Red Temática de Excelencia TEC2015-69787-REDT

2nd Workshop on Photonic Integrated Circuits for Telecom & Bio / Life Sciences

Thursday October 26th

9:00	**9:30**	**Registration**
9:30	**9:45**	**Welcome by the local host** Centre Tecnologic de Telecomunicacions de Catalunya
9:45	**10:00**	**Photonic Integrated Circuits for Telecom & Bio/Life Sciences Network of Excellence** P. Muñoz Photonics Research Labs - Universitat Politècnica de Valencia **Abstract:** This thematic network of excellence addresses photonic integrated circuit design and is motivated by: a) photonic integrated circuit design is a widely transversal competence that is creating an enormous amount of research and business opportunities b) Spain has strong worldwide leading research groups on photonic integrated circuits and its applications and c) in a highly competitive R&D and market, joining efforts is a must. The general goal of this network of excellence is to integrate the research efforts in Spain on photonic integrated circuits design for telecom and bio applications. In this talk, the network goals, activities and achievements will be presented. **Pascual Muñoz** leads research on Photonic Integrated Circuits (PICs). Dr. Muñoz received the VPI Speed Up Photonics Award in 2002 for innovative AWG with multimode interference (MMI) couplers modeling, by Virtual Photonics and IEEE Communications Magazine, and the IEEE/LEOS Graduate Student Fellowship Program in 2002. He received the extraordinary doctorate prize from UPV in 2006. From his research line, he co-founded the UPV spin-off company VLC Photonics in 2011, where the PIC design know-how, expertise and tools have been transferred, and he served as CEO from 2011 to 2013. Dr. Muñoz is a Senior Member of the IEEE and OSA.

10:00	**11:00**	**Session 1: Microwave photonics and sensors**
10:00	10:30	*Optical fiber sensor needs photonic integrated components* S. Sales Photonics Research Labs - Universitat Politècnica de Valencia **Abstract:** Optical fiber sensors have intrinsic advantages such as configurability, miniature size, light weight, immunity to electromagnetic and radiofrequency interference and the possibility to operate in toxic, corrosive or potentially explosive environments. However, there are many fields where the optical fiber sensors are not applied yet. The main problem is the not the sensors but the interrogation instrument. Integrated photonics components can widen the range of applicability of optical fiber sensors. **Salvador Sales** has been working in the area of photonics and optical communications for 25 years, since 1996. He is a researcher of the Photonics Research Labs and his main research lines have been: Microwave Photonics, Photonic Components, Slow Light Devices, Fibre Sensors and Optical networks. He has over 275 international refereed publications, of these over 150 in SCI-JCR Journal publications (Nature Group, IEEE, OSA, IEE, APS), and over 125 International Conference publications (ECOC, OFC, OFS, EWOFS, CLEO, etc.), 3 Chapters in international research books, 9 Patents. He has taken part in 52 research projects of which in 19 I have been the principal researcher (PR) including 6 funded by the European Union, 2 by the European Space Agency, 4 by the Spanish government, 3 by the Valencian regional government and 4 by private companies. Overall, prof. Sales has been responsible for the rising of an overall turnover of 2.5 million € in photonic instrumentation and infrastructure for ITEAM-UPV Laboratories in Optical Communications
10:30	11:00	*Extreme Photonic-based signal generation* G. Carpintero Grupo de Optoelectrónica y Tecnología Láser - Universidad Carlos III de Madrid

		Abstract: Photonic-based signal generation has comfortably developed into the microwave range (3 GHz to 30 GHz) when generating these frequencies were a challenge to the electronic generation techniques, raising the field of Microwave Photonics. The challenge has been moved to extreme high frequencies, the Terahertz range. In this presentation we will discuss the extreme challenge that represents today the generation of extreme values of frequency in the low (1 GHz) and the upper end (beyond 1THz). **Guillermo Carpintero Muñoz** leads the research on Photonic Integrated Circuits (PICs) at the Universidad Carlos III de Madrid. He has spent a sabbatical leave as Visiting Professor at University College London, with Prof. Alwyn Seeds in 2011, and has been Research Fellow at Osaka University, Japan with Prof. Tadao Nagatsuma in 2014. His research has been awarded the "Heather Williamson Young Investigator Award" in 2000 from the International Society for Optics and Photonics (SPIE), in 2009 received the UC3M Social Council Excellence Award and the 2011 Best European R&D Project in Cooperation Award from MadrI+D Foundation.

11:00	**11:30**	**Coffee break**

11:30	**13:00**	**Session 2: Bio and medical optics**
11:30	12:00	*Probing tissue with diffuse light towards non-invasive clinical monitors* T. Durduran Institut de Ciències Fotòniques **Abstract:** This talk will describe the fundamentals of photon propagation in live tissue, introduce its clinical relevance, describe the technological basis for building clinical instruments and provide examples from clinics. **Turgut Durduran** is an ICREA professor at ICFO-The Institute of Photonic Sciences (Barcelona, Spain). He leads the Medical Optics group which aims to develop and translate new diffuse optical technologies for clinical and pre-clinical use. He participates in and co-ordinates several national, European and worldwide projects.
12:00	12:30	*Reliable optical point-of-care (PoC) devices for label-free biosensing* M. Holgado Universidad Politécnica de Madrid **Abstract:** Most of the biosensing systems are based on chemical development or amplification (labeled technologies). This is the case of ELISA tests or lateral flow devices. However, still a limited number of label-free Point of Care (PoC) devices are marked available, although continuous developments and efforts are reported. In this paper we attempt to discuss how can be improved the LoD of optical label-free biosensing systems considering both: the transducers and the readers to offer a better performance in optical label-free PoCs. Transducers are decisive for having high sensitivity, and optical PoCs are fundamental for reading out the signal with low uncertainty. **Miguel Holgado** received the Bachelor's and Master's degree in Electrical Engineering from Technical University of Madrid (UPM) (1996), and Doctoral degree (Ph.D.) at the Institute of Material Science (ICMM) belonging to the Spanish National Research Council CSIC (2000). He is Deputy Vice-Rector for Innovation, group leader of the Optics, Photonics and Biophotonics at the Center for Biomedical Technology CTB-UPM, and associate professor at the Applied Physics and Material Engineering Department of Industrial Engineering School (ETSII-UPM). Prior to that, he has worked as R&D engineer at Laser Section of TPyCEA at the Spanish Ministry of Defense and responsible for RAMAN spectroscopy service Lab at ICMM-CSIC. He also has been process engineer at Lucent Technologies Microelectronics during 4 years, Spanish representative in the 5th and 6th European R&D Framework Programme at the Center for Industrial Technology (CDTI), Sub-director of RTD projects at Nanophotonics Technology Center at Technical University of Valencia and Head of European Communities Unit at CSIC. Dr. Holgado has led and participated in 12 European and in 12 National research projects as well as other R&D initiatives. He is the author/co- author of more than 50 scientific publications, which have been cited more than 1300 times, and more than 80 communications to congresses. He is also the inventor of 6 patents applications. In addition, Dr. Holgado is also founder of Bio Optical Detection; a spin-off company (BIOD S.L.) from the UPM, which develops optical Point-of Care devices.
12:30	13:00	*Full integration of photonic sensor chips for marine environmental applications*

		A. Fernández Gavela Universidad de Oviedo **Abstract:** This talk is an overview of the full integration of asymmetric Mach-Zenhder (aMZI) and BiModal Waveguides (BiMW) optical biosensors in a buoy for real-time and continuous analysis of water pollutants in the ocean. The integration involves the optical incoupling, the optical detection and the microfluidic system, which allow a multiplexed measurements. This work has been developed in a collaboration between NanoBiosensors and Bionalytical Applications (nanob2a) group from the Institut Catalá de Nanociència i Nanotecnologia (ICN2) in Barcelona and LioniX Company (Netherlands) in the framework of BRAAVOO European project **Adrián Fernández Gavela** received the Physics degree in the University of Oviedo (Spain) in 2008. He got the PhD in 2014 working in the Photonic Integrated Laboratory in the University of Oviedo focusing on the design and fabrication of polymer optical waveguides, and in the integration of microfluidics system in sensors. From 2014 to 2016 he was working in the Institut Catalá de Nanociència i Nanotecnologia (ICN2) in the group NanoBiosensors and Bionalytical Applications (nanob2a) in Barcelona (Spain), focusing in the optimization and integration of photonics chip sensors for bioanalytical applications. He became Associate Professor in the University of Oviedo in 2016 and he continues in the same lines of research.

13:00	**14:30**	**Lunch break**

14:30	**16:15**	**Session 3: Optical Networking**
14:30	15:15	*Control, Management and Orchestration of Optical Networks: An Introduction, Challenges and Current Trends* R. Casellas Centre Tecnologic de Telecomunicacions de Catalunya (CTTC/CERCA) **Abstract:** This talk is an introduction to control and management; focusing on main drivers, key benefits and functional/protocol architectures. It covers multi-domain and multi-layer networks and includes complex use cases and current trends such as joint IT/network orchestration and slicing. **Ramon Casellas** (IEEE Senior Member) is with CTTC, Spain, since 2006 where he holds a Senior Researcher position. Before, he worked as an associate professor at the networks and computer science department at the ENST France, having obtained his Ph.D. in 2002. Since joining CTTC, he has been involved in multiple European, national and industry grant research projects, on topics related to traffic engineering, network optimization and network control and management, with emphasis on optical and multi-layer transport networks. His research interests include the GMPLS/PCE architectures and protocols, Software Defined Networks (SDN) and Network Function Virtualization (NFV). He has coauthored over 150 papers, 4 book chapters and 4 IETF RFCs.
15:15	15:45	*Key Technologies for 5G Metro Ready Networks* J. P. Fernández-Palacios Giménez Telefonica GCTO **Abstract:** Telefonica vision on main technologies for 5G transport networks covering Cloud RAN, Flex Ethernet, Sliceable Transponders and SDN. The talk is an architecture overview with special focus on technologies enabling dynamic badwidth allocation and cost optimization in fronthaul and midhaul segments. **Juan Pedro Fernández-Palacios Giménez** received the MS in Telecommunications Engineering from Polytechnic University of Valencia in 2000. In Sept. of 2000 he joined Telefonica I+D where his research activities where focused on the design of new data and control plane architectures for IP over optical networks. He is author of more than 50 publications and 6 patents on optical networks and was coordinator of two European research projects on optical transport networks named MAINS and IDEALIST. In 2013 he joined the Telefonica Global CTO office leading the Transport Group in charge of coordinating procurement and deployment projects in Telefonica Group. In 2016, he was also acting as Head of Transport in Telefonica-O2 Germany. Since June 2017 he is leading the Integrated Transport Centre in Telefonica in charge of defining the strategic network planning for IP, DWDM, MW and satellite networks in Argentina, Chile, Peru, Colombia and Brazil.

15:45	16:15	*100 G alternatives for 5G Xhaul* L Potì Consorzio Nazionale Interuniversitario per le Telecomunicazioni **Abstract:** Following the capacity growth in the radio access, the capacity of optical backhaul has to grow accordingly, to avoid capacity bottlenecks starting from the first aggregation stages of the fiber transport network. Moreover, to guarantee the maximum cost efficiency, the future transport infrastructure for 5G shall provide both backhaul and fronthaul services, imposing strict latency requirements (a few microseconds) and limiting the choice of the Forward Error Correction (FEC) algorithms that may be used to extend the link reach. Here we review some possible alternatives suitable for 100G transmission over short distances, including modulation techniques and integrated devices. **Luca Potì** is Head of Research Area with the Interuniversity National Consortium for Telecommunications (CNIT) at the Photonic Networks and Technologies Lab and external collaborator for Scuola Superiore Sant'Anna, at the Institute of Communication, Information, and Perception Technologies (TeCIP) both located in Pisa, Italy. He has published 1 book, 6 book chapters, and more than 400 international journal papers, conference papers, and patents. He served as a coordinator and/ or scientist within more than 45 Industrial and Institutional International Projects. His research interests were mainly focused on ultra-fast communication systems, in fact, in 2001 his group demonstrated first Italian transmission system working at 160 Gbit/s. For such purpose strong expertise has been developed in ultra-short optical pulse generation for telecommunication. In 2011 his group demonstrated together with Ericsson the first coherent system working at 448 Gbit/s on an installed commercial apparatus in field trial hosting real traffic. The same in 2012 system has been upgraded to 1Tbit/s super-channel in a flexible optical network. In 2012 he was invested with the career award PWI for the outstanding research results in the previous 10 years. Recently he is interested in optical coherent systems, wavelength switched optical networks, and optical systems for biomedical application and tribology.

16:15	**16:45**	**Coffee break**

16:45	**18:15**	**Session 4: Telecom Devices and Systems I**
16:45	17:15	*Photonic integrated WDM Cross-connects for Optical Metro Node and Data Center Network Architectures* Nicola Calabretta IPI – Institute of Photonic Integration, Eindhoven University of Technology **Abstract:** We present a photonic WDM cross-connect switches for interconnecting network elements as well as computing and storage resources which can find application in a disaggregated optical metro node architecture and data center network architectures. The lossless photonic WDM cross-connect node based on semiconductor optical amplifiers (SOA) allows to switch multiple format data signals in wavelength, space, and time for full flexibility and statistical multiplexing, scalability of the interconnected network elements as well as capacity. **Dr Nicola Calabretta** received the M.Sc. degree in telecommunications engineering from Politecnico di Torino, Turin, Italy, in 1999. In 2004 he received the Ph.D. degree from the Eindhoven University of Technology, Eindhoven, The Netherlands. From 2004 to 2007 he was with Scuola Superiore Sant'Anna University, Pisa, Italy where he was involved in the EU project IST-NOBEL I and IST-NOBEL II. In 2007 he visited the Technical University of Denmark, Denmark. He is currently with Institute of Photonics Integration as Assistant professor, the Eindhoven University of Technology. He has partecipated to several EU projects, and currently involved in METRO-HAUL projects focusing on the development of a high-performance photonic switches for metro-access node. He co-authored over 300 journal papers and conference proceedings and holds 3 international and 2 provisional patents. His fields of interest are optical interconnects, high performance optical networks for telecom and mmW distribution, and photonic integrated optical switching circuits. He is a member of the TPC of Optical Fiber Communication (OFC) conference, Photonics in Switching, IEEE CSNDSP, IEEE ICC, IEEE COMNETSAT, IEEE IBP, and NOC. He was involved in several EU projects: COSIGN, LIGHTNESS, EURO-FOS, and other nation projects: MEMPHIS, TOSCA, KOREA-ITALY Bilateral project.
17:15	17:45	J. A. Lázaro Universitat Politècnica de Catalunya
17:45	18:15	*Software defined optical transmission and programmable modular transceivers: benefits,*

		design and key enabling technologies M. Svaluto Moreolo / J. M. Fabrega Centre Tecnologic de Telecomunicacions de Catalunya **Abstract:** Software defined optical transmission (SDOT) and programmable modular transceivers, exploiting multiple dimensions and photonic technologies, enable to support future networks with advanced and novel functionalities, meeting the capacity and reach targets, according to the segment requirements. Programmability and modularity together with advanced monitoring techniques are crucial for integration in software defined optical networks, facilitating a migration towards more flexible and scalable paradigms, where the infrastructure can be suitably sized and adapted on-demand. Photonic technologies and photonic integration allow further meeting ultimate performance in terms of cost, power consumption and footprint. This talk focus on SDOT enabling technologies, design guidelines and related trade-offs in terms of complexity and cost. Furthermore, programmability and modularity as well as advanced monitoring techniques are discussed. **Michela Svaluto Moreolo** received the M.Sc. degree in Electronics Engineering and the Ph.D. degree in Telecommunications Engineering from University Roma Tre, Rome, Italy, in 2003 and 2007, respectively. In 2004, she was a visiting researcher at the Institute of Semiconductor and Solid State Physics, Johannes Kepler University, Linz, Austria. Until December 2008, she was with the Applied Electronics Department of University Roma Tre. Since 2009, she is with CTTC/CERCA, Spain, where she currently is a Senior Researcher and the coordinator of the Optical Transmission and Subsystems research line in the Optical Networks and Systems Department. Since September 2016, she is also a member of the Management Team of the CTTC, with the role of Project Management Coordinator. Her research interest areas include optical/digital signal processing and advanced transmission technologies for future optical networks. Dr. Svaluto Moreolo is an IEEE Senior Member. **Josep M. Fabrega** received his BSc and MSc degrees in telecommunications engineering, and PhD degree in signal theory and communications from UPC-BarcelonaTech, Barcelona, Spain, in 2002, 2006 and 2010, respectively. Currently he is a senior researcher in the Optical Networks and Systems Department of CTTC, Castelldefels, Spain. Prior to that, he was with the scientific staff of the UPC-BarcelonaTech Optical Communications Group from 2004 to 2010. He has been actively involved in several National and EU- funded (FP6, FP7 and H2020) R&D projects. He is the author of more than 30 papers and co-author of another over 40 papers, including 2 patents. His research interests include broadband optical communications emphasizing on advanced modulation formats and optical signal delivery over novel network architectures. Dr. Fabrega received the EuroFOS best student research award for his PhD thesis in 2010.

18:15		**Visit to CTTC labs**

20:00		**Social event / dinner**

Friday October 27th

9:00	11:00	**Session 5: Telecom Devices and Systems II**
9:00	9:30	*Semiconductor Optical Amplifiers and III/V Photonic Integrated Circuits* L. Spiekman Aeon Corporation **Abstract:** The SOA has been making a comeback after initially being made obsolete by the arrival of the EDFA. The unpretentious little amplifying chip has regained important standing in datacenter interconnect applications, and in addition is the active element around which most III/V Photonic Integrated Circuits are built. I will talk about the use of SOAs in commercial applications, and will review recent research results featuring discrete and integrated SOAs. **Leo Spiekman** is the CTO of Aeon Corporation, a company located on the East Coast of the US that develops and manufactures discrete SOAs and SOA-based PICs. This technology has been his career-long focus at places such as Bell Labs, Philips, Genoa, and Alphion, going as far back as his PhD in III/V Integrated Optics at Delft University of Technology. He has written the chapter on SOAs in the Optical Society's Handbook of Optics, and has served the community at large as a program committee member of ECOC and a chair of OFC.
9:30	10:00	*PICs for signal processing and coherent reception of optical signals* I. Garcés Universidad de Zaragoza **Abstract:** In this talk we will present the last work on PICs from the Photonics Technology Group of the University of Zaragoza. It will be mainly addressed the challenges we had to face in the design and characterization of a Photonic Integrated Circuit used for optical signal processing of high bit rate data and fabricated within the framework of the PEGASO Spanish project, and our latest work in 2x3 coherent optical receivers done in collaboration with the University of Malaga. **Ignacio Garcés** obtained his PhD in Physics in 1996 studying silica-on-silicon ARROW integrated optical waveguides and their application to optical sensors. He became Associate Professor in 2000 and Full Professor of Optical Communications in 2010. He has been involved in several public and privately funded projects related to silica-on-silicon integrated optics, optical sensors, plastic optical fiber communications and, lately, telecom applications using high resolution spectroscopy and new Passive Optical Networks.
10:00	10:30	*Subwavelength Engineered Photonic Integrated Circuits* I. Molina-Fernández Universidad de Malaga **Abstract:** Silicon photonics is one of the rare cases in which basic research has been transferred to industry in less than 15 years. By locally engineering the refractive index of silicon by forming a pattern of holes at the subwavelength scale, it is possible to manipulate the flow of light in silicon photonic waveguides. Subwavelength waveguiding devices have already demonstrated the ability to significantly improve the performance of passive devices in a wide variety of aspects including loss/efficiency, colorless performance and polarization management, between others. We will review the basics of subwavelength waveguiding devices and present some of latest achievements. **I. Molina-Fernández** received the Ingeniero de Telecomunicación degree from the Universidad Politécnica de Madrid, Madrid, Spain, in 1989 and the Ph.D. degree from the Universidad de Málaga, Málaga, Spain, in 1993. Since 1989, he has been with the ETSI Telecomunicación, Universidad de Málaga, as an Associate and then Full Professor, where he is the leader of the Photonics&RF group. His research interest is in the area of optical and microwave communications were he has led several projects regarding design of optical integrated devices and prototyping of microwave/millimeter wave systems. He is co-author of more than 100 international publications in microwave and photonic topics. He has been participating in more than 25 research and development national and international projects.
10:30	11:00	*Materials and Devices for Integrated Optoelectronics, Biosensing and Human Centric Lighting* B. Garrido*, O. Blázquez, J. López-Vidrier, A. Huguet, R. Pruna, M. López, J.L. Frieiro and S. Hernández Universitat de Barcelona

		Abstract: The activities of the Group of Electro-Photonics (GEF) of the University of Barcelona span several areas of expertise in the Optoelectronics arena. In this talk, we will first address materials and basic devices for Optoelectronics, which we believe are the basis and the core for solving many new challenges. Silicon nanocrystals (Si-nc) in the form of super-lattices can be used for fabricating tandem solar cells with improved efficiency over silicon ones. At the same time, Si-nc embedded in dielectrics are routinely used as low-power light emitters with good possibilities for integration with silicon technology. More exotic combinations like for instance i) Multilayered nanostructures with Al and rare earths sandwiched between SiO2 walls and ii) Quaternary compounds with variable composition such as SiAlON, have shown amazing properties aiming at light emission in the visible, and demonstrated behavior as memory resistors (memristors). In the field of biosensing, we have recently shown that we can take advantage of nanostructured ITO electrodes for general purpose amperometric biosensors. Finally, we will address our latest projects in Human Centric Lighting for which we combine several LEDs into a light source with dynamical spectral properties. **Dr. Blas Garrido**, Full Professor at the University of Barcelona, leads the Optoelectronics research group at the Department of Electronics of the University of Barcelona since 1997. His main research focus is on nanostructured materials and devices for photovoltaics, light emitting devices and integrated optoelectronics/photonics. He is also interested on quantum transport in dielectric materials and superlattices for nanoelectronics. He has recently started some research work on chip on board (CoB) devices and systems for human centric solid state lighting (SSL). Prof. Blas Garrido has participated as group and workpackage leader in 6 european projects of 6th and 7th framework program, and in 8 National Projects, all of them related with optoelectronic and photovoltaic materials and devices. He is teaching in the Photonics, Nanoscience and Renewable Energy Masters of the University of Barcelona (and other partners). Prof. Garrido has published more than 250 papers and participated in more than 300 contributions to international conferences, including 43 invited.

11:00	**11:30**	**Coffee break**

11:30	**13:00**	**Session 6: Fabrication**
11:30	12:00	A. Melloni Politecnico di Milano
12:00	12:30	*Photonic Integrated devices for energy applications fabricated at ISOM* J. Martínez Rodrigo ISOM – Universidad Politécnica de Madrid **Abstract:** This talk is an overview of the different photonic devices fabricated at the clean room of Institute of Optoelectronic Systems and Microtechnology (ISOM). The family of the devices goes from photodetectors to solar cells and also from LEDs to sensors. For the improvement of these devices different proccessing of the fabrication will be described and also the use of new nanomaterials with novel properties will be consider. **Javier Martinez** is a Ph. D in Physics and also an Electronic Engineer from University of Valladolid. His Postdoctoral research activity was carried out at the Lawrence Berkeley National Lab (USA). During six years, he was working at the Intitute of Microelectronics of Madrid from CSIC for the development of new nanolithography techniques that allow to create sensors for molecular recognition at the nanoscale. Since 2011, he is a researcher at the Institute of Optoelectronic Systems and Microtechnology (ISOM) from the Technical University of Madrid. His research interest is focus in the development of nanoelectronic and optoelectronic devices fabricated with graphene with different industrial applications.
12:30	13:00	*Silicon photonics fabrication at València Nanophotonics Technology Center* A. Griol Nanophotonics Technology Center – Universitat Politècnica de València **Abstract:** The València Nanophotonics Technology Center (NTC) is a research center within the Universitat Politècnica de Valéncia that develops nanophotonic devices and systems using the most advanced micro/nanofabrication processes. The Nanophotonics Technology Center has a complete production line for the micro/nanofabrication , class 10 to 1000 clean-room, on silicon with CMOS compatible technology that allows the processing of both photonic and electronic devices. Different fabrication processes as well as developments are shown in this talk including typical nanofabrication procedures as e-beam and UV lithography, dry and wet etching or metal evaporation/sputtering and lift-

		off. **Amadeu Griol** works as a senior researcher at NTC. He received telecommunication engineer and PhD degrees in the Universitat Politècnica de València in 1998 and 2003 respectively. He has been working more than seven years in electron-beam lithography and characterization of optical devices for communication and sensing applications. He has worked in several national and European projects in tasks as biosensing devices, planar photonic crystals and periodic structures, silicon photonics and all-optical signal processing.He has over 150 papers in international journals and conferences and participates as author in several technical books and encyclopaedias.