LAURA SIRONI

Education:

- PhD in Physics: *01/01/2008-01/01/2011* at the Università degli Studi di Milano-Bicocca. Thesis title: "Nanoparticles for in-vitro and in-vivo biosensing and imaging" performed at the Biophysics laboratory, Department of Physics.
- Physics Master Degree: *2007* at the Università degli Studi di Milano-Bicocca; 110/110 cum laude with an experimental work on: "Study of second harmonic polarization in biological tissues" performed at the Biophysics laboratory, Department of Physics.
- Bachelor Degree in Physics: *2004* at the Università degli Studi di Milano-Bicocca; 110/110 cum laude with an experimental work on: "Resonant energy transfer by means of two photon microscopy" performed at the Biophysics laboratory, Department of Physics.

Academic career:

2016-current Assistant Professor in Applied Physics, RTD-B (art. 24 c.3-b L. 240/10), 02/B3 (FIS/07) at the Università degli Studi di Milano Bicocca

2012-2016 Assistant Professor in Applied Physics , RTD-A (art. 24 c.3-a L. 240/10), 02/B3 (FIS/07) at the Università degli Studi di Milano Bicocca

01/2012-09/2012 Postdoc at the Laboratory of "Dynamics of Immune Responses", Division of Immunology, Transplantation and Infectious Diseases, San Raffaele Scientific Institute. Group Leader: Dr. Matteo Iannacone

05/11- 07/11 Visiting researcher at the laboratory of Prof. A. Zumbusch, University of Konstanz, Germany

02/2011-12/2011 Laboratory technician within the project " Development of a coherent Raman microscopy system for biomedical imaging", at the Università degli Studi di Milano-Bicocca.

Research activity:

LS has a scientific background in advanced spectroscopic methods and in fluorescence techniques combined to linear and non linear optical microscopy for biological and medical applications. LS has acquired expertise in time resolved fluorescence spectroscopy (both lifetime and anisotropy decay) in-vitro and in-vivo (cells), fluorescence correlation spectroscopy (FCS), fluorescence lifetime imaging (FLIM) and resonant energy transfer (FRET) in solutions and in cells. LS has also experience with cell culture, immunofluorescence techniques and flow citometry. The research activity of LS is also devoted to deep-tissue in-vivo and ex-vivo multi-photon excitation imaging.

In the last years, hot spots of LS's research have been:
1) *Nanosensing of proteins:* 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, photoinduced 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.

2) *Nanoparticles-cell interaction:* characterization of newly synthesized metallic or hybrid metalorganic fluorescent probes, displaying interesting and promising cell penetration properties. In particular LS focused on the exploitation of non spherically symmetric gold nanoparticles (nanostars and nanorods) as probes in cellular imaging, thanks to the emitted luminescence primed by two-photon excitation. The diffusion coefficient and aggregation properties of the NPs were studied both in solution and in cells by means of fluorescence correlation techniques. LS also investigated the possibility to use the NPs functionalized with thermoresponsive copolymers as drug delivery systems; the same NPs grafted on mercaptopropyltrimethoxysilane-coated glass slides show an efficient photothermal response upon infrared laser excitation, inducing local hyperthermia and efficient killing of Staphylococcus aureus biofilms.
3) *Intravital Non-linear optical Microscopy (both in vivo and ex vivo):* since her Master Degree Thesis LS has contributed to set-up and optimize an intravital microscopy system based on two photon excitation at the Laboratory of Advanced Bio-Spectroscopy (Biophysics Group, Università degli Studi di Milano-Bicocca). This system was devoted to the study of the second harmonic signal generated by tissues and to applications in the field of immunology. LS studied the interaction between dendritic and natural killer cells in explanted lymph nodes maintained in intravital conditions in collaboration with Prof. Francesca Granucci and Dr. Ivan Zanoni (Biotechnology Department, Università degli Studi di Milano-Bicocca).
Moreover, during her postdoc, LS was in charge of the two-photon intravital microscopy system and of the computational analysis related to the in vivo experiments (intravital microscopy applied to the study of liver immunopathology and host-pathogen interactions in lymph nodes, collaboration with Dr. M. Iannacone - Dynamics of Immune Responses, Division of Immunology, Transplantation and Infectious Diseases, San Raffaele Scientific Institute-, Dr. G. Sitia and Prof. L. Guidotti -Immunopathology Unit, Division of Immunology, Transplantation and Infectious Diseases, San Raffaele Scientific Institute-).

At present, LS research focuses also on the development of image correlation spectroscopy techniques based on linear and non linear excitation (RICS: raster image correlation spectroscopy, TICS: temporal image correlation spectroscopy, SLIC: scanning laser image correlation) devoted to study nanoparticles-cell interactions and the hemodynamics on model organisms (zebrafish). At the same time, LS has modified, improved and optimized the LABS instrumentation to evaluate in vivo blood flow velocity in zebrafish embryos by means of dual-spot correlation experiments.
LS exploited also the features of a STED (Stimulated Emission Depletion) nanoscope to study single molecules and biological system by means of super-resolved (down to 60 nm) microscopy experiments. To this purpose LS developed a novel cross correlation method that combines fluorescence correlation spectroscopy to raster scanning imaging. With this method, the blood flow velocity can be mapped directly from a single image: this enables to maintain also the information on the sample morphology. LS is applying this method to study the hemodynamics not only in simple model organisms (zebrafish), but also in a large and complex network of vessels (such as the hepatic microcirculation) in intravital condition.
LS exploited also the features of a STED (Stimulated Emission Depletion with 60 nm resolution) nanoscope to study single molecules and biological systems, and she is adapting the nanoscope to implement fluorescence correlation spectroscopy to attoliter volumes.

GRANTS

Team leader Academic Funding "competitive fundings from University of Milano-Bicocca" (2017-current) Project: "Predicting the efficacy of repurposed drugs for cystic fibrosis by time-lapse and label-free microscopy" (25 k€)

Team leader Academic Funding "competitive fundings from University of Milano-Bicocca" (2014-current) Project: "Imaging liver immunopathology by intravital microscopy"(20 k€)

TEACHING

AA 2013-14 - current Biophysics Laboratory (64 h), Bachelor Degree in Physics

AA 2013-14 Physics (Mechanics and Fluidodynamics) Exercise, Bachelor Degree in Chemical Science and Technology

AA 2012-13 Physics (Mechanics and Fluidodynamics) Exercise, Bachelor Degree in Chemical Science and Technology; Optics and spectroscopy applied to Nanotechnology, Master Degree in Physics (16 h)

AA 2008-2009 Tutor for Physics III course; Bachelor Degree in Physics