

### **Personal information:**

- Born on August 20th 1972 in Milano (Italy), married, one son.
- Physics Master Degree (1997) at the Università degli Studi di Milano, 110/110 cum laude with an experimental dissertation on “Conformational changes of the BLG protein studied by fluorescence spectroscopy”, supervisor Prof. G. Baldini.
- PhD in Physics (1997-2000) at the Università degli Studi di Milano, with an experimental work on “Conformational changes of the BLG protein and role of the electrostatic interactions” performed at the Structure of Matter Section of the Physics Department, supervisor Prof. Baldini.

### **Professional positions:**

- Actual position: Associate Professor in Applied Physics 02/B3 (FIS/07) at the Università degli Studi di Milano-Bicocca (since 01/10/2014).
- December 2004-September 2014: Researcher in Applied Physics 02/B3 (FIS/07) at the Università degli Studi di Milano-Bicocca.
- April 2004-December 2004: Temporary contract as Researcher FIS/07 at the Università degli Studi di Milano-Bicocca reserved for winners of a researcher position at the same university.
- 2002-2004: Post-doc fellowship MURST (1/12/02 – 30/11/04).
- 2001-2002: Post-doc fellowship MURST project Cofin 2000 on “Diffusive and internal dynamics of labelled proteins by means of time resolved fluorescence”.
- 1997: Post-degree fellowship INFN on “Dynamics, interactions and folding of transport proteins”.

### **Scientific activity:**

Research field (02/B3): Biophysics, Optical Microscopy, (Image) Correlation Spectroscopy, Non-linear Optical Microscopy, Nanoparticles for Biosensing.

The research activity of LD has mainly focused in molecular biophysics, and it has been devoted, in particular, to the application of spectroscopic techniques to the study of the structural and dynamic properties of proteins, and to the analysis of their interaction, by combining experimental and theoretical-simulative approaches.

Since 2001 LD collaborates to the development of a laboratory for advanced spectroscopy (LABS) at the Physics Department of the University of Milano-Bicocca under the supervision of first Prof. G. Baldini and later Prof. G. Chirico, where fluorescence techniques have been combined to non linear optical microscopy to perform experiments at high spatial (sub-micrometers) and temporal (nanoseconds) resolution on the stability of biomolecules and on their interactions, down to the single molecule level or in cells or tissues, for biological and medical applications.

As a member of the Biophysics group at the University of Milano-Bicocca, LD contributes to the development of a research line of the Master Degree in Physics of this university, by exploiting the state-of-the-art microscopy and advanced spectroscopy instrumentation to supervise Bachelor and Master degree thesis and PhD and post-doc positions.

LD has acquired experience in time resolved fluorescence spectroscopy (both lifetime and anisotropy decay) and in in-vitro and in-vivo (cells) single molecules fluorescence by studying the dynamics, the conformational changes, the folding process (denaturation) and the interactions of globular proteins, focusing, in particular, on the effects of charge on the biomolecules and of the ionic screening of the solvent.

Moreover, LD has acquired expertise on advanced fluorescence techniques by employing non linear excitation to perform experiments of fluorescence correlation spectroscopy (FCS), fluorescence lifetime imaging (FLIM) and resonant energy transfer (FRET) in solutions and in cells, studying, for instance, chimeras of different green fluorescent protein (GFP) mutants.

In the last years, hot spots of LD's research have been 1) the investigation of the internal photodynamic of particular photo-switchable mutants of fluorescence proteins (GFP) with a recently developed pump & probe modulated FCS technique, 2) the characterization of newly synthesized metallic or hybrid metal-organic fluorescent probes, having long lifetimes upon one- or two-photon excitation and displaying interesting and promising cell penetration properties, or an efficient photothermal response upon infrared laser excitation, inducing local hyperthermia effects, and 3) the development of nano-biosensors based on the lifetime changes of particular fluorophores, with several possible applications, such as the determination of proteins concentration in solution or cellular extracts, the measurements of the local temperature, photo-induced drug-delivery and photo-thermal treatments. In particular, via antigen-antibody recognition a picomolar sensitivity has been reached for the determination of the concentration of the tumor marker p53 protein. Moreover, sensors based on metallic anisotropic or branched nanoparticles, whose cellular uptake has been followed with imaging, tracking and correlation experiments, allow the local and real-time measurements of the temperature with a 0.03 ns/C sensitivity.

At the moment, LD research focuses on the development of non linear excitation techniques to perform high spatial and temporal resolution imaging and correlation experiments, for applications to studies at the single molecule level, in cells or in tissues, or in-vivo on model organism (zebrafish, xenopus). To this aim LD has both modified, improved and optimized the LABS instrumentation to perform in-vivo multispot correlation experiments, with possible single plane excitation (to determine, for instance blood flow velocity in zebrafish embryos), and exploited the features of a STED (Stimulated Emission Depletion) nanoscope to study biological system by means of super-resolved (down to 60 nm) microscopy experiments. Particular attention has been focused on the peculiar properties of anisotropic (non spherically symmetric) gold nanoparticles (rods or stars), to exploit them as probes for cellular imaging thanks to their unique luminescent properties primed by non linear excitation. Fluorescence correlation techniques have been applied to characterize their diffusion coefficient and their aggregation properties both in solution and in cells in vivo. Finally, image correlation spectroscopy techniques (RICS, raster image correlation spectroscopy, TICS, temporal image correlation spectroscopy, SLIC, scanning laser image correlation) are currently devoted to study nanoparticles-cell interactions and the hemodynamics on model organisms (zebrafish).

The results of the scientific activity of LD have been presented in 51 papers on international journals, in 2 book chapters and in over 75 communications to national and international meetings and congresses.

h-index=15 , average citation/work=14 , total citations=655.

**Research and professional experiences:**

- 1999 Participant to the III National School of Pure and Applied Biophysics, "Spectroscopies and Computational Methods in the Study of Biological systems", organized by the SIBPA and the IVSLA, 25<sup>th</sup>-29<sup>th</sup> January 1999, Venice.
- 1999 Participant to the National School of Matter Science, "Biomolecules Physics and Surfaces Physics", organized by the ISI Foundation, 6<sup>th</sup>-17<sup>th</sup> September 1999, Villa Gualino, Turin.
- 2007 Organizer of a theoretical-practical workshop on confocal and non linear microscopy at the Physics Department of the University of Milano-Bicocca: "Visualizing Biological Function: Confocal Spectroscopy-Microscopy", 24<sup>th</sup>-25<sup>th</sup> October 2007, Milan.
- 2007-present Reviewer for the following peer reviewed scientific journals: Biophysical Journal, International Journal of Biological Macromolecules, Scientific Reports, etc.
- 2009 Organizer of a theoretical-practical workshop on novel probes and methodologies in biomedical imaging at the Physics Department of the University of Milano-Bicocca: "Visualizing Biological Function: Confocal Spectroscopy- Microscopy", 10<sup>th</sup>-12<sup>th</sup> March 2009, Milan.
- 2012 Organizer of the XVI School "Multimodal Methods for Cell Imaging and Tracking", 30<sup>th</sup> January – 3<sup>rd</sup> February 2012, Campo Santo Stefano, Venice.
- 2013 ANVUR habilitation to Associate Professor in Applied Physics (FIS/07).
- 2013-present Referee and rapporteur for FIR (Future in Research) and SIR (Scientific Independence of young Researchers) projects on behalf of the MIUR, Ministry for Education, University and Research.
- 2014 Member of the PhD Faculty in Physics and Astrophysics.
- 2014 MeetMeTonight 2014, The European researchers night for scientific dissemination.
- 2015 Science Corner for EXPO2015 Milano for scientific dissemination.
- 2015 Supervisor of the Piano Lauree Scientifiche 2014-2016 (Scientific Degrees Plan) promoted by the MIUR, Ministry for Education, University and Research, for the degree in Physics.
- 2015 Supervisor of the Laboratory LABEX, aimed to high school students within the Scientific Degrees Plan, promoted by the MIUR, Ministry for Education, University and Research.

**Participation to research projects:**

LD has participated to several research projects funded to Prof. G.Baldini, Prof. G.Chirico and Prof. M.Collini with whom LD collaborates in the Biophysics group:

1. Cariplo Foundation 2010: "Gold nanorods (NR) and asymmetric nanoparticles (ANP) capped with a biocompatible polymer bearing binding groups for molecules and metal cations: pharmacological and thermal antimicrobial action activated by near-IR irradiation" (total cost: k€470);
2. Regional Project Accordo Quadro (2009): "Development of a coherent Raman microscopy system for biomedical imaging" (k€220);
3. PRIN08: "Studies of fluorescence correlation spectroscopy of photo-activable proteic constructs for dynamic applications in optical microscopy by means of two color excitation" (k€45);
4. PRIN06: "Binding kinetics studies by means of single molecule fluorescence for high resolution revelation in medicine and biology" (k€32);
5. Cariplo Foundation 2005: "Construction and read out of 2D networks of fluorescent molecules by AFM: towards molecular optical memories" (k€180);
6. FIRB 2004: "Protein folding and aggregation: metals and biomolecules in conformational diseases";
7. FIRB 2004 (INFM): "Folding and interaction mechanisms of beta-homologue proteins by means of NMR and advanced spectroscopies" (k€20);
8. PRIN 2003: "Metal Carbonyl Clusters Functional to Nanomaterial" (k€20);
9. PAIS 2003 (INFM): "MEAB: multiphoton excitation of advanced bioprobes" (k€ 80);
10. PRIN02: "Characterization of novel fluorescent probes for two photon excitation of biomolecules" (k€ 58);
11. PAIS 2002 (INFM): "FOLGIN, Stabilization of native intermediates in beta-lactoglobulin folding pathway: role of ligand interaction as detected by NMR and optical spectroscopies" (k€ 80);
12. PRIN00: "Diffusive and internal dynamics of labeled proteins by means of time resolved fluorescence" (k€ 78).

#### **Organization of workshops and schools:**

- XVI Scuola di Biofisica Pura e Applicata "Multimodal Methods for Cell Imaging and Tracking", Campo Santo Stefano, Venezia, 30<sup>th</sup> January – 3<sup>rd</sup> February, 2012.
- Theoretical-practical workshop on novel probes and methodologies in biomedical imaging "Visualizing Biological Function: Confocal Spectroscopy- Microscopy", 10<sup>th</sup>-12<sup>th</sup> March 2009.
- Theoretical-practical workshop on confocal and non linear microscopy "Visualizing Biological Function: Confocal Spectroscopy-Microscopy", Milano, 24<sup>th</sup>-25<sup>th</sup> October, 2007.

#### **Scientific Collaborations:**

- Scientific and Technological Department, University of Verona (H.Molinari);
- Telethon Institute at the Venetian Institute for Molecular Medicine, Padova (M.Zaccolo);
- S.C. Regenerative Medicine, National Institute for Cancer Research, Genova (M.Rocco);

- Dynamics of Immune Responses, Division of Immunology, Transplantation and Infectious Diseases, San Raffaele Scientific Institute, Milano (M.Iannacone);
- Istituto Superiore di Sanità, Roma (F.Mazzei, S.Soddu);
- San Raffaele Foundation, Milano (V.Caiolfa);
- LAMBS-INFN, Physics Department, University of Genoa, and IIT (A.Diaspro);
- Chemistry Department, University of Milano (M.Panigati, D.Maggioni, S.Maiorana, E.Licandro);
- Chemistry Department, University of Pavia (P.Pallavicini);
- Biochemistry Department, University of Parma (S.Bettati, A.Mozzarelli);
- Biotechnology and Biosciences Department, University of Milano-Bicocca (I.Zanoni, E.Martegani);
- Environmental Sciences Department, University of Milano-Bicocca (P.Mantecca, M.Camatini);
- Experimental Medicine Department, University of Milano-Bicocca (I.Rivolta, G.Miserocchi);
- Neurological Institute Carlo Besta, Milano (F.Acerbi);
- Physics Department, Politecnico di Milano (G.Cerullo, D.Polli, M.T.Raimondi);
- University of Tel-Aviv (P.Blinder);
- Tumour National Institute Regina Elena, Roma (G.Piaggio).

***Other activities and teaching:***

Since 2003 LD held teaching charges for the Physics Department of the Università' di Milano-Bicocca, for both the Bachelor (LF) and the Master (LSF) Degree in Physics.

- aa 03/04: (LF) Laboratory of Biological and Medical Physics (in collaboration with Prof. Amaldi)
- aa 04/05: (LSF) Biophysics laboratory I modulo 7 CFU
- aa 05/06 and aa 06/07: (LF) Laboratory of Biological and Medical Physics 6 CFU, and (LSF) Biophysics laboratory I modulo 7 CFU
- aa 07/08: (LF) Laboratory of Biological and Medical Physics 6 CFU, Recitations for the course Physics III (I e II modulo) 2.5 CFU, and (LSF) Biophysics laboratory I modulo 7 CFU
- aa 08/09: (LF) Laboratory of Biological and Medical Physics 6 CFU, Recitations for the course Physics III (I e II modulo) 2.5 CFU
- aa 09/10 and aa 10/11: (LF) Laboratory of Biological and Medical Physics 6 CFU
- aa 11/12: (LF) Recitations for the course Physics I (II modulo) 2 CFU, and (LSF) Biophysics laboratory 6 CFU
- aa 12/13: (LF) Recitations for the course Physics I (I e II modulo) 4 CFU, and (LSF) Biophysics laboratory 6 CFU
- aa 13/14: (LF) Recitations for the course Physics I (I e II modulo) and Complements of Physics I 4 CFU, and (LSF) Biophotonics Laboratory II 6 CFU

- aa 14/15: (LF) Lecturer of the course Elements of Medical and Environmental Physics 3 CFU, and (LSF) Biophotonics Laboratory II 6 CFU
- aa 15/16: (LF) Lecturer of the course Elements of Medical and Environmental Physics 6 CFU, Lecturer of the course Physics I for the Bachelor Degree in Chemical Sciences and Technologies 6 CFU, and (LSF) Biophotonics Laboratory II 6 CFU

Moreover from 1998 to 2003 LD has held assistant teaching charges at the Politecnico di Milano for Proff. M.Marangoni, S.Taccheo e R.Osellame.

LD has been the supervisor of several thesis for the Master Degree in Physics and stages for the Bachelor Degree in Physics.

Since 2008 LD is involved for the Biophysics group in the stages for the students of the secondary school.

LD has been member of commissions for PhD defenses and has been enrolled twice (2006, 2011) as a member for the board for the PhD admission valuation procedure.

Associate Professor in Applied Physics 02/B3 (FIS/07) at the Physics Department of the Università degli Studi di Milano-Bicocca (since 01/10/2014) Laurea Degree in Physics (1997, Milano). PhD in Physics (1997-2000), Università degli Studi di Milano. Post-doc fellowships (2001-2004) for the study of the dynamics, the interactions and the folding of carrier proteins.

The research activity of LD has mainly focused on molecular biophysics, and it has been devoted, in particular, to the application of advanced spectroscopic techniques, aided by non linear excitation, to study structural and dynamic properties of proteins and their interactions, by combining experimental and theoretical-simulative approaches. Fluorescence techniques have been combined to non linear optical microscopy to perform experiments at high spatial and temporal resolution, down to the single molecule level, in cells or tissues or model organisms, for biological and medical applications. LD has acquired experience in time resolved fluorescence spectroscopy and in in-vitro and in-vivo single molecules fluorescence, in fluorescence correlation spectroscopy (FCS), fluorescence lifetime imaging (FLIM) and resonant energy transfer (FRET). Hot spots of LD's research have been the characterization of metallic or hybrid metal-organic fluorescent probes, the development of nano-biosensors based on the lifetime changes of particular fluorophores, with several possible applications, the modification of the LABS equipment and the use of a STED nanoscope to perform in-vivo multispot correlation experiments, with possible single plane excitation, the development of image correlation techniques to study in vivo nanoparticles-cell interactions and the hemodynamics on model organisms (zebrafish).

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