Andrea Armani received her BA in physics from the University of Chicago (2001) and her PhD in applied physics with a minor in biology from the California Institute of Technology (2007), where she continued as the Clare Boothe Luce post-doctoral Fellow in biology and chemical engineering. She is currently a Professor of Chemical Engineering and Materials Science and Electrical Engineering-Electrophysics in the Viterbi School of Engineering at the University of Southern California. Armani has received numerous awards, including the Sigma Xi award for excellence in research, the SPIE BiOS Young Investigator Award, ONR Young Investigator Award, the Technology Review Top 35 Innovators under 35, the Congressionally Directed Medical Research Program New Investigator Award, the USC Mellon Mentoring Award for Undergraduate Mentoring, the NIH New Innovator Award, the PECASE, the Hanna Reisler Mentoring Award, and the World Economic Forum Young Global Leaders.

Developing nanotechnology to study biological systems

Innovation in technology routinely leads the way for discovery in chemistry and biology. To explore the inherent complexity present in biological systems, existing technologies are being pushed to their limits, and once again, scientists are looking to engineers to create innovative solutions to enable their exploration and discovery. Our research is motivated by specific challenges posed by discussions with medical researchers and physicians. This presentation will highlight a few of the novel smart materials and biodetection technologies which have been inspired by these collaborations. For example, we have synthesized and characterized a UV-responsive polymeric material which irreversibly cleaves upon exposure to UV light. This photoresponsive behavior is selective to UV wavelength, with minimal response to visible or near-IR wavelengths. Additionally, upon cleavage, the polymer changes color. By integrating the polymer into a tri-layer structure, we have demonstrated a flexible UV indicator strip for preventative healthcare. Additionally, we have recently invented a fully integrated polarimetric elastography instrument for characterizing the mechanical properties of visco-elastic materials. This portable system shows promise for rapid testing and characterization of animal and human tissue samples, enabling numerous types of research investigations.

How to Prepare for an Academic Position

Simply applying for faculty positions can be a daunting undertaking. However, the challenges do not end when a position is obtained. At this point, it is necessary to transition from a full-time researcher into a complex blend of manager, researcher, mentor, and teacher. Depending on the interest of the audience, this presentation (or discussion) will cover topics including: how to best prepare a faculty application packet (assemble a research statement, teaching statement, acquire and prepare reference letter writers, apply for academic jobs, prepare for an academic job interview), how to start-up a lab (e.g. identify and acquire funding), and how to manage a lab (e.g. manage and motivate students/post-docs, grow a lab).

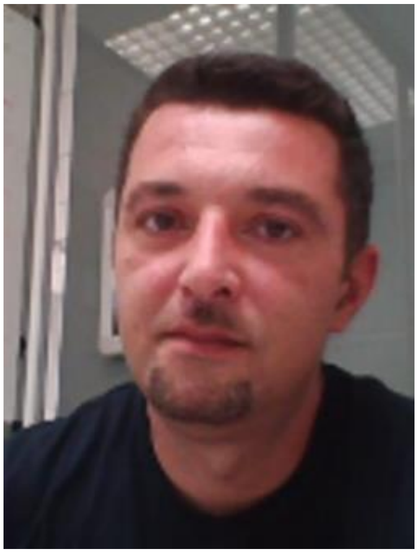
Gian-Franco Dalla Betta (SM'94–M'98–SM'06) was born in Venice, Italy, in 1967. He received the M.S. degree in electronics engineering from the University of Bologna, Bologna, Italy, in 1992 and the Ph.D. degree in microelectronics from the University of Trento, Trento, Italy, in 1997. From 1997 to 2002, he was with ITC-irst, Trento, Italy. Since 2002, he has been with the University of Trento, Trento, Italy, where he is currently a full professor of electronics.

He is the author or coauthor of more than 350 papers published in international journals and conference proceedings. His main research interests are in silicon radiation detectors and integrated optical sensors. He has been serving as an Associate Editor of the IEEE TRANSACTIONS ON NUCLEAR SCIENCE

Lucio Pancheri received the Ph.D. in Information and Communication Technologies from the University of Trento in 2006. From 2006 to 2012 he has been a research scientist at Fondazione Bruno Kessler (FBK), Trento, Italy, where he has been involved in the development of CMOS optical sensors for advanced imaging and biomedical applications. From 2012 he is an assistant professor at the University of Trento. In the last years, his research activity has been mainly focused on the development of radiation and charged particle sensors in the framework of several research projects funded by INFN.

Silicon integrated photon detectors

Impact ionization has been exploited for decades to enhance the Signal-to-Noise Ratio in Avalanche Photodiodes and has more recently enabled high-sensitivity photon detectors such as EM-CCDs and analog Silicon Photomultipliers. The fast evolution of CMOS imaging processes and 3D integration technologies is now paving the way to a new generation of detectors based on avalanche multiplication that can fully exploit the power of integrated electronics. These detectors can provide the unique combination of picosecond timing resolution and photon counting capability in a pixelated solid-state device. An increasing number of research institutions and commercial foundries are now developing the technologies needed to obtain efficient single-photon time-resolved imaging instruments. This seminar will review the state of the art of integrated Sigle Photon Avalanche Diodes and discuss the opportunities to exploit these technologies in research and consumer applications.



Mher Ghulinyan received his M.S. in 1995 and Doctoral degree in physics in 1999 from the Yerevan State University. As a postdoc (2002 to 2006) at the University of Trento, his early-carrier research in Silicon Photonics – silicon-based Optical superlattices (OSL) – paved the way to the first-time demonstrations of fundamental phenomena: photonic Bloch oscillations [PRL-2003, cover story] and resonant Zener tunneling [PRL-2005-a], Anderson localization of light and observation of optical necklaces [PRL-2005-b], vapor control of photonic bands [PRB-2006] and optical switching using capillary condensation [Nat.Photon.-2007]. Currently, he is a senior researcher at the Centre for Materials and Microsystems (FBK) and holds a leading role in the development of FBK-CMM's capacities to perform optical engineering and fabrication of different micro/nano-optical components and circuitry. His interests are in the field of resonator optics, with a particular focus on monolithically integrated optically active and passive planar microresonators. Current research includes developments towards integrated Silicon Quantum Photonics and heterogeneously integrated active Silicon Photonics. Since 2012 holds the master's course of Photonics at the University of Trento as contract professor. He is a member of the Optical Society of America (OSA), author and editor of two book, several book-chapters, more than 120 research papers and inventor of 2 patents.

Integrated photonics research in FBK

We will present an overview of novel technological platforms for the realization of fully integrated microresonator structures for silicon photonics. As a particular example, we will describe thin silicon nitride-based ultra-high-quality factor ring resonators monolithically integrated on a silicon chip. These devices are based on a strip-loaded configuration in which the absence of physically etched lateral boundaries in the guiding components leads to significantly reduced scattering losses. Consequently, Q's of $3{,}7\times10^6$ in the NIR (780nm) and up to 1×10^6 in the C-band (1550nm) were measured for very thin guiding material thickness of 80 nm and 115 nm, respectively. These developments are subject to further improvements that may allow employing strip-loaded devices in nonlinear frequency conversion or quantum computing schemes within the desired spectral range, provided by the material transparency. Current and future developments to bring the strip-loaded devices onto SOI platform will be also overviewed.

Andrea Chiappini is a researcher at the Institute of Photonic and Nanotechnologies research unit in Trento. The 22nd October 2003 he received the degree in Physics from the University of Trento with a final score of 110/110 con laude. In December 2006 he obtained the PhD degree discussing the thesis "Realization and characterization of confined structures: control of optical and spectroscopic properties", developed inside the activities of the research group CSMFO of the CNR-IFN of Trento and the Department of Physics of the University of Trento. His main scientific interest concern “Sol-Gel Photonics” with particular attention to the realization and the characterization of confined structures, for tailoring the optical and spectroscopic properties. He is also active in outreach activities organizing specific workshops and trainings for Science and Physics teachers on the topic “Photonics for Schools” and realizing didactic exhibits in collaboration with MuSe (Museum of Science) in Trento. He is referee of several ISI journals in the field of optics and materials for Photonics He has been coordinator and principal investigator of two research projects and key scientist in several national and international projects. He is co-author of 54 papers on ISI journals, 4 on non-ISI journals, 95 proceedings and 156 communications in national and international, 53 are invited communication. He has a 18 h-index.

Photonic Glasses: advances and perspectives

Glass Photonics is pervasive in a huge number of human activities and drive the research in the field of enabling technologies. Glass materials and photonic structures are a cornerstone of scientific and technological buildings in integrated optics. It is recognized that photonics and glass science smartly cooperate to develop new physics, new devices, and new applications. This cross-disciplinary approach leads to “smart structures”, which can perform sensing, and functionalized ones to successfully address socio-economic challenges, such as security, -, energy saving, efficient and clean industrial production, environmental protection, and fast and efficient communications.

This lecture presents some recent results obtained by our consortium in rare earth doped photonic glasses and confined structures, in order to give some highlights regarding the state of art in glass photonics. Starting from planar waveguides we will move to spherical microresonators, a very interesting class of photonic confined structures. Then we will present 1D-photonic crystals and opals allowing management of optical and spectroscopic properties. We will conclude the short review with some remarks about the perspective for glass photonics.

The research activity is performed in the framework of COST Action MP1401 Advanced fibre laser and coherent source as tools for society, manufacturing and lifescience (2014-2018), ERANET-LAC FP7 Project RECOLA - Recovery of Lanthanides and other Metals from WEEE (2017

Cristina Potrich is senior researcher at the Bruno Kessler Foundation, Center for Materials and Microsystems, LaBoratory of Biomarker Studies and Structure Analysis for Health and affiliated to the CNR - Institute of Biophysics in Trento. Her main interest is the development of biofunctional materials applied to the micro-nanotechnologies for genomics and proteomics, in particular she spent the last years in the development of Lab-on-a-chip devices for medical applications. She is a molecular biologist as education (March 1996: degree in Biology at the University of Padua. Top grade) but has also a strong background in the biophysical field (PhD in Molecular Physiology and Structural Biology; 11 years of research activity at the CNR Institute of Biophysics in Trento. General topic of the research was the interaction of cytolysins with natural and synthetic membranes). She is co-author of more than 40 papers published in international journals, three book chapters and contributions, both oral and as poster, to congresses with review.

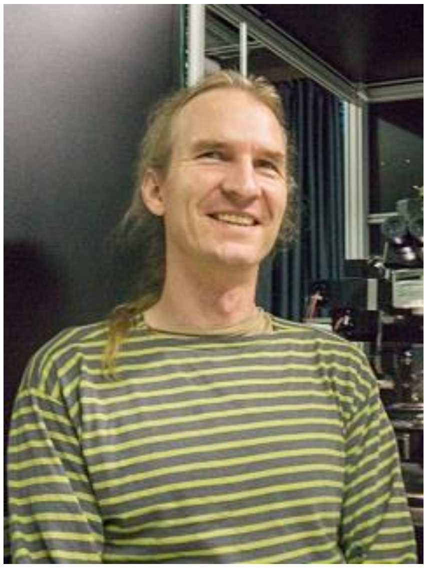
Smart biointerfaces for the detection of circulating biomolecular markers

The analysis of low abundant biomarkers, such as circulating microRNAs, small proteins or even toxins, demands innovative detection methods with increased resolution, sensitivity and specificity. A general requisite for the successful implementation of these tools is the development of suitable bio-functional materials and surfaces. Biofunctional surfaces have the huge potential to capture and concentrate biomarkers dispersed in biological fluids. Here, the realization of biofunctional surfaces for the capture of specific biomarkers will be presented, together with their detection based on photonic techniques. Practical examples will be: i) the detection of microRNAs via photonic crystal (biosurface based on specific probes); ii) the detection of thrombin via microspheres (biosurface based on specific aptamers); iii) the detection of Vascular Endothelial Growth Factor via SPAD (biosurface based on specific aptamers); iv) the detection of aflatoxin M1 via MZI (biosurface based on Fab).

Andrea Adami earned the Italian Master degree in Materials Engineering in 2003 and the PhD in Information and Communications Technologies in 2010, both at the University of Trento, Italy. He is currently researcher at FBK on the topic of sensors and microsystems. Since 2003, he acquired good experience on device design and development, especially on chemical sensors, micromechanical sensors and microfluidics for several applications. Currently, his main research interest is the development of microsystems and microfluidics for agrofood applications, and in particular microsystems for sample preparation in analytical systems. He is author of more than 70 papers in International Conferences and Scientific Journals.

Microsystems for analytical devices

This talk will briefly describe the state of the art and principal concept of microfluidics applied to analytical devices, highlighting the complementarity with photonics to implement high performance systems. The talk will also present case studies on Lab-on-chips and microfluidic sample preparation as an overview of the activities at Microsystems Technology Research Unit (FBK).



Albrecht Haase studied physics at the Freie Universität Berlin from 1995 to 2000. During his Master's thesis he worked on miniaturized magnetic traps for cold atoms at the University of Innsbruck. He extended these studies with a PhD obtained in 2005 from the the University of Heidelberg with a thesis on atom chips, integrating nanofabricated conductors to produce magnetic potentials for Bose Einstein Condensation with microoptics for atom manipulation and detection. He continued with a 2 year PostDoc at the Institute of Photonic Sciences in Barcelona, where he developed entangled photon sources for single-photon single-ion interaction. In 2008, he accepted the challenge to enter a new field of research at the University of Trento, where he used hes expertise in nonlinear photonics to setup a Laboratory for Nonlinear Bioimaging. In 2013, he founded the Neurophysics group where he study phenomena at the interface between physics and neurosciences.

Exploring the physics of the brain with nonlinear fluorescence imaging

I will present our work in the Neurophysics group, were we investigate physical mechanisms underlying signal reception, transduction, and processing in the brain. Our experimental tools are nonlinear optical imaging methods like multi-photon fluorescence microscopy, allowing to study structure and function of neuronal networks in small animal models *in vivo*. A model that provides optimal brain performance over brain size is the honeybee. In my talk, I am going to illustrate how we experimentally follow the information flow along the olfactory processing pathway in the bee brain. At the input level, we test a potential quantum biological mechanism involved in odour molecule-receptor interaction. At the odour information coding level, we study how odour information is imprinted on brain activity. To understand learning and memory, we trace learning-induced changes in structure and function of the neural networks. At the end of my talk, I will give an outlook on future projects aiming at active brain manipulation via optogenetics.

Massimo Borghi received his B.S. degree in physics from the University of Modena and Reggio Emilia, Italy, in 2010, the M.S. degree in experimental physics from University of Trento, Italy, in 2012, and the Ph.D degree in physics from the University of Trento, Italy, in 2016. From 2016, he is a post-doc in physics at the Nanoscience Lab of the University of Trento. His research interests include passive integrated networks involving single and coupled resonators, nonlinear Silicon photonic devices for frequency up/down conversion, electro-optic effects in strained silicon devices, quantum optics in both free space and integrated Silicon On Insulator circuits.

Experimental investigation of the optical properties of a material

Almost every experiment needs a modeling stage, in which the behavior of the system is predicted and the device performances can be optimized. A common problem while dealing with new custom materials is that their physical constants are usually are unknown or they have been determined with not sufficiently high precision. This can constitute a severe limitation in the modeling capabilities, and decrease their reliability when the model is transferred to real devices.
In this talk will be presented several experimental techniques aimed to determine some optical constants of materials. These includes the thermo-optic coefficient, the nonlinear refractive index, the second order susceptibility tensor and the photoelastic constants. Particular emphasis will be devoted the necessity of handling together optics with different physics, as structural mechanics, electronics and thermodynamics. Explicit examples of experiments performed at the NanoScience Laboratory of the University of Trento will be discussed.