PAOLO POSTORINO
Curriculum Vitae

Education

Type	Year	Institution	Notes (Degree, Experience,…)
University graduation	1989	Università di Roma "La Sapienza"	Laurea in Fisica
Pre-doctorate training	1989-1990	Rutherford Appleton Laboratory, UK	Visiting scientist at the Spallation Neutron Source ISIS
PhD	1990-1993	Joint Ph.D. School Università di Perugia e L'Aquila	Ph.D. Fellowship in "Condensed Matter Physics"
Licensure 01	2000	Università degli Studi della Calabria	Idoneità nazionale Professore Associato – Settore B01B: FISICA
Licensure 02	2013	Ministry of Education, University and Research, Italy	Abilitazione Scientifica Nazionale Professore di I Fascia - SC 02/B1 Experimental Condensed Matter Physics

Appointments

– Academic Appointments

Start	End	Institution	Position
1993	2002	University of Roma "Sapienza" - Department of Physics – Faculty of Engineering	University Researcher (Gruppo Discipline n. 87 – Struttura della Materia)
2002	2010	University of Roma "Sapienza" - Department of Physics – Faculty of Engineering	Associate Professor in Experimental Physics (SSD FIS/01)
2010	today	University of Roma "Sapienza" – Department of Physics – Faculty of Science	Associate Professor in Experimental Physics (SSD FIS/01 – SC 02/B1)

Other Appointments

Start	End	Institution	Position
1987	1988	Compulsory military service under the Italian armed forces	

High Education & Teaching experience

I have been invited to give lectures and advanced courses to PhD students and to students of national and international specialized Schools, mostly on the use of optical spectroscopy techniques and high pressures methods, among which:

Year	Institution	Lecture/Course
1996	Università di Camerino International School *Structural Techniques for Advanced Radiation Sources*	Lectures on *Neutron diffraction techniques*
2003	ICTP, Trieste Summer School on *Manganites at high-pressure*	Lectures on *High Pressures Techniques in Optical Spectroscopies*

2009	Palinuro *School of Superconductors and Functional Oxides*	Lectures on Optical spectroscopy in strongly correlated electron systems
2009	Porto Conte Ricerche, Alghero Advanced course on *Tecniche Strumentali applicate alle Biotecnologie*	*La spettroscopia Raman: uno strumento semplice ed efficace per applicazioni multi-disciplinari*
2011	ICTP, Trieste *Joint ICTP-SISSA Colloquium on Condensed Matter*	*Tuning lattice distortion by pressure: the insulator to metal transition and the onset of phase-separated states*
2013	Institute for Plasma Research & Department of Science and Technology, Ahmedabad (India) *School on Advanced Characterization methods for nanophase materials*	Lectures on *Optical Spectroscopy at High Pressure*
2005 – today	"Sapienza" Ph.D. School of Physics	Lectures on *Raman Spectroscopy*
2018	CEA for students of Michigan University	Lectures on *Principles of Engineering Materials*
2019	CEA for students of Michigan University	Lectures on *Principles of Engineering Materials*

From 2004 to 2011, I have been a member of the board of the Ph.D School of *Material Science* (Collegio dei Docenti) of the University of Roma *Sapienza*.

Since 2012 I am member of the board of the Ph.D School of *Mathematical Models for Engineering, Electromagnetics and Nanosciences* of the University of Roma *Sapienza.*

I have been a member of many committees for the selection of researchers and post-doc fellows for university and national research institutions. I am a regular member of the final examination committees of Ph.D. Thesis in several Italian (Perugia, Salerno, Roma Tre, Camerino, Firenze, Aquila) and international Universities (Technische Universitat Munchen, Indian Institute of Technology Kharagpur, Sorbonne Université), and I have been a member (and President in 2017) of the evaluation and selection committee for the admission to the PhD in Physics of the University of Rome "Sapienza".

2004 – 2011	"Sapienza" - Ph.D. School of Material Science.	Member of the board (Collegio dei Docenti) of the Ph.D. School
2012 – today	"Sapienza" Ph.D. School of *Mathematical Models for Engineering, Electromagnetics and Nanosciences*	Member of the board (Collegio dei Docenti) of the Ph.D. School

Since 1993, as a staff member of the University of Roma "Sapienza", I have been regularly teaching several courses to student classes of both the Engineering and the Science Faculty of the University of Roma "Sapienza". These are Fisica I (Mechanics and Thermodynamics), Fisica II (Electromagnetism), Esperimentazione Fisica (Physics Laboratory), Fisica III (Modern Physics), Struttura della Materia con Elementi di Meccanica Quantistica (Structure of matter with basics of quantum mechanics) and Struttura della Materia (Structure of Matter). My typical teaching assignment has been **120 hours (12 CFU) per academic year** with an average number of students of about **100 per year**.

Since 1994 I have been, and I am, **the supervisor of about 50 Master Degree** and, since 1999, of **17 Ph.D. students** at the University of Roma "Sapienza", 1 of which in co-tutoring with Prof. G. Abstreiter of Technischen Universität München and 1 with Prof. F. Bruni of the Roma Tre University. Most of the students who graduated or got a Ph.D. under my supervision are now working (have worked) in international research institutions and Universities, e.g. ETH-Zurich, Soleil-Paris, CSEC-Edinborough, TUM-Munich, TUE-Eindhoven, APS-Argonne (Illinois US), ESRF-France, ALBA-Spain, Stanford University

(California-US), AMOLF-Amsterdam, Basel University.

I have also contributed to the Italian version of the book Sears and *Zemansky's University Physics* by H.D. Young and H.A. Freedman.

The details of the courses that I have been giving along the years, all given at *Sapienza*, are listed in reverse chronological order in the following table:

Year	Institution	Lecture/Course
2018/19	LM Ingegneria delle Nanotecnologie	Struttura della Materia con Elementi di Meccanica Quantistica – 6 CFU
	LM Fisica	Struttura della Materia – 6 CFU
2017/18	LM Ingegneria delle Nanotecnologie	Struttura della Materia con Elementi di Meccanica Quantistica – 6 CFU
	LM Fisica	Struttura della Materia – 6 CFU
2016/17	LM Ingegneria delle Nanotecnologie	Struttura della Materia con Elementi di Meccanica Quantistica – 6 CFU
	LM Fisica	Laboratorio di Biofisica 12 CFU
2015/16	LM Ingegneria delle Nanotecnologie	Struttura della Materia con Elementi di Meccanica Quantistica – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 9 CFU
2014/15	LM Ingegneria delle Nanotecnologie	Struttura della Materia con Elementi di Meccanica Quantistica – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 9 CFU
2013/14	LM Ingegneria delle Nanotecnologie	Struttura della Materia con Elementi di Meccanica Quantistica – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 9 CFU
2012/13	LM Ingegneria delle Nanotecnologie	Struttura della Materia con Elementi di Meccanica Quantistica – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 9 CFU
2011/12	LM Ingegneria delle Nanotecnologie	Struttura della Materia con Elementi di Meccanica Quantistica – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 9 CFU
2010/11	LM Ingegneria Ambiente e Territorio	Fisica III – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2009/10	LM Ingegneria Ambiente e Territorio	Fisica III – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2008/09	LM Ingegneria Ambiente e Territorio	Fisica III – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2007/08	LM Ingegneria Ambiente e Territorio	Fisica III – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2006/07	LM Ingegneria Ambiente e Territorio	Fisica III – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2005/06	LM Ingegneria Ambiente e Territorio	Fisica III – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2004/05	LM Ingegneria Ambiente e Territorio	Fisica III – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2003/04	LM Ingegneria Ambiente e Territorio	Fisica III – 6 CFU

	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2002/03	LM Ingegneria Ambiente e Territorio	Fisica III – 6 CFU
	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2001/02	LT Ingegneria Ambiente e Territorio	Fisica I – 6 CFU
2000/01	Corso di Laurea Ingegneria Edile e Architettura	Fisica Generale Corso in affidamento
1999/2000	Corso di Diploma Universitario Ingegneria Ambiente e Risorse	Fisica Generale II Corso in affidamento
1998/99	Corso di Laurea in Fisica	Esperimentazione di Fisica I Corso in affidamento
1997/98	Corso di Laurea in Fisica	Esperimentazione di Fisica II Corso in affidamento

Service activities to the Department and the University

1) Representative (elected) of the Researchers of the SSD B03X – Struttura della Materia – Faculty of Engineering (2000/02)
2) Member (elected) of the Executive Board of the Physics Department (2015/17)
3) Member (elected) of the Executive Board of the Science Faculty (Facoltà di Scienze Fisiche Matematiche e Naturali) (2016/18)
4) Member of the Executive Board (Comitato Direttivo) of the Research Center on the Application of Nanotechnologies to Engineering (Centro di Ricerca per le Nanotecnologie Applicate all'Ingegneria – CNIS)
5) Delegate to represent the Physics Department in the Working Group of the Technological District for Culturale Heritage and Humanities (Distretto Tecnologico per i Beni Culturali – Dtc Lazio), established and financed by Regione Lazio
6) Member of the Education and Teaching Committee (Commissione Didattica) of the Physics Department
7) Member of the Committee for Educational Guidance in Physics of Matter for students (Commissione per i percorsi formativi degli studenti – Curriculum *Fisica della Materia*)
8) Delegate of the Physics Department Director to Safety & Security of the Fermi Building (Physics Dept.)
9) Delegate to represent the Physics Department in the TICHE - Technological Innovation in Cultural Heritage Foundation (Fondazione TICHE)
10) Member of the University Tender Committee in charge of the evaluation procedure for *Fornitura di un Sistema multifunzionale in ultra-alto vuoto con spettroscopia di fotoemissione XPS per il laboratorio di spettromicroscopia integrata dell'Amaldi Research Center* (2019)

Society memberships, Awards and Honors

Year	**Title**
2002 - 2005	Member of the International Scientific Committee of the EHPRG
2009 - 2012	Member of the International Scientific Committee of the EHPRG
2014 - 2017	Member of the International Scientific Committee of the EHPRG
2009 - 2012	Member of the International Evaluation Committee – Panel 4: Magnetic Excitations - of the ILL (Institut Laue Langevin, Grenoble, FR)
2012 -	Reviewer selected by ANVUR (National Agency for the Evaluation of the Research and

today	University system) for Evaluation of the Quality of Research (VQR) over the periods 2004-2010 and 2011–2014, and for SIR project.
2015 - today	Member of the Board of CNIS (Centro di ricerca per le Nanotecnologie applicate all'Ingegneria Sapienza)
2016 - 2019	Member of the Editorial Advisory Board of the journal *Novel Superconducting Materials*
2017 - today	Member of the Editorial Board of the *Journal of Physics: Condensed Matter*
2019 - today	Member of the Working Group in charge of producing the *Three-Years Strategy Plan* of the *National Technological Cluster for Cultural Heritage*, selected and appointed by the Executive Board of the TICHE Foundation
2019 - 2020	Member of the Scientific Committee of the XXVII International Conference on Raman Spectroscopy - ICORS

I am also a member of programme and organizing committees for several national and international conferences on condensed matter under high pressure, and a reviewer for many international journals. I am a regular referee for Phys. Rev. Lett., Phys. Rev. B, J. Appl. Phys., Appl. Phys. Lett., J. Chem. Phys., Dalton Transaction, J. Raman Spectroscopy, Nano Letters, Scientific Reports, J. Phys. Chem. B and C.

Funding Information [grants as PI-principal investigator or I-investigator]

Year	Title	Program	Grant value
1989 – 1990	*Development of the inverse geometry neutron spectrometer eVS installed at the pulsed neutron source ISIS (UK)*	Funded by European Commission	
1993 – 1994	*Spectroscopy in systems under high pressure*	CNR Special Project	
1994 – 1996	*Insulator to Metal Transitions and Structural Transitions in molecular Systems under High Pressure*	CNR Special Project	
1998 – 1999	*Insulator to Metal Transition in Simple Molecular Fluids*	Project PAISS funded by INFM	≈ 30.000 € for the Work Package, received as Unit Responsible
2002 – 2004	*Study of epitaxial and isotropic strain effects on the metallization process in manganites through Raman, infrared, and X-ray spectroscopies*	PRIN 2002: Effetto dello strain sulla transizione metallo isolante e sulla fase metallica di FILM sottili ed eterostrutture di manganiti. Funded by MIUR	90.000 € for the Work Package, received as Unit Responsible
2004 - 2006	*Study of the charge-localization extent induced by isotropic and epitaxial strain in manganese perovskites by means of optical spectroscopies and structural diffraction techniques*.	PRIN 2004: Perovskiti funzionali: sintesi, proprieta' magnetiche e di trasporto elettronico e ionico. Funded by MIUR	60.000 € for the Work Package, received as Unit Responsible
2005 – 2008	*PRESS MAG-O*	Project funded by INFN and selected as one of the Highlights 2006 of the INFN - Research Group V	120.000 € for the whole project

2009 - 2011	*Chemical Control and Doping Effects in Pnictide High-temperature Superconductors*	Funded by Fondazione CARIPLO	60.000 € for the Work Package, received as Unit Responsible
2011 - 2012	*Protic Ionic Liquids: structural and spectroscopic study by means of experimental and computational techniques*	Project ATENEO financed by the University of Roma *Sapienza*	85.000 € for the whole project
2013 - 2015	*Integrating photons and Neutrons at ESS*	Funded by Elettra-Sincrotrone Trieste on a competitive call for PIK (Project In-Kind) projects for the European Spallation Source ESS	25.000 € for the Work Package, received as Unit Responsible
2014 - 2016	*The Carbon Age of Superconductivity: Organic Superconductors and their Synthesis, Characterization and Theoretical Modelling*	Funded by Fondazione CARIPLO	70.000 € for the Work Package, received as Unit Responsible
2015 - 2016	*Underwater Tracking System*	Funded by INFN	150.000 € for the whole project
2018 – today	*Time-resolved Raman spectroscopy and time-resolved absorption & reflectivity, coupled to spin and time-resolved ARPES at NFFA-SPRINT & Elettra-Fermi for out-of-equilibrium studies of condensed matter*	Funded by NFFA-SPRINT (CNR & EU Funding)	150.000 € for the technical Work Package (man-power not-included), to be received as WP-Responsible

Research Activities

Since 2000, I am the Group Leader of the HPS (High Pressure Spectroscopy) group at the Physics Department of University of Roma "Sapienza", which, at present, consists of 2 Associate Professors, 4 Ph.D., 1 Post-doc, and 1 Master degree student.

SYNOPSIS

My research activity is in the field of experimental condensed matter physics. Since the beginning of my activity, and up to now, I have been more specifically focused on the investigation of condensed matter under extreme temperature and pressure conditions by means of diffraction techniques (neutrons and x-rays) and optical spectroscopy (Raman and Infrared).

My research activity always developed within international collaborations and I carry out my experiments at the major neutron and synchrotron radiation facilities, as well as at my laboratory and the optical spectroscopy laboratories of the Physics Dept. of Rome University *Sapienza*. I have always been working in collaborating groups: at the beginning of my activity when, as a Ph.D. student, I joined the group of Disordered and Liquid Systems based at the University of Rome *Sapienza* and at the University of L'Aquila, and over **the last 20 years as a research group leader** at the Physics Dept. University of Rome *Sapienza*.

Indeed, **starting from 1999, I was the responsible of a research line** funded by INFM within the Liquids and Disordered Systems division and I organized my own research group and laboratory of high pressure spectroscopy (HPS Group@Sapienza, see https://gruppohps.wordpress.com). In the following years, I got

financed under several national research grants (see funding lists) for the implementation of the lab and for Ph.D and Post-doc fellowships. At present, the laboratory is fully equipped to design, prepare and carry out Raman and Infrared experiments on microscopic samples under variable temperatures (from 5 K up to 1000 K) and high pressures (up to 50 GPa). A sample preparation lab is also available as a support facility to prepare experiments that are, then, carried out at national and international facilities. Very recently, in 2014, a new state-of the-art MicroRaman spectrometer has been added to the lab. It is fully operational making also the Terahertz frequency range accessible to the experiments. Thanks to a first grant of 53.000 Euros gained under a "Sapienza" University call (Grandi Attrezzature 2013), and a second grant of 30.000 Euros ("Sapienza" University Call – Medie e Grandi Attrezzature 2018), and to a close collaboration with Prof. F. Bordi and Prof. F. Sciortino, we started to build a new apparatus in the HPS Lab based on a tunable wavelength lasers for LTS (Laser Transmission Spectroscopy). LTS is a new method alternative to Dynamic Light Scattering for full characterization of nanoparticles in colloids. In very recent days we have been able to collect the first transmission spectra from colloids and we are confident the instrument will be fully operational by spring 2017. In 2018, I started a collaboration with the group NFFA-SPRINT based in Trieste (IOM-CNR & Elettra Sincrotrone) aiming at designing and building an optical system for time-resolved Raman measurements with options for time-resolved absorption & reflectivity measurements. The plan is to install the instrument at SPRINT/Elettra and operate it in coupled mode with the spin and time-resolved ARPES. The project focuses on the study of out-of-equilibrium and fast dynamics of low-dimensional and highly-correlated electron systems. Under the financing of the Department of Physics as one of the Excellence Departments in Italy, I am involved in the spectroscopic characterization of the VIRGO mirrors and, within the Amaldi Research Center, I am engaged in the activities XPS and Raman of the infrastructure *Integrated System of Spectro-Microscopies*.

During the years of leading the HPS group, apart from an Associate Professor (P. Dore) and a University Researcher, now retired, I attracted **17 Ph.D. students** and **7 Post-Docs** (A. Congeduti, F. Bordignon, D. Di Castro, B. Joseph, S. Mangialardo, F. Capitani, F. Ripanti equivalent to more than **9 person/years**) working in my group. During these years, **more than 50 graduate students** carried out their Master Thesis work at the HPS laboratory. A number of national/international collaborations are active and particularly close and fruitful are those with my former students who are nowadays working abroad in well recognized and highly qualified research institutions of France, Switzerland, Germany, The Netherlands, UK, and US. Over the period 2003 - 2010, my laboratory was part of the Research and Development Center CRS-Coherentia of the INFM-CNR.
Because of my recognised experience in the high pressure field, I have been elected as one of the members of the International Scientific Committee of the European High Pressure Research Group for several three-years terms (2002-05, 2008-2011, and 2014-2017) and I am among the Italian reference researchers in the field. Since 2005, I am one of the organizers of the biennial workshop of the Italian High Pressure scientific community.
To carry out my research activity over the years, I obtained funding to cover capital, operation and people costs (Ph.D. and post-doc fellowships) from public (INFM, CNR, INFN, MIUR) and private (Fondazione CARIPLO) organizations, as well as from my University through the funding scheme "Progetti di Ateneo". The expenses of the experimental projects involving measurements at the national and international facilities (ELETTRA, ESRF, ILL, LLB, ISIS, SOLEIL, ALBA, APS) have been covered by the facilities, since the proposals had been selected and approved by the international peer review committees appointed by the facilities.

SHORT HISTORY

- My research activity started as a Ph.D. student when I joined the group of Disordered and Liquid Systems based at the Universities of Rome Sapienza and L'Aquila, contributing to the study of hydrogen-bonded systems, in particular water under extreme pressure-temperature conditions.
- In the following years, I extended my research interests to high pressure/high temperature molecular systems and, in particular, to pressure-induced insulator to metal transitions in liquid and solid halogens.

- From 2000 on, I started what became my primary research line, namely the study of strongly correlated electron systems including colossal magneto-resistance systems, superconductors, transition metal oxides and in general functional oxides, by optical spectroscopy and diffraction techniques. Also for this research activity I often exploited high pressure (0 - 50 GPa) methods. Indeed, the possibility of compressing the lattice in a clear and controlled way allows to exploit the volume as a thermodynamic variable. Such an unusual extra degree of freedom provides a simple means to decouple the effects of the microscopic interactions simultaneously at work in highly correlated systems. The interpretation of the experimental results is often rather cumbersome because the Hamiltonian contains interaction terms over the same energy scale, which are related to the different coupling mechanisms. Therefore, during the last years a close collaboration with the theoretical group of condensed matter in our department and at the SISSA School in Trieste was established.
- Thanks to the experience reached over the years, I launched a new research line focused at exploiting optical methods for more technological and practical applications. Together with several collaborators, I am involved in spectroscopic investigations of cultural heritage artworks as well as systems for bio-medical applications and materials of biophysical relevance. The latter research activity has been growing over the last few years and several master and Ph.D. students are now working on this thematic. In particular, we have published several papers exploiting the high potential of conventional Raman spectroscopy and of the recent Surface Enhanced Raman Spectroscopy (SERS) in the field of biophysics research. A number of collaborations have been developed with groups from our Department and the Department of Chemistry but also with external institutions (Istituto Superiore di Sanità, Italian Institute of Technology).

Keywords	Brief Description
1. HYDROGEN BONDED SYSTEMS	
	1a. Water under extreme thermodynamic conditions
Keywords	The research started during my staying at ISIS Spallation Neutron Source (UK) and continued for several years. Among a number of experiments carried out on hydrogen bonded systems, using different neutron spectrometers available at ISIS, those on supercritical water were particularly remarkable. Indeed, a neutron-diffraction study, we published in ***Nature*** **in 1993**, showed for the first time a de-structuring of water that, above the critical point, behaves like a simple liquid. The whole of the results so obtained stimulated many theoretical works, and these results still represent a benchmark for the literature, even recent, on liquid H_2O. (Collaboration with A. Soper, ISIS UK)
- High pressure	
- Neutron scattering	
- Water	
Keywords	**1b. Hydrogen bond in ionic liquids**
- Hydrogen bond	Quite recently, in collaboration with the Dept. of Chemistry of *Sapienza*, I started the investigation of the microscopic behavior of ionic-liquids and their interactions with biological macromolecules. In particular, we demonstrated that a combined theoretical (*ab initio*) and experimental spectroscopic approach is successful for a deeper understanding of the hydrogen bond network that underlies the local structure of these highly interacting systems, which we found to actually survive also in their liquid phase. Several papers have appeared on these systems in the last 4-5 years and I am the corresponding author of the monography: ***Raman Spectroscopy in Ionic liquids Under Variable Thermodynamic and Environmental Conditions*** published in the book **The structure of Ionic Liquids** edited by Springer.
- Optical properties	
- Green Chemistry	
2. CONDUCTIVITY AND STRUCTURAL TRANSITIONS, PRESSURE EFFECTS	My research in this field was largely devoted to the study of pressure driven Insulator to Metal Transition (IMT) in simple molecular systems (solid and liquid halogens) and in strongly correlated electron systems such as colossal magneto-resistance (CMR) materials and transition metal oxides. I employed structural (x-ray diffraction, EXAFS) and optical spectroscopy (Raman and IR) techniques jointly with high-pressure methods (diamond anvil cells, Paris-Edinburgh large-volume cells). Particularly remarkable are my studies on Iodine, CMR Manganites, MgB_2, Vanadium Oxides and charge density waves in Tellurides.
Keywords	**2.a Molecular systems**
- High pressure	My study of the IMT in I_2, considered a classical counterpart of H_2, was carried out by coupling several experimental techniques (Infrared, Visible, and UV absorption spectroscopy, Raman, EXAFS) and developing specific high-temperature high-pressure experimental apparatus for each technique. The results in I2 (liquid, solid and in solution) show the importance of the thermally-induced disorder in causing early metallization in the liquid. A general model for metallic liquid halogens was proposed by us, based on the occurrence of instantaneous percolative paths among interacting molecules. The analysis of the IMT transitions in simple liquid systems such as Cs, Rb, Hg, and H2, led us to the idea of a sort of universal liquid at least in proximity of the IMT. (Main collaborations with the High Pressure group at the ESRF and the group of J.P. Itie LURE, FR).
- Insulator-to-metal transition	
- Optical spectroscopy	
- Molecular systems	

Keywords	**2.b Strongly correlated electron systems**
- Insulator-to-metal transition - Strongly correlated electron systems - High pressure	The main idea behind my work on CMR manganites, which I started about 10 years ago, consisted in using hydrostatic and "chemical" pressure for tuning the Jahn-Teller distortion that affects the MnO6 octahedra and, consequently, the electron-phonon coupling. This strategy allowed to decouple the effects of the different microscopic interactions acting simultaneously, and thus to identify the mechanisms driving the CMR and the IMT transitions and their close coupling with the PM/FM magnetic transition. My studies on $La_{1-x}Ca_xMnO_3$ CMR manganites enabled to obtain the first extended experimental P-T phase diagram of a manganite, and a microscopic theoretical model to reproduce it by introducing a strongly P-dependent antiferromagnetic interaction. High pressure studies carried out on the parent LaMnO3 and Ga/Mn substituted compounds confirmed the above scenario and revealed the onset of a magnetic/structural phase separation scenario at high-P and low-T, as well as an IMT transition above 32 GPa in a weakly Jahn-Teller distorted LaMnO3. (Main collaborations with D.D. Sarma, IIS India, and Stanford University US). The results obtained were reported in many papers including 4 articles in *Phys. Rev. Lett.*, and one in *PNAS*.
	Later on, I extended the leading idea of the pressure modulation of a symmetry breaking interaction, such as the Jahn-Teller (local distortion), to other interactions (lattice extended) and accordingly suited systems. Namely, the studies carried out on Peierls distorted VO_2 led us to the identification of a new metallic monoclinic phase achieved under pressure (above 10 GPa), which definitely clarifies the major role of the electron-electron vs the electron-phonon coupling in driving the IMT in these systems. Particularly interesting are also the studies on the effects of the lattice compression on the incommensurate modulation of the electron density in di- and tri-tellurides, where we found that the charge density wave state is suppressed under pressure. (Main collaborations with L. Degiorgi ETH Zurich, I.R. Fisher Stanford University, US, Infrared Beamline at ELETTRA).
Keywords	**2.c Superconducting systems**
- HTc superconductors - Chemical vs hydrostatic pressure - Raman spectra	A peculiar class of highly correlated electron systems is that of high temperature superconductors, among which a most approachable one is MgB2 whose rather simplicity allows for a deeper insight into fundamental physical properties. Therefore, I started my work on superconductors with MgB2 as a first sample, and extended it to iron based systems and, recently, to doped polycyclic aromatic hydrocarbons. The research strategy was the investigation of the phonon spectrum by Raman and infrared spectroscopy usually in combination with a theoretical analysis, with the aim of identifying the key coupling drivers for the onset of the superconductive phase. A high appreciation by the scientific community was received for the papers on doped MgB_2, (two of them received about 120 citations) where a novel interpretation of the Raman spectra was proposed. I have also obtained new experimental results about the pressure effects on the superconducting temperature and on lattice structure and dynamics of prototypical iron-based superconductors, in collaboration with M. Hanfland of the ESRF (FR) and L. Malavasi Pavia Univ. (published on *J. Am. Chem. Soc.* in 2009)
Keywords	**2.d Low dimensional systems.**
- Low-dimensional systems	A common indication emerging from the results of the above studies is the special relevance of the intrinsic dimensionality of the systems. In particular,

- Semiconducting nanowires - Optical properties - High pressure	structural transitions induced by strict confinement can be used to tune relevant electronic properties of systems. Following this idea and fully exploiting the potential of the spectroscopic techniques coupled to high pressure methods, I started a collaboration with G. Abstreiter (TUM –Munchen) and E. Bakkers (TUE-Eindhoven) on nano-sized materials like Ga-As nanowires. In the last few years, relevant papers have been published in ACS Nano and Nano Letters. Exploiting my previous experience, my present research nowadays focuses on the single/few layers TMD (Transition Metal Dichalcogenides) which, notably, are among the most interesting graphene-like materials as well as on 2D heterostructures in collaboration with other researchers of our Department (e.g. F. Mauri), D. Di Castro of Tor Vergata University, I. Zardo of Basel University, L. Malavasi of Pavia University.
3. APPLIED SPECTROSCOPIC METHODS	Taking full advantage of the deep knowledge and experience I matured in the field of optical spectroscopy, and thanks to the increased number of young researchers in my group, I launched several research activities where we began to apply experimental methods to the study of more technological and practical subjects.
Keywords - Raman spectroscopy - Imaging	**3.a Cultural Heritage** Cultural heritage research offers valuable contributions to heritage conservation and study through multidisciplinary projects, which, in our case, brought to significant improvements in diagnostics and in the identification of the causes/effects of alterations. In particular, we carried out systematic spectroscopic studies on polychromes by fully exploiting the high spatial resolution of our microRaman spectrometer. Our results enabled to unveil some aspects of the Etruscan painting techniques as well as to understand the alteration phenomena affecting medieval artworks. This is a multi-disciplinary research activity carried out within a collaboration with the Istituto del Restauro di Roma and the group of the Roma Tre University (M.A. Ricci). Taking full advantage from these collaborations, two monographies on two books and several papers have been published over the last ten years.
Keywords - Plasmonic nanoparticles - SERS imaging - Cellular diagnostics	**3.b Biological and Biomedical applications.** The exploitation of spectroscopic techniques to address research topics of biomedical and environmental interest has been pursued during the last years, and some experimental projects were launched in collaboration with groups from the Istituto Superiore di Sanità, Roma and one group from the Faculty of Engineering of *Sapienza* University (A. Polettini). Recently I shifted my research interests more towards biophysical topics. In particular, we investigated the aggregation processes in protein misfolding, the main ossidative processes in DNA, and we addressed the possibility of developing high sensitivity - high selectivity biosensors. Our specific ability in this field is that of combining conventional Raman spectroscopy and SERS (Surface Enhanced Raman Spectroscopy) exploiting new tools, such as hydrostatic pressure (up to 1.5 GPa) and chemical treatments with ionic-liquids, to drive and control the microscopic processes at work in an assembly of large biomolecules. Our first papers in this field appeared in 2012 (Soft Matter and RCS Advances) and several others followed. As to the specific aspect of developing state-of-the-art biosensing devices, a paramount role is played by SERS. In collaboration with the Biophysics Research Group of our Dept. (F. Bordi), we have approached the

	problem from the basic aspects of designing and realizing proper micrometric metallic nanostructures through the self-assemby of metallic nanoparticles. SERS measurement on model systems have confirmed theoretical predictions and exploiting these results we are now successfully applying a new strategy for the targeting of cancer cells. A relevant paper on Nanoscale has been just published (2017).

Summary of Scientific Achievements

The results of my research activity have been presented to more than 100 international conferences and workshops (both invited and contributed). I am co-author of **179 publications (WoS)** on peer reviewed journals, which received about **3212 citations (2835 without self-citation)** and an H-index **HF=30**. The **5 most cited articles** received **227, 145, 117, 108, 97** citations.
Over the period 2009-2019, I have published **104 papers** on peer reviewed journals, which received about **1312 citations** with an **H-index HF=22.**
Using *Google Scholar*, my total bibliometric score results to be about 230 papers, 4100 citations, and HF=34.

Product type	Number	Data Base	Start	End
Papers [international]	179	WoS	1989	2019
Papers [national]				
Books [scientific]	3	ISBN		
Books [teaching]	1	ISBN		

Total Citations	3212	WoS
Average Citations per Product	17,94	WoS
Hirsch (H) index	30	WoS
Normalized H index*	0.97 = 30/31 [31 resulting from (2019-1989)+1, 1989 being the year of the first publication]	WoS

*H index divided by the academic seniority.