Groupes et symétries : des Écossais du néolithique à John McKay
Titres et résumés

La liste de titres et de résumés ci-dessous est par auteur selon l'ordre alphabétique. Ceux qui possèdent l'* représentent les titres qui sont prévus à l'horaire des conférences; si le temps le permet, d'autres conférences pourront être ajoutées. Tous les titres et résumés seront inclus dans la brochure de la conférence.

Groups and symmetries: from the Neolithic Scots to John McKay
Titles and Abstracts

The list below is given alphabetically by author. Those indicated with * are currently scheduled as talks; others may be added as time permits. All the listed *Titre* / *Title*s and *Résumé* / *Abstract*s will be included in the conference brochure.

==========

Daniel Allcock (U. Texas, Dallas)

**Titre / Title*: A Monstrous Proposal

Résumé / *Abstract*: Some coincidences suggest that the Monster might appear in the setting of complex hyperbolic geometry, with possible algebra-geometric overtones.

==========

Helene Airault (Univ. Picardie)

Titre / *Title*: Symmetric sums associated to the factorization of the Grunsky coefficients

Résumé / *Abstract*: Properties of the Grunsky coefficients associated with powers of a given power series are examined.

==========

Philip Boalch (ENS, Paris)

**Titre* / *Title*: Painlevé, Klein and the icosahedron

Résumé / *Abstract*: We will describe how finite groups (and a few infinite groups) help to find algebraic solutions of the Painlevé VI equation. This is a second order nonlinear ODE which should be viewed as the "nonlinear version" of the Gauss hypergeometric equation, as will be explained. Thus the thrust of the talk is aimed at finding the nonlinear analogue of Schwarz's

famous list of algebraic solutions of the hypergeometric equation. In particular we will show that the resulting list is richer than the finite subgroups of SU(2). (Along the way we establish two other more obvious extensions of Schwarz's list to certain {\em nonrigid} linear ODEs---the main problem here being the construction of nonrigid ODEs with given finite monodromy groups.)

==========

Abdlilah Bouali (Univ. Picardie)

Titre / Title: Generalized Humbert polynomials

Résumé / Abstract : In this paper, we define a new class of Humbert polynomials which generalizes the well-known classes of Gegenbauer, Legendre, Pincherelle, Horadam-Mahon, Kiney, Horadam-Pethe, Gould and Path-Khan polynomials. We show that these generalized Humbert polynomials are eigenpolynomials of the Hamiltonian of the Calogero-Sutherland model. We prove throughout the paper several recurrence relations and explicit formulae. As an application, we will recover some standard results on the classical polynomials mentioned above.

==========

Harvey Cohn (IDA Center for Communications Research)

Titre / Title: Spontaneous Generation of Hilbert Modular Functions
(Preliminary report)

Résumé / Abstract : It is now almost classical that the modular function j(z) can be deduced from a modular equation, e.g., one connecting j(z) with j(2z). A joint paper with John McKay [Math. of Comput. 65 (1996) 1295-1309] showed that the exact coefficients in the equation were superfluous as long as the asymptotic structures were correct and there were enough modular equations; indeed if there were not enough, some invariants from replicability theory would intrude. The absence of Fuchsian structure makes the process "spontaneous."

A suitable challenge might be an extension to Hilbert modular functions (with say two invariants in two complex variables). Modular equations (systems) are very few; the author found one system for the case sqrt(2) [Math. of Comput. 38 (1982) 227-236], and then showed that the modular invariants can be deduced from this system [New York Num. Thy. Sem. 1881-1995, Springer 1996, pp. 19-41]. It would be interesting to ignore the exact coefficients (given the asymptotic structure), with enough modular equation systems to produce the invariants as before. It would be more interesting to see which new invariants intrude when too few systems are used.

==========

John Conway (Princeton University)

**Titre / Title*: Three-dimensional Space Groups

Résumé / *Abstract*: The 3-dimensional crystallographic space groups were independently enumerated by Barlow, Schoenfliess and Fedorov in the 1890s. There are 219 of them (or 230 if we count left- and right-handed forms). A century later Delgado, Huson, Thurston and I greatly simplified the enumeration, in a way that illuminates many relationships between the groups.

I shall describe our notation for the 35 "prime" groups (those that have no invariant family of parallel lines), and show how it displays all the index 2 relationships between them.

==========

Jorge Devoto (Buenos Aires)

**Titre* / *Title*: Monstrous Moonshine and Whitham Equations

Résumé / *Abstract*: Some years ago John McKay noticed some similarities between some terms associated to the Monstrous Moonshine functions and coefficients which characterize the dispersionless Kadomtsev Petviashvily (dKP) hierarchy. We shall make a survey of these relations and show some recent developments.

==========

Igor Dolgachev (U. Michigan)

**Titre* / *Title*: McKay correspondence for cocompact discrete subgroups of SU(1,1)

Résumé / *Abstract*: We will discuss a possible approach to extension of the McKay correspondence for finite subgroups of SU(2) to cocompact discrete subgroups of SU(1,1)

==========

Chongying Dong (U.C. Santa Cruz)

**Titre* / *Title*: Representation theory of vertex operator algebras

Résumé / *Abstract*: This is a survey talk on recent development on representation theory of vertex operator algebras.

==========

John Duncan (Harvard)

**Titre* / *Title*: Jacobi forms in moonshine

Résumé / *Abstract*: Recent constructions of some sporadic groups indicate that Jacobi forms play a role in moonshine. We outline the relevant constructions and describe some properties of the Jacobi forms arising.

==========

Noam Elkies (Harvard)

**Titre* / *Title*: On some uses of moduli of high-rank K3 surfaces

Résumé / *Abstract*: Explicit computation of some families of K3 surfaces of high Neron-Severi rank yields formulas and CM coordinates for certain Shimura modular curves, new record ranks for elliptic curves over Q(t) and Q, and related applications. Along the way, we notice a new(?) connection between the E9 root system and the typical configuration of reducible fibers of a rational elliptic surface with an N-torsion point (each N<=6), and likewise between the 19-root system of the even unimodular lattice of signature (17,1) and the typical configuration of reducible fibers of a K3 elliptic surface with an N-torsion point.

==========

Nora Ganter (U. Illinois)

**Titre* / *Title*: Hecke operators in generalized Moonshine and equivariant elliptic cohomology

Résumé / *Abstract*: After a short introduction to generalized Moonshine, I will explain how the theory of equivariant elliptic cohomology suggests a geometric interpretation of Norton's conditions. Then I will discuss three different definitions of Hecke operators on generalized Moonshine functions:
1) a geometric one, using isogenies,
2) a combinatorial one, given by cohomology operations on the loop space of an orbifold, and
3) the twisted Hecke operators of classical Moonshine.
I will prove that all three definitions give rise to exactly the same formula.

==========

Eyal Goren (McGill)

**Titre* / *Title*: Families of Ramanujan graphs and quaternion algebras

Résumé / *Abstract*: This is joint work with D. Charles and K. Lauter (Microsoft Research). Using quaternion algebras over a totally real field one can construct families of Ramanujan graphs as quotients of a Bruhat-Tits tree by a discrete subgroup coming from the quaternion algebra. Such constructions were made by Lubotzky-Phillips-Sarnak and Pizer for rational quaternion algebras and by Jordan-Livne for quaternion algebras over totally real fields. The cases we consider are special because they are connected to arithmetic geometry and theta series, and so our emphasis is different than Jordan-Livne's. We also consider nested families of Ramanujan graphs and some new questions arising in that context.

==========

Valery Gritsenko (Lille)

*_Titre / Title_; Arithmetic of the root system E_8 and
the geometry of the moduli spaces of $K3$ surfaces

Résumé / Abstract: The global Torelli theorem for projective $K3$ surfaces was first proved by Piatetskii-Shapiro and Shafarevich 36 years ago, opening the way to treating moduli problems for $K3$ surfaces. The moduli space of polarised $K3$ surfaces of degree $2d$ is a quasi-projective variety of dimension 19. For general d very little has been known hitherto about the Kodaira dimension of these varieties. In this talk we present an almost complete solution to this problem. Our main result obtained by myself together with K. Hulek and G. Sankaran says that this moduli space is of general type for $d>61$ and for $d=46$, 50, 54, 57, 58, 60. In order to prove this theorem we solve a general problem on the finite quotient singularities of the modular varieties of orthogonal type. The Borcherds products and the arithmetic of the root lattice E_8 play also an important role in the proof.

==========

George Hart (Stony Brook University)

*_Titre / Title_: Sculptural Presentation of the Icosahedral Rotation Group

Résumé / Abstract: This will be a hands-on activity in which the participants jointly construct a four-foot diameter sculpture from laser-cut wooden parts. The result has sixty icosahedrally arranged components and can be considered a physical presentation of the symmetry group. This activity is a fun application and celebration of symmetry in artistic form. Further details are available at http://www.georgehart.com/people/workshop.html

==========

Nicholas M. Katz (Princeton)

*_Titre / Title_: Report on exponential sums

Résumé / Abstract: A report on exponential sums over finite fields.

==========

Anatoliy Klimyk (Kiev)

Titre / Title : Weyl groups, (anti)symmetric multivariate exponential and trigonometric functions, and generalized Fourier transforms

Résumé / *Abstract*: The talk represents results obtained jointly with Prof J. Patera which concern an application of symmetries in analysis. Multivariate exponential functions, symmetric or antisymmetric with respect to a Weyl group W of a simple Lie algebra, are studied. They generate determinantal exponential and trigonometric functions, which are eigenfunctions of the Laplace operator vanishing on the boundary of the fundamental domain of the affine Weyl group corresponding to the Weyl group W. Multivariate symmetric and antisymmetric continuous and finite Fourier transforms are constructed. Multivariate symmetric and antisymmetric sine and cosine transforms are given.

==========

Kefeng Liu (UCLA)

**Titre* / *Title*: Modular invariance and Virasoro algebra in geometry

Résumé / *Abstract*: I will discuss certain applications of modular invariance and Virosoro algebra in geometry and topology, through elliptic genera and moduli spaces of Riemann surfaces.

==========

Yuri Manin (Max Planck Institut, Bonn)

**Titre* / *Title*: Modular shadows and the Lévy-Mellin transform

Résumé / *Abstract*: I will explain some recent developments concerning the structure of the "invisible boundary" of the modular tower for SL(2). I will start with a formalism of pseudo--measures generalizing the well--known theory of modular symbols for $SL(2)$. These pseudo--measures, and the related integral formula which I call the Lévy-Mellin transform, can be considered as an "infinity-adic" version of Mazur's p-adic measures that have been introduced in the seventies in the theory of p-adic interpolation of the Mellin transforms of cusp forms. Finally, a formalism of iterated Lévy-Mellin transform will be sketched.

==========

Yuri Manin (Max Planck Institut, Bonn)

**Titre* / *Title*: Counting rational points and rational curves: from Waring's problem to quantum cohomology (CRM-ISM Colloquium)

Résumé / *Abstract*: I will explain some results, constructions, and conjectures of the last two decades, motivated by number theory and quantum string theory respectively, whose common theme is: counting rational points/rational curves on algebraic varieties.

==========

Jack Morava (The Johns Hopkins University)

**Titre* / *Title*: Symmetric functions, Faber polynomials, and replicable functions

Résumé / *Abstract*: I will try to explain some things John McKay has told me about relations between Hecke operations, Faber polynomials, and replicable functions, in terms of universal properties of the ring of symmetric functions.

==========

Ram Murty (Queen's)

**Titre* / *Title*: Effective Equidistribution of Eigenvalues of Hecke Operators

Résumé / *Abstract*: Fix a prime p and consider the space of cusp forms S(N,k) of weight k and level N, with N coprime to p. In 1995, Serre showed the existence of a measure F(p) with respect to which the eigenvalues of the p-th Hecke operator acting on S(N,k) are equidistributed as k+N tends to infinity. We will derive an effective version of Serre's theorem and apply it to study the factorization of J_0(N) into simple abelian varieties. Our methods can also be applied to study the variation of eigenvalues of the Frobenius automorphism acting on a family of curves mod p and the variation of eigenvalues of adjacency matrices of regular graphs. This is joint work with Kaneenika Sinha.

==========

Iku Nakamura (Hokkaido)

**Titre* / *Title*: The G-orbit Hilbert schemes and McKay correspondence for simple singularities

Résumé / *Abstract*: : For a given finite subgroup G of $\rm{SL}(2,{\bf C})$ there is a famous McKay correspondence between the minimal resolution of the quotient ${\bf C}^2/G$ and irreducible representations of G. The G-orbit Hilbert scheme of ${\bf C}^2$ is, by definition, the Hilbert scheme which parametrizes all the zero dimensional G-invariant subschemes ($=G$-clusters), each with structure sheaf isomorphic to the regular representation of G. This turns out to be a minimal resolution of ${\bf C}^2/G$. Thus any point of the minimal resolution of ${\bf C}^2/G$ has a nontrivial interpretation as a G-module, the defining ideal of the G-cluster. This enables us to give an explanation for the McKay correspondence, other than that given by Gonzalez-Springberg and Verdier. We report this and related results, based on joint works with Ito, Shinoda and Gomi.

==========

Viacheslav V. Nikulin (Leeds)

Titre / *Title*: Finiteness of the number of arithmetic groups generated by reflections in hyperbolic spaces"

**Résumé* / *Abstract*: In 1980, 1981, the speaker proved that the number of maximal arithmetic reflection groups is finite in hyperbolic space of each fixed dimension $n\ge 10$. In 1981, Vinberg proved that such groups don't exist in dimension $n\ge 30$. During 25 years, there were no new general results in this domain.
In 2005, Long, Maclachlan and Reid proved finiteness in dimension $n=2$, and Agol proved finiteness in dimension $n=3$.

In 2006, math.AG/0609256, the speaker proved finiteness in all remaining dimensions $4\le n\le 9$. Thus, finally, the proof of the finiteness is completed in hyperbolic spaces all together.
In my talk, I hope to review these old and new results.

==========

Simon Norton (Cambridge)

**Titre* / *Title*: Irrational Moonshine

Résumé / *Abstract*: Following the enumeration of all genus zero modular groups containing some Gamma0(n) by Cummins, I discuss the properties of the corresponding Hauptmoduls, including possible relations between the moonshine and replicability properties of such functions and the relevant groups.

==========

Yousuke Ohyama (Osaka Univ.)

Titre / *Title*: The Darboux-Halphen-Brioschi system and isomonodromic deformations

Résumé / *Abstract*: The Darboux-Halphen-Brioschi (DHB) system can be solved by solutions of a Fuchsian differential equation of the second order. The DHB system is a subsystem of the Painleve sixth equation and is related to isomonodromic deformations.
We will also study monodromy problem of linear equations by means of isomonodromic deformations. The monodromy data can be explicitly determined when 1) the Painleve function is "symmetric", 2) the Painleve function is analytic around a fixed singular point, 3) the Painleve function is algebraic.