

# Guido De Philippis

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## PERSONAL DATA

**Date and place of birth:** 16th August 1985, Fiesole (FI)

**Nationality:** Italian

## CURRENT POSITION

Associate Professor, SISSA Trieste, since April 2016

## PAST POSITIONS

- **January 2015-March 2016** Chargé de recherche CNRS, ENS Lyon.
- **January 2014-December 2014** Post Doc, University of Zurich, Zurich.
- **January 2013-December 2013** HCM Post Doc, Hausdorff Center for Mathematics, Bonn.

## EDUCATION

- **November 2012.** Ph.D in Mathematics, Scuola Normale Superiore, Pisa.  
Title of the thesis: *Regularity of optimal transport maps and applications*.  
Advisors: Prof. Luigi Ambrosio, Prof. Luis Caffarelli.
- **October 2009.** Master degree in Mathematics, magna cum laude, at the University of Florence.  
Title of the thesis: *“Il determinante Jacobiano per mappe singolari”*.  
Advisor: Dott. Emanuele Paolini.
- **October 2007.** Bachelor degree in Mathematics, magna cum laude, at the University of Florence.  
Title of the thesis: *“Una dimostrazione della minimalità del cono di Simons”*.  
Advisor: Dott. Emanuele Paolini.

## PRIZES AND AWARDS

- Invited Speaker ICM 2018
- EMS prize 2016 of the European Mathematical Society.
- Carlo Miranda Prize 2014 of the Accademia di Scienze Fisiche e Matematiche di Napoli.
- Gioacchino Iapichino Prize 2012 of the Accademia Nazionale dei Lincei.
- 2007-2009 INdAM's Fellowship (National Institution for Advanced Mathematics) for master students.

## GRANTS

- **2015-2018:** PI of the MIUR SIR-grant “Geometric Variational Problems” (RBSI14RVEZ).

## RESEARCH

My research interests are in the area of Calculus of Variations, Geometric Measure Theory and PDE.

## Research papers

1. G. DE PHILIPPIS, E. PAOLINI: *A short proof of the minimality of Simons cone*. Rend. Sem. Mat. Univ. Padova, **121**, (2009), 233-241.
2. G. DE PHILIPPIS: *Weak notions of Jacobian determinant and relaxation*. ESAIM Control Optim. Calc. Var., **18** (2012) 181-207.
3. L. AMBROSIO, G. DE PHILIPPIS, L. MARTINAZZI: *Gamma-convergence of nonlocal perimeter functionals*. Manuscripta Math., **134**, (2011), 377-403.
4. L.AMBROSIO, G.DE PHILIPPIS, B.KIRCHHEIM:*Regularity of optimal transport maps and partial differential inclusions*. Atti Accad. Naz. Lincei Cl. Sci. Fis. Mat. Natur. Rend. Lincei (9) Mat. Appl., **22**, (2011) 311-336.
5. L. AMBROSIO, M. COLOMBO, G. DE PHILIPPIS, A. FIGALLI : *Existence of Eulerian solutions to the semigeostrophic equations in physical space: the 2-dimensional periodic case*. Comm. in Partial Differential Equation., **37**, (2012), 2209-2227.
6. L. AMBROSIO, G. CRASTA, V. DE CICCO, G. DE PHILIPPIS: *A nonautonomous chain rule in  $W^{1,1}$  and in BV* Manuscripta Math., **140**, (2013), 461-480.
7. L. BRASCO, G. DE PHILIPPIS, B. RUFFINI: *Spectral optimization for the Stekloff–Laplacian: the stability issue* . J. Funct. Anal., **262**, (2012), 4675-4710.
8. G. DE PHILIPPIS, A. FIGALLI :  *$W^{2,1}$  regularity for solutions of the Monge Ampère equation*. Invent. Math., **192** (2013), 55-69.
9. F. CHARRO, G. DE PHILIPPIS, A. DI CASTRO, D. MÁXIMO: *On the Aleksandrov-Bakelman-Pucci estimate for the infinity Laplacian*. Calc. Var. Partial Differential Equations. **48** (2013), 667-693
10. G. DE PHILIPPIS, A. FIGALLI, O.SAVIN: *A note on interior  $W^{2,1+\varepsilon}$  estimates for the Monge Ampère equation*. Math. Ann., **357**, (2013), 11-22
11. G. DE PHILIPPIS, A. FIGALLI: *Second order stability for the Monge-Ampère equation and strong Sobolev convergence of optimal transport maps*. Anal. PDE., **6**, (2013), 993-1000
12. L. AMBROSIO, M. COLOMBO, G. DE PHILIPPIS, A. FIGALLI: *A global existence result for the semigeostrophic equations in three dimensional convex domains*. Discrete Contin. Dyn. Syst., **34**, (2014), 1251-1268.
13. G. DE PHILIPPIS, A. FIGALLI: *Sobolev regularity for Monge-Ampère type equations*. SIAM J. Math. Anal., **45**, (2013), 1812-1824
14. G. DE PHILIPPIS, B. VELICHKOV: *Existence and regularity of minimizers for some spectral functionals with perimeter constraint*. Appl. Math. Optim. **69** (2014), 199-231
15. G. DE PHILIPPIS, F. MAGGI: *Sharp stability inequalities for the Plateau problem*. J. Differential Geom. **96** (2014), 399-456
16. G. DE PHILIPPIS, A. FIGALLI: *Optimal regularity of the convex envelope*. Trans. Amer. Math. Soc. **367** (2015), 4407-4422.

17. G. DE PHILIPPIS, A. FIGALLI: *Higher integrability for minimizers of the Mumford-Shah functional*. Arch. Ration. Mech. Anal. **213** (2014), 491-502.
18. G. DE PHILIPPIS, M. MARINI: *A note on Petty's Theorem*. Kodai Math. J. **37** (2014), 586-594
19. G. DE PHILIPPIS, A. FIGALLI: *Partial regularity of optimal transport maps*. Publ. Math. Inst. Hautes Etudes Sci. **121** (2015), 81-112.
20. F. CAGNETTI, M. COLOMBO, G. DE PHILIPPIS, F. MAGGI: *Essential connectedness and the rigidity problem for Gaussian symmetrization*. J. Eur. Math. Soc. (JEMS) **19** (2017), no. 2, 395-439.
21. G. DE PHILIPPIS, A. MÉZÀROS, F. SANTAMBROGIO, B. VELICHKOV: *BV estimates in optimal transportation and applications*. Arch. Ration. Mech. Anal. **219** (2016), 829-860.
22. F. CAGNETTI, M. COLOMBO, G. DE PHILIPPIS, F. MAGGI: *Rigidity of equality cases in Steiner's perimeter inequality*. Anal. PDE **7** (2014), 1535-1593.
23. G. DE PHILIPPIS, F. MAGGI: *Regularity of free boundaries in anisotropic capillarity problems and the validity of Young's law*. Arch. Ration. Mech. Anal. **216** (2015), 473-568.
24. G. DE PHILIPPIS, F. MAGGI: *Dimensional estimates for singular sets in geometric variational problems with free boundaries*. J. Reine Angew. Math. **725** (2017), 217-234
25. L. BRASCO, G. DE PHILIPPIS, B. VELICHKOV: *Faber-Krahn inequalities in sharp quantitative form*. Duke Math. J. **164** (2015), 1777-1831.
26. S. DI MARINO, G. DE PHILIPPIS, M. FOCARDI: *Lower semicontinuity for non-coercive polyconvex integrals in the limit case*. Proc. Roy. Soc. Edinburgh Sect. A **146** (2016), 243-264.
27. G. DE PHILIPPIS, A. FIGALLI: *A note on the dimension of the singular set in free interface problems*. Differential Integral Equations **28** (2015), 523-536.
28. G. CRASTA, V. DE CICCO, G. DE PHILIPPIS: *Kinetic formulation and uniqueness for scalar conservation laws with discontinuous flux*. Comm. Partial Differential Equations **40** (2015), 694-726.
29. G. DE PHILIPPIS, G. FRANZINA, A. PARTELLI: *Existence of isoperimetric sets with "converging densities" on  $\mathbb{R}^N$* . J. Geom. Anal. **27** (2017), 1085-1105.
30. G. DE PHILIPPIS, A. DE ROSA, F. GHIRALDIN: *A direct approach to Plateau's problem in any co-dimension* Adv. Math. **288** (2016), 59-80.
31. G. CRASTA, V. DE CICCO, G. DE PHILIPPIS, F. GHIRALDIN: *Structure of solutions of multidimensional conservation laws with discontinuous flux and applications to uniqueness*. Arch. Ration. Mech. Anal. **221** (2016), 961-985.
32. G. DE PHILIPPIS, F. RINDLER: *On the structure of  $\mathcal{A}$ -free measures and applications*. Ann. of Math. **184** (2016), 1017-1039.
33. G. DE PHILIPPIS, J. LAMBOLEY, M. PIERRE, B. VELICHKOV: *Regularity of minimizers of shape optimization problems involving perimeter*. J. Math. Pures Appl. .To appear.
34. G. DE PHILIPPIS, A. FIGALLI: *Rigidity and stability of Caffarelli's log-concave perturbation theorem*. Nonlinear Anal. **154** (2017), 59-70.
35. G. DE PHILIPPIS, N. GIGLI: *From volume cone to metric cone in the nonsmooth setting*. Geom. Funct. Anal. **26** (2016) 1526-1587
36. G. DE PHILIPPIS, A. DE ROSA, F. GHIRALDIN: *Rectifiability of varifolds with locally bounded first variation with respect to anisotropic surface energies*. Comm. Pure Appl. Math. To appear.
37. G. DE PHILIPPIS, N. FUSCO, A. PRATELLI: *On the approximation of SBV functions*. Atti Accad. Naz. Lincei Cl. Sci. Fis. Mat. Natur. Rend. Lincei (9) Mat. Appl. To appear.

38. G. DE PHILIPPIS, F. RINDLER: *Characterization of generalized Young measures generated by symmetric gradients*. Arch. Ration. Mech. Anal. **224** (2017), 1087-1125.
39. A. ARROYO-RABASA, G. DE PHILIPPIS, F. RINDLER: *Lower semicontinuity and relaxation of linear-growth integral functionals under PDE constraints*. Adv. Calc. Var. To appear.

### Submitted

1. G. DE PHILIPPIS, A. DE ROSA, F. GHIRALDIN: *Existence results for minimizers of parametric elliptic functionals*. Submitted.
2. P. ANTONINI, G. DE PHILIPPIS, N. GIGLI: *The injectivity radius of Lie manifolds*. Submitted
3. G. DE PHILIPPIS, N. GIGLI: *Non collapsed spaces with Ricci curvature bounded from below*. Submitted
4. G. DE PHILIPPIS, A. PRATELLI: *The closure of planar diffeomorphisms in Sobolev Spaces*. Submitted

### Survey papers

1. G. DE PHILIPPIS, A. FIGALLI: *The Monge-Ampère equation and its link to optimal transportation*. Bull. Amer. Math. Soc. **51** (2014), 527-580.
2. G. DE PHILIPPIS, A. FIGALLI: *Partial regularity results in optimal transportation*. Springer INdAM series (2014).
3. G. DE PHILIPPIS: *On the singular part of measures constrained by linear PDEs and applications*. Proceedings of the 7ECM. (2016)

### Books and contributions in volumes

1. G. DE PHILIPPIS: *Regularity of optimal transport maps and applications*. PhD Thesis, Edizioni della Normale. Distributed by Springer. ISBN: 978-88-7642-456-4.
2. L. BRASCO, G. DE PHILIPPIS: *Spectral inequalities in quantitative form*. Chapter in "Shape optimization and spectral theory," 201–281, De Gruyter Open, Warsaw, 2017, edited by Antoine Henrot.
3. G. DE PHILIPPIS, A. MARCHESE, F. RINDLER: *On a conjecture of Cheeger*. To appear as chapter in "Measure Theory in Non-Smooth Spaces", De Gruyter, edited by N. Gigli.

### Invited Lectures

- *Una dimostrazione della minimalità del cono di Simons*. Workshop on Calculus of Variations and PDE. Firenze, January 2009.
- *Il determinante Jacobiano per mappe di Sobolev*. XX Convegno Nazionale di Calcolo delle Variazioni. Levico, February 2010.
- *Perimetri non locali*. XXI Convegno Nazionale di Calcolo delle Variazioni. Levico, February 2011.
- *Existence of Eulerian solution to the semigeostrophic system on the 2D torus*. Oberwolfach workshop on Variational Methods for Evolution Equations, December 2011
- *Stability for the Plateau problem*. Journée Thématique Calcul des Variations. Marseille, December 2011
- *Regularity of optimal transport maps*. Workshop "Optimal Transportation (to) Orsay". Orsay June 2011
- *Stability of optimal shapes for the Stekloff-Laplacian*. Oberwolfach workshop on Calculus of Variations. Oberwolfach, July 2012
- *Existence of distributional solutions to the semigeostrophic equations*. Meeting on Applied Mathematics and Calculus of Variations. Rome, September 2012

- *Fractional perimeter Gamma converges to the De Giorgi perimeter*. Two Days on Nonlocal Operators and Applications. Parma, October 2012
- *Partial regularity of optimal transport maps*. ERC Workshop on Optimal Transportation and Applications. Pisa, November 2012
- *Higher integrability for the gradient of minimizers for the Mumford-Shah functional*. Recent advances in Partial Differential Equations and Applications. Milan, June 2013
- *Higher integrability for the gradient of minimizers for the Mumford-Shah functional*. Oberwolfach Workshop on Partial Differential Equations. Oberwolfach, August 2013.
- *Partial regularity of optimal transport maps*. MSRI's Introductory Workshop on Optimal Transport: Geometry and Dynamics. Berkley. August 2013.
- *Faber-Krahn inequalities in sharp quantitative form* (joint talk with Lorenzo Brasco). 3rd Italian-Japanese workshop on "Geometric properties for parabolic and elliptic PDE's". Tokyo. September 2013
- *Spectral optimization problems with perimeter constraint*. ERC Workshop on "New Trends in Shape Optimization". Erlangen. September 2013
- *The sharp quantitative Faber-Krahn inequality*. ERC Workshop on " Geometric Measure Theory, Analysis in Metric Spaces and Real Analysis". Pisa. October 2013.
- *Spectral optimization problem with perimeter constraint* . Two Days on Hyperbolic PDE's, Geometric Measure Theory and Optimal Transport. SISSA. Trieste. October 2013.
- *The sharp quantitative Faber-Krahn inequality, Kinetics, non standard diffusions and stochastics: emerging challenges in the sciences*, Austin, May 2014.
- *Regularity of free boundaries in anisotropic capillarity problems and the validity of Young's law*, Nonlinear partial differential equations and stochastic methods, Jyvaskyla, June 2014.
- *The sharp quantitative Faber-Krahn inequality* , Oberwolfach workshop on Calculus of Variations. Oberwolfach, July 2014.
- *The sharp quantitative Faber-Krahn inequality, Analytic and Geometric Methods In the Calculus of Variations and PDE*, Accademia dei Lincei. Roma, September 2014.
- *BV estimates in optimal transportation and applications*. Workshop Optimal Transport in the Applied Sciences. Linz, December 2014.
- *BV estimates in optimal transportation and applications*. XXV Convegno Nazionale di Calcolo delle Variazioni. Levico, February 2015.
- *BV estimates in optimal transportation and applications*. Geometric Analysis, Free Boundary Problems and Measure Theory. Leipzig, June 2015.
- *Regularity of free boundaries in anisotropic capillarity problems and the validity of Young's law*. Shape optimization and spectral geometry. Edinburgh, June 2015.
- *BV estimates in optimal transportation and applications*. Oberwolfach Workshop on Partial Differential Equations. Oberwolfach, August 2015.
- *Faber-Krahn inequalities in sharp quantitative form*. Korean French Conference in Mathematics. Pohang, August 2015.
- *A direct approach to the Plateau problem* Workshop on shape optimization and calculus of variations. Chambéry. September 2015.
- *Regularity of free boundaries in anisotropic capillarity problems and the validity of Young's law*. Workshop in Analysis. Lyon. October 2015.

- *An approximation result in SBV*. Sixth Trilateral Meeting on Nonlinear Partial Differential Equations and Applications, Parma, December 2015.
- *On the structure of  $\mathcal{A}$ -free measures and applications*. Regularity theory for elliptic and parabolic systems and problems in continuum mechanics. Telč. April 2016.
- *On the structure of  $\mathcal{A}$ -free measures and applications*. Oberwolfach workshop on Calculus of Variations. Oberwolfach, July 2016.
- *On the singular part of measures constrained by linear PDEs and applications*. 7th European Congress of Mathematics. Berlin, July 2016.
- *On the structure of  $\mathcal{A}$ -free measures and applications*. Meeting on Applied Mathematics and Calculus of Variations. Rome, September 2016.
- *On the structure of  $\mathcal{A}$ -free measures and applications*. Workshop in Recent Trends in the Analysis of PDE's. Pavia, October 2016.
- *BV estimates in optimal transportation and applications*. Workshop "Transport phenomena in collective dynamics: from micro to social hydrodynamics". Zurich, November 2016.
- *Allard's rectifiability theorem for anisotropic energies*. CIRM Workshop "Shape Optimization, Isoperimetric and Functional Inequalities". Luminy, November 2016.
- *Allard's rectifiability theorem for anisotropic energies* Warwick EPSRC Symposium: Geometric PDE's. Warwick, December 2016.
- *On the structure of  $\mathcal{A}$ -free measures and applications*. International conference on moving interfaces and Related Phenomena in Mathematics and Physics. Shanghai April 2017.
- *On the structure of  $\mathcal{A}$ -free measures and applications*. Barcellona Mathematica Days. Barcellona, April 2017.
- *On the converse of Rademacher Theorem and the rigidity of measures in Lipschitz differentiability spaces*. Rolf Nevanlinna Colloquium, Zurich, June 2017.
- *Allard's rectifiability theorem for anisotropic energies*. Curves and Networks in Geometric Analysis Pisa, July 2017.
- *On the converse of Rademacher Theorem and the rigidity of measures in Lipschitz differentiability spaces*. Geometric Measure Theory, Warwick July 2017.
- *On the structure of  $\mathcal{A}$ -free measures and applications*. Equadiff 2017, Bratislava, July 2017.
- *On the converse of Rademacher Theorem and the rigidity of measures in Lipschitz differentiability spaces*. Oberwolfach Workshop on Partial Differential Equations. Oberwolfach, August 2017.
- *On the structure of  $\mathcal{A}$ -free measures and applications*. IperPV 2017, Pavia, September 2017.
- *On the structure of  $\mathcal{A}$ -free measures and applications*. Workshop on Elliptic Partial Differential Equations of Second Order: Celebrating 40 Years of Gilbarg and Trudinger's book, Melbourne, October 2017.
- *Spectral Optimisation problems with perimeter penalisation* ENSL meets SISSA, Lyon December 2017.

### Scientific visits (long periods)

- University of Texas Austin. February-May 2011.
- University of Texas Austin. January-May 2012.
- Laboratoire Jacques Louis Lions, FSMP Distinguished Professor Fellowship. October-November 2017.

## Conference organization

- *Isoperimetric Problems Between Analysis and Geometry*, with F. Morgan and A. Pratelli, Pisa, June 2014
- *Workshop on Geometric Measure Theory, Shape Optimization and Free Boundaries*, with G. Franzina, Trieste, October 2016.
- *Nonlocal Partial Differential Equations and Applications to Geometry, Physics and Probability*, with L. Caffarelli, E. Carlen, I. Gamba, F. Maggi. Trieste (ICTP), May 2017.
- *Recent Advances in PDE and Calculus of Variations*, with F. Rindler, Venice, July 2017.
- *Geometric Measure Theory in Verona*, with A. Massaccesi, G. Orlando, D. Vittone, Verona, June 2018.
- Co-organiser of the workshop on “Partial Differential equations” at the MFO, Oberwolfach, 2019-2023.

## Editorship

- **2016- present.** *Advances in nonlinear analysis*
- **2017- present.** *Journal of Functional Analysis*
- **2017- present.** *ESAIM: COCV*

## TEACHING

### Invited graduate or research-level courses

- *An introduction to optimal transportation and Monge Ampère type equations.* School and Workshop on “Geometric Measure Theory and Optimal Transport”, ICTP-Trieste, July 2013.
- *The Monge Ampère equation.* University of Florence. April-May 2015.
- *The selection principle: the use of regularity theory in proving quantitative inequalities.* Thematic period on Calculus of Variations, Optimal Transportation, and Geometric Measure Theory: from Theory to Applications. Lyon, June 2016.
- *Concentrations and Oscillations in Nonlinear PDE and in the Calculus of Variation.* Laboratoire Jacques Louis Lions. November 2017.

### Graduate classes

- *Topics in non-linear elliptic PDE.* University of Zurich, February 2014-May 2014.
- *Concentrations and Oscillations in Nonlinear PDE and in the Calculus of Variation.* SISSA-Trieste. June-July 2016
- *Geometric Measure Theory.* SISSA-Trieste. September 2016-April 2017

### Master classes

- *Functional Analysis.* SISSA and University of Trieste. March-June 2018

## Undergraduate classes

- 2010-Teaching assistant for the course “Analisi Matematica 2 e Complementi” (Calculus 2). Bachelor Degree in Engineering. 1 semester, 20 hours. University of Pisa.
- 2012- “Elementi di Matematica e Statistica” (Calculus 1), Bachelor Degree in Biotechnology. 1 semester, 72 hours, (9 CFU). University of Florence.
- 2014-Teaching assistant for the course “Geometry and Topology”. Bachelor Degree in Mathematics. University of Zurich,

## MENTORING

### PhD students

- **2014- 2017.** Antonio De Rosa. University of Zurich. (Coadvising with Camillo De Lellis)
- **2016- present.** Giulia Vescovo. SISSA
- **2017- present.** Ekaterina Mukoseeva. SISSA

### Master Students

- **2016** Riccardo Tione
- **2018** Luigi De Masi

### Post Doc

- **2016- present.** Jonas Hirsch
- **2016- present.** Michele Marini