DESCRIPTION OF THE GROUP

General presentation

Our group is composed of 17 researchers, among which 8 seniors and 9 graduate students, issued from three universities: Marne-la-Vallée, Paris 7 and Rouen. The group has a very strong scientific unity, and meets every week in Marne-la-Vallée for the Algebraic Combinatorics Seminar.

Researchers involved in the project

Senior researchers

— Christophe CARRÉ, Maître de Conférences, Université de Rouen
— Jacques DÉSARMÉNIEN, Professeur, Université de Marne-la-Vallée
— Gérard DUCHAMP, Professeur, Université de Rouen
— Daniel KROB, Chargé de Recherches CNRS, Université Paris 7
— Alain LASCOUX, Directeur de Recherches CNRS, Université Paris 7
— Bernard LECLERC, Chargé de Recherches CNRS, Université Paris 7
— Pierre-André PICON, Professeur, Université de Marne-la-Vallée
— Jean-Yves THIBON, Professeur, Université de Marne-la-Vallée

Graduate students

— Abdelhamid ABDERREZZAK, Université Paris 7
— Philippe ANDARY, Université de Rouen
— Renaud EPPSTEIN, Université de Marne-la-Vallée
— Sungsoon KIM, Université Paris 7
— Eric LAUGEROTTE, Université de Rouen
— Loic LE BRIS, Université de Marne-la-Vallée
— Jean-Christophe NOVELLI, Université Paris 7
— Bun-Chan-Vorac UNG, Université de Marne-la-Vallée
— Sébastien VEIGNEAU, Université de Marne-la-Vallée

Marne-la-Vallée / Paris / Rouen

RESEARCH TOPICS

The research carried out by our team consists in the application of combinatorial methods to various problems in Representation Theory, Algebraic Geometry and Mathematical Physics. More precisely, we exploit the well-developed combinatorics of Young tableaux and symmetric functions to the effect of understanding recently discovered fundamental objects such as crystal bases of quantum groups, Schubert and Grothendieck polynomials or Kazhdan-Lusztig polynomials. We are also interested in Lie series and free Lie algebras, shuffle algebras and their generalizations.

Typical examples of our recent activities are listed below.

- Using an explicit realization of the Hecke algebras of type A by symmetrizing operators acting on the ring of polynomials, we have described their irreducible representations and obtained a q-analogue of the straightening algorithm of classical invariant theory.

- In collaboration with I.M. Gelfand, we have developed a theory of noncommutative symmetric functions and discussed several applications to Solomon's descent algebras, calculations of Lie idempotents and Lie series, Laplace operators of universal enveloping algebras of classical Lie algebras.

- We have investigated the specialization of Hall-Littlewood functions at roots of unity, and exhibited a connection between this question and the problem of the cyclic decomposition of tensor powers of a finite-dimensional representation of the general linear group. This lead us to a combinatorial description of the expansion of some particular plethysms on the basis of Schur functions.

- We have given a new combinatorial description of the q-analogues of weight multiplicities of irreducible GL_n-modules in terms of the geometry of the associated crystal graphs.

This kind of research generally leads to the elaboration of efficient algorithms for the manipulation of the objects under study. Specific softwares devoted to our research topics are developed and freely distributed. In particular, we have contributed programs to the computer algebra system SYMMETRICA designed by the Bayreuth team under the direction of A. Kerber and A. Kohnert.

We have been collaborating with the following teams: Aberystwyth, Amsterdam and Bayreuth.

Selected recent publications

1. G. Duchamp, D. Krob, A. Lascoux, B. Leclerc, T. Scharf & J.-Y. Thibon, *Euler-Poincaré characteristic and polynomial representations of Iwahori-Hecke algebras*, Publications of the Research Institute for Mathematical Sciences (Kyoto) 1995, to appear.

2. J. Désarménien, G. Duchamp, D. Krob et G. Mélanqn, *Quelques remarques sur les super-algèbres de Lie libres*, C. R. Acad. Sci. Paris, **318** (1994), 419-424.

3. D. Krob & B. Leclerc, *Minor identities for quasi-determinants and quantum determinants*, Comm. Math. Physics **169** (1995), 1-23.

4. T. Scharf, J.-Y. Thibon & B.G. Wybourne, *Powers of the Vandermonde determinant and the quantum Hall effect*, Journal of Physics A **27** (1994), 4211-4219.

5. I.M. Gelfand, D. Krob, A. Lascoux, B. Leclerc, V.S. Retakh & J.-Y. Thibon *Noncommutative symmetric functions*, Advances in Mathematics **112** (1995), 218-348.

6. G. Duchamp, D. Krob, B. Leclerc & J.-Y. Thibon, *Déformations de projecteurs de Lie*, C.R. Acad. Sci. Paris, **319** (1994), 909–914.

7. W. Fulton & A. Lascoux, *A Pieri formula in the Grothendieck ring of a flag bundle*, Duke Math. J., **76** (1994), 711-729.

8. A. Lascoux, B. Leclerc & J.-Y. Thibon, *Crystal graphs and q-analogues of weight multiplicities for the root system A_n*, Letters in Mathematical Physics 1995, to appear.

9. C. Carré & B. Leclerc, *Splitting the square of a Schur function into its symmetric and anti-symmetric parts*, Journal of Algebraic Combinatorics 1995, to appear.

10. A. Lascoux, B. Leclerc & J.-Y. Thibon, *Twisted Action of the Symmetric Group on the Cohomology Ring of a Flag Manifold*, Proceedings of the Banach Institute, Warszaw, to appear.

11. S. Veigneau, *SP, a package for Schubert polynomials realized with the computer algebra system MAPLE*, submitted to the Journal of Symbolic Computation.