

Lara Selvaggi, PhD

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Objective

Research and development of systems for the analysis and characterization of biological samples and industrial products.

Personal Information

Date of birth: 02/02/1982

Nationality: Italian

Status: Married

Driving License: Full

Professional Profile

- Construction of an experimental apparatus for Optical Tweezer (OT) with application in bio-physics.
- Construction of experimental apparatus for Laser-Tracking (LT) and Particle-Tracking.
- Microrheology experiments by means of Laser-Tracking, Single-Particle-Tracking and Multiple-Particle-Tracking (MPT) on biological samples such as hyaluronic acid and cell cytoplasm.
- Microinjection of probes into living cells for measurements of cytoplasm viscoelasticity.
- Measurements by means of MPT in living cells (oocytes of starfish, oocytes of frogs) to relate the viscoelastic properties of the cytoplasm to the cytoskeleton mechanics. Viscoelastic changes induced by different cellular processes have been analyzed.
- Combination of interferential phase contrast microscopy (DIC) technique with MPT for the study of mitochondrial cloud migration inside *Xenopus Laevis* I stage oocytes.
- Biochemical characterization of cell components by means of Raman spectroscopy.
- Construction of an experimental apparatus that generates multiple optical traps (Multi-Trap) by holographic techniques. Applications on polystyrene beads and red blood cells.
- Implementation of Multi-Trap setup with another lateral microscope to make tomography reconstructions of samples. It has been used for biologic applications such as red blood cell investigation.
- Atomic Force Microscopy (AFM) measurements to characterize the adsorption of proteins (gliadins) on mica substrates.
- Characterization of mucus from patients with Cystic Fibrosis by means of MPT and Raman Spectroscopy.

Technical Skills

Bio-Physics field

- Microscopy (video-microscopy, bright field, fluorescence, DIC)
- Laser
- Optics
- Microinjection *in vivo*
- Atomic Force Microscope
- Cell Biology
- Development Biology

Informatic field

- Word
- Excel
- Image J
- Matlab
- Power-Point
- Photoshop
- Labview

January 2010 – May 2010

Design of a new saleable diagnostic tool to investigate the disease stage in Cystic Fibrosis patients. This instrument, named LASED (Liquid Analyzer System Enhanced Database), evaluates also the effectiveness of the therapeutic treatments by viscosity, scattering and chromatography measurements. For more information: www.lased.it

November 2006 – December 2009

University Federico II of Naples, Laboratory TASC Sincrotrone Trieste, University of Calabria.

PhD in Science and Technology of mesophase and molecular materials.

Thesis title: *"Mechanical properties of biopolymers studied at Mesoscopic-scale."*

The PhD thesis is divided into two main sections, respectively, developed at the University Federico II of Naples and laboratories TASC in Trieste, and an appendix developed at the University of Calabria.

Section 1: *Study of mechanical properties within starfish oocytes before and after the process of maturation.*

After degree, measurements in starfish oocytes have been continued with appropriate optimizations of the experimental setup. Single-Particle-Tracking technique has been replaced by Multiple-Particle-Tracking (MPT) technique which reduces the length of acquisitions since it tracks simultaneously the motion of several probe beads.

Moreover, to reduce the size of the injected beads inside the cells and increase the resolution of the measures, fluorescent particles have been used. Beads functionalized with different chemical groups have been tested to explore how the effect of surface chemistry of the probes affects the analysis of viscoelastic medium in which they are immersed.

Maturation of oocytes has been induced by the addition of a hormone (1-MA) to compare the viscous properties of the cell cytoplasm before and after maturation. Moreover, changes in cytoskeleton filaments have been analysed by Confocal Microscopy and a relation between viscoelastic changes and cytoskeleton mechanics has been found. The cytoplasm in the two different stages has been also analyzed by Raman spectroscopy which confirmed the MPT results.

Section 2: *Implementation of an experimental apparatus for Multi-Trapping combining two orthogonal views of the sample for applications in various fields (nanotechnology, microfluidics, tomography, ...).*

An homemade Optical Tweezers setup has been equipped with a lateral microscope to allow the observation of the sample under investigation from two orthogonal sides. The trapped sample is simultaneously imaged by the trapping objective and by the lateral objective. The generation of multiple optical traps is realized by combining the use of diffractive optics with a spatial light modulator. In this way it was possible to obtain optical traps with 3D configurations which are able to manipulate in real time the trapped

**Professional
Experience**

sample. This system has been used to rotate polystyrene beads, pieces of glass with arbitrary shape and red blood cells in different planes. It has been also carried out a preliminary tomography reconstruction of red blood cells to investigate their shapes in samples of healthy and unhealthy patients.

Appendix: *Characterization of the adsorption of proteins on mica substrates using atomic force microscopy (preliminary work).*

Atomic force microscope (AFM) has been used to characterize the mode of adsorption of gliadin, gluten proteins, on mica substrates. Solutions of gliadins have been analyzed under different concentrations, pH and time of adsorption.

Collaborations:

CEINGE, 2° Policlinico in Naples.

A research project to perform analysis of micro-rheology on samples of bronchial mucus from patients with Cystic Fibrosis. The idea was to get information on the viscoelastic properties of this mucus, by means of Multiple Particle Tracking technique, in order to optimize the processes of therapy and drug delivery.

Biology Dep., Federico II in Naples.

A research project to investigate the mitochondrial cloud (MC) migration inside I stage *Xenopus Laevis* oocytes. Multiple Particle Tracking technique has been applied in order to understand if the MC migration was governed by a viscoelastic change in the region where it moves. No microinjection was performed; endogenous granules with suitable size have been used as probes inside the cell. Differently from expectations, the displacement of the mitochondrial cloud is resulted independent of the viscosity of the region it goes through.

October 2000 - October 2006

University Federico II of Naples, Zoological Station "A. Dohrn", Naples

Experimental thesis for Physics degree.

Thesis title: *"Study of viscoelastic properties of biological material."*

The thesis work was done in the laboratory of Biophotonics and Optical Spectroscopy of Prof. A. Sasso, University Federico II of Naples. The experimental devices used were homemade and specially optimized for the experiments.

Microrheology measurements were performed in living starfish oocytes to study the viscoelastic properties of the cytoplasm in different location inside the cell.

Laser-Tracking technique and Single-Particle-Video-Tracking technique were used to do investigation in a large frequency range. Micro-particles were microinjected as probes inside oocytes. These beads governed by Brownian motion gave information about the medium in which they moved. Using the Brownian motion analysis is possible to calculate

the mean squared displacement of the beads to know the viscous and the elastic moduli of the cytoplasm. Studies of viscoelasticity have done in different locations of the cell: close to the nucleus and close to the cortex to elucidate differences in the filamentous networks aggregation inside the cell.

Other professional experience:

September 2001 - Today

Dance school Lunacy, Naples

Teacher of classical ballet.

Classical dance teacher and choreographer for ballets, shows and stages.

Member guest of commission for examination of ballet dancer in several dance schools.

**Education
and
Certification**

- **PhD in Physics** from the University of Calabria.
- **Degree in Physics 110/110 cum laude** from the University Federico II of Naples.
- **Scientific maturity** achieved at Liceo E. Vittorini Naples.
- **Ballet degree** from the dance school Schininà-Vecchi in Naples.

**Personal
interests
and activity**

- Dance, travel, music
- Teacher of classical ballet.

Languages

- Italian (*Native*)
- English (*Good spoken, written, understanding*)

List of Publications

- **“Spectroscopical and mechanical characterization of normal and thalassemic red blood cells by Raman Tweezers.”**

Anna Chiara De Luca, Giulia Rusciano, Rosanna Ciancia, Vincenzo Martinelli, Giuseppe Pesce, Bruno Rotoli, Lara Selvaggi, and Antonio Sasso

Optics Express, Vol. 16, Issue 11, pp. 7943-7957 (2008)

- **“Mechanical changes of living oocytes at maturation investigated by multiple particle tracking.”**

Pesce, Giuseppe; Selvaggi, Lara; Caporali, Antonio; de Luca, Anna Chiara; Puppo, Agostina; Rusciano, Giulia; Sasso, Antonio

Applied Physics Letters, Vol. 95, Issue 9, (2009)

- **“Optimized multi-view imaging improves the observation of optically manipulated non-spherical particles.”**
L. Selvaggi, E. Ferrari, A.R. Moradi, S.C. Santucci, P. Beuzer and D. Cojoc
Journal of Optics, 12 (2010) 035303.
- **“Multiple Particle Tracking to investigate viscoelastic properties in living cells.”**
Lara Selvaggi, Marinella Salemm, Giuseppe Pesce, Giulia Rusciano, Carmen Vaccaro, Antonio Sasso, Chiara Campanella, Rosa Carotenuto.
Methods (book), Elsevier. Vol. 51, Issue I, May 2010. ISSN:1046-2023
- **“Raman spectroscopy of Xenopus laevis oocytes”**
Giulia Rusciano; Giuseppe Pesce; Marinella Salemm; Lara Selvaggi; Carmen Vaccaro; Antonio Sasso; Chiara Campanella; Rosa Carotenuto.
Methods (book), Elsevier. Vol. 51, Issue I, May 2010. ISSN:1046-2023
- **“High and low frequency mechanical properties of living starfish oocytes”**
Giuseppe Pesce, Lara Selvaggi, Giulia Rusciano, Antonio Sasso.
Journal of Biophotonics (in press)

Contribution in Schools and Congresses:

July 2007: EBSA Congress (European Biophysical Societies' Association) in London.

September 2007: Doctorate School G. Occhialini in Jesi.

February 2008: Winter-college “on Micro and Nano Photonics for Life Sciences”

May 2008: Nano Hot '08 in Portorose

July 2008: ICCHP in Linz

September 2008: COST school in Ischia “Optical Micro-Manipulation by Nonlinear Nanophotonics”

July 2010: ICCHP in Wien

July 2010: Nanogagliato in Gagliato (Calabria, Italy)

Awards:

June 2010: Nanogagliato, prize in NanoScience <http://www.accademiadigagliato.sitiwebs.com/>