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Biographic Data and Appointments

Born 11 March 1962, in Firenze, ITALY. 1989 'Laurea' in Physics, University of Firenze
1989-91: Ph.D. in Physics, University of Firenze (LENS).
1991-92: Visiting Researcher, Stanford University, (Prof. M.D. Fayer).
1993-94: Post-doc fellow at LENS collaborating with several research groups.
1995-2001: Research staff at LENS.
2001-present: Researcher at Dpt. of Physics and LENS, University of Firenze.

Membership and Service

1998-2008: Board Member of 'Structural and dynamical properties of Solids'- Cond. Matter Division dell' EPS; 2004-2010: Member of executive board of CRS-INFM "Soft matter"-Univ. di Roma, CNR; 2009-today: Italian Member for Meeting Committee in the Cost Action MP0902.;
2001-today: Supervisor of the LENS research line on "Soft Matter Physics".

Project Participation and Coordination

Italian Funding: MURST-Cofin 1998INFM-Paiss 1999, MURST-Cofin 2000, PRIN 2002, PRIN 2005.
European Funding: HCM Network 1994-97; COST MP0902 2009-2013, *Composites of Inorganic Nanotubes and Polymers*. Budget: 134.667,00 EUR in total.
Italian Funding: PORFSE 2007-2013, *Development of a 2D THz Imaging Apparatus*,. The funding is for a 2 Years Post-Doc position. Budget 60.000,00 EUR.

Publications and Bibliography

40 Invited Talks at Conferences,
101 Publications: http://www.mendeley.com/profiles/renato-torre1/
ISI web ID: http://www.researcherid.com/rid/G-6313-2012
1 Book: R.Torre, *Time-Resolved Spectroscopy in Complex Liquids*, Springer 2008, New York

Teaching experience

Physics Courses: Experimental Physics I, Experimental Physics III, Electromagnetic fields and waves, Physics of liquids;
Chemistry Courses: Experimental Chemical-Physics I
Supervisor of: 10 "Laurea" Thesis and 6 PhD Thesis in Physics and Chemical-Physics.

10 recent publications:

Plazanet, M., Sacchetti, F., Petrillo, C., Demé, B., Bartolini, P., & Torre, R. (2014). Water in a polymeric electrolyte membrane: Sorption/desorption and freezing phenomena. *Journal of Membrane Science, 453*, 419–424. doi:10.1016/j.memsci.2013.11.026

Taschin, A., Bartolini, P., Eramo, R., Righini, R., & Torre, R. (2013). Evidence of two distinct local structures of water from ambient to supercooled conditions. *Nature Communications*, *4,* 2401. doi:10.1038/ncomms3401

Taschin, A., Bartolini, P., Marcelli, A., Righini, R., & Torre, R. (2013). A comparative study on bulk and nanoconfined water by time-resolved optical Kerr effect spectroscopy. *Faraday Discussions*, *167*, 293. doi:10.1039/c3fd00060e

Malfanti, I., Taschin, A., Bartolini, P., & Torre, R. (2012). Evidence of slow acoustic surface waves on a 1D phononic surface by a pulsed laser spectroscopic technique resolved in time and space. *EPL (Europhysics Letters)*, *97*(4), 44010. doi:10.1209/0295-5075/97/44010

Consolino, L., Taschin, A., Bartolini, P., Bartalini, S., Cancio, P., Tredicucci, A., Torre, R., De Natale, P. (2012). Phase-locking to a free-space terahertz comb for metrological-grade terahertz lasers. *Nature Communications*, *3*, 1040. doi:10.1038/ncomms2048

Taschin, A., Cucini, R., Bartolini, P., & Torre, R. (2011). Does there exist an anomalous sound dispersion in supercooled water? *Philosophical Magazine*, *91*(13-15), 1796–1800. doi:10.1080/14786435.2010.522215

Malfanti, I., Taschin, a., Bartolini, P., Bonello, B., & Torre, R. (2011). Propagation of acoustic surface waves on a phononic surface investigated by transient reflecting grating spectroscopy. *Journal of the Mechanics and Physics of Solids*, *59*(11), 2370–2381. doi:10.1016/j.jmps.2011.07.010

Cucini, R., Taschin, a., Bartolini, P., & Torre, R. (2010). Acoustic, thermal and flow processes in a water filled nanoporous glass by time-resolved optical spectroscopy. *Journal of the Mechanics and Physics of Solids*, *58*(9), 1302–1317. doi:10.1016/j.jmps.2010.06.002

Taschin, A., Cucini, R., Bartolini, P., & Torre, R. (2010). Temperature of maximum density of water in hydrophilic confinement measured by transient grating spectroscopy. *EPL (Europhysics Letters)*, *92*(2), 26005. doi:10.1209/0295-5075/92/26005

Plazanet, M., Bartolini, P., Torre, R., Petrillo, C., & Sacchetti, F. (2009). Structure and acoustic properties of hydrated nafion membranes. *The Journal of Physical Chemistry B, 113*(30), 10121–10127. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/19719280

Research Experience

I have a wide experimental experience, since 1990, with laser sources of different types and application of these sources to perform complex optical spectroscopic investigations. In particular, I have a very good knowledge of pulsed laser systems of different nature and their utilization to realize time-resolved non-linear spectroscopic investigations. I started with the dye lasers producing tunable pico-second pulses. During the pioneering years, 1990-1995, of pulsed tunable laser I realized the laser cavity and the amplification stage and utilized this laser systems to measure the Time-Resolved Coherent Antistokes Raman Spectroscopy (CARS) of the molecular vibrations of benzene studying both the experimental determination of the non-linear response and the molecular dynamic problem. In the following, during my research period at the Stanford University in collaboration with prof. M.D.Fayer, I realized a laser system producing femto-second laser pulses at high repetition rate. This innovative laser systems enable to study the relaxation phenomena in liquid crystals approaching the isotropic-nematic phase transition. I studied also the Second Harmonic Generation from metal surfaces characterizing the propagation and scattering of "plasmons". Detecting the electronic resonance of a beta-carotene we measured the rotational dynamics in the time-domain. As well, using the fluorescence spectroscopy time-resolved with single photon counting detection, I measured the energy transfer processes and single molecule dynamics.
With the realization of reliable commercial femto-second laser sources, based on Kerr-lens mode-locking phenomena, the time-resolved non-linear spectroscopy move from a pioneering tools to a mature investigation technique. I built and utilized several femto-second laser systems with Ti:Sapphire as active medium, both producing pulses of low-energy/high rep. rate and high-energy/low rep. rate. Using these laser sources I measured the non-linear response of several material giving a new insight of the matter proprieties.

Since 1992, I have been interested in the study of the dynamics of complex liquids. In particular in the aggregation and correlation processes taking place in the vicinity of a phase transition that transform a simple liquid into a structured liquid or into a meso-phase. These particular liquid states are interesting because acquire some universal features that are independent by their molecular nature. A lot of my work has been focused on the glass transition and supercooled liquids. We published a pioneering work on the measure by optical Kerr effect of the structural relaxation of a glass-former and its interpretation by mode-coupling theory. Later I performed many different experimental studies measuring the structural relaxation and the viscoelastic proprieties of many glass-formers, evidencing the recurrent and universal dynamic laws that define the particular states of matter.

Between the glass-former liquid WATER likely the most important. I performed a measurement of the fast structural relaxation of water by time-resolved, showing for the first time its non-exponential decay and the critical slowing down of the relaxation times in the supercooled phase. This paper gives new insight into the nature of water physics and its glassy states. We are pursuing the study of metastable phases of water by experimental investigation of acoustic features and vibrational features. We measured the modification on water proprieties induced by nano-confinement into hydrophilic channels or polymeric membrane. Also the aqueous ionic solutions can give very valuable information on the water non-equilibrium properties.

Propagation of surface acoustic waves (SAW) has relevant interest in both fundamental research and technological applications. The propagation of acoustic waves in phononic crystals shows many peculiar phenomena that open the possibility for the realization of acoustic metamaterials. A clear example is the creation of phononic band gaps (i.e a frequency intervals over which the propagation of sound is forbidden), that enables a unique control on the propagation of sound. Other phenomena are connected with the acoustic processes characterized by frequencies and wave-vectors at the band edge, where the folding and bending of the acoustic bands take place. We studied SAW propagation on a 1D phononic surface (PS) by mean of an heterodyne-detected transient reflecting grating experiment. We excited and detected coherent stationary SAWs characterized by variable wave-vectors. The measured SAW frequencies enables the characterization of the band diagram of this PS sample beyond the first Brillouin zone. Four different SAW frequencies have been revealed, whose band diagram show articulated dispersion phenomena. In order to address the nature of the investigated SAWs, the experimental results are compared with a numerical simulation of elastic modes based on a finite element model. The observed SAWs are addressed to four Bloch waves characterized by different frequencies and surface energy localization. Moreover, we measured the SAW propagation on a flat non-phononic part of the sample surface and compared it with results from the PS.

Very recently, I began to investigated innovative spectroscopic techniques based THz radiation. Using a non-linear crystal response it is possible to convert the optical femto-second laser pulse into THz pulse radiation with the a time duration of about one picosecond. These new pulsed radiation open the possibility to investigate a very interesting and almost unknown spectrum of the matter response. Covering the 0.1-10 GHz spectrum of frequency this radiation enable the investigation of collective roto-vibrational mode in no transparent materials, including all the biological systems. Moreover, I am realizing an improvement of the time-resolved non-linear spectroscopic techniques towards a spatial sub-micron spatial resolution that will enable innovative real-time microscopic imaging of the material dynamics.

I am working at LENS that represents a very international and interdisciplinary platform to develop any new spectroscopic tools. The synergy of these spectroscopic skills with the bio-medical group needs will open new points of view that will turn into breakthrough knowledge and technology.