Summer school in Contact and Symplectic topology

May 30th – June 10th, 2010

Monday May 30th

8:30 – 9:30: Registration

9:30 – 10:30: P. Massot *Topological methods in 3--dimensional contact geometry*

11:00 – 12:00: F. Bourgeois *Contact homology, symplectic homology and Legendrian surgery*

14:00 – 15:00: P. Massot *Topological methods in 3--dimensional contact geometry*

15:30 – 16:30: F. Presas *Open books and Lefschetz pencils in contact geometry.*

Tuesday May 31st

9:30 – 10:30: F. Presas *Open books and Lefschetz pencils in contact geometry.*

11:00 – 12:00: F. Bourgeois *Contact homology, symplectic homology and Legendrian surgery*

14:00 – 15:00: P. Massot *Topological methods in 3--dimensional contact geometry*

15:30 – 16:30: F. Presas *Open books and Lefschetz pencils in contact geometry.*

16:45 – 17:30: M. Pabiniak *Lower bounds for the Gromov width of coadjoint orbits in U(n)*

Wednesday June 1st

9:30 – 10:30: F. Bourgeois *Contact homology, symplectic homology and Legendrian surgery*

11:00 – 12:00: P. Massot *Topological methods in 3--dimensional contact geometry*

14:00 – 15:00: F. Presas *Open books and Lefschetz pencils in contact geometry.*

15:30 – 16:30: F. Bourgeois *Contact homology, symplectic homology and Legendrian surgery*

Thursday June 2nd

Free day (Ascension Day)

Friday June 3rd

9:30 – 10:30: P. Massot *Topological methods in 3--dimensional contact geometry*

11:00 – 12:00: F. Presas *Open books and Lefschetz pencils in contact geometry.*

14:00 – 15:00: F. Bourgeois *Contact homology, symplectic homology and Legendrian surgery*

15:30 – 16:30: Y. Huang *Classification of overtwisted contact structures via convex surfaces*

Monday June 6th

9:30 – 10:30: D. Auroux *An introduction to Fukaya categories*

11:00 – 12:00: G. Matić *Contact invariants in Heegaard Floer Homology*

14:00 – 15:00: N. A'Campo *Monodromy of complex hypersurface singularities*

15:30 – 16:30: D. Auroux *An introduction to Fukaya categories*

16:45 – 17:30: R. Avdek *A symplectic sum operation for contact manifolds*

Tuesday June 7th

9:30 – 10:30: N. A'Campo *Monodromy of complex hypersurface singularities*

11:00 – 12:00: D. Auroux *An introduction to Fukaya categories*

14:00 – 15:00: K. Niederkrüger *Introduction to contact topology in higher dimensions*

15:30 – 16:30: G. Matić *Contact invariants in Heegaard Floer Homology*

16:45 – 17:30: A. Vaugon *On the growth rate of contact homology*

Wednesday June 8th

9:30 – 10:30: D. Auroux *An introduction to Fukaya categories*

11:00 – 12:00: K. Niederkrüger *Introduction to contact topology in higher dimensions*

14:00 – 15:00: N. A'Campo *Monodromy of complex hypersurface singularities*

15:30 – 16:30: D. Auroux *An introduction to Fukaya categories*

16:45 – 17:30: V. Gripp *An absolute grading in Heegaard Floer homology*

Thursday June 9th

9:30 – 10:30: K. Niederkrüger *Introduction to contact topology in higher dimensions*

11:00 – 12:00: N. A'Campo *Monodromy of complex hypersurface singularities*

14:00 – 15:00: G. Matić *Contact invariants in Heegaard Floer Homology*

15:30 – 16:30: K. Niederkrüger *Introduction to contact topology in higher dimensions*

16:45 – 17:30: J. Nelson *Cylindrical Contact Homology for the links of simple singularities*

Friday June 10th

9:30 – 10:30: G. Matić *Contact invariants in Heegaard Floer Homology*

11:00 – 12:00: K. Niederkrüger *Introduction to contact topology in higher dimensions*

14:00 – 15:00: N. A'Campo *Monodromy of complex hypersurface singularities*

15:30 – 16:30 G. Matić *Contact invariants in Heegaard Floer Homology*

Courses:

Frédéric Bourgeois: *Contact homology, symplectic homology and Legendrian surgery.*

The first part of the course will be an overview of several holomorphic curves invariants for symplectic and contact manifolds, such as contact homology and symplectic homology. The relationship between these invariants will then be explained; this will lead to a common algebraic framework. We will finish with a description of the effect of Legendrian surgery on these invariants.

Patrick Massot: *Topological methods in 3--dimensional contact geometry.*

This course will be an introduction to Giroux's theory of convex surfaces in contact 3-manifolds and its simplest applications. The first goal is to explain why all the information about a contact structure in a neighborhood of a generic surface is encoded by finitely many curves on the surface. Then we will describe the bifurcations that happen in generic families of surfaces (with one or sometimes two parameters). Hopefully, time will permit to use this to convince the audience that the standard contact structure on S^3 is tight (Bennequin) and that all tight contact structures on S^3 are isotopic to it (Eliashberg). There are no prerequisite from contact topology, the course will start with the definition of contact structures.

Francisco Presas: *Open books and Lefschetz pencils in contact geometry.*

The goal of this course is to introduce the notion of open book and Lefschetz pencils decomposition and to show some of the uses of them in contact topology. We will discuss the constructions in dimension 3 manifolds in detail and we will give an outlook of what can be done in higher dimensional manifolds.

Norbert A'Campo: *Monodromy of complex hypersurface singularities*

In the course we will discuss properties of the monodromy, which is a relative mapping class of the Milnor fiber. A special representative will preserve some additional structure. We will give two examples of additional structures. For each such structure we will formulate a problem whose positive answer would imply the Zariski conjecture about the multiplicity. We will give these positive answers for the case of plane curve singularities. We will also discuss how the monodromy and the Reeb flow on the boundary of the Milnor fiber are related.

Denis Auroux: *An introduction to Fukaya categories*

The first half of this course will be an overview of Lagrangian Floer homology: the Lagrangian intersection problem, holomorphic discs, the Floer differential, product structures, and A-infinity relations. This will lead to an (incomplete, but sufficient for many purposes) definition of the Fukaya category. In the second half, we will take a closer look at several flavors of Fukaya categories, and some applications. In particular, we will discuss how Dehn twists and connected sums give rise to exact triangles, and briefly present Seidel's work on Fukaya categories of Lefschetz fibrations. If time permits, we will finish by a short introduction to wrapped Fukaya categories and their relation to symplectic field theory.

Gordana Matić: *Contact invariants in Heegaard Floer Homology*

In the first half of the course we will give a brief introduction to Heegaard Floer Homology. We will then explain how to define invariants of contact structures in Heegaard Floer Homology for closed manifolds, and show some applications of the invariant. In the second half of the course we will concentrate on manifolds with sutured boundary. We will introduce partial open book decompositions and see how they lead to a contact invariant in Sutured Floer Homology. We will finish with some examples, calculations and applications.

Klaus Niederkrüger: *Introduction to contact topology in higher dimensions*

This series of talks will be mostly focused on fillability questions for higher dimensional contact manifolds. The first two talks will give an overview of some basic examples and theorems known so far, comparing them with analogous results in dimension three. We will also explain several constructions and operations that lead to non-fillable manifolds. The second half of this series will explain how to use holomorphic curves with boundary to prove the fillability results stated in the first half of the course. No knowledge of holomorphic curves will be required, and

many properties will only be quoted. The aim is that at the end of the talks, the audience has some intuitive knowledge how to read off holomorphic curve properties from certain topological information of the contact manifold.

Students' talks:

Vinicius Gripp: *An absolute grading in Heegaard Floer homology*

Joanna Nelson: *Cylindrical Contact Homology for the links of simple singularities*

Milena Pabiniak: *Lower bounds for the Gromov width of coadjoint orbits in U(n)*

Avdek Russel: *A symplectic sum operation for contact manifolds*

Anne Vaugon: *On the growth rate of contact homology*