

## Personal Informations

Last name: Tarulli Di Giallonardo

First name: Mirko

Date of birth: March 02, 1977

Place of birth: Pescara - Italy

Nationality: Italian

Marital Status: Single

Current position: Academic Visitor at the Mathematics Department at Imperial College London, UK (October 1, 2010 - June 30, 2011).

Scientific Research Field: MAT/05 - Mathematical Analysis.

Languages: Italian, English.

Business address:

- Dipartimento di Matematica “L. Tonelli” - Via F. Buonarroti, 2 - 56100 Pisa (Italy)  
e-mail: tarulli@mail.dm.unipi.it
- Mathematics Department at Imperial College London - 180 Queen’s Gate London , SW7 2AZ, UK  
e-mail: m.tarulli@imperial.ac.uk

Home address: Via Pola, 51/b - 67039 Sulmona (L’Aquila) (Italy)

Education:

- June 1996  
High school Diploma (Maturità di Liceo Scientifico).
- July 2002  
Degree (Laurea) in Mathematics, Department of Mathematics, University of L’Aquila, Italy.
- 6 June 2006  
Ph.D. (Dottorato di Ricerca), Department of Mathematics “L. Tonelli”, University of Pisa, Italy.

## Scientific Career

Academic Year 1995-96:

- June 1996  
High school Diploma (Maturità di Liceo Scientifico) with full marks (60/60).

Academic Year 2001-02:

- September 2001 - December 2002  
Three months of study at the Sofia University and Technical University of Sofia. Sofia, Bulgaria.
- July 2002  
Taking the degree certificate (Laurea) in Mathematics at the University of L'Aquila with full marks (110/110 cum laude).  
Title of the thesis:  
*Stime a priori su varietà di Riemann a curvatura costante negativa.*  
Adviser: Prof. Vladimir Georgiev.

Accademic Year 2002-03:

- November 2003  
Winning a competition for a Ph.D. position (Dottorato di Ricerca) in Mathematics at the University of Pisa, Italy; research adviser: Prof. Vladimir Georgiev.

Academic Year 2003-04:

- 19 November 2003  
Organizing Committee of "INCONTRO DI FISICA MATEMATICA Equazioni dispersive della fisica matematica, aspetti teorici e numerici" Dipartimento di Matematica Università di Pisa, Italy.
- 20-22 October 2004  
Organizing Committee of the Meeting "IPERPISA 2004 XI Incontro Nazionale sulle Equazioni Iperboliche", Dipartimento di Matematica, Università di Pisa, Italy.

Academic Year 2004-05:

- 26 May-19 June 2005  
Visit in the Institut für Angewandte Analysis Technische Universität Bergakademie, Freiberg, Germany. Supervisor Prof. Dr. M. Reissig.

- 6 June 2006

Taking the Ph.D. degree (Dottorato di Ricerca) at the Department of Mathematics “L. Tonelli”, University of Pisa, Italy.

Title of the thesis:

*Smoothing-Strichartz estimates for dispersive equations perturbed by a first order differential operator.*

Adviser: Prof. Vladimir Georgiev.

Academic Year 2006-07:

- 15 August 2006-15 August 2007

One Year Position as Visiting Assistan Professor in the Department of Mathematics and Statistics, University of Vermont, USA.

Academic Year 2007-08:

- 1 July 2007-30 June 2008

Winning a grant (INdAM fellowship) for a Postdoc position (Collaboratore ad Attività di Ricerca) at the Department of Mathematics “L. Tonelli”, University of Pisa, Italy; research adviser: Prof. Vladimir Georgiev

Academic Year 2008-09:

- 1 July 2008-30 June 2009

Winning a grant (INdAM fellowship) for a Postdoc position (Collaboratore ad Attività di Ricerca) at the Department of Mathematics “L. Tonelli”, University of Pisa, Italy; research adviser: Prof. Vladimir Georgiev

Academic Year 2009-10:

- 1 August 2009-30 July 2010

No-tenure researcher (Collaboratore ad Attività di Ricerca) at the Department of Mathematics “L. Tonelli”, University of Pisa, Italy; research adviser: Prof. Vladimir Georgiev

Academic Year 2010-11:

- 1 October 2010-30 June 2011

One Year Position as Academic Visitor in the Department of Mathematics at Imperial College London, UK; research adviser: Prof. M. Ruzhansky.

## Scientific Research

My scientific research has been mainly devoted to the following fields:

- Scattering Theory and Hamiltonian Theory
- A Priori Sobolev Estimates on Riemannian Manifolds With Constant Negative Curvature
- Perturbative Theory for semilinear Wave Equation
- Strichartz Estimates for the Wave Equation and Schrödinger Equation on Riemannian Manifolds
- A Priori Estimates On Riemannian Manifolds With Schwarzschild Metrics
- Smoothing And Strichartz Estimates for the Wave Equation and Schrödinger Equation Perturbed by a Magnetic Potential (Small and Large with respect to suitable norms)
- Wave Equation and Klein-Gordon Equation with Time Depending Perturbation (Resolvent and Microlocal analysis)
- Orbital and Asymptotic Stability of Nonlinear Evolution Equations
- Oscillatory Integrals and Microlocal Analysis
- Singular Integral Operators, Hardy-Littlewood Maximal function and Littlewood-Paley Theory
- Weighted Estimates on Symmetric Spaces and on a Riemannian Manifold
- All Aspects of Harmonic Analysis

## Research Experience

- Worked with the group of Vladimir Georgiev supported by the Research Training Network (RTN) HYKE, financed by the European Union, contract number: HPRN-CT-2002-00282.
- Worked with the group of Vladimir Georgiev supported by Contract PRIN-2005010482 (2005-2007) with Italian Ministry of Education, University and Research and the INDAM Contract “**Mathematical modelling and numerical analysis of quantum systems with applications to nanosciences**”.
- Participation to the PRIN Project “**Stime di decadimento e buona positura per problemi di tipo iperbolico e dispersivo**”. National coordinator: Prof. Piero D’Ancona (Università “La Sapienza”, Roma), local coordinator: Prof. Sergio Spagnolo (Università di Pisa).

- Participation to the research project “**Stime dispersive e questioni di continuazione unica**” within the AZIONI INTEGRATE ITALIA-SPAGNA (Miur). Italian coordinator: Vladimir Georgiev, Spanish coordinator: Luis Vega (Universidad del Pais Vasco - Euskal Herriko Unibertsitatea).

## Scientific Activity

My research interests involve several aspects of the Harmonic Analysis. I started to work with Professor Vladimir Georgiev during the early years of my University study. I learned tools of Harmonic analysis on Manifolds and on Symmetric Spaces and of Differential Geometry and this activity produces my thesis *Stime a priori su varietà di Riemann a curvatura costante negativa*, where i generalized some estimates valid on Euclidean space  $\mathbf{R}^n$  to Manifolds with constant negative sectional curvature (Hyperbolic Spaces). Part of this thesis was published as “Some A Priori Estimates On Riemannian Manifold With Constant Negative Curvature”.

A second project, again with Professor Vladimir Georgiev, concerned the use of the resolvent and the scattering techniques in order to obtain stability and dispersive effect for some hyperbolic equations perturbed by potentials. More precisely I obtained a priori estimates for the resolvent of “free” Laplacean and “perturbed by a small magnetic field” Laplacian in  $\mathbf{R}^3$  in suitable weighted Hilbert spaces, after I applied these estimates to Schrödinger, wave and Dirac Equations obtaining a smoothing effect (for wave equation and Dirac Equation a  $L^2$  integrability of the Local Energy) and the problem of the resonances was also considered. This is contained in the works “Resolvent estimates for compact perturbation of the Laplace operator and application” and “Resolvent estimates for scalar fields with electromagnetic perturbation.”

Successively in a joint work with V.Georgiev “Scale Invariant Energy Smoothing Estimates For The Schrödinger Equation With Small Magnetic Potential”, we considered some scale invariant generalizations of the smoothing estimates for the free Schrödinger equation obtained by Kenig, Ponce and Vega. Applying these estimates and using appropriate commutator estimates, we obtain similar scale invariant smoothing estimates for perturbed Schrödinger equation with small magnetic potential. These techniques were refined in a joint work with Vladimir Georgiev and Atanas Stefanov (University of Kansas), “Smoothing - Strichartz Estimates For The Schrödinger Equation With Small Magnetic Potential”. The work treats smoothing and dispersive properties of solutions to the Schrödinger equation with magnetic potential. Under suitable smallness assumption on the potential involving scale invariant norms we prove smoothing - Strichartz estimate (Bilinear Estimate) for the corresponding Cauchy problem. An application that guarantees absence of pure point spectrum of the corresponding perturbed Laplace operator is discussed too. Other two works are in preparation. In the first one , “Estimates For The Helmholtz Equation In The Smoothing Spaces And Applications, I prove some frequency-localized estimates for the Helmholtz equation and show that from these ones we can obtain estimates in a large class of smoothing spaces. The second work in preparation is Smoothing - Strichartz Estimates For A Class Of Dispersive Equation Perturbed By A First

Order Differential Operator, where under a suitable modification of an interpolation lemma due to Markus Keel and Terence Tao, combined with some tools of the harmonic analysis, I obtain smoothing - Strichartz bilinear estimate for the corresponding Cauchy problems of a class of dispersive equations and I apply such result to the Wave Equation, Klein-Gordon equation and Schrödinger equation. Applications to the problem of perturbation of these equation by a first order differential operator will be discuss too(in particular this technic solve the case of the perturbation by a magnetic potential). On the other hand, I am interested on the problem of “Wave equation on Schwarzschild Metric”, in order to obtain some smoothing and dispersive properties (resolvent estimates, microlocal analysis, harmonic analysis pseudodifferential approach...). The problem of Maslov index is also considered.

Another direction of my research is to consider wave and Klein-Gordon Equation with time depending coefficient and with Time-Periodic perturbation in order to find  $L^p - L^q$  estimates and to construct counterexamples where such estimates are not valid. The techniques involved in this problem are use of some tools of microlocal analysis and pseudodifferential operators and the project came from a collaboration with Professor Michael Reissig (Institut für Angewandte Analysis Technische Universität Bergakademie Freiberg). I was also in the Department of Mathematics of the UVM (University of Vermont) as Visiting Assistant Professor. Here, I’m working in collaboration with Michael J. Wilson and we obtained a first joint result that will appear in the work entitled “On a Caldéron-Zygmund Commutator Estimate”, where We generalize an estimate using techniques of the Littlewood-Paley theory, fractional integrals theory and maximal function theory. Moreover we apply this to prove some embedding for some weighted Besov spaces the very useful in the theory of partial differential equations. Currently, I am working on the problem of stability (orbital and asymptotic) with S. Cuccagna, V Georgiev and N. Visciglia (here I remember the paper “On asymptotic stability in energy space of ground states of NLS in 2D” and “On asymptotic stability of standing waves of discrete Schrödinger equation in  $\mathbf{Z}$ ”, joint works with S. Cuccagna). Moreover I collaborate with N. Visciglia and M. Ruzhansky in order to get the Bilinear smoothing-Strichartz estimates (endpoint) for a large class of evolution equations and Strichartz estimates for Lie group and homogeneous spaces.

## Teaching Activities

Academic Year 2004-05:

- Teaching activity (Assistant) in the course of Analysis II for Physicists, instructor Prof. Vladimir Georgiev. University of Pisa, Italy.

Academic Year 2005-06:

- Teaching activity (Assistant) in the course of Analysis III for Physicists, instructor Prof. Vladimir Georgiev. University of Pisa, Italy.

Academic Year 2006-07:

- Teaching activity (Assistant Professor) in the course Math 19P, Math 19S (Fall Semester, Academic Year 2006-07) and Math 19A, Math 19C (Spring Semester, Academic Year 2006-07), Department of Mathematics and Statistics, University of Vermont, USA.

Academic Year 2007-08:

- Teaching activity (Assistant) in the course Mathematics and Statistics for Biologists, instructor Prof. Paola Cerrai (for this aim, I get the title of “*Culture della Matematica*”).

Academic Year 2008-09:

- Teaching activity (Assistant) in the course of Harmonic Analysis, instructor Prof. Vladimir Georgiev. University of Pisa, Italy. Teaching activity (Assistant) in the course of Analysis for Computer Scientists and Chemists, instructor Prof. Mauro Sasseti.

Academic Year 2009-10:

- Teaching activity (Assistant) in the course of Analysis I for Engineers, instructor Prof. Vladimir Georgiev. University of Pisa, Italy. Teaching activity (Assistant) in the course of Analysis for Computer Scientists and Chemists, instructor Prof. Mauro Sasseti and Prof. Patrizia Gianni.
- Teaching activity (Assistant) in the course of Elements of PDE, instructor Prof. Vladimir Georgiev. University of Pisa, Italy. Teaching activity (Assistant) in the course of Analysis for Computer Scientists and Chemists, instructor Prof. Mauro Sasseti.

## Talks and Academic Conferences

Academic Year 2003-04:

- 7-14 June 2003  
Talk entitled “Some A Priori Estimates On Riemannian Manifold With Constant Negative Curvature” in 29-th International Summer School “Application of Mathematics in Engineering and Economics” , Sozopol, Bulgaria.

Academic Year 2004-05:

- 20 January 2004  
Talk entitled “Resolvent Estimates For Compact Perturbations and Applications”. Workshop Progetto GNAMPA 2003 “Problemi iperbolici in geometria e fisica”, University of “La Sapienza”, Rome, Italy.

- February 15 - May 15, 2004  
Participation to “Phase Space Analysis” Scuola Normale Superiore, Centro De Giorgi Pisa, Italy.
- 7 - 14 July 2004  
Talk entitled “Resolvent estimates for scalar fields with electromagnetic perturbation” in the NLW-HYKE: Summer School and Workshop on “NonLinear Wave Equations” Training Event of the HYKE network 7- 14 July 2004, Vienna, Austria .
- 14 December 2004  
Talk entitled “Smoothing and Strichartz Estimates for the Schrödinger Equation with small Magnetic Potential” Università de L’Aquila, Italy.
- 1 - 2 March 2005  
Talk entitled “Scale invariant smoothing estimates for the Schrödinger Equation with small Magnetic Potential” in the “Equazioni Dispersive della Fisica-Matematica, Aspetti Teorici e Numerici”, Università “La Sapienza” di Roma, Italy.
- 8 June 2005  
Talk entitled “Scale invariant smoothing estimates for the Schrödinger Equation with small Magnetic Potential” and ”Strichartz Estimates for Wave and Schrödinger equations perturbed by Potential. Institut für Angewandte Analysis Technische Universität Bergakademie Freiberg, Germany.
- 15 June 2005  
Talk entitled “An Overview On General Results for perturbed Dispersive Equations: Harmonic Analysis Techniques”. Institut für Angewandte Analysis Technische Universität Bergakademie, Freiberg, Germany.

## Academic Year 2005-06:

- 8-13 November 2005  
Participation to “Phase Space Analysis Of Pde’s”, Pienza, Italy.  
Academic Year 2005-06:
- 25 October 2006  
Talk entitled “An overview on dispersive equations perturbed by a potential: smoothing and Strichartz estimates”.  
Joint CEE, ME, and Applied Mathematics Seminar. University of Vermont, USA.
- 21 March 2007  
Talk entitled “Calderón-Zygmund commutator estimates and theory of function spaces”.  
Analysis Seminar, Department of Mathematics. University of Vermont, USA.



Academic Year 2007-08:

- 25-28 September  
Talk entitled “A Calderón-Zygmund commutator-type estimate”.  
Workshop “Existence and stability properties of solitary and standing waves in nonlinear differential equations”, Dipartimento di Matematica “L. Tonelli”, Università di Pisa.
- 29-30 November 2007  
Talk entitled “Estimates for dispersive equations in weighted Besov spaces and application”.  
International Workshop on Trends in Differential Equations and Dynamical Systems”, Dipartimento di Matematica Pura ed Applicata - Università di Modena and Reggio Emilia, Modena.
- 21-24 July 2008  
Talk entitled “On asymptotic stability in energy space of ground states of NLS in 2D”.  
SIAM Conference on Nonlinear Waves and Coherent Structures (NW08), Università di Roma “La Sapienza”.

Academic Year 2008-09:

- 8-12 September 2008  
Participation to the Summer School “Hamiltonian PDE’s and Variational Methods”, Villa Orlandi, Capri.
- 11-13 February 2009  
Talk entitled “On asymptotic stability in energy space of ground states of NLS in 2D”.  
IperBA09, XIII Incontro Nazionale Problemi di Tipo Iperbolico. Università di Bari.
- 24-29 May, 2009  
Participation to the Indam intensive period “New connections between dynamical systems and Hamiltonian PDE’s”, Università di Napoli “Federico II”.
- 13-17 July, 2009  
Participation to the 7th ISAAC Congress, Department of Mathematics, Imperial College London.

Academic Year 2007-08:

- 11-13 November 2009  
Talk entitled “On Asymptotic Stability of Standing Waves of Discrete Schrödinger Equation in  $\mathbf{Z}$ ”.  
“Three dispersive days on dispersive aspects related to linear and nonlinear Schrödinger equations”. Departments of Mathematics, Universities of Milano.

- 9-12 February, 2010  
Participation to the Workshop “Linear and Nonlinear Hyperbolic Equations”,  
Centro di Ricerca Ennio De Giorgi, Pisa, Italy

## Publications

- [1] Tarulli M., Resolvent estimates for compact perturbation of the Laplace operator and application. *C. R. Acad. Bulgare Sci.* 57 (2004), no. 4, 5–10.
- [2] Tarulli M., Resolvent estimates for scalar fields with electromagnetic perturbation. *Electron. J. Differential Equations* 2004, No. 146, 14 pp. (electronic).
- [3] Tarulli M., Some A Priori Estimates On Riemannian Manifold With Constant Negative Curvature.  
*Applications Of Mathematics in Engineering and Economics.*  
153-157, Sofftrade, Sofia, 2005.
- [4] Georgiev V., Stefanov A., and Tarulli M., Strichartz estimates for the Schrödinger equation with small magnetic potential.  
*Journes “Équations aux Dérivés Partielles”, Exp. No. IV, 17 pp., École Polytech., Palaiseau, 2005.*
- [5] Georgiev V. and Tarulli M., Scale Invariant Energy Smoothing Estimates For The Schrödinger Equation With Small Magnetic Potential.  
(ArXiv: <http://arxiv.org/abs/math.AP/0509015>).  
*Asymptotic Analysis* 47(1,2) (2006), IOS Press.
- [6] Georgiev V., Stefanov A., and Tarulli M., Smoothing - Strichartz Estimates For The Schrödinger Equation With Small Magnetic Potential.  
(ArXiv: <http://arxiv.org/abs/math.AT/0509416>).  
*Discrete and Continuous Dynamical Systems - A (DSCS-A)*, (17) (2007), 771–786.
- [7] Tarulli M., Strichartz Estimates For The Wave Equation With Magnetic Potential. *Comptes rendus de l’ Académie bulgare des Sciences Tome 60, No 1, 2007.*
- [8] Tarulli M. and Wilson J. M., On a Calderón-Zygmund Commutator-Type Estimate.  
(ArXiv; <http://arxiv.org/abs/math.FA/0702202>).  
*J. Math. Anal. Appl.* 347, (2008), 621632.
- [9] Cuccagna S., Tarulli M., On asymptotic stability in energy space of ground states of NLS in  $2D$ .  
(<http://arxiv.org/abs/0801.1277>).  
*Annales de l’Institut Henri Poincaré / Analyse non lineaire*, 26 (2009), 1361-1386.

- [10] Cuccagna S., Tarulli M., On asymptotic stability of standing waves of discrete Schrödinger equation in  $\mathbf{Z}$ .  
(<http://arxiv.org/abs/0808.2024>).  
SIAM Journal on Mathematical Analysis, No.3, Vol.41, 2009.
- [11] Tarulli M., On the connection between the weighted Besov spaces and the Smoothing-Strichartz estimates for dispersive equations. In Preparation.
- [12] Tarulli M., On the  $L^p$  continuity of wave operators in  $\mathbf{R}$ . In Preparation.
- [13] Georgiev V., Tarulli M., Exponential local energy decay for linearized wave equation near solitary solutions. In Preparation.
- [14] Cuccagna S., Tarulli M., On asymptotic stability of standing waves of discrete Schrödinger equation in  $\mathbf{Z}^2$ . In Preparation.
- [15] Cuccagna S., Tarulli M., The Hamiltonian structure of the nonlinear Klein-Gordon equation and the asymptotic stability of its ground states. In Preparation.

## Published Contributions To Academic Conferences

- [1] Tarulli, M. Resolvent estimates for scalar fields with electromagnetic perturbation. Communication (Poster Session) in the XI Incontro Nazionale sulle Equazioni Iperboliche IPERPISA 2004 (October 2004).
- [2] Georgiev, V. Stefanov, A and Tarulli M. Strichartz Estimates For The Schrödinger Equation With Small Magnetic Potential.  
Journées Équations aux dérivées partielles.  
Forges-les-Eaux, 6 Juin-10 Juin 2005  
GDR 2434 (CNRS).

## Professional Service

- Referee For *Mathematical Reviews*.
- Referee For *Applied Mathematics-A Journal of Chinese Universities*.

Dr. Mirko Tarulli Di Giallonardo