

Roberto De Leo

Curriculum Vitæ

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Scientific Interests

Applied Math/Dynamical Systems

1. Dynamics of solitons in double pendulums chains.
2. Magnetoresistance in normal metals under a strong magnetic field.

Global Analysis

1. Infinitesimal invertibility of the isometric operator and free maps.
2. Cohomological equation on the plane.

Low dimensional topology

1. Topology of foliations induced on surfaces $S \subset \mathbb{T}^3$ by closed 1-forms $\omega \in \Omega^1(\mathbb{T}^3)$;
2. Topology of quasiperiodic foliations of the plane with 3 and more quasiperiods;
3. Topology of regular foliations on the plane.

Education

- 1996–2000 **PhD**, *University of Maryland*, College Park, USA.
PhD in Pure Mathematics
- 1996–1998 **MA**, *University of Maryland*, College Park, USA.
M.A. in Pure Mathematics
- 1994–1996 **Laurea**, *Università di Cagliari*, Cagliari, Italy.
Laurea in Mathematics
- 1990–1994 **Doctorate**, *Università di Cagliari*, Cagliari, Italy.
Doctorate in Physics
- 1986–1990 **Laurea**, *Università di Cagliari*, Cagliari, Italy.
Laurea in Physics

PhD thesis

- year 2000
- title *Topological aspects of planar sections of periodic surfaces.*
- advisor S.P. Novikov, Fields Medalist (1970), U. of Maryland and IPST (USA), Steklov Inst. (Russia)
- jury W.M. Goldman, M. Brin, S.J. Gates

Doctorate thesis

year 1994
title *Positronium decay in four photons*
advisor A. Devoto, U. of Cagliari

Academic Employments and Fellowships

August 2013 – present **Assistant Professor**, *Department of Mathematics*, Howard University, Washington, DC.
Sep–Dec 2012 **Visiting Lecturer**, *Department of Mathematics*, University of Maryland, College Park, MD.
Sep–Dec 2011 **Visiting Scientific Researcher**, *IPST (Institute for Physical Science and Technology) and Department of Mathematics*, University of Maryland, College Park, MD.
April 2011 **Visiting Scientific Researcher**, *IPST (Institute for Physical Science and Technology) and Department of Mathematics*, University of Maryland, College Park, MD.
2011–2012 **Associate Research Fellow**, *Department of Physics*, University of Cagliari, Italy.
2007–2010 **Associate Research Fellow**, *Department of Mathematics*, University of Cagliari, Italy.
Feb–May 2007 **Visiting Scientific Researcher**, *IPST (Institute for Physical Science and Technology) and Department of Mathematics*, University of Maryland, College Park, MD.
2003–2007 **Researcher**, *Department of Physics*, University of Cagliari, Italy.
Jan–Aug 2002 **Fellowship**, *Department of Mathematics*, University of Cagliari, Italy.
2001 **Consultant**, *CRS4 (Computational center)*, Cagliari, Italy.
1997–2000 **Fellowship**, *Indam (Istituto di Alta Matematica “F. Severi”)*, Italy.

Teaching

Fall 2016 **MATH006 (College Algebra) and MATH450 (Topics in Applied Mathematics – Scientific Computing)**, *Department of Mathematics*, Howard University, Washington, DC.
Spring 2016 **MATH006 (College Algebra) and MATH155 (Calculus I)**, *Department of Mathematics*, Howard University, Washington, DC.
Fall 2015 **MATH006 (College Algebra) and MATH159 (Differential Equations)**, *Department of Mathematics*, Howard University, Washington, DC.
Spring 2015 **MATH006 (College Algebra) and MATH159 (Differential Equations)**, *Department of Mathematics*, Howard University, Washington, DC.
Fall 2014 **MATH158 (Calculus III)**, *Department of Mathematics*, Howard University, Washington, DC.
Spring 2014 **MATH006 (College Algebra) and MATH159 (Differential Equations)**, *Department of Mathematics*, Howard University, Washington, DC.
Fall 2013 **MATH150 (Modern Geometry) and MATH156 (Calculus 1)**, *Department of Mathematics*, Howard University, Washington, DC.
Fall 2012 **Lecturer for the course MATH115 (Precalculus)**, *Department of Mathematics*, University of Maryland, College Park, MD.

- Fall 2012 **Lecturer for the course MATH141H (Calculus 2)**, *Department of Mathematics, University of Maryland, College Park, MD.*
- April 2012 **Lecturer for a mini-course on numerical resolution of ordinary differential equations**, *Department of Mathematics, Moscow State University, Russia.*
- Spring 2010 **Lecturer for the course “Mathematics”**, *Department of Education, University of Cagliari, Italy.*
- Spring 2009 **Lecturer for the course “Mathematics”**, *Department of Education, University of Cagliari, Italy.*
- Spring 2008 **Lecturer for the course “Mathematics”**, *Department of Education, University of Cagliari, Italy.*
- 2007-08 **Teacher of Mathematics and Physics**, *Liceo Scientifico “L.B. Alberti”, Italy.*
- Spring 2006 **Lecturer for the course “Foundations of Mathematics”**, *Department of Education, University of Cagliari, Italy.*
- Spring 2005 **Lecturer for the course “Foundations of Mathematics”**, *Department of Education, University of Cagliari, Italy.*
- Spring 2004 **Teaching Assistant for the course “Mathematical Physics”**, *Department of Physics, University of Cagliari, Italy.*
- Spring 2004 **Lecturer for the course “Foundations of Mathematics”**, *Department of Education, University of Cagliari, Italy.*
- Spring 2003 **Lecturer for the course “Foundations of Mathematics”**, *Department of Education, University of Cagliari, Italy.*
- 2002-03 **Teacher of Mathematics and Physics**, *Liceo Scientifico “L.B. Alberti”, Italy.*
- Spring 2002 **Teaching Assistant for the course “Geometry 1”**, *Department of Mathematics, University of Cagliari, Italy.*
- Spring 2002 **Lecturer for the course “Foundations of Mathematics”**, *Department of Education, University of Cagliari, Italy.*
- Fall 2001 **Lecturer for the course “Computer Science”**, *Special School for High-School Teachers, University of Cagliari, Italy.*
- Fall 2000 **Teacher of Mathematics and Physics**, *Liceo Scientifico “L.B. Alberti”, Italy.*
- Fall 1997 **Teaching Assistant for the course MATH140 (Calculus 1)**, *University of Maryland, College Park, MD.*
- Spring 1997 **Teaching Assistant for the course MATH115 (Precalculus)**, *University of Maryland, College Park, MD.*
- Fall 1996 **Grader for the course MATH403 (Introduction to Abstract Algebra)**, *University of Maryland, College Park, MD.*
- 1994-95 **Teacher of Mathematics and Physics**, *Liceo Scientifico “L.B. Alberti”, Italy.*
- 1993-94 **Teacher of Mathematics and Physics**, *Liceo Scientifico “L.B. Alberti”, Italy.*

PhD Students

- 2004–2007 **Sergio Demelio**, *Department of Physics, University of Cagliari, Italy.*

Publications on solitons in double pendula chains

- [1] M. Cadoni, R. De Leo and G. Gaeta, *Solitons in a double pendulums chain model, and DNA roto-torsional dynamics*, *J. of Nonlinear Math. Phys.*, 14(1), 128-146, 2007, q-bio/0604027

- [2] M. Cadoni, R. De Leo and G. Gaeta, *Composite model for DNA torsion dynamics*, Phys. Rev. E, 75, 021919 (21 pages), 2007, q-bio/0604014
- [3] M. Cadoni, R. De Leo and G. Gaeta, *A symmetry breaking mechanism for selecting the speed of relativistic solitons*, J. Phys. A: Math. Theor., 40, 8517-8534, 2007, hep-th/0702213
- [4] M. Cadoni, R. De Leo and G. Gaeta, *Sine-Gordon solitons, auxiliary fields, and singular limit of a double pendulums chain*, J. Phys. A: Math. Theor., 40, 12917-12929, 2007, arXiv:0706.3173 [math-ph]
- [5] M. Cadoni, R. De Leo, S. Demelio and G. Gaeta, *Twist solitons in complex macromolecules: from DNA to polyethylene*, Int. J. on Non-Linear Mech., 43, 1094-1107, 2008, arXiv:0710.4475 [q-bio.BM]
- [6] R. De Leo and S. Demelio, *Numerical analysis of solitons profiles in a composite model for DNA torsion dynamics*, Int. J. on Non-Linear Mech., 43, 1029-1039, 2008, arXiv:0711.1069 [q-bio.BM]
- [7] M. Cadoni, R. De Leo, S. Demelio and G. Gaeta, *Propagation of twist solitons in fully inhomogeneous DNA chains*, J. of Non-linear Math. Phys., 17:4, 557-569, 2010, arXiv:0904.0148 [q-bio.BM]
- [8] M. Cadoni, R. De Leo and S. Demelio, *Soliton propagation in homogeneous and inhomogeneous models for DNA torsion dynamics*, J. of Non-linear Math. Phys., 18:S2, 287-319, 2011
- [9] R. De Leo and S. Demelio, *Some numerical results on motion of kinks in some model of DNA torsional dynamics*, CAIM 2:1 (2011)

Publications on the topology of closed 1-forms and magnetoresistance of normal metals

- [1] R. De Leo, *Existence and measure of ergodic leaves in Novikov's problem on the semiclassical motion of an electron*, Russian Math. Surveys, 56(6), 166-168, 1999, math-ph/0005031
- [2] R. De Leo, *Numerical analysis of the Novikov problem of a normal metal in a strong magnetic field*, SIAM J. on Applied Dyn. Sys., 2(4), 517-545, 2003, math-ph/0006023
- [3] R. De Leo, *Characterization of ergodic regime directions in the Novikov problem of a normal metal in a strong magnetic field*, Russian Math. Surveys, 58(5), 1042-1043, 2003, math/0207234
- [4] R. De Leo, *Topological effects in the magnetoresistance of Au and Ag*, Physics Letters A, 332, 469-474, 2004
- [5] R. De Leo, *Proof of a Dynnikov conjecture on the Novikov problem of plane sections of periodic surfaces*, Russian Math. Surveys, 60(3), 566-567, 2005
- [6] R. De Leo, *First-principles generation of Stereographic Maps for high-field magnetoresistance in normal metals: an application to Au and Ag*, Physica B, 362, 62-75, 2005, cond-mat/0409383
- [7] R. De Leo, *Topology of plane sections of periodic polyhedra with an application to the Truncated Octahedron*, Experimental Mathematics, 15(1), 109-124, 2006, math/0502219
- [8] R. De Leo and I.A. Dynnikov, *An example of fractal set of directions of planes that give a chaotic intersection with given 3-periodic surface*, Russian Math. Surveys, 62:5, 990-992, 2007
- [9] R. De Leo and I.A. Dynnikov, *Geometry of plane sections of the infinite regular skew polyhedron $\{4, 6|4\}$* , Geometriae Dedicata, 138:1, 51-67, 2009, arXiv:0804.1668 [math.GT]

Publications on the asymptotic growth of norms in semigroups

- [1] R. De Leo, *Exponential growth of norms in semigroups of linear automorphisms and Hausdorff dimension of self-projective IFS*, Journal of Geometrical Analysis, 25:3, 1798-1827, 2015
- [2] R. De Leo, *A conjecture on the Hausdorff dimension of attractors of real self-projective Iterated Function Systems*, Experimental Mathematics, 24:3, 270-288, 2015

Publications on the theory of Isometric Immersions and geometry

- [1] R. De Leo, *A note on non-free isometric immersions*, Russian Mathematical Surveys, 63(3), 577-579, 2010, arXiv:0905.0928 [math.DG]
- [2] G. D'Ambra, R. De Leo and A. Loi, *Partially Isometric Immersions and Free Maps*, Geometriae Dedicata, 151:1, 79-95, 2011, arXiv:1007.3024 [math.DG]
- [3] R. De Leo, *Partial immersions and partially free maps*, Differential Geometry and its Applications, 29:S1, 52-57, 2011, arXiv:1010.5362 [math.DG]

Publications on the Cohomological Equation

- [1] R. De Leo, *Solvability of the cohomological equation for regular vector fields on the plane*, Annals of Global Analysis and Geometry, 39:3, 231-248, 2011, arXiv:1007.3016 [math.DG]
- [2] R. De Leo, T. Gramtchev and A. Kirilov, *Global Solvability in Functional Spaces for Smooth Nonsingular Vector Fields in the Plane*, in Pseudo-Differential Operators: Analysis, Applications and Computations, L. Rodino, M.W. Wong and H. Zhu eds., vol. 214 of Operator Theory: Advances and Applications, Springer, 2011, arXiv:1001.2121 [math.AP]
- [3] R. De Leo, *Weak solutions of the cohomological equation in the plane for regular vector fields*, Mathematical Physics, Analysis and Geometry, 18:18, 2015

Preprints

- [1] R. De Leo, H. Mawi and C. Gutierrez, *On the numerical solutions of the far field refractor problem*, submitted in May 2016 to *Mathematical Models and Methods in Applied Sciences*.
- [2] R. De Leo, *Proof of a Gromov conjecture of the infinitesimal invertibility of the metric inducing operators*, submitted in May 2016 to the *Journal of Differential Geometry*.

Conferences and Talks

- 27-29 May 2016 *Solvability of the Cohomological Equation for regular vector fields on the plane*, 2016 Lehigh University Geometry and Topology, Lehigh University, Bethlehem, PA. USA
- 25 Jan; 1, 8, 22, 29 Feb; 7, 28 Mar; 4, 11, 18, 25 Apr 2016 *Free immersions of surfaces in the Euclidean spaces of minimal dimension*, Geometry and Topology seminar, Department of Mathematics, Howard University, Washington, DC. USA
- 30 March 2016 *An integral equation coming from a problem of Donaldson*, Evolution Equations & Dynamical Systems seminar, Department of Mathematics, Howard University, Washington, DC. USA
- 22-24 May 2015 *Topology of planar sections of the skew polyhedron $\{4, 6|4\}$* , 2015 Lehigh University Geometry and Topology, Lehigh University, Bethlehem, PA. USA
- 14 April 2015 *Exponential growth of norms in semigroups of linear automorphisms and Hausdorff dimension of self-projective iterated function systems*, Evolution Equations & Dynamical Systems seminar, Department of Mathematics, Howard University, Washington, DC. USA
- 5, 12, 19, 26 October 2014 *A quick survey of Hamiltonian systems*, Geometry and Topology seminar, Department of Mathematics, Howard University, Washington, DC. USA

- 2 April 2014 *Magnetoresistance in Normal Metals under a strong magnetic field*, Howard University, Washington, DC.
USA
- 26 March 2014 *Soliton propagation in homogeneous and inhomogeneous models for DNA torsion dynamics*, Advancing Computational Biology Howard University Symposium, Howard University, Washington, DC.
USA
- 13-15 March 2014 *Exponential growth of norms in semigroups of linear automorphisms and Hausdorff dimension of self-projective iterated function systems*, 48th Spring Topology and Dynamics Conference, University of Richmond, Richmond, VA.
USA
- 11 November 2013 *Planar Sections of Triply Periodic Surfaces*, Department of Mathematics, Howard University, Washington, DC.
USA
- 11 February 2013 *Soliton propagation in homogeneous and inhomogeneous models for DNA torsion dynamics*, Department of Mathematics, Howard University, Washington, DC.
USA
- 16 July 2012 *Partially isometric immersions and free maps.*, Department of Mathematics, Università di Roma “La Sapienza”, Roma.
Italy
- 21 May 2012 *Asymptotic growth of norms in semigroups of linear automorphisms and Hausdorff dimension of self-projective sets.*, Alexandrov Readings, International Topological Conference., Moscow State University, Moscow.
Russia
- 16 July 2012 *Partially isometric immersions and free maps.*, Department of Mathematics, U. of Roma, La Sapienza, Roma.
Italy
- 18 April 2012 *Some problems concerning (partially) free maps and the sets of (partial) isometries.*, Department of Mathematics, Moscow State University, Moscow.
Russia
- 7 Dec 2011 *Soliton propagation in homogeneous and inhomogeneous models for DNA torsion dynamics.*, Department of Mathematics, University of Sussex, Brighton.
UK
- 18 Mar 2011 *Hiring seminar.*, Department of Mathematics, University of Leicester, Leicester.
UK
- 10 Feb 2011 *Weak solutions of the cohomological equation on R^2 .*, Department of Mathematics, University of Leicester, Leicester.
UK
- 22-24 Sep 2010 *Global Solvability for Smooth Nonsingular Vector Fields in the Plane*, International Workshop on Global Properties of Partial Differential Equations on Manifolds, Cagliari, Italy.
- 27-31 Aug 2010 *Partially Isometric Immersions and Free Maps*, Differential Geometry and its Applications 2010, Brno, Czech Republic.
- 21-25 Jun 2010 *Propagation of twist solitons in fully inhomogeneous DNA chains*, SIMAI 2010, Cagliari, Italy.

- 9 Feb 2010 *An introduction to logic through puzzles.*, Department of Mathematics, University of Cagliari, Cagliari.
Italy
- 13-18 Jul 2009 *On the cohomological equation in the plane for regular vector fields*, 7th Isaac Congress, London, UK.
- 3-5 Jun 2009 *Propagation of twist solitons in real inhomogeneous DNA , Part II*, DNA 2009, Cagliari, Italy.
- 16-23 May 2009 *Appearance of a topological first integral in a multivalued Poisson dynamical system*, Nonlinear Evolution Equations and Dynamical Systems 2009, Isola Rossa, Italy.
- 1-11 Jul 2008 *Implementation of a software library to study the asymptotics of plane sections of periodic surfaces*, Algebraic Topological Methods in Computer Science 2008, Paris, France.
- 16-20 Jul 2007 *Plane foliations of $\{6, 4|4\}$ and $\{4, 6|4\}$* , Discrete Differential Geometry 2007, Berlin, Germany.
- Apr 2007 *Asymptotics of plane sections of the regular skew polyhedron $\{4, 6|4\}$* , Dynamical Systems seminar, U. of Maryland, College Park, USA.
- 20-22 Sep 2006 *Composite models for DNA torsional dynamics*, Mathematical Models for DNA Dynamics, Cagliari, Italy.
- 2004 *Geometry of plane sections of periodic surfaces*, Department of Mathematics, U. of Cagliari, Cagliari, Italy.
- 2004 *Getting fractals out of periodic surfaces*, Department of Mathematical Methods and Models for the Applied Sciences, U. of Roma “La Sapienza”, Roma, Italy.
- 2004 *Topological effects on the magnetoresistance of normal metals*, Mathematical-Physics seminar of U. of Roma “La Sapienza”, Roma, Italy.
- 2003 *Topological phenomena in normal metals*, Geometry seminar of U. of Roma “La Sapienza”, Roma, Italy.
- 2000 *Numerical analysis of the asymptotic behaviour of quasi-electrons orbits in a normal metal under a strong magnetic field*, Dep. of Physics, U. of Cagliari, Italy.
- 1999 *Topology of orbits of quasi-electrons in a normal metal under a strong magnetic field*, Dep. of Mathematics & Physics, U. of Camerino, Italy.

Languages

Italian	Native (C2)
English	Fluent (C1)
French	Average (B1)
Russian	Beginner (A2)
Latin	Reading (B1)

Computer skills

Applications	Mathematica, MatLab, GeoGebra, Emacs, Apache httpd, Mysql
Typesetting	T _E X
Programming	Fortran, Perl, Php, Java, Setl, C/C++

Software Packages Authored

- NTC A C++ library, built on top of the well-known open-source C++ library VTK, able to evaluate homology class of loops in \mathbb{T}^3 and in surfaces embedded in it. The library is available at the CompuTop software archive.
- PerlVTK Perl bindings for the C++ library VTK. The package, created and maintained by me in the first two years, is currently maintained by John Cerney (maintainer of the PDL package for scientific computations with Perl) and it is available at the CPAN repository.