Andrea Giugni
CURRICULUM VITAE

Work Experience

• Dates (from-to)	8 Dec 2013 – 8 Jun 2020
• Employer's name and locality	**King Abdullah University of Science and Technology** (KAUST), Thuwal (Jeddah), 23955, Saudi Arabia
• business or sector, employ	University Research Lab, **Research Scientist** (Senior Researcher 4^{th} level)
• main activities and responsibilities	The activity at KAUST University started with the design and realization of a new multidisciplinary research laboratory for biological and solid-state matter physical investigation, the SMILEs Lab (Structural Molecular Imaging Light Enhanced spectroscopies), extending over a surface area of about 300 m^2.

I, personally, have equipped the laboratory with lots of advanced optical, chemical, electronics facilities to support the several scientific research themes undertaken. Of certain importance are three complemental high-resolution scanning probe microscopes that I customized, providing optical Raman and the plasmonically excited hot-electron spectroscopy set-ups, either with pulsed either continuous-wave excitation, opening to the possibility of concurrent multispectroscopies investigation at the nano-scale.

The three instruments, located in an acoustically isolated room inside the main lab, personally projected to reduce environmental noise and seismic vibrations, allow to access with nanometric resolution physio-chemical properties of solid-state and life science samples, hence to offer the researchers the possibility of the atomic level detection and characterization with a new set of simultaneous complemental techniques, previously not available.

Hyperspectral, chiral sensible, and picosecond-pulsed CARS micro-Raman spectrometers complete the instrumental spectroscopy facility. The laboratory was further integrated with a class 2 cell-room and dedicated biosafety-compliant hoods, gas lines, and cryopreservation instruments, allowing the bio-culture, preparation, and investigation of cells and samples for the SPM/spectroscopy studies. A workshop for mechanical, microfluidic, and electrical prototyping, as well as a dedicated computational room for electromagnetic simulation and data analysis with a workstations cluster, complemented the laboratory. KAUST financed the whole laboratory realization and commissioning with about 3.5 M USD budget.

My scientific activity at KAUST focused on the investigation of morphology, structure, phase transitions, dynamics, and charge transport of new materials of physio-chemical syntheses, such as organic/inorganic perovskites, graphene, and its oxides compounds, bi-dimensional dichalcogenides metals, as MoS_2, HBN, novel mXenes thin films, all with various chemical structures, most of them proposed for plasmonic-hot electrons photodetection and ultrafast FET devices. I have investigated AlGaN quantum-wells heterostructures for light emission operation; several types of perovskites specifically for photovoltaic characterization and fundamental physic phenomena investigation. I have examined the inverse crystallization triggered by surface tension and the incommensurate structural phase transition in perovskites, offering an original explanation in terms of energy distribution in superstructures of multi-unit cell size. Another original contribution focuses on the role of strain to control photo-physics in such complex crystal compounds. I also investigated biomaterial morphology harnessing for biophysical applications, as the in vitro controlled release of brain-derived neurotrophic factor, and new biopolymers, for tissue engineering and cell culture scaffolding. Particular interest has been recently devoted also to the studies, by integrating micro- and nano-Raman during electrochemistry studies, of the photon-electron-phonon interaction and chemical structural modifications in organic electrochemical transistors based on hydrophilized n- or p-type biopolymers. Of paramount importance was the explanation of the physical process that regulates the cation/anion uptake and interaction with the sensed molecules with the self-doping polymer structures to regulate the conductance itself. These studies contribute to explain, for the first time, the possibility of a self-powered organic field-effect transistor. Two other relevant activities were pursued in the bio-physic field. One, thanks to the use of a nanofabricated multifactional tool, allowed for the first time the direct visualization with the TEM imaging of the DNA/RNA molecules at the nucleic bases or bundle scales, confirmed by micro-Raman spectroscopy characterization. The other to investigate with vibrational and atomic force spectroscopies the amyloid fibrils in regards to their structural and functional alteration, being recognized ones of primary importance as causes of Alzheimer's disease.

Most of the techniques I used for the investigation of the soft and solid matter adopt originally designed plasmonic devices to enhance and confine, with localized plasmon resonances, the interaction, and inelastic scattering from vibrational excitations, commonly observable in Raman spectroscopy. The main tool is, however, a homemade tapered plasmonic scanning probe. Its realization requires advanced optical and nanofabrication skills and competences. It allows exploiting surface plasmon polariton propagation and confinement, spectroscopy, and imaging at nano-scale by hot-electrons transport and scattered-photons either in continuous wave either in the ultrafast excitation regimes. The technique, named HENs, naturally broadband, is suitable for pump & probe and time-resolved experiment as well.

The damping of SPPs in quantum-confined space is at the base of the efficient generation hot-electrons. HENs evidenced new specific phenomena at edges and grain borders of two dimensional nanotransistors, as for example the nonlocal enhancement of electron transport in the MoS_2/SnO_x junction as result of a quantum confinement.

Part of the research activity included the design, the study via FDTD electromagnetic simulation of the same plasmonic nanostructures for scanning probe and the SERS devices for the spectroscopic application that subsequently I realized with focused ion beam milling and electron beam induced deposition.

I collaborated with my reference professor as well as many other leading research groups, in KAUST and from international research centres, to define and organize the research activities, and projects' proposals. I have supported and supervised master and Ph.D. students on their specific experimental works. We were entitled to three Research Grants, peer-reviewed, in collaboration with international partners during these years, funded with more than 4M USD.

Research product: [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] [44] [45] [47] [48] [49] [50] [51] [52] [53] [54] [55] [56] [57] [58] [59] [60] [61] [62] [63] [64] [65] [66]

• Dates (from-to)	19/10/2012 - 31/12/2013
• Employer's name and locality	Italian Institute of Technology "Istituto Italiano di Tecnologia" - IIT - Via Morego 30 – Genova, Italia
• business or sector, employ	Research Institute, Post-doctoral Research Fellow (senior)
• main activities and responsibilities	Research collaboration with the Nanostructure Division, directed by Prof. Enzo Di Fabrizio. I was responsible for the specific research project proposed: "Development of a new assisted Scanning Probe Microscope instrumentation for the investigation of solid-state and biologically-inspired systems at the nano-scale." I realized the first prototypal plasmonic setup and conducted the original research activity that proved the possibility of using a plasmonic assisted hot electron source to conduct spectroscopy investigation at the nano-scale. Maintaining international collaboration either focused on plasmonic research either on the collective dynamic of soft matter. Research product: [28] [31] [32] [33]

• Dates (from-to)	01/11/2010 - 31/10/2012
• Employer's name and locality	Italian Institute of Technology "Istituto Italiano di Tecnologia", Clean Room Laboratories, Smart Materials and Nanofabbrication Facility, - IIT - Via Morego 30 – Genova, Italia
• business or sector, employ	Research Institute, Post-doctoral Research Fellow
• main activities and responsibilities	Research collaboration with the Nanostructure Division, directed by Prof. Enzo Di Fabrizio. I was responsible for a specific research project proposed: " Brillouin Light Scattering per lo studio della Dinamica Strutturale di Sistemi proteici e lo sviluppo di dispositivi nano fabbricati". My research activity focused on the physics of disordered materials and soft matter (liquids, supercooled liquids, glasses, colloids, and polymers) in continuity with one of my primary activity and in view of its possible applicability and integration with nanostructures. I become an expert in Raman spectroscopy and scanning probe techniques. I investigated nanostructured materials, sensing devices constituted of plasmonic arrays of structures, and heterostructures, like the core/shell of

CdSe/CdS rods, evidencing the photon–exciton and photon–plasmon interaction.

I have investigated the technological possibility of patterning nano-scale size conductive or oxidative features on silicon, on graphene, and graphene oxide, with their possible application in electronics and biology.

The research group, coordinated by Prof. E. Di Fabrizio, maintained several national and international collaboration, being a primary partner of three ERC grants: NanoAntenna No. 241818, (Nano-Optical Antennas for Tunable Single-Photon Super-Emitters) FP7-IDEAS-ERC; SMD ERC no. CP-FP 229375-2 (Single or few molecules detection by combined enhanced spectroscopies), FP7-NMP; the FOCUS project ERC FP7 No. 270483 (Single Molecule Activation and Computing).

Research product: [21] [22] [23] [24] [25] [26] [27] [29] [30] [46]

• Dates (from-to)	01/01/2010 - 31/10/2010
• Employer's name and locality	National Institute for Metrology Research: INRiM (Istituto Nazionale di Ricerca Metrologica) - Strada delle Cacce, 91 – Torino, Italia
• business or sector, employ	Research Institute, Physical Metrology Division. Research Scientist. Bando n.10/07/2009, G.U. n. 57 del 28 luglio 2009 - IV serie speciale per attività di ricerca nell'ambito del progetto J.R.P. NANOTRACE, Euramet.
• main activities and responsibilities	The activity was devoted to new types of optical interferometers. The project had the aim to develop new interferometric techniques for traceable measurements at the nano-scale with picometer level uncertainty in collaboration with Dot. M. Pisani, PI of the project, we realized a homodyne and a heterodyne interferometer, internally referred to a standard wavelength, which satisfied a 100 μm free-pathway with a 10 pm uncertainty. Today this research has become the first portable picometer metrological referred reference Actuator, and it has been used by Alenia Spazio and ESA for the calibration of sensitive satellite mission instrumentation. This activity allowed me to collaborate with almost all the European Metrology institutes, INRiM (IT), BEV (A), CMI (CZ), NPL (UK), MIKES (FI), PTB (D), UME (TK), all involved in the NANOTRACE project. Research product: [18] [19] [20]

• Dates (from-to)	23/12/2008 - 31/12/2009
• Employer's name and locality	University of L'AQUILA - Via Giovanni Di Vincenzo 16/B - L'AQUILA, Italia
• business or sector, employ	University, Physics Department, Technical-administrative employee.
• main activities and responsibilities	During that year, I was employed as a technician in the Physics department. I worked in collaboration with the research groups realizing mechanical structures, custom instrumentations, with CAD/CAM design and machining, coding the acquisition software, as well as performing the research activity. In particular, I projected and realized an electrospinning apparatus for carbon nanotube-based material for the NANOCAT spin-off, and I collaborated with the CETEMPS center, both at L'Aquila, to the realization of an airborne-based instrument for time-resolved fluorescence for the chemical investigation of the atmosphere, afterward

installed on the British FAAM BAe 146 Research aircraft.
Research product: [17]

• Dates (from-to)	02/01/2008 - 22/12/2008
• Employer's name and locality	University of L'AQUILA - Via Giovanni Di Vincenzo 16/B - L'AQUILA, Italia
• business or sector, employ	University, Physics, Physics Department Research Fellow.
• main activities and responsibilities	Research project Title: "Vibrational Dynamic and relaxation phenomena in disordered systems." This activity was hosted by the BLUSA laboratory directed by Prof. Nardone part of the CRS-Soft CNR and was pursued mainly with the use of the high-resolution spectrometer for visible and ultraviolet radiation, HIRESUV, but also including large-scale facilities inelastic X-ray and neutron scattering experiments, thanks to national and international collaborations and funded on PRIN-2007 project. Five university centres participated in this National project that was coordinated by Prof. F. Sacchetti of Perugia University. We investigated liquid and supercooled sulphuric acid, ordinary and deuterated molecules, and the confinement effect on water dynamics obtained with the use of the Nafion112 membrane, in collaboration with CRS-soft di Perugia. The activity required the design and realization of environmental controlled cells specific for visible and UV scattering for a supercooled fluid with the possibility to exchange momentum in a wide range. In collaboration with Trento and Elettra synchrotron groups, we continued investigating prototype glasses to clarify the role of the structural disorder and structural relaxation on the hyper-sound attenuation. To this scope, I realized two different environmental vacuum chambers for very high temperatures, up to 2300K, and conducted Brillouin scattering experiments. In L'Aquila, I continued the experimental investigation of the alpha quartz; this time, we obtained the attenuation and velocity of acoustic excitation down to the liquid helium temperature. I continued the Brillouin scattering investigation of borated densified glasses in collaboration with the group of Prof. G. Carini, Messina University, aiming the structural relaxation and densification roles in the high-frequency dynamics of amorphous materials. Support to Master Students (L'Aquila University). Research product: [12] [13]

• Dates (from-to)	02/01/2007 - 31/12/2007
• Employer's name and locality	University of L'AQUILA - Via Giovanni Di Vincenzo 16/B - L'AQUILA, Italia
• business or sector, employ	University, Physics, Physics Department Research Fellow.
• main activities and responsibilities	Research project title: "Vibrational Dynamic and relaxation phenomena in disordered systems". Principal investigator: Prof. M. Nardone. The research fellowship was supported by PRIN2005 funds resulting in collaboration with Prof. G. Viliani of Trento University. In this period, I designed the upgrade of the monochromator HIRESUV allowing a

parallel acquisition system based on CCD and with spectral-zoom ability, this increased the versatility, and the reduced the measurement acquisition time sensibly (coll. Prof. M. Sampoli, Firenze University).

In collaboration with Firenze, Trento, Elettra (doc. C. Masciovecchio), ESRF (prof. G. Monaco) groups, we investigated the Brillouin linewidth as a function of temperature and exchanged wavevector in an extended range of the di 3-methyl-pentane, a prototype of intermediate glass former. For the first time, with the HIRESUV monochromator, we were able to evidence transverse excitation in the supercooled regime of the fluid. The research allowed an original interpretation model of the acoustic attenuation.

In collaboration with the group of Trento, I continued the experimental investigation on the strong glasses, like Silica Germania, and their densified types. I optimized the performance, after a complete ray tracing investigation, of HIRESUV, that was routinely able of a 100MHz spectral resolution and a free spectral range of ±170GHz, at 500THz. Essential characteristics to study inelastic UV and visible scattering of acoustic-like excitation.

Support to Master Students (L'Aquila University).

Research product: [9] [15] [16] [17]

• Dates (from-to)	18/09/2006 - 31/12/2006
• Employer's name and locality	University of ROMA "Tor Vergata" - Via O. Raimondo,18 - ROMA, Italia Tech2emotion Consortium and the Physics department of Roma Tre University
• business or sector, employ	University, Research collaboration in Physics, Physics Department, "Collaboratore coordinato continuativo". L.240/2010
• main activities and responsibilities	Prof. M. Antonietta Ricci led the research program "Raman spectroscopy for the future ophthalmological application." I realized, in collaboration with Prof. M. Nardone, an original optical ray-tracing study, developing an innovative cross-gratings configuration, a new-concept of Raman spectrometer having in mind as the primary target the realization of a scientific medical instrument for the in vivo spectral characterization of the ocular fundus. Raman spectroscopy should have allowed the characterization and the definition of a set of parameters to the early diagnosis of retinopathy and maculopathy diseases.

• Dates (from-to)	01/08/2004 - 31/07/2006
• Employer's name and locality	University of ROMA "La Sapienza" - P.zza Aldo Moro, 5 - ROMA, Italia
• business or sector, employ	University, Physics Department, Research collaboration in Physics, "Collaboratore coordinato continuativo", L.240/2010
• main activities and responsibilities	Involved in the FIRB, "Colloidal systems with short-ranged interactions: protein crystallization models", I explored using inelastic light scattering the structural relaxation in different glasses, crystals and supercooled liquids in collaboration with different university groups. With the high-resolution Brillouin scattering facility at L'Aquila University (Prof. M. Nardone) we pursued the experimental verification of some models proposed for the glass transition.

Support to Master Students (L'Aquila University).
Research product: [8]

• Dates (from-to)	01/09/2003 - 31/07/2004
• Employer's name and locality	Istituto Nazionale per la Fisica della Materia (INFM-CNR), UdR L'Aquila Dip. Fisica. University of L'AQUILA - Via Giovanni Di Vincenzo 16/B - L'AQUILA, Italia.
• business or sector, employ	University, Research collaboration INFM-CNR, LIMUV project PAIS 2003 fund, for Brillouin spectroscopy in the ultraviolet range, "Collaboratore a progetto" L.240/2010
• main activities and responsibilities	Collaboration project title: "Liquid Metals by ultraviolet spectroscopy" PI dot. R. Eramo. During the two postdoc years, the primary activity was the investigation of the collective dynamics in liquid metals either with vis-UV radiations either with X-rays. In particular, I realized the environmental set-ups and conducted the experiments on the liquid potassium metal that can be considered a prototype of disordered glass-formers. Support to Master Students (L'Aquila University). Research product: [10] [14]

• Dates (from-to)	01/09/2000 - 31/08/2003
• Employer's name and locality	University of L'AQUILA - Via Giovanni Di Vincenzo 16/B - L'AQUILA, Italia
• business or sector, employ	University, Physics Department, Ph.D. Student, Physics, "XV ciclo di Dottorato".
• main activities and responsibilities	During my Ph. D. study, I participated in several national collaborations aiming at the structural relaxation and models' verification of the so-called glass transition in strong and fragile glasses. My activity was within the research group of prof. G. Signorelli and after of Prof. M. Nardone. I got the Ph.D. title defending a thesis on the new results obtained on the structural relaxation as could be measured with the UV inelastic scattering radiation in water and glycerol "Studio di processi di rilassamento in glicerolo e acqua con tecnica di Brillouin scattering nell'ultravioletto". I dedicate a significative part of the Ph.D. work to the realization and collaboration in the HIRESUV project (spectral resolution > 10^6 and rejection function > 10^{12} for visible and ultraviolet radiation with continuous momentum exchange up to 0.1 nm^{-1}). I gained strong competence in classical Optics, electronics, interfacing, and coding the remote control of scientific instruments as well as in their mechanical design. I became skilled in low and high temperatures instrumentation as well as in vacuum technologies. I completed the studies of the collective dynamics of atomic and molecular systems in an unexplored frequency-momentum region conducting experiments at the Elettra (IUVS beamline, Trieste, Dr. C. Masciovecchio) and the ESRF (X-rays beamline ID16, Prof. F. Sette) synchrotron facilities. At that time, there were also scientific collaborations with Prof. G. Ruocco, "Sapienza" Roma, Prof. A. Fontana, and Prof. G. Viliani, University of Trento, Prof. M. Sampoli, University of Florence, Prof. D. Fioretto and Prof. F. Sacchetti, University of Perugia.

Research product: [4] [5] [6] [7] [11]

• Dates (from-to) 01/07/2000 - 30/10/2000

• Employer's name and locality Istituto Nazionale per la Fisica della Materia (INFM), Italia

• business or sector, employ University of L'AQUILA - Via Giovanni Di Vincenzo 16/B - L'AQUILA, Italia

Research collaboration to Research Project.

• main activities and responsibilities Collaboration project title: "Collaborazione Progetto HIRESUV". HIRESUV project was funded (4+2 years) by INFM as an advanced national research project, PI Dot. Paola Benassi. I focalized my activity in the optical propagation study of the monochromator to clarify the potentiality and the possible critical issues of the proposed structure. At the time, I developed a specific Ray-tracing code using the Matlab environment.

• Dates (from-to) 01/10/1999 - 31/12/1999

• Employer's name and locality Laboratorio Europeo di Spettroscopia non Lineare, LENS, - (ex. *Largo Enrico Fermi 2*) Via Nello Carrara, 1 - Sesto Fiorentino (FI), Italia

• business or sector, employ Research Institute, Research collaboration "Collaboratore coordinato continuativo".

• main activities and responsibilities Collaboration project title: "A time-of-flight electron spectrometer". My activity was the characterization of the LENS time-of-flight high-resolution spectrometer for electron and ions realized by the research group of Prof. S. Cavalieri and Dot. L. Fini, It was conceived for the products of the molecular photoionization products in the multiphoton absorption of light in atomic matter experiments.

Research product: [3]

• Dates (from-to) 01/06/1998 - 22/06/1999

• Employer's name and locality Research Institute, Laboratorio Europeo di Spettroscopia non Lineare, LENS, - Via Nello Carrara, 1 - Sesto Fiorentino (FI), Italia

• business or sector, employ Master Student in Physics, experimental study.

• main activities and responsibilities During my Master thesis study, I started my experimental physics research in the laboratory of Prof. Stefano Cavalieri and Dot. Lorenzo Fini. I become an expert of electron and ion spectroscopy of high resolution and excitation energy obtained by multiphoton absorption scattering of nanosecond pulsed laser in the visible and UV. My thesis was on the analysis of the products of the photoionization process. It allowed the determination of the energy-resolved angular distributions of the electron's amplitude wavefunctions and the branching ratio of the intermediate electron-levels in the bound of the atoms of xenon and barium. Part of the research was in collaboration with Prof. Dr. D. Charalambidis, University of Crete, Greece.

Research product: [1] [2]

Research activities highlights

My works, as related here below in the extended description paragraph, falls within the fields of experimental condensed matter Physics, bio-Physics, Optical Spectroscopies, Metrology and Plasmonic. I devoted a significative part of my activity to the design and realization of many successful experimental apparatuses, innovative optical and electrons' spectrometers, either form the mechanical either electronic and control-software point of view. Exploiting high vacuum and advanced temperature control technology I was able to access extended temperature ranges from few to over two thousand kelvins with many of the environments chambers I projected to fit with synchrotrons x-ray and UV beamlines, as well as optical Raman-Brillouin spectrometers.
I have used optical, numerical tools, and FDTD electromagnetic simulations to get a deeper description of the functional and physical principles exploited in large-scale optical set-ups used, as well as in plasmonic nanostructures and nano-scaled sensing devices I realize for the investigation of material and biological samples at macro-, meso- and nano-scales. All these activities led to original and significative scientific results in all the experimental fields investigated.
I have a consolidated experience in the realization and organization of multidisciplinary research laboratories for bio- and solid-state matter. The considerable number of research topics addressed, Universities, and Research Institutes in which I have had the pleasure of working has given me a solid background and high-level competences in many experimental scientific fields.
I have participated in many proposals responding to national and international research projects calls, outlining the arguments, the research strategies, the tasks, and when requested, the beam-time at inelastic neutron and X-ray scattering facilities. I have got scientific responsibility for specific projects, original or proposed in collaboration. Up today, my research has been partially funded by 13 peer reviewed projects, currently, at KAUST University, by three Research Grants.

I can summarize the main research interests and competences as follows:

- Optics, nonlinear optics, Plasmonics.
- Continuous-wave optical spectroscopies: Brillouin, Raman, SERS, TERS.
- Nanosecond to picosecond optical and electron spectroscopy.
- Atomic physics and ultra-high vacuum technology.
- Angular resolved photoelectron and ion spectroscopy via multiphoton absorption.
- Glass transition, relaxation processes, and the dynamical slowing down process in soft matter.
- Propagation and attenuation of hypersound waves in structural glasses and crystals.
- High-frequency vibrational modes of glasses and liquids.
- Intra-molecular vibrational modes of liquids and molecules. Molecular fingerprints.
- Length and space metrology.
- Plasmonic devices' design for enhanced scattering and for sensing applications.
- Hot-electron nanoscopy.
- Surface plasmon polaritons dephasing processes
- Quantum confinement and electron femtosecond relaxation dynamic.
- Energy harvesting, and charge transport at the nano-scale.
- The relation between structure and electronic properties in novel 1D, 2D, 3D materials investigated for electronics and photovoltaics.
- Scanning probe microscopy, topography, and electronics to gain physical characterization at the nano-scale.

- Biopolymer and organic electrochemical transistors.
- Scaffold design for biophysical applications and cell culture.
- Scanning electron microscopy, deposition, lithography; focused Ion beam milling, clean room processes.

Research activity. A more extensive description of the topics.

My initial research activity, in 1998, was at the LENS laboratories (Firenze) as Master Student and then as a research collaborator where I focused on the multi-photonic ionization of atomic and molecular species, and in particular to the study of wave functions of atomic electrons [1,2]. I studied bound and electronic continuum states via angularly resolved photoionization technique in resonant and off-resonant interaction with nanosecond lasers pulses either in direct-absorption or pump and probe configuration [2]. At the time, I became expert in vacuum techniques, atomic physics, classical and quantum optics, on nanosecond visible and ultraviolet-pulsed laser sources, as well as femtosecond mode-locked optical cavities. I also collaborated to the developing of a time of flight spectrometer used for the detection of orbital electronic quantum states and ions mass spectroscopy studies [3]

In 2000, my principal investigation moved to the study of the complex microscopic dynamics of fluid and disordered materials. I was involved in many national research projects and international collaborations, all aiming the experimental determination of the generalized dynamics of the so-called soft matter (MHz to THz frequency range) and the influence of the structural relaxation and the fast dynamic on macroscopic properties of materials [4,5]. As a hot topic of modern material science, the study of systems with particular attention to their microscopic structures and the definition of structural lengths or relaxation time constants allows the description of some distinctive quantitative features related to different fluctuations of the macroscopic quantities (acoustic propagation and viscosity for example) that can be measured in samples appearing macroscopically equivalent.

In this research field, I have pursued two principal experimental activities, one directly supporting the other. The first focused on the development of a new spectrometer to extend the wavenumber/frequency ranges accessible to the experimental investigation towards the mesoscopic regime. Indeed, the most important collaboration was for the realization of the dual grating spectrometer HIRESUV funded by former INFM (Istituto Nazionale per la Fisica della Materia), at present at the University of L'Aquila. HIRESUV for throughput (>30%), spectral resolution (<.5GHz), rejection (>10^{12}), and free accessible spectral range (~5THz) results in the most performing Brillouin scattering spectrometer for visible and ultraviolet excitation [6]. At that time, I gain significant knowledge about the scattering of electromagnetic radiation, as can be investigated with modern complementary spectroscopies, and I became an expert in optical instrumentation design and electronic control, achieving practical skills necessary to develop innovative scientific instrumentations.

The second activity aimed at the experimental study of the soft matter through spectroscopic techniques, as the inelastic scattering of the light and UV or X-ray radiations. In particular, I investigated the high-frequency temperature-dependent dynamics of fluids [7-9] (water, glycerol, Nafion, $CaCl_2$ and H_2SO_4 solutions and trimethylpentane and cyclohexanes), topologically disordered materials (including SiO_2 GeO_2 glasses, aerogels, molecular and supercooled liquids, and polymers) and ordered SiO_2 crystals [10,11], also magnonic excitations in Fe-Al multilayers. It is known that the dynamic properties of a liquid, approaching the glass transition, slow down dramatically in the supercooled regime and that the density fluctuations play a fundamental role in the dynamics. The obtained results contributed to clarifying how the glass formation is related to the "progressive" arrest of longtime density fluctuations, known as structural arrest [12,13] to the dynamic and static features characterizing the samples microscopically [14].

Experimental results show that approaching the vitreous transition from the glass phase side, results in the particle mean-square displacement increases to a finite value and that the hypersonic attenuation at low temperature or high-frequency results dominated by the structural disorder. Instead, approaching the transition from the liquid phase side, the diffusivity of supercooled liquids is experimentally observed to decrease to zero, resulting in a good agreement with the predictions of the commonly accepted theory. Furthermore, velocity and damping of propagating sound waves, as seen through high-resolution instruments in a broad spectral range, show a faceted phenomenology indicating at least the coexistence of steps or secondary relaxation processes for typical glass formers. According to this description, we tried to access to a wide as possible frequency range, also thanks to the developing of the HIRESUV spectrometer, and when requested, I extended the research moving to Neutron and Synchrotron radiation European Facilities (Grenoble, Trieste) to conduct neutron, X-ray, and deep UV inelastic scattering experiments. In this way, it was possible to measure the longitudinal and transverse hypersonic excitations during the cooling down of liquid metals and moderate to fragile glasses fluids, allowing a consistent description of the entire relaxation processes in terms of model-relaxing shear and bulk contributions, and thus, supporting empirical relationships concerning the glass-forming liquids [8,9,15,16]. The research was possible thanks to the participation in National Research Projects PAIS, PRIN, FIRB, and replying to calls for beamtime allocation at European facilities and the SOFT (INFM-CNR) Research Center.

In that period, another significant activity was the collaboration (2006-2007) with the Tech2emotion Consortium and the Physics department of Roma Tre University, in the research program "Raman spectroscopy for the future ophthalmological application." At the time, I realized, developing an original optical ray-tracing study of a cross-gratings configuration, a new-concept of Raman spectrometer having in mind as the primary target the realization of a scientific medical instrument for the in vivo spectral characterization of the ocular fundus. Raman spectroscopy should have allowed the characterization and the definition of a set of parameters to the early diagnosis of retinopathy and maculopathy diseases.

In 2008, I got a permanent position as a technician at the L'Aquila University, Physics department. During that year, I worked in collaboration with the research groups of the physical department, realizing mechanical structures, custom instrumentations with CAD/CAM design and machining, coding the acquisition software of the same instrumentation with Labview programming language, as well as supporting the research activity [17]. Relevant of note was a collaboration with the Center for Advanced Nano-Technologies Nano-Cat di L'Aquila for the design and realization of an electrospinning apparatus for carbon nanotube-based material, and the collaboration with the CETEMPS center at L'Aquila, to the realization of an airborne-based instrument for time-resolved fluorescence for the chemical investigation of the atmosphere, installed on the British FAAM BAe 146 Research aircraft. In particular, for that European project, I contribute significantly to the design and the realization of the mechanical part of the instrument and the four-channel thermal dissociation laser-induced nitrates fluorescence chambers installed in the instrument.

In 2009, I gained a research position at INRiM (National Institute of Metrological Research), Torino, within the European Joint Research Program Nanotrace, mainly devoted to optical interferometry at the nano-scale. The project had the aim to develop new interferometric techniques for traceable measurements at the nano-scale with a 10 pm level uncertainty. It was a challenging task yet required by the outstanding progress that has been made in the nanosciences as well as in the development of test instruments allowing observations at the sub-nanometer scale (subatomic level resolution). Most of those measurements need traceability to be meaningful at the metrological level. In this perspective, I collaborated to the developing of a homodyne and a heterodyne interferometers, internally referred to a wavelength standard, which satisfied a 100 μm free-pathway with a 10 pm uncertainty [18]. The first exploited the multi-reflection angular amplification principle, the second the high harmonic lock-in detection technique, and the correction of the nonlinearity through an electro-optical element. Today this research has become the first portable picometer metrological referred reference Actuator[19]. At the time, it was also proposed a novel technique to measure absolute distances, based on a Michelson interferometer where relative and absolute interferometry theories merged. Its experimental realization resided in a two tunable lasers superposition to create a synthetic wavelength with sub-fringe stability and detection resolution [20].

At the end of 2010, I moved to the Istituto Italiano di Tecnologia, Genova. At the Nanostructures Division, my activity directed towards several new research fields continued today. Complementary spectroscopic methods (micro Raman, FTIR, and photoluminescence), scanning probe microscopies (SNOM, topography, conductive and lithography AFM), and Clean Room nanofabrication techniques were routinely adopted for the realization and investigation of plasmonic nanostructures, either as a primary plasmonic research argument either used as a tool for biophysical and material investigation. Arguments of research were also heterostructures, as well as new materials such as graphene and its oxide. For example, core-shell (dots and rods) heterostructures of CdSe/CdS were synthesized and studied to obtain their characterization either as single bright light emitters either as a self-organized nanostructure [21]. As interesting applications, I investigated specific phenomena observed in these quantum devices: the super-lattice effect due to self-organization, and the photon-exciton-plasmon coupling. This process allows, using a single commercial laser, the generation of a tunable sub-diffraction-limited source array selecting the length of the plasmonic resonator. The phenomenon exploits the high quantum efficiency emission of nanorods and the confinement action at the nano-scale of plasmon-polariton excitations that provide the transfer of electromagnetic field along metallic wires.

I was also involved in biophysical oriented studies [22,23]. For instance, we demonstrated the possibility to use straightforward arbitrary mask ultraviolet radiation patterning on chemical vapor deposited single-layer graphene to realize a substrate supporting ordered neuron growth [24,25]. In this case, we observed that a patterned graphene monolayer better promotes, at the micro and nano-scale level, the surface adhesion and coating of polylysine with respect to the commercial substrates, an event that is absolute of primary importance for neuronal growth, polarization, synapse formation and longer-term survival in vitro. In another study, we proposed micro-pillared silicon templates to stretch DNA strands. The obtainable structure, forming a precise, well-organized array of nanowires, when covered with ZnO nanocrystals via thermal vapor deposition and gold, allows the realization of hybrid organic-metal-semiconductor devices as an interesting research platform for electrical network, catalysis, sensing [23]. Silicon nanolithography, graphene, and graphene oxides nano-machining were investigated with complementary techniques. Raman spectroscopy and different AFM fabrication modalities showed the possibility to realize and characterize nano-circuits, directly using a modified scanning probe apparatus as a stylus printer for the circuit, with the possibility of writing down oxidative or conductive nanoscale-sized features and microcircuits through an electrochemical reaction process [26]. We also showed how it is possible to get conductive features and design circuits on the graphene oxide substrate, characterizing the result regarding electric conductivity and chemical bond formation via advanced spectroscopies [27].

At that time, the Nanostructures Division was deeply involved in the field of Plasmonics, pushed by the disclosure of many fundamental scientific breakthroughs in the comprehension of the processes that control solid-state and wildlife at the nanoscopic level. Plasmonics is the science of Optics at the nano-scale, and it is ruled by the electro-mechanic nature of the energy transport, mediated by the conduction electrons in many metals. As a research field, it is naturally investigated by studying spectroscopically the electromagnetic response of devices generally realized by top-down or bottom-up Clean Room processes and nanofabrication lithography steps, as well as investigating their effects on the ordinary matter. In this context, I became an expert in Plasmonic science investigating either theoretically either via electromagnetic simulations or via experimental activities the surface plasmon polaritons, SPPs, propagation along with many different structures, and the possibility to manipulate the electromagnetic field at optical wavelengths [28-31] in nano-confined spaces with their use.

In 2013, exploiting specific nanofabrication techniques, optical and electronic original solutions, I developed a new hot-electron-based nanoscopy technique that has opened a new scenario for investigation of structural properties of samples at the nano-scale. In this regard, modifying a commercial atomic force microscope setup, I introduced plasmonic assisted hot electrons current measurements, in the pA - nA range, in high-frequency lock-in detection and with an unsurpassed signal to noise ratio and spatial resolution for this type of measure. Thanks to the engineered device, a pyramidal cantilever equipped with a conical plasmonic terminus and photonic grating coupler, realized on the front face of the device to couple far-field radiation lasers in SPPs, it was possible to demonstrate high-efficiency conversion level for SPPs into hot electrons [32]. In particular, we showed that coupled SPPs propagate toward the tip in an adiabatic compression process and that at the contact, the damping of SPPs in detectable hot electrons surpassed manifold the classical Fowler efficiency limit in the case of metal-semiconductor Schottky barriers and thus subsequent harvesting. It was possible to scan the surface of samples being sensible at the same time to surface topography, its electronic, and chemical composition with nanometric resolution. The result has been recognized as a seminal work in plasmonic and energy conversion efficiency at the nano-scale. The non-locally excited novel nanoscopy finds applications in surface science, nanotechnology, microelectronics, and biology of cell membranes and surfaces being also fully compatible with Raman spectroscopy and other optical investigation techniques [33,34].

Since 2013, I have a Research Scientist position at the Division of Physical Sciences and Engineering of KAUST University (Saudi Arabia), where I have mainly contributed to the project and realization of an entirely new advanced bio-physic laboratory. In this contest, I developed three complementary setups based on WiTEC, Asylum, and JPK atomic force microscopes and Princeton spectrometers to perfect and use the plasmonic assisted multi spectroscopy technique, [35] having in this way the possibility to probe simultaneously chemical, structural, and charge transport properties at the nano-scale [36].

Integrated into an atomic force microscope and excited in different optical configurations, the probes exploit synergic phenomena: extreme local field enhancement and confinement of hot plasmonic carriers at nano-scale mediated by a three-dimensional plasmonic nanostructure. It results in a probe breaking the optical limits and behaving as an ideal current source for conduction measurements [37-39] for hot electron nanoscopy and spectroscopy, a technique that we named HENs. For sizes small as < 10nm, the spatial confinement of SPPs produces the highest electric field nano source, on the lab scale and ambient environment, and causes the production of a large number of carriers with energy progressively above the Fermi level reducing the tip radius and extension of the contact with the sample. In these cases, the probed extension can be considered as small as less than 1000 atoms. These behaviors are completely different from what happens in the damping process of a plasmon wave in bulk material, where excited carriers have very small energies, and the photon scattering efficiency is faint. Such characteristics that I showed for our customized scanning nanoprobes make them the most suitable for injection of plasmonic carriers into semiconductors or molecules adsorbed on conductive surfaces accessing their HOMO and LUMO levels [35]. In our recent papers, we have shown how photogenerated current from the tip can be used to investigate innovative semiconductors for applications in electronics: the two-dimensional MoS_2 single crystal forming a junction with a p-type no-stochiometric SnO thin layer. Comparing the results with complementary Kelvin probe microscopy, traditional conductive AFM, and Raman measurements, we highlighted how by HENs-technique, it is possible to reveal details of local complexity in MoS_2 and non-stoichiometric polycrystalline structure of SnO at nanometric scale otherwise undetected [40,41].

I am still investigating the role that hot electrons could have to relate the functional and structural properties of matter at the nano-scale, as well as on the possibility to get a deeper understanding of phenomena at the basis of hot electron injection, to develop plasmonic nano-devices for energy harvesting, photo-catalysis, and solar cells research areas[42].

Another research theme focuses on the possibility to realize 3D scaffolds for tissue engineering, TE, applications with advanced bio and mechanical functionalities. In this field, we have proposed several fabrication processes for biocompatible solutions that promote the cellular replication thanks to specific patterns organized in three-dimensional networks. We have developed, optimizing sizes and fabrication processes, several polycaprolactone-based scaffolds, demonstrating for example, how large-scale micro-molding replica technique can be used to produce a successful scaffold for human neuronal stem cells proliferation [43], thanks to a microfabrication process that allows the control of micro and nano features on the surface of the device. The nanopatterning obtained on the microstructured PCL surface demonstrated to have a unique role for this bioresorbable material also in the case of NIH/3T3 mouse embryonic fibroblasts cells adhesion and healthy growth [44]. Results show how optimal fibroblasts proliferation proceeds on the surface of a pillared microstructured template and how cells grow mostly suspended in the inter-pillar spaces with optimal adhesion, possibly stratifying in the third dimension, as required to achieve tissues and organs regeneration. Fluorescence confocal analysis revealed optimal expression and localization of specific proteins permitting the visualization of lamellipodial focal adhesions structures, which are essential for cellular spreading and polarization.

To develop surfaces with improved cell culture biocompatibility, we optimized a solvent-casting and particulate-leaching fabrication technique to create porous three-dimensional PCL scaffolds [45]. These biocompatible porous surfaces were realized using simple size-sieved NaCl particles as a porogen, and investigated with mercury intrusion porosimetry and SEM imaging techniques aside from the in-vivo cells growth study. We explored different techniques to produce large-scale porous biocompatible polymeric scaffold, comparing NaCl and sucrose as a porogen of controlled size. Bone marrow-derived mesenchymal stem cells, chosen for cell culture trials, allowed us to conclude that, by using the same fast solvent-free injection/leaching process, the use of sucrose as porogen enables the obtainment of biocompatible scaffolds with a higher grade of porosity and more suitable cell adhesion capacity for tissue engineering purpose [46]. In the field of regenerative medicine, tissue engineering has a primary role. We proved how the development of nanotechnology coupled with advanced microfabrication techniques of biocompatible nanostructured materials strictly fulfill the requirement for the recovery of native tissues for TE applications [47]. One of the essential characteristics of the success of micro-engineered biopolymer relates to the possibility to program the scaffold to upload and subsequently release specific bioactivity factor that promotes the healthy growth and maturation of cells. We have proven it in a study where an optimized scaffold morphology and its preparation enhanced and prolonged the drug delivery capability in an in vitro controlled release of brain-derived neurotrophic factor study on primary astrocytes, cortical neuron cells, culture [48]. This significant result obtained for a cell type of poor regenerative ability represents a promising therapeutic option to enhance neuronal regeneration after lesion and for neural tissue engineering and prosthetics. Recently we undertook a study about a TE vascular graft scaffold, realized by two-photon laser lithography, allowing features design and scaffold elastic/plastic properties control at the microscale.

Two other relevant activities were pursued in the bio-physic field. One directed to visualize directly with TEM imaging, and characterizing with optical spectroscopy, the DNA/RNA molecules at the nucleic bases or bundle scales, the other to investigate with micro-Raman and force spectroscopies the amyloid fibrils in regards to their structural and functional alteration, being recognized one of primary importance as causes of Alzheimer disease.

Optimizing a nanofabrication process to produce superhydrophobic substrates able to tend DNA suspended filaments and bundles, and adapting them for ultra-high-resolution HR-TEM investigation, we were able to obtain a direct image of DNA [49]. It is different from diffraction images in the reciprocal space, and it is difficult to obtain for two main reasons: the intrinsic very low contrast of the elements that form the molecules and the difficulty of preparing the sample while preserving its pristine shape and size. Nevertheless, it can allow a quantitative evaluation of relevant characteristic lengths present in a molecule, thus possibly addressing biological problems that require knowledge at the single-molecule level. We evidenced how, with the use of our silicon devices, it is possible to have single filament suspended over the devices, ensuring no background signal and no need of staining techniques before the visualization and characterization, and how we can use this technique for many other biological samples, like neuron cells, membrane protein as RAD51 or lysozyme for examples [50]. In another study, we propose the use of Raman spectroscopy to characterize the conformation of a bundle of suspended DNA, determining if the helix arrangement is in the α- or the β-form [51]. In this case, we develop a device to concentrate in a specific position and stretch specific DNA filaments; this led to the clear identification of the DNA hydration state, of the backbone conformation, and the nucleotides. In a recent study [52], we further improved and extended to more complex biological specimens, such as the complex between DNA and the repair protein Rad51 or ion channels embedded in native cell membranes. We showed how employing a multidisciplinary, microscale engineered based approach, we can obtain a unifying technique that can be applied to different biological systems, with beneficial results for HR-TEM imaging, for the purity of the biological sample, and allowing a background free spectroscopic analysis.
It is known that the three-dimensional structure of a functional protein has a central role for its activity in the cellular environment and is characterized by the co-presence of three main types of secondary structure, namely α-helix, random coil, and β-sheet. Several pathologies are associated with the disarrangement of the tertiary structure of the protein, for example, the diseases related to amyloidosis. In this context, we used the shear flow generated at the rim of a drop evaporating on a micro-fabricated superhydrophobic surface to suspend and orient single/few lysozyme amyloid fibrils between two pillars for substrate-free characterization. Using micro-Raman spectroscopy, we evidenced a shift of the Amide I band, the main-peak of extended fibers, to the value attributed to β-sheet secondary structure, characteristic of the amyloid fiber [53]. Tau protein is another protein whose related pathologies, leading to neurodegeneration and cognitive impairment, are still poorly understood. We explained how a combination of shear stress, laminar flow, and crowded environment, which exist in the interstitial fluid and blood vessels of the brain, could trigger the formation of toxic species in the form of tau-protein aggregates. We reproduced such environment conditions using confined laminar flow on a superhydrophobic surface, showing that they drive the initial stages of tau protein aggregation [54]. In August 2020, we extend ad perfected these studies further, proposing the very compact droplet reactor, which can be realized on a superhydrophobic surface as a method to produce, control, and characterize amyloid fibrils growth [55]. The method that we firstly demonstrated allows us to produce in vitro and to characterize in situ the structure with real-time monitoring of the growth process by using combined light-sheet microscopy and thermal imaging resulting of primary importance in biology, medicine, and pharmacology. The convective flow induced by the temperature gradient inside the sample provides the driving force in the growth of well-ordered protein fibrils, offering a practicable procedure to finetune the amyloid fibrils formation as well of other types of proteins in future studies.

During these last years, we have revised several plasmonic nanostructures for the ultrasensitive detection of molecules focusing on design, fabrication, and application of various SERS devices [56,57]. We have reported our most recent advances in the development and application of 2D and 3D plasmonic nanostructures for sensing biological samples by Raman spectroscopy, focusing the investigation on the fabrication process and performance of several possible devices. We have shown how with the use of plasmonic self-similar chains, 3D nanostar dimers, and silver decorated nanotips, among others, it is possible to reach an unprecedented resolution analysis of extremely diluted inhomogeneous samples, for example opening to the possibility to sort and detect single mutated species on a collection of many different peptides [58]. We have also proposed to use microfluidic devices integrating plasmonic dimers nanostructures as a fast method for biological sensing when used in combination with Raman spectroscopy. The microfluidic device allowed us continuous single-cell analysis sorted among a complex multicellular sample [59]. Another method to simplify Raman scattering measurement in microfluidic devices was proposed in [60]. There we developed an optical biosensor by integrating optical waveguides (OWGs) and surface enhanced Raman spectroscopy (SERS) surfaces for continuous and label-free detection of biological compounds, implemented by a simple fabrication protocol, which includes photolithography and nanofabrication.

Using micro-Raman scattering and other high-resolution optical spectroscopies, I have investigated the structural properties of a single crystal of $MAPbBr_3$, a metal halide perovskite, part of an almost new class of synthesizable material that still await their translation into optoelectronic devices. The poor understanding and control of the crystallization process of these materials are current bottlenecks retarding the shift toward single crystal-based optoelectronics perovskites. In particular, in a recent study [61], I have contributed to elucidate the role of surface tension in the rapid synthesis of single crystals by inverse temperature crystallization. Raman clarified the complex structure of the fundamental unit cell of the crystal obtained and demonstrated the chemical and structural homogeneity of the samples. Currently, I am investigating with micro-, nano-Raman, and HENs techniques, several types of perovskites, such as the 2D layered, 3D hybrid, inorganic, zero-dimensional, "non-emissive", and other chemically synthesized perovskites and Argyrodites as results of a collaboration with two international research groups involved in the research for new material for nanoelectronic and photovoltaic.

In 2018, with the support of FDTD electromagnetic simulations, I investigated the possibility of realizing a broadband tunable electric field enhancer for surface-enhanced Raman spectroscopy applications constituted by standing plasmonic-active gold nanowires array grown on iron disks. The fabrication method elected, based on an inexpensive galvanic process, allows for the selection of size, diameter, and spatial arrangement of nanowires [62]. We confirmed the SERS effectiveness experimentally with the Raman of two standard molecules, Benzene-thiol and Rhodamine.

As a result of an international collaboration, we have demonstrated a promising approach to enhance the luminescence of AlGaN multiple quantum wells via the introduction of a lateral-polarity structure, LPS, comprising both III- and N-polar domains. We used space-resolved internal quantum efficiency mapping to show a higher relative IQE in N-polar domains, providing evidence of enhanced radiative recombination efficiency in the LPS. We attributed the enhanced luminescence in LPS to the surface roughening and compositional inhomogeneity in the N-polar domain. In particular, our contribution was to use AFM topography, electric AFM, and Scanning Kelvin Probe Microscopy, SKPM, techniques to verify this idea, mapping the carrier distribution within the LPS at the nano-scale. Specifically, in the case of light assisted SKPM, the measured surface potential voltage represented the change in surface band bending, clearly evidenced by our measurements [63].

In another recent collaboration [64], I investigated the influence of water on the performance of Organic Electrochemical Transistors, OECTs, used, for example, to translate low magnitude ionic fluctuations of biological origin into measurable electrical signals. Due to the remarkable technological interest in these bio-transducers, I investigated the structural and morphological changes occurring in films of a p-type poly-thieno-thiophene, p(g2T-TT), upon electrochemical doping with real-time electrochemical Raman investigation. I show how the hydrated dopant ions of chlorine into the film irreversibly change the polymer structure, impacting the efficiency, reversibility, and speed of charge negatively. The charge redistribution along the backbone (reduction of the π-electron delocalization and the formation of polarons) reduces the overall bond order in the polymer backbone inducing structural arrangement changes (attributed to the presence of Cl^- ions close to the thieno-thiophene rings). The study highlights the negative impact of a swollen (by water) channel material on the performance of accumulation mode OECTs and lays the foundation for future materials design.

Appeared in Nature Material is the demonstration for the first time of the integration of an n-type conjugated polymer (an alternating naphthalene dicarboximide (NDI) acceptor and bithiophene (T2) donor subunits with randomly distributed alkyl and ethylene glycol side chains) with a redox enzyme for the autonomous detection of glucose and power generation from bodily fluids[65]. Hydrophilic n-type semiconducting biopolymers, at the base of OECTs, are a promising class of materials for applications that rely on electron transfer for signal generation.

In an interesting paper [66] appeared on Advanced Material, we investigate the newly synthesized 2D MXene thin films for high-performance plasmonic photodetection. The significance and originality of our work lie in the fact we demonstrate firstly Mo_2CT_x photodetectors, based on plasmonic hot-electron transport, conducting a comprehensive study for the spatial and energy distribution of surface plasmons sustained by Mo_2CT_x nanosheets. Besides, the corresponding plasmon-assisted hot carrier dynamics have been evidenced by ultrafast femtosecond transient absorption and energetically characterized by EELS spectroscopy. My contributions to this study were the spectral photoresponse characterization of the Mo_2CT_x thin-film junction devices, their photocurrent imaging at microscale, the evaluation of the optical density of the new materials, the micro-Raman fingerprint identification (evidencing photon-electron-phonon interaction in the of equilibrium Stokes- anti-Stokes scattering comparison) and the chemical characterization of the densely populated surface of the flakes. I also elucidated the plasmonic operability of the material.

Recently I have written a News and Views for Nature Nanotechnology about the ultrafast dynamic, electron-electron relaxation in graphene and 2D materials and the possible future applications and research directions, moving from the very recent and unexpected results obtained on graphene third-order nonlinearity that can be enhanced by plasmonic excitation mediated by a nano-scale tapered plasmonic antenna[42].

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48 Limongi, T. *et al.* Delivery of Brain-Derived Neurotrophic Factor by 3D Biocompatible Polymeric Scaffolds for Neural Tissue Engineering and Neuronal Regeneration. *Molecular Neurobiology*, doi:10.1007/s12035-018-1022-z (2018).
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52 Marini, M. *et al.* Imaging and structural studies of DNA-protein complexes and membrane ion channels. *Nanoscale* **9**, 2768-2777, doi:10.1039/c6nr07958j (2017).
53 Moretti, M. *et al.* Raman study of lysozyme amyloid fibrils suspended on superhydrophobic surfaces by shear flow. *Microelectronic Engineering* **178**, 194-198, doi:10.1016/j.mee.2017.05.045 (2017).
54 Moretti, M. *et al.* Confined laminar flow on a superhydrophobic surface drives the initial stages of tau protein aggregation. *Microelectronic Engineering* **191**, 54-59, doi:10.1016/j.mee.2018.01.025 (2018).
55 Zhang, P. *et al.* A droplet reactor on a superhydrophobic surface allows control and characterization of amyloid fibril growth. *Communications Biology* **3**, 457, doi:10.1038/s42003-020-01187-7 (2020).
56 Das, G. *et al.* Plasmonic nanostructures for the ultrasensitive detection of biomolecules. *Rivista Del Nuovo Cimento* **39**, 547-586, doi:10.1393/ncr/i2016-10129-y (2016).
57 Gobind Das, M. M., Bruno Torre, Marco Allione, Andrea Giugni and Enzo Di Fabrizio. Graphene: A Building foundation for Efficient Plasmonic SERS Device. *Biochemistry and Analytical Biochemistry* **06**, doi:10.4172/2161-1009.1000310 (2017).
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60 Valpapuram, I. *et al.* Waveguiding and SERS Simplified Raman Spectroscopy on Biological Samples.

Biosensors **9**, 37 (2019).
61 Zhumekenov, A. A. *et al.* The Role of Surface Tension in the Crystallization of Metal Halide Perovskites. *Acs Energy Letters* **2**, 1782-1788, doi:10.1021/acsenergylett.7b00468 (2017).
62 Marinaro, G. *et al.* Plasmonic Nanowires for Wide Wavelength Range Molecular Sensing. *Materials* **11**, 827 (2018).
63 Guo, W. *et al.* Lateral-Polarity Structure of AlGaN Quantum Wells: A Promising Approach to Enhancing the Ultraviolet Luminescence. *Advanced Functional Materials* **28**, 1802395, doi:ARTN 1802395
10.1002/adfm.201802395 (2018).
64 Savva, A. *et al.* The Influence of Water on the Performance of Organic Electrochemical Transistors. *Chemistry of Materials*, doi:10.1021/acs.chemmater.8b04335 (2019).
65 Ohayon, D. *et al.* Biofuel powered glucose detection in bodily fluids with an n-type conjugated polymer. *Nature Materials*, doi:10.1038/s41563-019-0556-4 (2019).
66 D. B. Velusamy, J. K. E.-D., A. M. El-Zohry, A. Giugni, A. E. Mansour, E. Fabrizio, O. F. Mohammed, H. N. Alshareef, S. Lopatin, M. Hedhili 2D MXene Thin Films for High Performance Plasmonic Photodetection. *Advanced Materials* **manuscript adma.201807658** (2019).

EDUCATION AND TRAINING

• Dates (from-to)	30/03/2018 – 30/03/2024
• Name and Institution	Ministero dell'Istruzione, Università e Ricerca, Italia
• Main arguments and Studies	Abilitazione Scientifica Nazionale, (ASN), 02/B1, Seconda Fascia, N. Progr. 60484 (2018). Struttura della materia.
• Title	Abilitazione Scientifica Nazionale.

• Dates (from-to)	15/4/2016 - 29/4/2016
• Name and Institution	King Abdullah University of Science and Technology (KAUST), Saudi Arabia
• Main arguments and Studies	LabVIEW programming language. Exam and certification course by National Instruments instructor.
• Title	Certified LabVIEW Associated Developer (CLAD)

• Dates (from-to)	December 2013 – DEC 2018
• Name and Institution	King Abdullah University of Science and Technology (KAUST), Saudi Arabia
• Main arguments and Studies	2013 Biosafety Training certificate. 2014 Hazardous Waste certificate. 2014 Ultraviolet Radiation Safety certificate. 2014 Laser Safety certificate. 2014 Cleanroom Safety & Protocol certificate. 2014 Fume Hood certificate. 2014 Emergency and Crisis Management Overview certificate. 2014 Radiation Safety Certificate. 2014 Hazards and expectations associated with Liquid Nitrogen. 2014 Working with Reactive Materials Training. 2014 Fire Extinguisher certificate.

	2015 Lab safety, Incident reporting.
	2015 Standard Operating Procedure certificate.
• Title	Advanced training activity and lab safety certifications for the attended courses.

• Dates (from-to)	01/09/2000 - 31/08/2003
• Name and Institution	University of L'AQUILA - Via Giovanni Di Vincenzo 16/B - L'AQUILA, Italia
• Main arguments and Studies	University Ph.D. Student courses. Ph.D. research arguments: Optical spectroscopy, glass transition, high-frequency dynamics, structural relaxation in fluids. Thesis title: "Studio della dinamica collettiva in acqua e glicerolo: le nuove prospettive offerte dalla spettroscopia Brillouin nell'ultravioletto".
• Title	Ph.D. in Physics, XV ciclo di Dottorato (16 gennaio 2004).

• Dates (from-to)	06/2002
• Name and Institution	Abdus Salam International center for theoretical physics, Miramare, (Trieste), Italia
Main arguments and Studies	JOINT ICTP-INFM School on Spectroscopic Investigation of Collective Dynamics in Disordered Systems.
• Title	Certificate of participation.

• Dates (from-to)	22/06/1999
• Name and Institution	Firenze University – Facoltà di scienze matematiche e Fisiche, Dipartimento di Fisica, Firenze, Italia.
• Main arguments and Studies	A student in Physics, roll list #1915557. Experimental physics. Beyond main courses, I attended Physics of the solid-state, Electronic, Low-temperature physics, Quantum electronics, and Physics laboratory of quantum optics courses. Thesis title: "Misura della distribuzione angolare di elettroni emessi nella ionizzazione multi fotonica di atomi di xenon e bario".
• Title	Graduated in Physics

• Dates (fro to)	03/1996- 08/1996
• Name and Institution	Johannes Gutemberg-Universität Mainz, MAINZ, Germany. European Student Exchange Program "Erasmus Project"
• Main arguments and Studies	Quantum mechanics, advanced laboratory of physics, German language course.
• Title	Exams.

• Dates (from-to)	October 1987- July 1992
• Name and Institution	Liceo scientifico Niccolò Copernico, Prato, Italia.
• Main arguments and Studies o	Indirizzo scientifico sperimentale, lingua straniera inglese.
• Title	Scientific high school diploma. Diploma maturità scientifica.

PROCEEDING and CONFERENCES

1. “A plasmonic array of standing wires in trigonal symmetric for broadband, polarization-insensitive molecular sensing”. Oral presentation” Micro & Nano Engineering Rodos Palace Hotel, Rhodes Greece, 2019
2. “Transition metal-based 2D MXene thin films for plasmonic photodetection.” Oral presentation.” Oral presentation” Micro & Nano Engineering Rodos Palace Hotel, Rhodes Greece, 2019
3. “Structured light with angular momentum for excitation of near field hot spots” Micro & Nano Engineering Rodos Palace Hotel, Rhodes Greece, 2019
4. “A method for the multiple direct imaging by TEM, AFM, and SERS of ion channels on plasma membranes suspended on superhydrophobic surfaces” Micro & Nano Engineering Rodos Palace Hotel, Rhodes Greece, 2019
5. “Nanomechanical DNA resonator for DNA structural alterations studies” Micro & Nano Engineering Rodos Palace Hotel, Rhodes Greece, 2019
6. “Hot Electron Nanoscopy and spectroscopy (HENs): from probe design to real applications” Micro & Nano Engineering Rodos Palace Hotel, Rhodes Greece, 2019
7. “A method for the multiple direct imaging by TEM, AFM, and SERS of ion channels on plasma membranes suspended on superhydrophobic surfaces” Micro & Nano Engineering Rodos Palace Hotel, Rhodes Greece, 2019
8. “Trigonal symmetric plasmonic array of standing wires for broadband, polarization-insensitive molecular sensing.” Oral presentation #469 at Nanophotonics and Micro/Nano Optics International Conference 2018
9. “Structural and transport investigation of two different types of organic-inorganic halide perovskite structures.” Oral presentation #470 at Nanophotonics and Micro/Nano Optics International Conference 2018
10. Invited oral 103° Congresso Nazionale della Società Italiana di Fisica, codice: atticon10816 titolo: “Plasmon-induced hot-electron generation for nanoscopy and spectroscopy.” 11-15/09/2017
11. Invited oral. Lecture "Colloquia" for Ph.D. Students of Physics department of Trento University, Polo scientifico. Title: "A Plasmonic nano device for spectroscopy, transport and imaging investigation of the nano world" 07/09/2017
12. Invited oral: The 8th International Conference on Surface Plasmon Photonics (SPP8) Academia Sinica, Taipei, Taiwan May 22-26th, 2017 titolo: “Hot Electrons Nanoscopy and Spectroscopy (HENs).” 25/05/2017
13. Invited lectures at Ningbo Institute of Industrial Technology (CNITECH) of the Chinese Academy of Sciences (CAS), NINGBO, CINA. Arguments "Plasmon-induced Hot Electron generation: Application to the study of innovative 2D dichalcogenide based hybrid heterojunctions" 17-20/05/2017
14. Invited oral presentation at 1st Workshop of the IIT Nanostructures Group 2012. Title: “Complementary Inelastic Light Scattering techniques and applications.” Andrea Giugni. Park Hotel Azalea, Cavalese (TN); 28/03-01/04/2012
15. Invited oral presentation at 1st Workshop of the IIT Nanostructures Group 2012. Title: “Heterostructures characterization by Raman Scattering” Andrea Giugni. Park Hotel Azalea, Cavalese (TN); 28/03-01/04/2012
16. Oral presentation at XCVII Congresso Nazionale della Societa’ Italiana di Fisica. Title: “Ordered core-shell CdSe-CdS nanorods study by Raman spectroscopy” L'Aquila, 26 - 30 September, (2011) 26-30/09/2011

17. Oral presentation “Coupling colloidal nanocrystal emission to plasmons propagating in metallic nanowire structures” META'13 March 2013, Sharjah, United Arab Emirates.
18. Roberto Bellotti, Andrea Giugni and Gian Bartolo Picotto “The interferometer set-up in progress at INRiM for the NANOTRACE project” NanoScale 2010 Oct 27th - 29th, 2010 - Brno Czech Republic. (N° M01) - Poster presentation.
19. Andrea Giugni and Marco Pisani – “High-resolution actuator with 0.1mm travel and 10 pm accuracy to be used as a transfer standard for calibration of interferometers”. NanoScale 2010 Oct 27th - 29th, 2010 - Brno Czech Republic. (N° M11) – Poster presentation.
20. Zucco M, Antonietti N, Pisani M, Giugni A, “Absolute interferometry with optical fringe resolution”. ICSO 2010 International Conference on Space Optics. 4 – 8 October 2010. Imperial Rhodes Hotel Rhodes, Greece. (N°P24). Poster presentation.
21. Invited oral presentation at the International Nanotrace project Workshop. Title: “NANOTRACE annual meeting: The Transfer Standard” Andrea Giugni. National Metrology Institute (TÜBiTAK - UME) of Turkey, (7 Maggi 2010) 05-09/05/2010
22. Grossi V, Urbani A, Giugni A, Santucci S, Passacantando M. “Simultaneous growth of MWCNTs at different temperatures in a variable gradient furnace”. E-MRS Fall Meeting 2008- Book of Abstracts: 2008 E-MRS Fall Meeting & Exhibit, pp. 68-69. Oral presentation.
23. Giugni A “High temperature sound attenuation measurements in fused silica” XI International Workshop on Complex Systems Andalo (Trento), Italy 17-20 March 2008. Poster presentation.
24. Giugni A, Nardone M, Benassi P, Fontana A, Gessini A, Masciovecchio C, Baldi G “Sound attenuation in α-Quartz”. XI International Workshop on Complex Systems Andalo (Trento), Italy 17-20 March 2008. Poster presentation.
25. Giugni A, G. Baldi, P. Benassi, A. Fontana, M. Nardone, M. Zanatta “Contribution of anharmonicity in the explanation of acustic damping in v-SiO2”. XI International Workshop on Complex Systems Andalo (Trento), Italy 17-20 March 2008. Poster presentation.
26. Oral presentation “Anharmonicities and line width in α-Quartz” Giugni Andrea. XI International Workshop on Complex Systems Andalo (Trento), Italy 18 March 2008.
27. Baldi G, Benassi P, Caponi S, Fontana A, Giugni A, Nardone M, Sampoli M. “Low temperature phonon damping in vitreous silica explored by UV Brillouin spectroscopy”, IV Workshop on Non-Equilibrium Phenomena in Supercooled Fluids, Glasses and Amorphous Materials 17 - 22 September 2006, Pisa. (N° E1)-Poster presentation.
28. Benassi P, Giugni A, Nardone M, Sampoli M. “High-resolution high-contrast spectrometer for UV Brillouin spectroscopy HIRESUV” 5th International Discussion Meeting on Relaxations in Complex Systems 7-13 July, 2005 Lille, France. (N° NS1.) – Oral presentation.
29. Baldi G, Caponi S, Fontana A, Sampoli M, Benassi P, Giugni A, Nardone M, Scarponi F, Fioretto D, Bove L, Fabiani E. “Acoustic attenuation in the prototypical strong glass v-geo2: an experimental and numerical simulation study” 5th International Discussion Meeting on Relaxations in Complex Systems 7-13 July, 2005 Lille, France. (N° Gt-bp10a) – Oral presentation.
30. Baldi G, Benassi P, Caponi S, Fontana A, Gessini A, Giugni A, Masciovecchio C, Nardone M, Orsingher L, Rossi F, Sampoli M. “Dynamic Structure Factor of the Fragile Glass Former 3-Methylpentane by Visible and Ultraviolet Brillouin Light Scattering” 1st international workshop on neutron Brillouin scattering, 12-14 June, 2005, Perugia, Italy- Poster presentation.

31. Benassi P, Caponi S, Cunsolo A, Eramo R, Giugni A, Nardone M, Sampoli M. “Brillouin spectroscopy in the Ultraviolet spectral region” 9th International Workshop on Disordered Systems, 10-13 March 2003 Molveno, Italy- Poster presentation.
32. Oral presentation “HIRESUV: Brillouin Spectra in the Ultra Violet” Giugni Andrea. “JOINT ICTP-INFM School & Workshop on Spectroscopic Investigation of Collective Dynamics in Disordered Systems”, Abdus Salam International center for theoretical physics 22 June 2002 Miramare (Trieste), Italy.
33. Eramo R, Benassi P, Giugni A, Sacchetti F, Sampoli M. “Brillouin Spectra of water in the Ultraviolet” Gordon Research Conference on Liquids, Chemistry & Physics of August 5-10, 2001 Holderness School Holderness, NH- Poster presentation.
34. Benassi P, Eramo R, Giugni A, Sampoli M, Sacchetti F. “The monochromator HIRESUV” 8th International Workshop on Disordered Systems, Andalo (Trento), Italy, 12-15 March 2001- Poster presentation.
35. Cavalieri S, Eramo R, Fini L, Giugni A, Materazzi M. “Temporal coherent control on multiphoton transition using incoherent light.”Gordon Research Conference on Quantum Control of Atomic and Molecular Motion, Plymouth State College in Plymouth, NH, 1-6 August 1999- Poster presentation.
36. Giugni A, Cavalieri S, Eramo R, Fini L, Materazzi M “Photoelectron Angular Distributions in multiphoton Ionization by Time-of-Flight Spectrometry” ICOLS99, LASER SPECTROSCOPY Proceedings of the XIV International Conference (ICOLS99) Innsbruck, Austria, 7 – 11 June 1999- Poster presentation.

Competences

University Teaching, supervision of Master and Ph.D. students’ activities.
01/01/2004 - 31/12/2005
University of L'Aquila, Physics Department, teaching collaboration.
Teaching assistant activities and supervisor for the Courses:
“Introduzione alla Fisica Moderna” Prof. M. Nardone
“Spettroscopia” Prof. M. Nardone
01/01/2003 - 31/12/2004
University of L'Aquila, Physics Department, teaching collaboration.
Teaching activities and supervisor for the Course
“Laboratorio di Fisica 2". Prof. F. Lucari.
"Laboratorio di Fisica 1" Prof. F. Lucari.

I have co-supervised the thesis work of three Laurea students.
Reviewer for Nature Nanotechnology, Applied Physic Letters, ACS Photonics, Nanophononics, and Nanoscale journals.

Languages: Italian: native, English fluent, Spanish basic, German basic.

Technical and scientific skills

During my activity in different research fields, I gained, learned and consolidated a large number of competencies and skills in

- Continuous-wave and pulsed laser optics. (LENS, Firenze, L'Aquila, and KAUST Universities)
- Nonlinear optic. (LENS, Firenze, and KAUST Universities)
- Multiphoton electron-ion spectroscopy. (LENS)
- Brillouin visible and ultraviolet scattering. (L'Aquila University, and Synchrotron Elettra, Trieste)
- Inelastic x-ray scattering. (Synchrotron ESRF Grenoble, France)
- Optical homodyne- heterodyne- interferometry. (INRIM, Torino)
- Optical metrology and high-resolution atomic line spectroscopy. (LENS, INRIM)
- Optical and mechanical design of instrumentation for optical spectroscopy and interferometry. (L'Aquila University, INIRIN, IIT, KAUST University)
- High Vacuum Techniques design. (L'Aquila University, ELETTRA, ESRF, KAUST)
- Photon-correlation spectroscopy. (L'Aquila University)
- Raman scattering, TERS, SERS techniques. (L'Aquila University, IIT, KAUST)
- FTIR spectroscopy. (IIT)
- Plasma sputtering, thermal evaporation, CVD, RIE, techniques. (IIT, KAUST)
- Scanning Probe Microscopy. (IIT, KAUST)
- Plasmonic probe scanning Microscopy, and hot electron microscopy, HEN. (IIT, KAUST)
- Atomic force microscopy, electric force microscopy. (IIT, KAUST)
- Scanning electron microscopy. (IIT, KAUST)
- Dual beams: focused ion beam lithography and electron beam deposition, nano-machining. (IIT, KAUST University)
- High-resolution electron beam lithography. (IIT, KAUST University)
- Design and 3D machining of mechanical parts by means of manual and automated CAM tools for 3-5 axis mills and lates. (University of L'Aquila)
- High precision machining 4-axis tools for microfabrication. (University of L'Aquila, INRIM, IIT, KAUST)
- Electronic circuit realization and design via dedicated software, PCB prototype realization for automation and control of scientific instruments and for the realization of power circuits and signal amplification. (IIT, KAUST University)

I have competencies in IT as User (text, images elaboration, data analysis, software for control of scientific instruments) and as Administrator (OS installation, coding for scientific problems analysis and modeling, instrument interfacing, and control. Here down some of the software regularly used:
Microsoft Windows and IOs operative systems

- Microsoft Office software.
- Data acquisition and analysis software:
  LabVIEW, Matlab, Origin, SigmaStat and Sigmaplot, Gwyddion, PhysSpecV2, Project4, Asylum research, Labspec, Renishaw WIRE, PhysSpecV2, Control4 Raman acquisition and analysis, Raith EBL, FEI microscope SEM, FIB control software.
- Programming language:
  MATLAB (adopted to develop custom optical Ray Tracing software, advanced data analysis and control of scientific instrumentations). LabVIEW, LabVIEW Real-Time, LabVIEW FPGA for automation and control. (CLAD certify 2016), used for control acquisition and data analysis.
- Mechanical and electromagnetic simulation software:

Lumerical FDTD Solution, Inventor elastic module, Ansys, COMSOL Multiphysics.

- Design software:

  Advanced experience with the 2D/3D Graphical software as Corel Draw, Designer, Autodesk Inventor, and FEM Stress Analysis, advanced experience with CAM software as SolidCAM for prototyping and fast time to market of innovative instrument realization.
- Experience with the optical design and Ray-Tracing modelling ZEMAX software.
- Electronic circuit design via LT spice, PCB design, and realization ability.

Conference organization

I have co-organized the national workshop "SOFT" on soft condensed matter, held in L'Aquila in February 2005. The workshop has seen the participation of the Italian research community working on soft condensed matter and on the physics of disordered materials.

Personal competencies

I have a strong background in Physics, optics, spectroscopy, and nanotechnology with unusually great practical skills in mechanics, electronics, and software development. I have demonstrated a precious talent in understanding the technologies required for my studies showing the ability to range over different disciplines, with interest, curiosity, and competence. I have proven to be extremely independent in the laboratory as well as to focus on defining and reaching milestones relevant to my projects. I combine excellent practical skills, which are of paramount importance in the development of innovative scientific instrumentation, particularly spectrometers, interferometers, and scanning probe instrumentation, with a sharp understanding of the scientific problems to be addressed. I demonstrated a high degree of independence in the process of data analysis and in working out theoretical interpretations of the experimental results. I have also developed valuable communication skills, becoming very good at presenting scientific results, both in papers and conference presentations.

I have matured lecturing experience in modern physics and spectroscopy, which makes my competencies qualified for a position in a top-quality University or high-level Research Centre. I also followed the work of students during the laboratory activities at the L'Aquila University and then mentored Ph.D. students at the IIT with patience and dedication, always establishing optimal communications about the scientific problem and in personal relations contributing to the educations of the student and always promoting good attitudes in the workplace. As a research scientist fellow at KAUST, I co-supervise and organize the students' work, organize small groups collaboration toward the completion of specific tasks on arguments that span from physics to engineering, chemistry, and biology.

Proposals for national and international research projects

During the collaboration with many different research groups, I participated actively in proposals for national and international research projects calls defining the argument or the research strategies, and for beam-time allocation at inelastic neutron scattering and X-ray scattering facilities. I have got scientific responsibility for specific projects, original or proposed in collaboration. My research at KAUST University is partially funded by three research grants defined in collaboration with the laboratory PI, Prof. E. Di Fabrizio.

Here the list of the participated projects along with my career:

- HiReSUV, High-Resolution Spectroscopy in the UV, INFM 1998 (3+2) years.

- LiMUV, Liquid Metals by UV spectroscopy INFM-CNR, fondi PAIS 2003.
- Colloidal systems with short-ranged interactions: protein crystallization models, FIRB.
- Raman spectroscopy for the future ophthalmological application, Tech2eMotion Lazio.
- "Dinamica vibrazionale e fenomeni di rilassamento in sistemi disordinati", PRIN 2005.
- "Dinamica vibrazionale e rilassamenti in vetri densificati e in sistemi disordinati confinati", PRIN 2007.
- NANOTRACE: New Traceability Routes for Nanometrology, EURAMET 2008.
- ERC grant, NanoAntenna, Nano-Optical Antennas for Tunable Single Photon Super-Emitters, No. 241818FP7-IDEAS-ERC.
- ERC grant, SMD, Single or few molecules detection by combined enhanced spectroscopies, no. CP-FP 229375-2, FP7-NMP.
- ERC grant, FOCUS, Single Molecule Activation and Computing), FP7 No. 270483.
- IIT project: Development of a new assisted Scanning Probe Microscope instrumentation for the investigation of solid-state and biologically-inspired systems at the nano-scale.
- IIT project: Brillouin Light Scattering per lo studio della Dinamica Strutturale di Sistemi proteici e lo sviluppo di dispositivi nano fabbricati.
- CRG Competitive Research Grant, Multipurpose nano spectroscopies with spatial and temporal control through adiabatic compression and localization of surface plasmon polariton. 2014 (3 years).
- CRG Competitive Research Grant, 2016 Novel direct HRTEM imaging of DNA, DNA/proteins interaction, and cell membrane structure (3 years).
- CRG Competitive Research Grant, 2018, "Microlanding" (3 years).

Member of scientific societies

1999-2000 National Institute for the Physics of Matter (INFM) - Florence, Italy.

2001-2004 National Institute for the Physics of Matter (INFM) - L'Aquila, Italy.

2004-2009 INFM-CRS-Soft Matter (CNR), c/o Università la Sapienza, Italy.

2017- present. Società Italiana di Fisica (SIF), Italy.

Main collaborations

I had and I still have the pleasure to collaborate with several scientists. A list of the main collaborations includes: Prof. Cavalieri Stefano, (UniFi), Dot. Lorenzo Fini, (UniFi), Dot. Roberto Eramo (INO), Dot. Paola Benassi (UnivAQ), Prof. Michele Nardone (UnivAQ), Prof. Sandro Santucci (UnivAQ), Prof. Francesco Sacchetti (UniPG), Prof. Daniele Fioretto (UniPG), Dot. Silvia caponi (CNR), Prof. Giancarlo Ruocco (Sapienza), Prof. Aldo Viliani (UniTN), Prof. Giulio Monaco (UniTN), Dot. Giacomo Baldi (UniTN), Dot. Claudio Masciovecchio (Elettra), Prof. Remo Proietti (NIMTE, CN), Prof. Enzo Di Fabrizio (KAUST), Dot. Bruno Torre (KAUST), Prof. Husam N. Alshareef (KAUST), Prof. Osman M. Bakr (KAUST), Dot. Francesco De Angelis (IIT), Dot. Alessandro Alabastri (Rice University), Prof. Mark I. Stockman (Georgia State University) Prof. Husam N. Alshareef (KAUST, SA), Prof. Osman Bakr (KAUST, SA), Prof. Sahika Inal (KAUST, SA).

Date 06, November, 2020