

## $\epsilon$ -REGULARITY TECHNIQUES IN PDES.

*Duration of the course:* August 4th, 2014 - August 14 2014  
Monday- Friday, 75min lecture in the morning.  
Monday-Friday, Guest Seminars and Student Seminars in the afternoon.

### **Description of the course:**

The first part of the course will be devoted to phase transitions problems and minimal surfaces. We will present several results in both contexts emphasizing the common underlying ideas. Special interest will be given to flatness theorems and their application to 1D symmetry of global phase transitions and in particular to De Giorgi's conjecture.

### **Some references:**

Savin, O., *Phase transitions, minimal surfaces and a conjecture of De Giorgi.* Current developments in mathematics, 2009, 59–113, Int. Press, Somerville, MA, 2010.

Savin, O., *Regularity of flat level sets in phase transitions.* Ann. of Math. (2) 169 (2009), no. 1, 41–78.

Valdinoci, E.; Sciunzi, B.; Savin, O., *Flat level set regularity of  $p$ -Laplace phase transitions.* Mem. Amer. Math. Soc. 182 (2006), no. 858,

Savin, O., *Entire solutions to a class of fully nonlinear elliptic equations.* Ann. Sc. Norm. Super. Pisa Cl. Sci. (5) 7 (2008), no. 3, 369–405.

De Silva, D.; Savin, O., *Symmetry of global solutions to a class of fully nonlinear elliptic equations in 2D.* Indiana Univ. Math. J. 58 (2009), no. 1, 301–315.

We will then present  $\epsilon$ -regularity results which share some common tools and ideas with the results discussed in the first part of the course.

### **Some references:**

Savin, O., *Small perturbation solutions for elliptic equations.* Comm. Partial Differential Equations 32 (2007), no. 4-6, 557–578.

Wang, Y., *Small perturbation solutions for parabolic equations.* To appear in Indiana University Math Journal.

De Silva, D., *Free boundary regularity for a problem with right hand side.* Interfaces Free Bound. 13 (2011), no. 2, 223–238.

Finally, we will see how some of these ideas extend to the case of so-called non-local problems.

**Some references:**

Caffarelli, L.; Roquejoffre, J.-M.; Savin, O., *Nonlocal minimal surfaces*. Comm. Pure Appl. Math. 63 (2010), no. 9, 1111–1144.

Savin, O.; Valdinoci, E., *Some monotonicity results for minimizers in the calculus of variations*. J. Funct. Anal. 264 (2013), no. 10, 2469–2496.

De Silva, D.; Savin, O.,  $C^{2,\alpha}$  regularity of flat free boundaries for the thin one-phase problem. J. Differential Equations 253 (2012), no. 8, 2420–2459.