*Monday May 23*

*9:00-10:00am – Francesco Maggi, UT Austin*

**Quantitative isoperimetric principles and applications to phase transitions**  
  
We introduce some new sharp stability theorems for Almgren's isoperimetric principle and for the Euclidean concentration inequality that are motivated by the study of critical points of the Gauss free energy and of near-minimizers of the Gates-Penrose-Lebowitz free energy. The talk is based on joint works with Eric Carlen (Rutgers U), Giulio Ciraolo (U Palermo), Alessio Figalli (UT Austin), Brian Krummel (UT Austin) and Connor Mooney (UT Austin).

*10:00-11:00am – Yanyan Li, Rutgers University*

**Symmetry, quantitative Liouville theorems and analysis of large solutions of conformally invariant fully nonlinear elliptic equations**  
  
We establish blow-up profiles for any blowing-up sequence of solutions of general conformally invariant fully nonlinear elliptic equations on Euclidean domains. We prove that (i) the distance between blow-up points is bounded from below by a universal positive number, (ii) the solutions are very close to a single standard bubble in a universal positive distance around each blow-up point, and (iii) the heights of these bubbles are comparable by a universal factor. As an application of this result, we establish a quantitative Liouville theorem. This is a joint work with Luc Nguyen.

*11:30-12:30pm -- Arshak Petrosyan, Purdue University*

**Epiperimetric inequality approach to the regularity of the free boundary in thin and fractional obstacle problems.**  
We will discuss generalizations of Weiss’s homogeneity improvement approach to the thin and fractional obstacle problems as well as the parabolic Signorini problem. The main ingredients are an epiperimetric inequality and a monotonicity formula, which give a powerful combination in the analysis of free boundaries and establish the C1,**α** regularity of the regular set. The advantage of this method is that it is purely energy based and allows generalization to the case of thin obstacles living on codimension one C1,1 manifolds, or more generally, the thin obstacle problem for the divergence form operators with Lipschitz coefficients. The method can also be used in the study of the obstacle problem for the fractional Laplacian with drift, when the fractional order is greater that one half. It can also be used in the parabolic Signorini problem with variable coefficients, as a consequence of a recent proof of the boundedness of time derivatives under suitable conditions on the coefficients (Lip in space, W1,q, q>n+2 in time.)  
Based on joint works with Nicola Garofalo, Camelia Pop,  Mariana Smit Vega Garcia, and Andrew Zeller.

*2:30-3,30pm – Tristan Riviere, ETHZ*

**Harmonicity into Sub-Riemannian Geometries**

*4:00-5:00pm -- David Jerison, MIT*

**Singular limits of free boundary problems in the plane.**  
  
We discuss joint work with Nikola Kamburov describing  
the family of solutions to the one-phase free boundary  
problem in the disk with simply-connected positive phase.  If  
the curvature is large, then  the solution resembles the double hairpin solution discovered by Helein, Hauswirth and Pacard.   We prove this in a strong  
sense that reproduces (and somewhat improves upon)  
theorems of Colding and Minicozzi concerning minimal surfaces in  
this simpler free-boundary context. We will also describe the direct  
connection between these subjects discovered by M. Traizet.

*Tuesday May 24*

*9:30: 10:30am -- Tatiana Toro, U Washington*

**Boundary regularity in terms of interior and exterior harmonic measures.**

In this talk we describe the extent to which the absolute continuity of the interior and exterior harmonic measures determines the regularity the boundary of a domain. In this free boundary regularity problem the boundary condition is expressed in terms of the ratio of the "normal derivatives" rather than in terms of their jump.

*11:00-12:00pm -- Juncheng Wei, University of British Columbia*

**De Giorgi type conjecture and related problems for two phase free boundary problems**  
We consider De Giorgi's type conjecture for two phase free boundary problem in RN under the monotonicity condition uN>0. When N ≥ 9, N. Kamburov first constructed counter-examples to this conjecture. In this talk, we present recent works on this problem which shows parallel conclusions to Allen-Cahn equation: for dimensions N=2,3 we confirm the conjecture without any assumption; while for dimensions 4 ≤ N ≤ 8, we prove Savin's type theorem by imposing the extra limiting condition. In dimension 8, we also construct stable solutions which are not graphs and prove the existence of global minimizers (and hence give a new proof of the counter-example in dimension 9 by following Jerison-Monneau's approach). In dimension 3, we show the existence of  family of solutions with any prescribed logarithmic ends, which yields the existence of solutions to one phase problem.  (Joint work with K. Wang and Y. Liu).

*2:00-3:00pm – Charles Smart, U Chicago*

**The limit shape of convex hull peeling.**

This is joint work with Jeff Calder. Convex peeling provides a way to generalize one dimensional order statistics to higher dimensions. We prove that, under suitable conditions, the convex peeling of a random point cloud approximates the solution of a nonlinear partial differential equation. This requires identifying a suitable scale-invariant problem and using geometry to obtain tail bounds.

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*3:30-4:30pm -- Connor Mooney, UT Austin*

**Finite time blowup for parabolic systems in the plane.**

We will discuss an example of finite time blowup from smooth data for a linear uniformly parabolic system in two dimensions.

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*Wednesday May 25*

*9:00-10:00am – Alexis Vasseur, UT Austin*

**Holder regularity for hypoelliptic  kinetic equations with bounded  
measurable coefficients.**  
We prove that L2 weak solutions to a kinetic Fokker-Planck  
equation with bounded measurable coefficients are Holder continuous. This  
equation is hypoelliptic. The proof relies on classical techniques  
developed by De Giorgi and Moser together with the averaging lemma and  
regularity transfers developed in kinetic theory. This is a joint work  
with  Francois Golse, Cyril Imbert and Clement Mouhot.

*10:00-11:00am -- Donatella Danielli, Purdue University*

**Regularity results for a penalized boundary obstacle problem**

In this talk we will discuss the optimal regularity of solutions and the regularity of the free boundary for a two-penalty boundary obstacle problem modeling fluid flow through a permeable membrane. This is joint work with T. Backing and R. Jain.

*11:30-12:30pm -- Max Fathi, Berkeley*

**Entropic Ricci curvature on discrete spaces: examples and applications**I will present a few results on entropic Ricci curvature bounds for Markov  
chains on discrete spaces. This notion was introduced independently by J.  
Maas and by A. Mielke in 2011. Curvature bounds can be used to prove  
functional inequalities, such as spectral gap bounds and modified  
logarithmic Sobolev inequalities, which measure the rate of convergence to  
equilibrium for the underlying dynamic. Based on joint works with M. Erbar  
and J. Maas.

*2:30-3:30pm -- Vladimir Sverak, Minnesota*

**Geometric aspects of fluid flows and some finite dimensional  
model problems**

The equations describing inviscid incompressible fluid flows  
can be interpreted as equations for geodesics in the group of  
volume-preserving diffeomorphism. This geometric viewpoint was  
pioneered by V.I. Arnold, and further developed by many other  
mathematicians. Some of the questions arising in this context are  
interesting even for finite-dimensional groups, and in the lecture we  
will discuss some problems in this direction.

*4:00-5:00pm -- Alessio Figalli, UT Austin*

**Recent applications of quantitative stability to convergence to equilibrium**

Geometric and functional inequalities play a crucial role in several PDE problems.

Very recently there has been a growing interest in studying the stability for such inequalities. The basic question one wants to address is the following:

Suppose we are given a functional inequality for which minimizers are known. Can we prove, in some quantitative way, that if a function “almost attains the equality” then it is close to one of the minimizers?

Actually, in view of applications to PDEs, a even more general and natural question is the following: suppose that a function almost solve the Euler-Lagrange equation associated to some functional inequality. Is this function close to one one of the minimizers?

While in the first case the answer is usually positive, in the second case one has to face the presence of bubbling phenomena.

In this talk I’ll give a overview of these general questions using some concrete examples, and then present recent applications to some fast diffusion equation related to the Yamabe flow.

*Thursday May 26*

*9:30-10:30am -- Xu-Jia Wang, Centre for Mathematics and its Applications*

*Australian National University*

**Boundary behaviour of solutions to singular elliptic equations**  
  
We study regularity and singularity profile of solutions to a number of singular elliptic equations arising in geometric and physical applications. By careful construction of barrier functions we establish the optimal regularity for these equations near the boundary. Beyond the optimal regularity we can furthermore express the solution as a combination of logarithm and power functions, which gives precise information on the singularity of the solution.

*11:00-12:00pm -- Jean-Michel Roquejoffre,* [*Institut de Mathématiques*](http://www.math.univ-toulouse.fr)

*Université Paul Sabatier*

**A class of Hamilton-Jacobi equations with constraints: existence and uniqueness.**The model is a time-dependent Hamilton-Jacobi equation, which incorporates a tuning function whose role is to keep the maximal value of the unknown at the constant value 0. Our main result is that the full problem has a unique classical solution. The motivation is the singular limit of a selection-mutation model in population dynamics, which exhibits concentration on the zero level set of the solution of the Hamilton-Jacobi equation. The uniqueness result implies strong convergence and error estimates for the selection-mutation model.  
Joint work with S. Mirrahimi

*2:00-3:00pm -- Robert V Kohn, Courant Institute, NYU*

**A variational perspective on wrinkling patterns in thin elastic sheets**  
Thin sheets exhibit a daunting array of patterns. A key difficulty  
in their analysis is that while we have many examples, we have no  
classification of the possible "patterns." I have explored an alternative  
viewpoint in a series of recent projects with Peter Bella, Hoai-Minh  
Nguyen, and others. Our goal is to identify the \*scaling law\* of the  
minimum elastic energy (with respect to the sheet thickness, and the other  
parameters of the problem). Success requires proving upper bounds and  
lower bounds that scale the same way. The upper bounds are usually easier,  
since nature gives us a hint. The lower bounds are more subtle, since they  
must be ansatz-independent. In many cases, the arguments used to  
prove the lower bounds help explain "why" we see particular patterns.  
My talk will give an overview of this activity, and details of some  
examples.

*3:30-4:30pm -- Serena Dipierro, WIAS Berlin*

**Chaotic orbits for systems of nonlocal equations**

In this talk we consider a system of nonlocal equations driven by a perturbed periodic potential, and we construct multibump solutions which connect one integer point to another one in a prescribed way.

In particular, heteroclinic, homoclinic and chaotic trajectories are constructed.

A particular case of the problem under consideration is given by the

perturbed Peierls-Nabarro model for atom dislocations in crystals.

This is a joint work with Stefania Patrizi and Enrico Valdinoci.

*Friday May 27*

*9:30-10:30am -- Xavier Cabré (ICREA and UPC, Spain)*

**Curves and surfaces with constant nonlocal mean curvature**

The talk will be concerned with hypersurfaces of $\mathbb{R}^N$ with

constant nonlocal (or fractional) mean curvature. This is the equation

associated to critical points of the fractional perimeter under a volume

constraint. We first prove the nonlocal analogue of the Alexandrov result

characterizing spheres as the only closed embedded hypersurfaces in

**R**N with constant mean curvature. Our second result establishes

the existence of periodic cylinders in **R**N with constant nonlocal

mean curvature and bifurcating from a straight cylinder. These are Delaunay

type cylinders in the nonlocal setting. Here we use a Lyapunov-Schmidt

procedure for a quasilinear type fractional elliptic equation. Finally, we prove

the existence of different types of periodic lattices made of near-spheres and

having constant nonlocal mean curvature.

(These are joint works with Mouhamed M. Fall, Joan Solà-Morales, and

Tobias Weth)

*11:00-12:00pm -- Enrico Valdinoci, WIAS Berlin*

**Nonlocal minimal surfaces: quantitative estimates in the interior and at the boundary**  
We consider minimizers of the nonlocal perimeter introduced by L. Caffarelli, J.-M. Roquejoffre and O. Savin and we discuss their interior regularity properties and their boundary behavior.  
Roughly speaking, minimizers in balls of large radius in the plane are  
close to be flat; also, the surfaces have typically the tendency to  
stick at the boundary, thus producing boundary discontinuities.  
More general critical points will be also considered, in view of  
a suitable stability condition.