ABSTRACTS DAS PALESTRAS:

Some open problems in the calculus of variations and elasticity

John Ball

The talk will discuss various open problems in the multi-dimensional calculus of variations motivated by elasticity, in particular related to quasiconvexity, the regularity of minimizers, and criteria for local minimizers.

The hypoelliptic Laplacian

Jean-Michel Bismut

We construct a deformation of Hodge theory, whose corresponding a Laplacian is a hypoelliptic operator on the cotangent bundle. This Laplacian interpolates between classical Hodge theory and the geodesic flow, ande more generally any Hamiltonian dynamical system. This Laplacian should be thought of as a semiclassical limit of the Witten deformation of the Laplacian on the loop space, associated to the energy functional on the loop space. Applications to the Ray-Singer analytic torsion will be presented.

TSP: state and art

Martin Groetschel

The travelling salesman problem (TSP) is probably the best known example of a combinatorial optimization problem. Moreover, the TSP has, since the birth of combinatorial optimization in the fifties, served as a "role model"
for the development of the theory and algorithmic techniques in combinatorial optimization. I will outline the progress that has been made in this area during the last 50 years along the milestones of the "TSP history" finishing with the state of the art. What does the TSP have to do with art? An answer will be presented at the end of the lecture.

Quantization of contact manifolds

Masaki Kashiwara

There exists a canonical stack on the contact manifold which corresponds to the modules over micro-differential operators.
I want to speak on an attempt to its topologiacal counterparts.
Quasi-regular Dirichet Forms and Stochastic Analysis on Configuration Spaces

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The framework of quasi-regular Dirichlet forms provids a one to one correspondence between a class of Markov processes and the associated Dirichlet forms, and has been used in different areas of stochastic analysis. In this talk I shall briefly introduce the notion of quasi-regular Dirichlet forms and review its applications to the stochastic analysis on configuration spaces. In particular I shall explore Dirichlet form approch in the study of infinite particle systems. At the end of the talk I shall mention its recent connection to the space of geometric graphs and to totally disconnected spaces.

The curve counting problem

Ragni Piene

Classical enumerative geometry has dealt with problems like counting the number of plane curves of given degree that satisfy certain given conditions - starting with Apollonius' eight circles tangent to three given circles and on to an assortment of problems in projective geometry
over the real or complex numbers, or over fields of positive characteristics. Significant progress was made with the development of modern intersection theory. But the most surprising event was the input from physics, when string theorists predicted solutions to curve counting problems based on the determination of corresponding generating functions via the principle of mirror symmetry. The main focus of the talk will be the problem of counting curves with given singularities and lying on a smooth surface; this will be a report on joint work with Steven Kleiman.

Invariants of self-intersecting curves in $\boldsymbol{R}^3$

Victor A. Vassiliev

We study the invariants of generic smooth maps $\mathbf{R}^1 \to \mathbf{R}^3$ with an arbitrary fixed topological type of self-intersections, and, more generally, homology groups of spaces of such maps $\mathbf{R}^1 \to \mathbf{R}^3$ for any $n \geq 3$. We describe the groups of invariants and homology classes of *degree 1* of these spaces in the sense analogous to the notion of the degree of knot invariants. These calculations provide an easy algorithm of recognizing the planarity of a selfintersecting curve. Also we study possible combinatorial representations of such invariants, and use them to obtain lower estimates of denominators in combinatorial formulas of knot invariants.

Dynamics in the moduli space of Abelian differentials

Marcelo Viana

An Abelian differential is a holomorphic 1-form on a Riemann surface. Alternatively, it may be seen as a translation structure on the surface: a flat metric plus a global parallel vector field (the "South" direction).

The Teichmuller flow acts naturally on the space of Abelian differentials, and its behavior often translates to properties of typical (full Lebesgue measure) translation surfaces.

For instance, Masur and Veech proved that the Teichmuller flow is ergodic on each stratum of the space of Abelian differentials. As a consequence, the geodesic flow on almost every translation surface is uniquely ergodic. In the early nineties, Zorich and Kontsevich discovered, through numeric experiments, that the statistical behavior of these geodesic flows is governed by a complete asymptotic flag, to a remarkable level of detail. Moreover, they provided an explanation for this phenomenon in terms of a conjecture on the Lyapunov spectrum of the Teichmuller flow on each stratum. This conjecture was recently established by A. Avila and myself.