

## CURRICULUM VITAE OF ALESSANDRO NUCARA

### Present position

Researcher at Sapienza University of Rome, Physics Dept.  
SSD/SC FIS01/02B1

### Education e Formation

1989 Degree in Physics at Sapienza University of Rome  
1993 PhD in Physics at Sapienza University of Rome  
1993 Licensure for the teaching of Physics in the High School  
1993 Scholarships of INFN  
1994 Post-doctoral fellowship of Sapienza University of Rome  
1996 Contract of Researcher of CNRS at Orsay, France  
1998 Contract of Researcher of INFN at Sapienza, Rome  
1999 Assistant Professor at Sapienza University of Rome  
2012 Eligibility in the role of Professor  
2014 Visiting Professor at the Department of Physics of the University of Tours "Rabelais"  
(France)

Lecturer/Speaker in 16 international Conferences, Workshops and professional courses.  
Reviewer for Physical Review B and Journal of Physics C

### Collaboration with Scientific Institutions

Scientific Association to laboratory INFN LNF (since 1992)  
Scientific Association to the R & D center Coherentia INFN (1993-2005)  
Scientific Association to the R & D center SPIN of CNR (since 2010)  
Expert user at the beamline AILES, Soleil synchrotron, France  
Expert user at the beamline IRIS, Bessy II synchrotron, German  
Expert user at the beamline SINBAD, Dafne synchrotron, Italy  
Collaboration with CLNS@Sapienza

### Main topics of research

#### Molecular Physics

Experimental studies on light scattering from hydrogen bonded liquids, aimed at highlighting the translational and rotational molecular dynamics hindered by the bonds network. Search and assignment of vibrational (vibrons) and rotational (rotons) quasi-particles in molecular quantum solids by FTIR experiments. Studies on the vibrational and rotational energy levels of molecules in crystals as fundamental test of quantum mechanics topics.

#### Infrared Synchrotron radiation

Studies on the infrared light emitted by relativistic particles travelling in bending magnets and wiggler devices of synchrotrons. Characterization of the low-energy synchrotron radiation emitted by particles at the edges of magnetic fields. Design of the optical components of infrared synchrotron beamlines by computer simulation. Setup of optical and mechanical components of infrared beamlines.

#### Solid State Physics

Infrared properties of charge-lattice correlated crystals and films: studies on the insulator-to-metal transitions of magnetic oxides and high T<sub>c</sub> superconductors and on the charge-ordered phases of weakly and strongly correlated oxides of interest for their use in devices and in electronic applications. Studies of 2-dimensional electron gases confined in oxides interfaces: determination of carrier density and mobility through infrared reflection experiments. Experimental studies on multiferroic crystals aimed at elucidating the peculiar roles of magnetic and ferroelectric degrees of freedom: acquisition and analysis of the vibrational

spectra of these materials and comparison with the theoretical results obtained from DFT and shell-model approaches.

#### Spectroscopic Methods for Biosystems

Conventional and micro-infrared spectroscopy of proteins involved in biological and nutritional processes. Application of infrared spectroscopy to nutritional topics: quantitative assessment of proteins bioavailability and search for spectroscopic markers in food science. Improvements of the spectroscopic techniques for the extension of infrared microscopy to the subwavelengths regime: application on protein aggregates, cellular cytoplasm, bacteria and phospholipidic membranes. Studies on amyloid fibril formation and inhibition in protein complexes by conventional FTIR microscopy and AFM-infrared imaging.

#### Participation to peer-reviewed to Scientific Projects

Spettroscopia IR delle manganiti di PrCa (Ateneo Sapienza).

Studio dei diversi stati di ordinamento di carica nelle manganiti in funzione di temperatura e pressione mediante spettroscopia Raman ed Infrarossa (PRIN MIUR).

Indagine sulla natura dei portatori di carica nel LSCO (Ateneo Sapienza).

Studio infrarosso delle transizioni di fase nei piroclori (Ateneo Sapienza).

Studio degli effetti dello strain isotropo ed epitassiale sui processi di metallizzazione nelle manganiti mediante spettroscopia x, Raman ed infrarossa (PRIN MIUR).

Spettroscopia infrarossa di cuprati drogati con bario (Ateneo Sapienza).

Spettroscopia infrarossa di cuprati drogati con bario (Ateneo Sapienza).

Effetti della correlazione e delle fluttuazioni di ordinamento di carica sulla conducibilità ottica dei superconduttori ad alta T<sub>c</sub> (PRIN MIUR).

La transizione metallo-isolante nei superconduttori ad alta temperatura di transizione e nei sistemi elettronici correlati studiata tramite Spettroscopia Infrarossa con luce di Sincrotrone (Ateneo Sapienza).

La transizione metallo-isolante nei superconduttori ad alta temperatura di transizione e nei sistemi elettronici correlati studiata tramite Spettroscopia Infrarossa con luce di Sincrotrone (Ateneo Sapienza).

Developing a FTIR Spectra Collection for Interpreting Residues of the Prehistoric Activities ( Wenner-Gren Fund.).

Spettroscopia Terahertz di superconduttori e sistemi con ordinamento di carica (Ateneo Sapienza).

Spettroscopia infrarossa di materiali di interesse fisica, geologico e chimico ad alte pressioni (Grandi Attr. Sapienza).

Miglioramento del processo produttivo e valorizzazione di leguminose da granella in aree meridionali (MiPAAF).

Spettroscopia Terahertz di superconduttori e sistemi con ordinamento di carica (Ateneo Sapienza).

Spettroscopia pump-probe nel dominio del Terahertz di superconduttori e di sistemi quantum Wells ( Ateneo Sapienza).

Spettroscopia pump-probe nel dominio del Terahertz di superconduttori e di sistemi quantum wells (Ateneo Sapienza).

Interfacce di ossidi: nuove proprietà emergenti, multifunzionalità e dispositivi per l'elettronica e l'energia (OXIDE) (PRIN MIUR).

Infrared spectroscopy of Topological Insulators Ateneo Sapienza Nanospettrometro infrarosso per imaging di cellule e tessuti (Grandi Attr. Sapienza).

Fundamental properties and applications of 2-D Dirac electron gases in topological insulators (Ateneo Sapienza).

Biodiversità, territorio e nutrizione: la sostenibilità dell'agroalimentare italiano (MiPAAF).

Infrared micro-spectroscopy beyond the diffraction limit (CLNS-IIT).

The good and the bad of protein fibrillation (Uncovering Excellence Tor Vergata Univ).

Laser a cascata quantica per spettroscopia micro/nanometrica (Medie Attr. Sapienza).

Plasmon-enhanced vibrational circular dichroism (PRIN MIUR).

Osservazione con nanospettroscopia infrarossa di nanoparticelle di niobato di litio all'interno delle cellule (Ateneo Sapienza).

A mid-infrared laser spectroscopy sensor based on surface waves for the study of the anisotropic protein conformational changes (Ateneo Sapienza H2020).

Finanziamento delle attività base di ricerca (MIUR).

#### Participation to other Projects

1998 - 2002: Installation of the synchrotron infrared beamline SINBAD at the collider DAFNE.

Project funded by INFN.

**2002 - 2004:** Installation of the synchrotron infrared beamline SISSI at ELETTRA.  
Project funded by Sincrotrone Trieste SCpA and CNR.

### Teaching at Sapienza

1999-2000	Phys. Dept. SAPIENZA	Assistant professor in the course "Esperimentazione Fisica I"
2000-2001	Phys. Dept. SAPIENZA	Assistant professor in the course "Esperimentazione Fisica II"
2000-2001	Phys. Dept. SAPIENZA	Lectures for the PhD in Physics
2001-2007	Phys. Dept. SAPIENZA	Professor in the course "Laboratorio di Meccanica"
2007-2010	Chem. Dept. SAPIENZA	Professor in the course "Laboratorio di Fisica"
2010-2012	Chem. Dept. SAPIENZA	Professor in the course "Fisica I con laboratorio". Laboratory section
2011-2013	Phys. Dept. SAPIENZA	Assistant professor in the course "Meccanica"
2014-2018	Envir. Biology Dept. SAPIENZA	Professor in the course "Fisica"
2015-2018	Phys. Dept. SAPIENZA	Assistant professor in the course "Laboratorio di Fisica della Materia"

Supervisor of 10 Master Degree Thesis, 1 PhD thesis and 4 Bachelor thesis

### Scientific Achievements

Co-Author of over 100 publications on peer-reviewed journals.

Total Impact factor	<b>259</b>
Total Citations	<b>1173 (WOS), 1318 (Scopus)</b>
Average Citations per Product	<b>11.5 (WOS), 11.9 (Scopus)</b>
Hirsch index	<b>18 WOS, Scopus</b>
Normalized H index	<b>1.05 (since 2000)</b>
Normalized H index	<b>0.67 (since 1990)</b>

### Selected Publications

Giliberti V., Badioli M., Nucara A., Calvani P., Ritter E., Puskar L., and Aziz E. F., Hegemann P., Schade U., Ortolani M., Baldassarre L., *Heterogeneity of the Transmembrane Protein Conformation in Purple Membranes Identified by Infrared Nanospectroscopy*, SMALL **13**, 1701181, 2017

Frigerio J., Ballabio A., Isella G., Sakat E., Pellegrini G., Biagioni P., Bollani M., Napolitani E., Manganelli C., Virgilio M., Grupp A., Fischer M. P., Brida D., Gallacher K., Paul Douglas J., Baldassarre L., Calvani P., Giliberti V., Nucara A., Ortolani M., *Tunability of the dielectric function of heavily doped germanium thin films for mid-infrared plasmonics*, PHYSICAL REVIEW B **94**, 085202, 2016

Baldassarre L., Giliberti V., Rosa A., Ortolani M., Bonamore A., Baiocco P., Kjoller K., Calvani P., Nucara A., *Mapping the amide I absorption in single bacteria and mammalian cells with resonant infrared nanospectroscopy*, NANOTECHNOLOGY **27**, 075101, 2016

Carbonaro M., Di Venere A., Filabozzi A., Maselli P., Minicozzi V., Morante S., Nicolai E., Nucara A., Placidi E., Stellato F., *Role of dietary antioxidant (-)-epicatechin in the development of  $\beta$ -lactoglobulin fibrils*, BIOCHIMICA ET BIOPHYSICA ACTA-PROTEINS AND PROTEOMICS **1864**, 766, 2016

Carbonaro M., Maselli P., Nucara A., *Structural aspects of legume proteins and nutraceutical properties*, FOOD RESEARCH INTERNATIONAL, **76**, 19, 2015

Giliberti V., Baldassarre L., Rosa A., de Turreis V., Ortolani M., Calvani P., and Nucara A., *Protein clustering in chemically stressed HeLa cells studied by infrared nanospectroscopy*, NANOSCALE **8**, 17560, 2016

De Ninno A., Ciasca G., Gerardino A., Calandrini E., Papi M., De Spirito M., Nucara A., Ortolani M., Businaro L., Baldassarre L., *An integrated superhydrophobic-plasmonic biosensor for mid-infrared protein detection at the femtomole level*, PHYSICAL CHEMISTRY CHEMICAL PHYSICS **17**, 21337, 2015

Capitani F., Koval S., Fittipaldi R., Caramazza S., Paris E., Mohamed W.S., Lorenzana J., Nucara A., Rocco L., Vecchione A., Postorino P., Calvani P., *Raman phonon spectrum of the Dzyaloshinskii-Moriya helimagnet  $Ba_2CuGe_2O_7$* , PHYSICAL REVIEW B, CONDENSED MATTER AND MATERIALS PHYSICS **91**, 214308, 2015

Nucara A., Mohamed W.S., Baldassarre L., Koval S., Lorenzana J., Fittipaldi R., Balakrishnan G., Vecchione A., Calvani P., *Infrared phonon spectrum of the tetragonal helimagnet  $Ba_2CuGe_2O_7$* , PHYSICAL REVIEW. B, CONDENSED MATTER AND MATERIALS PHYSICS **90**, 014304, 2014

Perucchi A., Baldassarre L., Nucara A., Calvani P., Adamo C., Schlom D.G., Orgiani P., Maritato L. and Lupi S. *Optical properties of  $(SrMnO_3)_n / (LaMnO_3)_{2n}$  superlattices: an insulator to metal transition observed in absence of disorder*; NanoLetters, **10**, 4819, 2010

De Seta M., Capellini G., Busby Y., Evangelisti F., Ortolani M., Virgilio M., Grosso G., Pizzi G., Nucara A. and Lupi S.; *Conduction band intersubband transitions in Ge/SiGe quantum wells*; Appl. Phys. Letters **95** (5) Article Number: 051918, 2009

Nucara A., Maselli P., Calvani P., Sopracase R., Ortolani M., Gruner G., Cestelli Guidi M., Schade U. and Garcia J.; *Observation of charge-density-wave excitations in manganite*; Phys. Rev. Letters **101**, 066407, 2008

Carbonaro M. and Nucara A. *Application of FT-IR spectroscopy in the assessment of changes in secondary structure of food proteins taking legumes as a model*; Amino Acids **33**, 45, 2007.

S. Lupi, A. Nucara, A. Perucchi, P. Calvani, M. Ortolani, L. Quaroni, and M. Kiskinova; *Performance of SISSI, the infrared beamline of the ELETTRA storage ring*; Journal of the Optical Society of America B **24**, Issue 4, 959, 2007.

Sacchetti A., Cestelli Guidi M., Arcangeletti E. Nucara, A., Calvani P., Piccinini M., Marcelli A. and Postorino P.; *Far-infrared absorption of  $La_{1-x}Ca_xMnO_{1-y}$  at high pressure*; Phys. Rev. Letters **96**, 03503, 2006.

Falcaro P., Costacurta S., Mattei G., Amenitsch H., Marcelli A., Cestelli Guidi M., Piccinini M., Nucara A., Malfatti L., Kidchob T., and Innocenzi P.; *Highly ordered defect-free self-assembled hybrid  $lms$  with a tetragonal mesostructure*; Journal of the American Chemical Society **127**, 3838, 2005.

M. Cestelli Guidi, M. Piccinini, A. Marcelli, A. Nucara, P. Calvani and E. Burattini *Optical performances of SINBAD, the Synchrotron INfrared Beamline At DAFNE*; Journal of the Optical Society of America A, **22**, 12, 2810, 2005.

Roy P., Cestelli Guidi M., Nucara A., Marcouille O., Calvani P., Giura P., Paolone A., Mathis Y.-L. and Gerschel A.; *Spectral Distribution of Infrared synchrotron radiation by an insertion device and its edges: a comparison between experimental and simulated spectra*; Phys. Rev. Letters, **84**, 483, 2000.

Y.-L. Mathis, P. Roy, B. Tremblay, A. Nucara, S. Lupi, P. Calvani and A. Gerschel; *Magnetic field discontinuity as a new brighter source of infrared synchrotron radiation*; Phys. Rev. Letters, **80**, 1220, 1998.