**British Singularity Day**

**dedicated to the memory of**

**Vladimir Zakalyukin**

**Liverpool, 22 February 2012**

Programme

11:00-12:00  Jon Woolf (Liverpool)

*A functorial framework for intersection cohomology*

12:10-13:10  Alexei Gorinov (Liverpool)

*Cohomology of configuration spaces*

*and representations of the mapping class groups*

13:10-14:00 Lunch

14:00-15:00  Jean-Paul Gauthier (Toulon)

*Motion planning for kinematic systems*

15:10-16:10  Graham Reeve (Liverpool)

*Singularities of systems of chords in R^4*

16:10-16:40 Tea/coffee

16:40-17:40  Francesca Aicardi (Trieste)

*The geometry of indefinite binary quadratic forms*

***Venues:*** the first two lectures will be in Room D of ULRB (no.221 on the campus map), after which we move to the Mathematics building (no.206 on the map) for the lunch and later tea/coffee in room 304, and the last three lectures in room 211. The map is here:

http://www.liv.ac.uk/media/livacuk/maps/maps/liverpool-university-campus-map.pdf

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**ABSTRACTS**

**Jon Woolf**

Goresky and MacPherson's intersection cohomology is a modification of cohomology designed to extend Poincare duality to singular spaces. In fact one obtains intersection cohomology groups for each ‘perversity', and duality relates the groups of ‘complementary perversity'. Whilst very successful, the formalism of the theory is not as pleasant as that of cohomology, for instance there is a very restrictive notion of functoriality and no cup product. The aim of this talk is to show how, by packaging the intersection cohomology groups for all perversities into one invariant, one obtains a theory with nice formal properties. The aim is expository but as a byproduct there will be a few extensions to known results. If there is time I will also discuss the relation between perversities and constructible functions with values in the tropical integers.

**Alexei Gorinov**

Several years ago Kontsevich proposed an idea of constructing faithful finite-dimensional linear representations of the mapping class groups of surfaces. The idea briefly is that 1. every normal subgroup of the mapping class group of a surface contains at least one pseudo-Anosov element, and 2. every such element acts in a non-trivial way on the cohomology of a branched double cover (which depends on the element). In the talk we construct the resulting representations and describe some of their properties. If time allows, we will formulate some questions and conjectures.

**Jean-Paul Gauthier**

I shall present the main lines of a CONSTRUCTIVE theory, developed with Vladimir Zakalyukin within the past 10 years, with potential applications to robotics.
The natural abstract context of this study is subriemannian geometry, and the problem is formulated in terms of  "metric complexity" or "entropy" of a non-admissible path in the phase space, the path being embedded with the metric structure inherited from the Carnot-Caratheodory distance. It turns out that for the low dimensions or for a low number of kinematic constraints, there is a very strong stability property: more or less, the optimal appproximating curves are independant of the metric itself. I shall focus on the last developments, obtained last spring with V. Zakalyukin, and not yet published.

**Graham Reeve**

We shall discuss families of chords in affine 4-spacewhich connect points of two smooth surfaces at which the tangent planes are 'weakly-parallel', that is, are parallel to a common hyperplane. This work continues an earlier research by myself, Zakalyukin and others on 'centre symmetry sets' (the envelopes of such chords) for pairs of curves in the plane, pairs of surfaces in affine 3-space and a pair consisting of a curve and a surface in 3-space. We shall describe the classification of caustics, criminants and wavefronts according to the various geometrical relationships between the two surfaces in 4-space.

**Francesca Aicardi**

The problem of classifying indefinite binary quadratic forms with integer coefficients is solved by introducing a special partition of the de Sitter world, where the coefficients of the forms lie, into separate domains. Under the action of the special linear group on the integer plane lattice, each class of indefinite forms has a well-defined finite number of representatives inside each such domain. We show how to obtain, for any class, the number of points in all domains from a single representative of that class. We also answer Arnold's questions about the palindromicity of the periods of continued fractions of special quadratic surds.