

CV PROF. PAOLO POSTORINO

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EDUCATION AND TRAINING – EMPLOYMENT HISTORY

1987-1988 Compulsory military service under the Italian armed forces
1989 Laurea in Fisica, University of Roma *Sapienza*
1989 - 1990 Visiting scientist at the ISIS Spallation Neutron Source (RAL, UK)
1990 - 1993 Ph.D. Fellowship in “Condensed Matter Physics”, Joint Ph.D. School Universities of Perugia and L’Aquila
1993 – 2002 University Researcher at the Engineering Faculty – Physics Dept. – University of Roma *Sapienza*
2000 Winner of the national competition for Associate Professor in Physics
2002-2010 Associate Professor in Experimental Physics at the Engineering Faculty – Physics Dept. – University of Roma *Sapienza*
Since 2010 Associate Professor at the Science Faculty – Physics Dept. – University of Roma *Sapienza*
2012 National Academic Qualification as Full Professor (Abilitazione Scientifica Nazionale, Prima Fascia) for Experimental Condensed Matter Physics (SC 02/B1)

Since 2000 Group Leader of the HPS group at Dept. of Physics – University of Roma *Sapienza*, which, at present, consists of 2 Associate Professors, 3 Ph.D and 4 Master degree students

SYNOPSIS

My research activity is in the field of experimental condensed matter. 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 15 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 INFN within the Liquids and Disordered Systems division and I organized my own research group and laboratory of high pressure spectroscopy (HPS Group@Sapienza, see <http://www.phys.uniroma1.it/gr/HPS/HPS.htm>). 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 and it is fully operational making also the Terahertz frequency range accessible to the experiments.

During the 15 years of leading the HPS group, apart from an Associate Professor (P. Dore) and a University Researcher, now retired, I attracted **12 Ph.D. students** and **5 Post-Docs** (A. Congeduti, F. Bordignon, D. Di Castro, B. Joseph, S. Mangialardo, F. Capitani, equivalent to more than **8 person/years**) working in my group. During these years, **more than 30 graduate students** have carried out their Master Thesis work at the HPS group. 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 INFN-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-today) 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 (INFN, 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.

RESEARCH ACTIVITY

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 was established.

A common indication emerging from the results of the above studies is the special relevance of the intrinsic dimensionality of the systems. In particular, 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 to work on nano-sized materials like Ga-As nanowires. Relevant papers have been published in 2012 and 2013 and 2015 in ACS Nano and Nano Letters.

- Thanks to the expertise achieved 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. I am specifically interested to develop the latter scientific subject also because of the relevant connections with the physics of hydrogen-bonded materials.

- During the years and for each research line several international collaborations have been activated and among the many others I would like to mention, (in a rough chronological order): A. Soper, ISIS (UK); J.P. Itié SOLEIL (FR); D.D. Sarma, IIS (India); L. Degiorgi ETH Zurich (CH), I.R. Fisher Stanford University, (US), M. Hanfland of the ESRF (FR), G. Abstreiter TUM – (Munich); E. Bakkers TUE-(Eindhoven); HK Mao Carnegie (US).

BIBLIOMETRICS

The results of my research activity have been presented to more than 70 international conferences and workshops (both invited and contributed). I am co-author of about **140 papers** (ISI) on peer reviewed journals, which received about **2000 citations (1700 without self-citation)** for a **total impact factor of 487** and a H-index **HF=24**. The **3 most cited articles** received **213, 106, 95** citations.

In the period **2005-2015**, I have published **95 papers** on peer reviewed journal which received about **950 citations and HF=18**.

Using Google Scholar, my bibliometrics score results to be about 170 papers, 2300 citations, and HF=27

MEMBERSHIPS, COMMITTEES AND REVIEW PANELS

- 2002-2005 / 2009-2012 / 2014-today 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-today Reviewer selected by ANVUR (National Agency for the Evaluation of the Research and University system) for Evaluation of the Quality of Research (VQR) over the period 2004-2010 and for SIR project.
- 2015 Member of the Steering Committee of CNIS (Centro di ricerca per le Nanotecnologie applicate all'Ingegneria Sapienza)
- Member of SISN (Società Italiana Spettroscopia Neutronica), INFN, INFN (Istituto Nazionale Fisica Nucleare), and EHPRG (European High-Pressure Research Group), INSTM
- Member of programme and organizing committees for several national and international conferences on condensed matter under high pressure
- Reviewer for many international journals. 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

ACADEMIC ACTIVITIES AND INVITED LECTURE COURSES

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), and Struttura della materia con elementi di meccanica quantistica (Structure of matter with basics of quantum mechanics). My typical teaching assignment has been **140 hours (15 CFU) per academic year** with an average number of students of about **150 per year**.

Since 1994 I have been, and I am, **the supervisor of 35 Master Degree** and, since 1999, of **12 Ph.D. students** at the University of Roma “Sapienza”, 1 of which in co-tutoring with Prof. G. Abstreiter of Technischen Universität München. 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-Edinburgh, TUM-Munich, TUE-Eindhoven, APS-Argonne (Illinois US), ESRF-France, ALBA-Spain, Stanford University (California-US), AMOLF-Amsterdam, Basel University...

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 pressure methods, among which:

- International School "Structural Techniques for Advanced Radiation Sources", Camerino 1996
- ICTP Summer School on "Manganites at high-pressure", Trieste 2003
- School of Superconductors and Functional Oxides, Palinuro 2009
- Advanced course on "Tecniche Strumentali applicate alle Biotecnologie" (La spettroscopia Raman: uno strumento semplice ed efficace per applicazioni multi-disciplinari), Porto Conte Ricerche, Alghero 2009
- Joint ICTP-SISSA *Colloquium on Condensed Matter*, "Tuning lattice distortion by pressure: the insulator to metal transition and the onset of phase-separated states", Trieste 2011
- School on Advanced Characterization methods for nanophase materials. Ahmedabad (India) 2013

Since 2005 and on a yearly basis, I give lectures on Raman Spectroscopy at the Ph.D. School of Physics of the University of Roma *Sapienza*.

From 2004 to 2011, I was 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 *Mathematics for Engineering, Electromagnetism and Nanoscience* of the University of Roma *Sapienza*.

I have been 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 and European Universities.

MAIN SCIENTIFIC HIGHLIGHTS.

1) The interatomic structure of H₂O at supercritical temperatures.

P.Postorino, R.H. Tromp, M.A.Ricci, A.K.Soper, G.W. Neilson

Nature **366** 668 (1993) (cover page)

2) Anomalous bond length expansion in liquid iodine at high pressure.

U.Buontempo, A.Filipponi, D.Martinez-Garcia, P.Postorino, M.Mezouar, J.P.Itie'

Phys. Rev. Lett. **80** 1912 (1998). (Selected for ESRF Highlights 1997/98 and on the INFM Highlights 1998/99)

4) Anomalous high pressure dependence of the Jahn-Teller phonon in La_{0.75}Ca_{0.25}MnO₃

A.Congeduti, P.Postorino, E. Caramagno, M. Nardone, A. Kumar, D.D. Sarma

Phys. Rev. Lett. **86** 1251 (2001)

5) Pressure tuning of the electron-phonon coupling: the insulator-to-metal transition in manganites.

P.Postorino, A.Congeduti, P. Dore, A. Sacchetti, F. Gorelli, L.Ulivi, A. Kumar, D.D. Sarma

Phys. Rev. Lett. **91** 175501 (2003)

6) Far Infrared Absorption of La_{1-x}Ca_xMnO_{3-δ} at High Pressure.

A.Sacchetti, M.Cestelli Guidi, E. Arcangeletti, A. Nucara, P. Calvani, M. Piccinini, A. Marcelli, P. Postorino

Phys. Rev. Lett. **96**, 035503, (2006)

7) Pressure dependence of the charge-density-wave in rare-earth tri-tellurides.

A.Sacchetti, E.Arcangeletti, A. Perucchi, L. Baldassarre, P. Postorino, S. Lupi, N. Ru, I.R. Fisher, L. Degiorgi.

Phys. Rev. Lett. **98**, 026401 (2007) (selected paper for the ELETTRA Science Update)

8) Evidence of a Pressure-Induced Metallization Process in Monoclinic VO₂

E. Arcangeletti, L. Baldassarre, D. Di Castro, S. Lupi, L. Malavasi, C. Marini, A. Perucchi, P.Postorino

Phys. Rev. Lett. **98**, 196406 (2007)

- 9) High pressure behavior of Ga-doped LaMnO₃: a combined X-ray diffraction and optical spectroscopy study.**
L. Malavasi, M. Baldini, D. Di Castro, A. Nucara, W. Crichton, M. Mezouar, J. Blasco, P. Postorino.
J. Materials Chem. **20**, 1304 (2010)
- 10) A microscopic view on the Mott transition in chromium-doped V₂O₃.**
S. Lupi, L. Baldassarre, B. Mansart, A. Perucchi, A. Barinov, P. Dudin, E. Papalazarou, F. Rodolakis, JP. Rueff, JP. Itié, S. Ravy, D. Nicoletti, P. Postorino *et al.*
Nature Comm. **1**, 105 (2010)
- 11) Persistence of Jahn-Teller Distortion up to the Insulator to Metal Transition in LaMnO₃**
M. Baldini; VV Struzhkin; AF Goncharov; P Postorino; WL Mao,
Phys Rev. Lett. **106**, 066402 (2011)
- 12) Pressure Effects in the Isoelectronic REFe_{0.85}Ir_{0.15}AsO System.**
B. Maroni, D. Di Castro, M. Hanfland, J. Boby, C. Vercesi, MC. Mozzati, S. Weyeneth, H. Keller, R. Khasanov, C. Drathen, P. Dore, P. Postorino, L. Malavasi
J. Am. Chem Soc. **133**, 3252 (2011)
- 13) Pressure Tuning of the Optical Properties of GaAs Nanowires.**
I. Zardo, S. Yazji, C. Marini, E. Uccelli, AFI. Morral, G. Abstreiter, P. Postorino.
ACS Nano **6**, 3284 (2012)
- 14) E-1(A) Electronic Band Gap in Wurtzite InAs Nanowires Studied by Resonant Raman Scattering**
I. Zardo, S. Yazji, N. Hoermann, S. Hertenberger, S. Funk, S. Mangialardo, S. Morkoetter, G. Koblmüller, P. Postorino, G. Abstreiter
Nano Lett. **13**, 3011 (2013)
- 15) Optical Conductivity Measurements of GaTa₄Se₈ Under High Pressure: Evidence of a Bandwidth-Controlled Insulator-to-Metal Mott Transition.**
Vt. Phuoc, C. Vaju, B. Corraze, R. Sopracase, A. Perucchi, C. Marini, P. Postorino, M. Chligui, S. Lupi, E. Janod, L. Cario
Phys Rev. Lett. **110**, 037401 (2013)
- 16) Graphitic pattern on CVD diamond plate as micro-heating/thermometer devices.**
D. Di Gioacchino, A. Marcelli, A. Puri, A. De Sio, MC. Guidi, Y. Kamili, G. Della Ventura, A. Notargiacomo, P. Postorino, S. Mangialardo, E. Wörner, E. Pace
ACS Applied Materials & Interfaces **7**, 10896 (2015)
- 17) Origin of colossal magnetoresistance in LaMnO₃ manganite.**
M. Baldini, T. Muramatsu, M. Sherafati, H.K. Mao, L. Malavasi, P. Postorino, S. Satpathy, V.V. Struzhkin
PNAS **112**, 10869 (2015)
- 18) Hexagonal Silicon Realized.**
H.I.T Hauge, M.A. Verheijen, S. Conesa-Boj, T. Etzelstorfer, M. Watzinger, D. Kriegner, I. Zardo, C. Fasolato, F. Capitani, P. Postorino, S. Kolling, A. Li, S. Assali, J Stangl, E.P.A.M Bakkers.
Nano Lett. **15**, 5855 (2015)