian skein algebras* by Fabian Haiden (University of Oxford);
- *Partially wrapped Fukaya categories of symmetric products of marked disks* by Gustavo Jasso (Universität Bonn);
- *Homological mirror symmetry for log Calabi-Yau surfaces* by Ailsa Keating (University of Cambridge);
- *Homological mirror symmetry for not-so-simple singularities* by Yanki Lekili (Kings College London);
- *Plumbings and flops* by Ivan Smith (University of Cambridge).

All notes and videos from the Winter School are available at the [website](#).

MINICOURSE

Severin Barmeier and Zhengfang Wang, members of the group, gave a 4-lecture mini-course *Deformations of path algebras of quivers with relations* from September 29 to October 1, 2020. The videos are available at the [website](#).

RESEARCH OUTCOME

During the Junior trimester program the members of the group and their collaborators worked on the following topics: deformations of path algebras of quivers with relations; applications of representation theory to scattering amplitudes and categorification of scattering amplitudes; silting theory of Noetherian algebras; autoequivalences of derived categories of Brauer graph algebras and Brauer graph orders; derived equivalence classification of Brauer graph algebras; infinite triangulations and Verdier localisation; perfect matchings, dimer partition functions and cluster characters; continuous associahedron; web basis and categorification of Grassmannian cluster algebras; generalized cluster algebras and scattering diagrams; relative exact structures, Hall algebras and cluster characters.

Here is a list of research outcomes including preprints and ongoing projects, worked on or initiated during the program at the Hausdorff Institute by the members of the group (the members of the group are in bold).

Publications:

- **Severin Barmeier**, Koushik Ray, Learning scattering amplitudes by heart, Physics Letters B, 820, 136594, (arXiv:2101.02884).

Preprints:

- **Severin Barmeier, Zhengfang Wang**, Deformations of path algebras of quivers with relations (arXiv:2002.10001).
- **Severin Barmeier, Zhengfang Wang**, Deformations of categories of coherent sheaves via quivers with relations (arXiv:2107.07490).
- **Severin Barmeier**, Prafulla Oak, Aritra Pal, Koushik Ray, Hipolito Treffinger, Towards a categorification of scattering amplitudes (arXiv:2112.14288).
- **İlke Çanakçı, Alastair King, Matthew Pressland**, Perfect matching modules, dimer partition functions and cluster characters (arXiv:2106.15924).
- **Maitreyee C. Kulkarni, Jacob P. Matherne, Kaveh Mousavand, Job D. Rock**, A continuous associahedron of type A (arXiv: 2108.12927).
- **Sebastian Oppen, Alexandra Zvonareva**, Derived equivalence classification of Brauer graph algebras (arXiv:2103.12049).

Projects in progress:

- **Severin Barmeier, Martin Kalck, Zhengfang Wang**, Deformation quantization and singularity categories.
- **Severin Barmeier**, Sibylle Schroll, **Zhengfang Wang**, A_∞ deformations of Fukaya categories of surfaces.
- **Severin Barmeier, Zhengfang Wang**, Intrinsic formality of generalized Khovanov arc algebras and Stroppel's conjecture.
- **İlke Çanakçı, Martin Kalck, Matthew Pressland**, Infinite triangulations and Verdier localisation.

- **Wassilij Gnedin**, Silting theory of Noetherian algebras under change of rings .
- **Wassilij Gnedin**, Silting theory of Noetherian algebras modulo a normal regular element.
- **Wassilij Gnedin, Sebastian Opper, Alexandra Zvonareva**, Derived Picard groups of Brauer graph algebras and Brauer graph orders.
- **Ian Le, Emine Yildirim**, Web basis and Jensen-King-Su categorification of Grassmannian cluster algebras.
- **Daniel Labardini-Fragoso, Lang Mou** Generalized cluster algebras, Caldero-Chapoton algebras of gentle quivers with potential, and scattering diagrams.
- Xin Fang, Mikhail Gorsky, Yann Palu, Pierre-Guy Plamondon, **Matthew Pressland**, Relative exact structures, Hall algebras, cluster characters.