Book of Abstract

S1: DEVELOPMENT OF IMAGING, MICROSCOPY AND OPTICAL ANALYSIS: I
Pietro Ferraro - Chair

Terahertz meets bio-microscopy: the MIMOSA project
Domenico Paparo, Anna Martinez, Ida Orefice, Melania Paturzo, Andrea Rubano, Angela Sardo
In the last decade terahertz spectroscopy (THz-S) has emerged as an invaluable tool for investigating model systems of interest for biophysics. The main advantage of THz-S compared to other optical techniques is its harmlessness for living matter. This property was recently exploited for developing a new microscopy for biosamples based on the combination of an Atom Probe microscope and intense THz pulses. This has led very recently to the approval of the EU-Pathfinder project 'MIMOSA'. In this presentation we will review our recent applications of THz spectroscopy to diatoms and we will provide a brief introduction of the 'MIMOSA' project.

Stain-Free Intracellular Specificity for Tomographic Phase Microscopy in Flow Cytometry
Daniele Pirone, Pasquale Memmolo, Lisa Miccio, Vittorio Bianco, Pietro Ferraro
Tomographic Phase Microscopy (TPM) is a label-free optical microscopy technique for reconstructing the 3D spatial distribution of the refractive index (RI) at the single-cell level. In 2017, our research group has realized for the first time a TPM system working in flow cytometry (FC) modality. In TPM-FC, digital holograms of cells are recorded while flowing along a microfluidic channel and rotating because of the hydrodynamic forces of a laminar flow. Hence, TPM-FC can replicate the high-throughput property of the gold-standard technique for the single-cell analysis, i.e. Fluorescent Imaging Flow Cytometry (FIFC), but in 3D, quantitative, and label-free manner. However, the advantages of TPM-FC over FIFC are counterbalanced by the lack of intracellular specificity, that is limiting its promising applications in biomedicine. In fact, unlike FIFC, no exogeneous dye is employed to make distinguishable a subcellular organelle with respect to its background. In static TPM, Artificial Intelligence (AI) has been exploited for virtually staining the 3D RI tomograms. Instead, in TPM-FC, a dataset for the AI-based virtual staining made of 3D RI tomograms paired to the corresponding labelled tomograms cannot be created due to the flow modality. Hence, we have developed some computational approaches avoiding AI to fill the specificity gap between TPM-FC and FIFC for the identification and quantitative characterization in 3D of some endogenous organelles and exogenous nanoparticles. In this presentation, results about the nucleus, nucleolus, lipid droplets and nanographene oxide specificity will be shown. These results are expected to promote the development of advanced tools for the single-cell analysis in biomedicine.

AI-enpowered polarization sensitive Digital Holography for material specificity: an application on textile microfibers
Marika Valentino, Vittorio Bianco, Lisa Miccio, Pasquale Memmolo and Pietro Ferraro
In the last few years, Digital Holography (DH) has proved to be a powerful Quantitative Phase Imaging technique for investigating non-invasively transparent microscopic specimens, and has been applied in different fields, such as biomedicine, diagnostics and environmental monitoring. DH provides the phase contrast signature of the probed sample, thus conveying quantitative information, pivotal for the object characterization. Here, we implement a polarization resolved DH microscopy configuration to exploit the intrinsic optical features of the samples and to achieve material specificity in a label-free mode. As an applicative benchmark, we demonstrate to fully characterize natural, synthetic and animal microfibers, being able to distinguish them with an all-optical approach. In fact, this strategy allows us to analyse the Jones matrix and the birefringence property of the considered microfibers. The Jones formalism permits to cluster the microfibers in static mode, while the combination between the polarization resolved DH system and Artificial Intelligence empowers the material specificity of microfibers in flow. We classify synthetic from natural microfibers, reaching high accuracies for each kind of microfiber using a machine learning pipeline. Moreover, combining both Jones features and multi-channel DH features (phase, amplitude and birefringence), we discriminate among different animal microfibers. Our results demonstrate the feasibility to detect, identify and analyse fiber-shaped specimens, which is useful for the in-situ monitoring and helpful in avoiding visual operator dependence.

Image sensing for Agricultural, Cultural Heritage and NDT applications
Massimo Rippa*, Rossella Curcio, Pasquale Mormile
The research activity carried out in the "Thermography and Infrared Imaging Lab" of the ISASI-CNR is aimed

at the development of new methods of analysis and diagnostics mainly based on the use of imaging technologies. In particular, using the cameras of the laboratory operating in the spectral regions: Vis, NIR, SWIR, MWIR and LWIR, new Image Sensing techniques are developed for applications in the fields of precision agriculture, cultural heritage and non-destructive testing (NDT). This brief presentation will show the developments in the last year of activity carried out through various collaborations also in terms of present and future projects.

Naples Cryo Electron Microscopy laboratory

Emanuela Esposito, Maria Marzano, Gennaro Sanità, Umberto Amato, Maurizio Indolfi, Domenico Passaro, Ivo Rendina

The Cryo Electron Microscopy laboratory at ISASI Naples provide the possibility to identify, visualize and characterize biological macromolecules alone and in their cellular environment. The Cryo-EM lab is designed to efficiently combine different work flows for single-particle analysis (SPA), that provides the high-resolution 3D structure of proteins, enzymes and other macromolecules and electron tomography (ET), which is used to observe and measure the inner architecture of cells, tissues and organoids. An essential part of the work flow for ET includes plunge freezing and lamella preparation to observe vitrified samples using focused ion beam – scanning electron microscopy (FIB-SEM) technology. The Cryo-EM lab can also provide Material Science analysis and sample fabrication by (FIB-SEM) technology.

The Cryo-EM lab is equipped with the state-of-art electron microscope:

Thermo Scientific Glacios 200kV TEM equipped with Thermo Scientific Falcon 4 camera and Selectris X imaging filters;

Thermo Scientific Aquilos 2 Dual Beam cryo-FIB system;

Thermo Scientific Vitro-bot

Cryo-EM sample preparation and Nanoparticles subcellular localization

Maria Marzano, Gennaro Sanità, Ivo Rendina, Emanuela Esposito,

Cryo-electron microscopy (cryo-EM) is emerging as an elite technique in structural biology and it is rapidly developing as a key approach for determining the three-dimensional (3D) structures of large macromolecular assemblies. Beyond life sciences, the development of cryo-EM for materials sciences represents a new technology for characterizing systems too sensitive to electron irradiation or environmental exposure. In this context, vitrification represents a critical technique for optimal preparation and visualization of the sample cooled so rapidly that the surrounding water molecules do not have time to crystallize. Good vitrification is a crucial step within structural biology applications such as single particle analysis (SPA) and cryo-electron tomography (cryo-ET). Nanoparticles precise localization is one of the most important goals to realize an effective therapeutic/diagnostic system and study the clearance. Owing to Cryo-SEM and Cryo-TEM unique features, we will study the subcellular localization of MelaSil_Ag- HSA@DOX NPs (already widely characterized in previous works) in breast cancer 2D and 3D cellular models (spheroids) by using Focused Ion Beam, incorporated in Cryo-SEM system, to produce very thin lamellas for Cryo-TEM analysis. The high electron density of MelaSil_Ag-HSA@DOX silver core will be exploited to localize with high precision the NPs and to study their destiny in the chosen cellular models at different times of incubation.

S2: FUNCTIONAL DEVICES, SENSORS AND BIOSYSTEMS: I

Carmine Granata – Chair

Topology in Superconducting Quantum Arrays and Superconducting Qubit Networks

Berardo Ruggiero, C. Bonavolontà, M. Cirillo, E. Esposito, M. Fistul, C. Gatti, R. Russo, P. Silvestrini, M Valentino, and M. Lisitskiy

We present some investigations on new topological orders in the phase transitions of two-dimensional arrays of superconducting islands connected by Josephson junctions. The network connectivity becomes much more relevant than the real dimensionality and new physics is expected to arise, as predicted by existing theoretical models. On this base our research is also devoted to the experimental study of new topologies in superconducting qubit networks (SQNs) in the view of search of novel platform for quantum integrations.

Josephson device with a strong ferromagnetic interlayer: toward a new transmon qubit

Antonio Vettoliere e Carmine Granata

We report on the fabrication and characterization of tunnel Josephson Junctions (JJs), based on Nb technology with astrong ferromagnetic interlayer Ni80Fe20 alloy (Permalloy), for applications as RAM elements with reduced area andrelative low saturation and coercive fields. Furthermore, the fabrication and characterization of high-qualityferromagnetic JJs based on aluminum technology exploiting an innovative fabrication process inspired by niobium-based technology are reported. The high-quality of obtained JJs keeping the hysteretic behavior of the magnetic fieldpattern and typical transport properties make possible the implementation of Al tunnel-ferromagnetic JJs insuperconducting quantum bits, toward alternative approaches based on digital control of the Josephson device.

Characterization of functional panels by an integrated approach based on thermography and numerical simulations

Ciro Tortora, Veronica Vespini, Sara Coppola, Pietro Ferraro

In this case study, an integrated approach for the thermal characterization of a titanium (Ti) panel test made by additive manufacturing is proposed. The panel has been conceived integrating its mechanical properties for the structural support and for loading all the components and payloads of the satellite platform, with the innovative property of heat dissipation. This prototype module comprises internal heat pipes, containing numerous parallel micro-channel arrays, for managing the heat exchange related to the working condition of the payloads. The tests are carried out using thermal test and numerical simulations. The results are compared to obtain a better characterization of the thermal state of the panel under heating conditions. In the design particular attention was focused to the balance of the profile selected for the heat-pipes and the 3D printing resolution. The characterization of the working condition under heating has been also reported and discussed.

Sensori ottici di ossigeno basati su biossido di titanio: recenti sviluppi

S. Lettieri, R. Rega, A. Fioravanti, P. Marano, L. Giordano

In questa presentazione saranno illustrati alcuni dei recenti risultati da noi ottenuti nello studio delle interazioni tra ossigeno e nanostrutture di biossido di titanio (TiO2).

L'argomento è di potenziale interesse applicativo nel campo della sensoristica chimica ma ha anche implicazioni di tipo fondamentale, riguardanti le proprietà fotocatalitiche di tale materiale.

S3: FUNCTIONAL DEVICES, SENSORS AND BIOSYSTEMS: II

Mario Iodice - Chair

Optimization of Hydrogel Plasmonic Nanocomposites for Wearable Sensors and Food Quality Assessment

Bruno Miranda, Valeria Nocerino, Ilaria Rea, Principia Dardano, Stefania Dello Iacono, and Luca De Stefano

The quest for versatile, large-scale, optical devices for the in-situ detection of biomarkers and food pesticides is favouring the study of new hybrid materials [1]. In this context, the design and fabrication of nanocomposite materials made of polyethylene-glycol-diacrylate (PEGDA) and gold nanoparticles (AuNPs) represent a promising alternative to the laborious and non-scalable production of ordered arrays of nanostructures onto rigid substrates. The optomechanical properties of hydrogel-based nanocomposites have been optimized for competitive detections of biomarkers in interstitial fluid, and of pesticides and additives in wine, exhibiting excellent performances both in label-free (LSPR and SERS spectroscopy) and in label-based (MEF) sensing schemes.

Optical biosensing based on plasmonic metasurfaces

Ambra Vestri, Massimo Rippa, Valentina Marchesano, Lu Zhou, Domenico Sagnelli and Lucia Petti

Development, characterization and optimization of nanophotonic metamaterials is one of the main research area of the Petti's group. Moreover, the team interest is focused on the implementation of these micro/nano-metasurfaces for plasmonic biosensing. Novel nanopatterned substrates are fabricated using electron beam lithography technique (EBL), the morphological analysis is realized by Scanning Electron Microscopy (SEM) and the plasmonic properties are studied using different experimental set-ups for Localized Surface Plasmon Resonance (LSPR) and Surface Enhanced Raman Spectroscopy (SERS) measurements. Plasmonic substrates are exploited to realize performing biosensors for the detection of hazardous agents, from small molecules like pesticides to biological pathogens like viruses and bacteria.

Plasmonic bimetallic biosensors for diagnostics and environmental monitoring

Valeria Nocerino, Bruno Miranda, Ilaria Rea, Luca De Stefano

Recently, plasmonic nanoparticles have emerged as powerful transduction elements of biosensors for diagnostics and environmental monitoring [1]. In this context, we developed flexible plasmonic biosensors based on bimetallic nanoparticles (gold and silver) mixed in a pre-polymer solution of PEGDA and photopolymerized for an appropriate time [2]. The synthesis of silver nanoparticles was optimized with a bottom-up technique to obtain time-stable colloids of controlled sizes and optical properties. Differently, top-down fabrication methods of bimetallic nanostructures have been investigated, by using thermal evaporation, annealing, and reactive-ion etching processes [3]. Properly functionalized nanoplasmonic configurations can be exploited to recognize targets with high sensitivity and specificity.

Optical flexible biosensors for nucleic acid detection

Sara Martino, Ilaria Rea, Luca De Stefano

Nucleic acids (NAs) are fundamental carrying-information molecules that direct essential cellular mechanisms as cell-life cycle, protein synthesis and signal transduction. In recent years, nucleic acid are emerging as potential biomarkers of different diseases due to their ability to regulate genes expression. Molecular techniques, known as classical methods to detect NA, suffer from drawbacks, such as low sensitivity and long sample preparation steps. The advent of nanotechnology has opened up the possibility to construct flexible and nanostructured optical biosensors for NA detection. Due to their large surface-to-volume area, these biosensors allow an efficient immobilization of detection probe that can interact specifically with the target NA.

Polymeric, flexible patch for a pH-sensitive release of antioxidant selenium glycoconjugates.

Serpico L., Dello Iacono S., De Martino S., Battisti M., Dardano P., De Stefano L.

Wound care is a widespread health issue and represents a significant cost to the public health system. Wounds are clinically classified in acute and chronic lesions. The latter are often characterised by a limited repairing process due to several coexisting factors. It has been proved that high levels of Reactive Oxygen Species (ROS) compromise skin repair. Here, two novel selenium glycoconjugates are prepared and loaded in a hydrogel flexible film and are proposed as antioxidants to accelerate healing. The chemical interaction between the material and the embedded molecules is modulated by pH resulting in a pH-sensitive delivery system.

New photodynamic approaches for antimicrobial treatments

Marika Iencharelli, Alberto Danielli, Matteo Calvaresi, Angela Tino, **Claudia Tortiglione**

Antimicrobial resistance is one of the greatest threats to global public health. Growing antibiotic resistance has encouraged the revival of phage-inspired antimicrobial approaches. On the other hand, photodynamic therapy (PDT) is considered a very promising therapeutic modality against bacteria. Yet, very few efforts have been made to combine the advantages of both approaches in a modular, retargetable platform. The possibility to use M13 bacteriophage as a multifunctional scaffold enabling photodynamic cell ablation was recently showed [1-3]. However, in vivo models are required for clinical translation of these novel tools. Here we show the possibility to use an invertebrate model to test PDT treatment mediated by functionalized bacteriophages and present preliminary data on their use for antimicrobical purposes.

Xenobiotic Substances and Electrical Biological Responses

Silvia Santillo

The neuronal excitability is essential for maintaining the brain functions. In a single neuron, neuronal excitability is modulated by intrinsic membrane properties and ionic conductivity that determines the probability of action potential generation.

Understanding the effects of xenobiotics on basic functions of neuronal cells, such as excitability, as still poorly investigated, could constitute a new rationale for exploring the biological mechanisms of excitotoxicity phenomena which are involved in neurodegenerative alterations (Alzheimer’s and Parkinson's diseases).

S4: FUNCTIONAL DEVICES, SENSORS AND BIOSYSTEMS: III
Lucia Petti – Chair

Development of Multifunctional Micro-System for Biological and Biochemical application.
Federica Granata, Mario Iodice, Giuseppe Coppola.
The development of microfluidic systems has brought remarkable advances and opportunities in the fieldsof physics, chemistry, and biology. Microfluidic chips are technology platforms that act as real chemical/biologicallaboratories (Lab-on-a-chip) only a few centimeters in size. The coupling and integration between microfluidic devicesand optical systems have paved the way for new possibilities in the development of high-sensitivity, high-resolutionmicro-systems that exploit the interaction between light and fluids at the micrometer scale. In this context, thepresentation will illustrate the research activity developed for the design and fabrication of multifunctionalmicrosystems for various applications, ranging from optimized functionalization of plasmonic substrates tomicroreactors to improve embryo culture.

Near-infrared optical transceivers integrated on SOI waveguides for optical interconnects
T. Crisci, L. Moretti, C. Russo, M. Gioffrè, M. Iodice, G. Coppola and M. Casalino
Here, we present an innovative type of waveguide photodetector and modulator based on a grapheneabsorbing layer physically embedded between a crystalline and a hydrogenated amorphous silicon layer. Thisconfiguration allows to superimpose the maximum ntensity of the propagating mode on the thin graphene absorbinglayer. Experimental results show photodetectors with responsivity of 0.5A/W around 1550nm, while numerical simulations show modulators based on electro-absorption with modulation depth of M=0.325 dB/μm at 10V and afootprint of 5μm ^{2}.

Manipulation of fluids: Gold nanoparticles and thin functionalized polymeric films
Fabiana Graziano, Ciro Tortora, Volodymyr Tkachenko, Veronica Vespini, Sara Coppola, Simonetta Grilli, Pietro Ferraro
In this work we propose two methods for the manipulation of fluids: liquid and polymer. The first method is based on the pyroelectrohydrodynamic effect and the first results on handling of fluids were achieved for the dispensing of gold nanoparticles. The second method is the formation of thin polymeric film in water. Four different polymeric solutions containing mesoporous silica nanoparticles were prepared for the fabrication of the membrane samples. Interferometry for the characterization of the as formed membranes.

Porous biosilica nanoparticles for medicine
Ilaria Rea, Chiara Tramontano, Luca De Stefano
Diatoms are unicellular algae found in the aquatic environment. These microorganisms are enclosed in the frustule, a cage of amorphous porous silica. The unique properties of this biosilica, usually studied by taxonomists, have invaded the field of bio-nanotechnology and have become a rich and dynamic area of research on which hundreds of articles have already appeared. In this presentation, the enormous versatility of natural biosilica will be highlighted from different point of views: chemically, by showing the different modifications on the biosilica surface; therapeutically, by exploring the advantages of diatoms as nano-based drug delivery systems; diagnostically, by making SERS platforms for label-free intracellular sensing.

S5: APPLIED PHOTONICS & OPTOELECTRONICS: I
Giuseppe Coppola – Chair

Resonant cavity enhanced graphene/Silicon Schottky photodetectors for telecom and datacom applications
T. Crisci, L. Moretti, M. Gioffrè, M. Iodice, G. Coppola and M. Casalino
This research activity is focused on vertically-illuminated near-infrared photodetectors based on a graphenelayer physically embedded between a crystalline and a hydrogenated silicon layer. Under near-infrared illuminationour devices show an unforeseen increase of the thermionic current. This effect has been ascribed to the lowering ofthe graphene/crystalline silicon Schottky barrier as a result of an upward shift of the graphene Fermi level induced bythe charge carriers released from traps localized at the graphene/amorphous silicon interface under illumination. Acomplex model reproducing the experimental observations has been presented and discussed.

Integration of plasmonic and dielectric metasurfaces on conventional and unconventional substrates for sensing applications.

Valentina Di Meo, Alessio Crescitelli, Ivo Rendina and Emanuela Esposito

In this talk, the properties offered by plasmonic metasurfaces integrated on silicon chip as Surface Enhanced InfraRed Absorption (SEIRA) substrates will be shown. In particular, the detection of azide-based compounds, employed as chemical probes with typical IR signatures to monitor and sense SARS-CoV2 spike antigen, has been successfully demonstrated. Moreover, the possibility to integrate dielectric metasurfaces on unconventional substrates, such as an optical fiber tip, will be shown, paving the way to a new generation of very miniaturized sensors.

Development of photodetectors and electrodes for health/green applications

M. Casalino, T. Crisci, M. Gioffrè, M. Iodice, G. Coppola, R. Russo, S. Lombardo, R. Corso, A. Scuto

In this talk we will show how two-dimensional materials, and in particular graphene, could be useful for developing a new-concept of solar cell. Indeed, new generation of solar cells require a charge collector characterized by both excellent electronic conductivity and high transmittance. Graphene fulfils these requirements, thus solar cells based on graphene are attracting more and more the attention of the scientific community. This talk will describe also interesting approaches to improve the performance of a solar cell, for instance by employing strategies for reducing the high recombination rate occurring at edges and for increasing the self-cleaning capability of the glasses.

Plasmonic Effect for Nanoparticle Displacement

S. Balestrieri, G. Coppola, M. Iodice, G. Zito

Plasmonic phenomena are capable of producing localized and strongly amplified electric fields, which can be exploited for many applications in the field of micro- and nanotechnology. In this talk, we will focus on the possibility of designing plasmonic nanostructures capable of inducing a displacement of nanoparticles. The behavior of this plasmonic device as a function of its geometrical parameters and also the obtained dynamic parameters (velocity, force) will be illustrated. In addition, we will show, how in the context of plasmonic phenomena applied to nanoparticles, the spin-orbit coupling phenomenon induced by the evanescent waves of LSPs defines a polarization-dependent momentum that ensures the control of the velocity and force (and thus the trajectory) of a metallic nanoparticle directly with a laser source.

Graceful photonics in Nature: handling light by multiple pathways in diatoms

E. De Tommasi

Can beauty meet photonics? The elegance of diatom frustule shapes seems to have been sculptured by evolution through eras in order to perfectly manage sunlight harvesting in a harmonized symphony involving light refraction, diffraction, scattering, confinement, photoluminescence, and even spin-to-orbital angular momentum conversion of photons. The results of this last year, mainly involving the study of the photonic properties of Pleurosigma strigosum and Arachnoidiscus ehrenbergii diatoms will be illustrated, together with the most recent editorial activities, submitted proposals, and ongoing national and international collaborations.

Integrated PV-T collectors: challenges and opportunities

D. De Luca, A. Caldarelli, U. Farooq, E. Gaudino, P. Strazzullo, E. Di Gennaro, M. Musto, R. Russo

We investigate the performance of a novel flat photovoltaic-thermal (PV-T) module under high-vacuum, with the aim of optimizing the simultaneous production of thermal and electrical energy. In the proposed design, the photovoltaic (PV) cell is placed above the selective solar absorber (SSA), in a fully integrated PV-SSA structure, which allows full exploitation of spectral solar radiation. In this configuration, the losses related to non-absorpted low-energy photons and the thermalization of high-energy ones, typical of a classical single-junction PV cell, are recovered as heat. Overall, we highlight the advantage of high vacuum insulation and the versatility of the proposed system.

S6: APPLIED PHOTONICS & OPTOELECTRONICS: II
Luca De Stefano – Chair

Integrated Graphene/4H-SiC Schottky photodetectors
M. Medugno, E. Mallemace, S. Rao, F. Della Corte, T. Crisci, M. Gioffrè, M. Iodice and M. Casalino
We introduce silicon carbide photodetectors recently developed at ISASI-CNR. These devices are based on the internal photoemission (IPE) through a Graphene/4H-SiC Schottky junction and we demonstrate detection of wavelengths ranging from UV to NIR. In this talk we discussed technologies, experimental setup and measurements.

High responsivity Graphene/Si photodetectors from visible to near infrared
M. Valentino, C. Bonavolontà, M. Casalino, T. Crisci, M. Gioffrè, A. Vettoliere, I. Rendina, B. Ruggiero, P. Silvestrini
Graphene is a material with unique electrical and optical properties that have never been observed in conventional materials. Graphene can absorb light from ultraviolet to infrared, which makes it an excellent candidate for optoelectronic applications. Graphene combines the high carrier mobility property and the excellent light absorption capability which are ideal for development of next-generation optoelectronic devices, especially photodetectors. The recent progress of graphene/Silicon photodetectors obtained at CNR ISASI will be presented.

Azopolymers and its actuation with coherent and uncoherent light
D. Sagnelli, A. D'Avino, M. Rippa, V. Marchesano, A. Vestri, L. Petti.
Photo-mobile polymer films are smart materials used to develop new applications in various fields. Usually, these actuators are realized with a mixture of liquid crystals (LCs) including azobenzene moieties that play a fundamental role in converting light into mechanical work, thanks to its photo-isomerization reaction. An interesting approach is to expand the wavelenghts actuation range band of the PMPs by doping these films with nanoparticles. Furthemore, we use a facile, solvent free and reproducible approach to synthesize the nanocomposites. It is observed a great improvement of maximum bending degree and response to coherent and unpolarized uncoherent light.

Selective Solar Absorbers for efficient solar energy conversion and their thermal stability in vacuum
A. Caldarelli, D. De Luca, U. Farooq, E. Gaudino, P. Strazzullo, E. Di Gennaro, M. Musto, R. Russo
High vacuum flat plate (HVFP) collectors are a promising way to reduce the use of fossil fuels and help the transition to renewable energy resources. The mid-high working temperatures and the vacuum insulation of these collectors lead to a re-thinking of their main component: the selective solar absorber (SSA). Following this direction, the optimization of the SSA and the improvement of substrate performance could determine an increase in HVFP efficiency (up to 0.55 at 300 °C). In this new contest also the evaluation of the service life of these SSA has to be developed and studied.

In vivo photothermal effect mediated by plasmonic nanoparticles
V. Marchesano, M. L. Amenta, M. Moros, A. Tino, C. Tortiglione
Hyperthermia is a non-invasive technique allowing the controlled increase of temperature into biological tissues1. Multiple factors and parameters (treatment timing, repetition, heat intensity) can conditionate therapeutic effects. Recently, plasmonic materials such as gold nanoparticles (AuNPs) have been proposed as nano-hotspot to selectively generate heat in a spatiotemporal fashion, which is known as photothermal therapy2-3-4. Main applications of heat-based treatment are for therapies based on cell ablation, i.e. anticancer treatment. Based on recent studies using regenerative model organisms we propose a new application of mild hyperthermia mediated by AuNPs to enhance wound healing and tissue regeneration.

Quantum studies on structured light
A. Marino, M. Parisi, S. Mosca
Photons of structured light can have quantized orbital angular momentum. In the last years, the beams carrying orbital angular momentum (OAM) have largely attracted the attention of scientific community. Today the generation, manipulation and detection of light carrying OAM is an active research area with application in different field of science and technology. We will present the research activity arising from the INO and ISASI collaboration at the URT of the UNINA Physics Department. We will show some preliminary results on OAM

beams generation in isotropic media, highlighting them in the context of the future collaboration among the two groups.

Advanced dielectric nanostructures: from fundamental studies to tailored applications
F. Sgrignuoli, C. Schiattarella, B. Guilcapi Alulema, S. Romano, V. Mocella, G. Zito
Bound States in the Continuum (BICs) are non-radiating resonances, mainly engineered in dielectric photonic nanostructures, which are part of the vast scenario of topological phenomena. BIC modes require a careful theoretical design to optimize the resonant mechanism and are incompatible with free-space propagation. This feature prevents scattering losses, virtually increasing its lifetime indefinitely and, as such, also its radiative Q-factor. Herein, fundamental phenomena like BIC-mediated spin-to-orbital angular momentum conversion and topological edge states are discussed. At the same time, the large BIC near-field localization and giant light-matter interaction are successfully applied for upconversion luminescence emission enhancement and high-sensitivity sensing mechanisms.

S7: INFORMATION SCIENCES & ARTIFICIAL INTELLIGENCE
Antonio Calabrese - Chair

Use and Abuse of "Artificial Intelligence"
M. De Gregorio, A. Sorgente
In Artificial Neural Network computing the learned knowledge about a problem domain is "implicitly" used by ANN-based system to carry on Machine Learning, Pattern Recognition and Reasoning in several domains. By adopting a Weightless Neural Network model of computation called WiSARD, we show how the knowledge of a problem, internally stored in a data representation called "Mental" Image (MI), can be made "explicit" both to perform additional and useful tasks in the same domain, and to better tune and adapt WNN behavior in order to improve its performance in the target domain.

AI for Cultural Heritage and more
A. Sorgente, G. Coda, M. De Gregorio, V. Di Maio, F. Mele, P. Vanacore
In this talk, some AI applications for the Cultural Heritage domain within the IDEHA project (Innovation for Data Processing in Heritage Areas) will be briefly presented.
In particular, a tourist tour generator that takes into account the user profile, a system for video surveillance of indoor and outdoor cultural areas, and a system of cultural content suggestions during navigation of virtual environments will be shown.
Furthermore, again using AI techniques, a system to support the classification and organization of grocery products is presented.

PREdiction, PREvention, PREdisposition
Andrea De Salve, ISASI Lecce Unit
The presentation investigates the study, the experimentation, and validation at an industrial level of new methods and tools based on innovative ICT technologies of pattern recognition and machine learning for the prediction and prevention of clinical pathologies. The main purpose of the research activity is the design of a decision support system enabling risk profiles identification of neurodegenerative and metabolic diseases and the preparation of structured therapeutic pathways, also paying attention to economic and financial aspects. The main scenarios on which the new methods have been developed and validated are those of Obesity and Mild Cognitive Impairment.

Bioinformatics in rare genetic diseases and cancer genomics
Margherita Mutarelli
An overview of the projects involving the ISASI Computational Biology and Bioinformatics activity will be presented, with a particular interest on the applications of the Sequential Analysis of MacroMolecules accessibility (SAMMY-seq), a novel epigenomic next generation sequencing technique tailored to identify the state of open and closed chromatin regions in different cellular conditions. A critical step is the set-up of an analysis pipeline using state- of-the-art standards to ensure portability and reproducibility but also the development of different approaches in the analysis of the produced sequences as proposed in a recently approved for financing project on Emery Dreifuss Muscular Dystrophy.