Peter Albers (Heidelberg): Numerical simulations of (magnetic) billiards

I will present results of numerical simulations of magnetic billiards. This is joint work with Gautam Banhatti and Michael Herrmann. On the one hand they very clearly show KAM theory at work. Here small perturbations can be a magnetic field or changes in the geometry of the table. On the other hand we experimented with strong magnetic fields and I would like to raise questions concerning 'limit dynamics' and 'integrability' of magnetic billiards for very strong magnetic fields.

Mathieu Dutour Sikirić (Zagreb): Polyhedral computations and applications to topology

Polytopes occurs in many fields of mathematics. We will present facet computation and linear programming from the practical viewpoint.

Then we will turn to the problem of computing with lattices, of perfect forms and its relation with the packing problem and well rounded lattices.

Finally, we will explain how perfect forms allow one to compute some homology groups, and the situation for the integer symplectic groups.

Marco Fenucci (Pisa): Systematic search for periodic orbits of the N-body problem with the symmetry of Platonic polyhedra and numerical investigation of their stability

We describe an algorithm to search for all the periodic orbits of the N-body problem that can be found following the steps of the proof in [1]. These orbits have the symmetry of Platonic polyhedra and are obtained by a variational method. We compute them in two steps: first we search for approximating orbits, defined by Fourier polynomials, that minimize the Lagrangian action over suitable sets. Then we apply a shooting method to improve this approximation. We also investigate their stability by numerical methods.

[1] G. Fusco, G.F. Gronchi, P. Negrini, Platonic Polyhedra, Topological Constraints and Periodic Solutions of the Classical N-Body Problem, Invent. Math. **185** (2011), 283–332.

Davide Ferrario (Milano-Bicocca): Symmetries and periodic orbits for the N-body problem: a computational approach

The main goal is to understand and to find periodic orbits in the N-body problem, in the sense of finding methods to prove or compute their existence, and more importantly to describe their qualitative and quantitative properties. In order to do so, and in order to classify such orbits and their symmetries, computers have been extensively used in many ways since decades. I will focus on some very special symmetric orbits, which occur as symmetric critical points (local minimizers) of the gravitational Lagrangean action functional. The exploration of the loop space of the N-point configuration space raised some computational and mathematical questions that I have found interesting. The aim of the talk is to explain how such questions and issues were (more or less naively) considered in the development of a software package that combined symbolic algebra, numerical and scientific libraries, human interaction and visualization, in a set of tools that I have been using.

Hansjörg Geiges (Köln): Introduction to the N-body problem

I shall give an informal introduction to some basic geometric aspects of the N-body problem, based on my text *The Geometry of Celestial Mechanics*.

Giovanni F. Gronchi (Pisa): Variational methods to search for periodic orbits of the N-body problem with the symmetry of Platonic polyhedra

We show how symbolic computation and numerical methods can be used in the existence proof and in the visualization of some periodic orbits of the N-body problem. These orbits are obtained by a variational method: they are minimizers of the Lagrangian action in a set of T-periodic loops, equivariant for the action of the rotation group G of a Platonic polyhedron. The trajectory of each particle belongs to a fixed free homotopy class of $\mathbb{R}^3$ minus the set of rotation axes of G. In this procedure we combine Fortran, Maple and Matlab programmes.

Jean Gutt (Köln): Knotted symplectic embeddings

I will discuss a joint result with Mike Usher, showing that many toric domains X in the 4-dimensional euclidean space admit symplectic embeddings f into dilates of themselves which are knotted in the strong sense that there is no symplectomorphism of the target that takes $f(X)$ to X.

Michael Jünger (Köln): Combinatorial Optimisation (from a pragmatic point of view)

'Algorithmic Symplectic Packing' requires to find optimum solutions to hard optimisation problems. It is intended to apply methods of Combinatorial Optimisation in the hope to advance the state of the art. This talk introduces basic methods in Combinatorial Optimisation including linear and semidefinite optimisation, (mixed) integer optimisation, polyhedral combinatorics as well as cutting plane and branch & bound techniques. A selection of prominent combinatorial optimisation problems will serve as examples that illustrate computational approaches.

Michael Jünger (Köln): Algorithmic Symplectic Packing (Software Demonstration)

In preparation of the project C2 'Algorithmic Symplectic Packing' in the CRC/ TRR 191 we have written a computer program that finds all optimum packings of (not too many) simplices into a simplex or into a box. We give a live demonstration of the software, and, referring to the morning talk, we explain the used computational techniques and explore strengths, shortcomings and planned next steps.

Jungsoo Kang (Bochum): Symmetric periodic orbits in the restricted three-body problem

Symmetry appears naturally in many dynamical problems. For example the planar restricted three-body problem is symmetric with respect to the reflection along the line passing through two massive primaries. In this talk I will discuss symmetric periodic orbits in the planar restricted three-body problem and explain how these orbits can be detected using global surfaces of section.

Asaf Kislev (Tel Aviv): Hofer geometry on surfaces

The Hofer norm of a Hamiltonian diffeomorphism ϕ is the minimal oscillation of a Hamiltonian function that generates ϕ.One can think about it as the minimal energy needed to generate the dynamics of ϕ. This norm yields a very interesting geometric structure on the group of Hamiltonian diffeomorphisms, and it has many applications in symplectic topology. There are many open questions about this geometry even when the ambient symplectic manifold is of dimension two. In this talk, I will describe in short three questions related to Hofer geometry on surfaces. The first one is about non-commutative embeddings into $\mathrm{Ham}\,(\Sigma, \omega)$, where Σ is a surface of genus ≥ 4. The second question concerns with the boundary depth in the Floer theory of equators on S^2. The third question is related to bounds on the defect of the symplectic quasi-state on S^2.

In each one of these problems a computer program helped in finding the solution. I will present some of the ideas in the solutions but will not get into the details of the proofs.

Otto van Koert (Seoul): Proving the existence of periodic orbits and computing their Conley-Zehnder indices on a computer

In this talk, we give an overview of some rather classical methods to prove the existence of periodic orbits on a computer using some basic topological theorems. We apply these methods to a couple of classical problems, such as the restricted three-body problem. The symplectic topology part comes in when computing the Conley-Zehnder index: this can be done completely automatically on a computer.

Leonid Polterovich (Tel Aviv): Persistence modules in symplectic topology

The theory of persistence modules and their barcodes, which originated in topological data analysis, provides an efficient way to book-keep homological information contained in Morse theory and in its symplectic counterpart, Floer theory. I will discuss some recent advances in this direction.

Daniel Rosen (Tel Aviv): Introduction to Floer theory

Felix Schlenk (Neuchâtel): Explicit symplectic embeddings of balls into balls and cubes

We describe the known explicit symplectic embeddings of a ball B^{2n} into $\mathbb{R}^{2n}$. Given these embeddings two questions arise: Let b_k and c_k be the maximal percentage of the volume of a ball B^{2n} or a cube C^{2n} that can be filled by k equal symplectically embedded balls.

1. If b_k or c_k is known, can it be realized by explicit embeddings? (Example: b_k and c_k are all known in dimension 4.)

2. If b_k or c_k is not known, use these embeddings to provide interesting lower bounds. (Example: b_k is not known in dimension 6 if $9 \leq k \leq 20$.)

Since there are many explicit embeddings, finding the best among them in general requires powerful computer algorithms.

Vukasin Stojisavljevic (Tel Aviv): Persistence modules with operators

An operator on a (graded) persistence module is simply an endomorphism which shifts the filtration (and grading) by a fixed constant. Structures like this naturally appear in Morse and Floer theory, where the operator is given via (quantum) intersection product with a fixed (quantum) homology class. We will describe a formalism of persistence modules with operators, which allows us to simultaneously treat these situations from a formal point of view, and present some applications. The talk is based on a joint work with Leonid Polterovich and Egor Shelukhin.

Shira Tanny (Tel Aviv): A Poisson bracket invariant on surfaces

I will discuss geometry and analysis of a Poisson bracket invariant of finite open covers in dimension 2. Joint with L. Buhovsky and A. Logunov.

Jun Zhang (Tel Aviv): Floer-Novikov barcode and its application

In this talk, I will first explain how to define barcodes for Floer-type chain complexes over Novikov rings from joint work with Michael Usher, which broadens the application of persistent homology in Floer-theoretic based topological questions. Then, as one application, I will demonstrate how this general barcode theory can be used to construct invariants to generalize Polterovich-Shelukhin's result on detecting autonomous Hamiltonian diffeomorphisms in Hamiltonian diffeomorphism group.