Mathematics Seminar
of the
University of Luxembourg
in cooperation with the
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4 March 2008, at 5 pm **Room 3.04 bs**

Mikolaj Rotkiewicz
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Double vector bundles revisited

Abstract

Double structures appear in geometry in many contexts. These objects carry two structures of the same kind, which satisfy some compatibility conditions. The most important examples for applications in mechanics are iterated tangent and cotangent bundles: T^*TM, TTM, T^*T^*M, etc. Each of these manifolds has two natural structures of a vector bundle. Following K. Mackenzie, the compatibility condition can be expressed by saying that all natural maps (additions, zero sections, etc.) are morphisms with respect to the other bundle structure. My talk is based on a joint work with J. Grabowski, in which we show that this condition can be much simplified in terms of Euler vector fields. Moreover, I am going to explain dualities of n-vector bundles ($n \geq 2$). It turns out that all duals of an n-vector bundle E live in T^*E which is an $(n+1)$-vector bundle.

11 March 2008, at 5 pm **Room 3.04 bs**

Miguel Couceiro
University of Luxembourg

Join-irreducible Boolean functions

Abstract

Throughout this presentation we only consider the simplest interesting case of multivariate functions, the so-called Boolean functions. Mainly, we shall be interested in a quasi-ordering

of functions which is know as the simple minor relation. This quasi-order can be described as follows: an m-ary function g is said to be *simple minor* of an n-ary function f, denoted $g \leq f$, if g can be obtained from f by identification of variables, permutation of variables or addition of dummy variables.

The importance of the simple minor relation $\leq$ in the equational approach to specify properties of Boolean functions was made apparent by Ekin, Foldes, Hammer and Hellerstein who showed that the classes (or properties) of Boolean functions definable by functional equations coincide exactly with the initial segments of this quasi-order. This correspondence to function class definability led to several studies of the simple minor relation. As any quasi-order, the simple minor relation $\leq$ on the set Ω of all Boolean functions induces a partial order on the set $\tilde{\Omega}$ made of equivalence classes, where properties of $\leq$ are easier to express. Several results concerning the structure of this partially ordered set (poset) have been established and connections to hypergraph theory have been recently revealed.

In this talk we shall survey these and other results concerning the poset $\tilde{\Omega}$. We start by presenting some properties of this poset and establish connections to the equational approach to function class definability. Then we will present a classification of $\tilde{\Omega}$ showing that it is universal among countable posets, and address some open problems. In particular, we shall consider the question of determining the join-irreducible elements of this poset, i.e., elements having a unique lower cover in $\tilde{\Omega}$. By establishing a complete correspondence between Boolean functions and hypergraphs, join-irreducibility translates into combinatorial properties of hypergraphs such as set-transitivity. As a partiular case, we explicitly describe those graphs which correspond to join-irreducible members of $\tilde{\Omega}$. We will discuss some results obtained jointly with Stephan Foldes, Maurice Pouzet, Erkko Lehtonen and Moncef Bouaziz.

18 March 2008, at 5 pm **Room 3.04 bs**

Giovanni Peccati
University Paris 6

High-frequency asymptotics on the sphere and Clebsch-Gordan random walks

Abstract

We discuss high-frequency central limit theorems on homogeneous spaces, and how they can be expressed in terms of convolutions of Clebsch-Gordan coefficients. These coefficients appear in unitary matrices connecting reducible representations of SO(3). This allows reinterpreting part of our results in terms of coupling of angular momenta in a quantum mechanical system. An important motivation for our research comes from the probabilistic representation and the statistical analysis of the Cosmic Microwave Background (CMB) radiation.

This is based on joint works with D. Marinucci (Rome).