Supervisor Project Idea

Supervisor

Insert a brief CV and/or external link, the total number of publications, the ORCID link, 5 of the most significant/recent publications, and a list of funded projects and awards. max 300 words

Luca Pierantoni is Full Professor of Electromagnetic Fields. He received the Laurea Degree (1988) in Electronic Engineering, and the PhD Degree (1993) in Electromagnetics, from the University of Ancona, Italy. 1996-1999: Senior Research Scientist at the Technical University of Munich, Germany. Publications: 230 (Scopus), https://orcid.org/0000-0002-2536-7613.

Awards and membership. Founder and first chair of the MTT-S RF Nanotechnology technical committee. IEEE MTT-S Distinguished Microwave Lecturer (DML, 2012-2014) and IEEE MTT-S DML Emeritus (DML-E, 2015-2016). IEEE Nanotechnology Council (NTC) Distinguished Lecturer (2015-2016). Vice-President of the IEEE Nanotechnology Council (2023-2024). Member of the International Microwave Symposium Technical Program Committee. Senior Editor of the IEEE Trans. on Nanotechnology (TNANO). Member, Italian Institute of Nuclear Physics (INFN). Vice-Chair, MTT-S Quantum Technologies Working Group. Chair, IEEE MTT-S Intersociety Distinguished Lecture program. Certificate "In Recognition for service as Technical Committee Chair, IEEE MTT-S (2015). Prize Plaque in Recognition of Distinguished Service as Distinguished Microwave Lecturer, IEEE MTT-S (2015). First Prize, IEEE IMS Student Design Competition (2015, 2016, 2017).

Projects. Europen Projects: GreEnergy H2020-LC-SC3-2020-RES-RIA; NANO-EH, H2020 FET PROACTIVE (2020-2022); NANOPOLY, H2020 FETOPEN (2019-2021); NANOSMART, H2020 ICT (2019-2021); NTX, H2020 FETOPEN (2017-2018); PHENOMEN, H2020 FETOPEN (2016-2019); NANO RF, FP7 ICT (2012-2016); MILESAGE, GRAPHENE FLAGSHIP (2014-2016). PI of the Project TW-CNT, Québec-Italie Project (2011-2012).

Publications. L. Pierantoni, et al., A New 3-D Transmission Line Matrix Scheme for the Combined Schrödinger–Maxwell Problem in the Electronic/Electromagnetic Characterization of Nanodevices, https://doi.org/10.1109/TMTT.2008.916883. **L. Pierantoni**, et al., Boundary Immittance Operators for the Combined Schrödinger- Maxwell Problem of Carrier Dynamics in Nanodevices, https://doi.org/10.1109/TMTT.2009.2017351. **L. Pierantoni** et al., Broadband Microwave Attenuator Based on Few Layer Graphene Flakes, IEEE MTT-T 10.1109/TMTT.2015.2441062.

D. Mencarelli, **L. Pierantoni,** et al., A Multichannel Model for the Self-Consistent Analysis of Coherent Transport in Graphene Nanoribbon, https://doi.org/10.1021/nn2011333.

E. Laudadio, P. Stipa, **L. Pierantoni,** D. Mencarelli, Phase Properties of Different HfO2 Polymorphs: A DFT-Based Study, https://doi.org/10.1109/SMICND.2015.7355209.

Research Group Description

Provide the name the reference department and a brief description of the research group, including external links, and available instrumentations and infrastructures. max 300 words

Department DII.

L. Pierantoni https://www.univpm.it/luca.pierantoni,

D. Mencarelli https://www.univpm.it/davide.mencarelli

L. Zappelli https://www.univpm.it/leonardo.zappelli

P. Russo https://www.univpm.it/paola.russo

Microwave Laboratory: two vector network analyzers (VNA) Agilent, model E5071C. **Photonics Laboratory:** active anti-vibration tables, laser sources, detectors, fiber optic/photonics components, optical spectrum analyser working in the THz range.

Microscopy Laboratory: AFM Microscope, Scanning Capacitance Microscopy and Kelvin Probe Microscopy, STM and broadband Scanning Microwave Microscope (SMM). CAD Lab for IC Design.

Modeling and Simulation Laboratory: 16-core central processing unit (CPU) of type Intel I9 10900K workstations for atomistic simulations.

Department SIMAU.
E. Laudadio https://www.univpm.it/emiliano.laudadio
P. Stipa https://www.univpm.it/pierluigi.stipa
E. Mohebbi, e.mohebbi@staff.univpm.it
E. Pavoni, e.pavoni@staff.univpm.it
Chemistry Laboratory: Perkin Elmer Spectrum GX1 Fourier Transform Infra-Red (IR) spectrometer, Bruker EMX/Xenon Electron Paramagnetic Resonance (EPR) spectrometer.
Atomistic Simulation Laboratory. Ab-initio techniques based on ab-initio, Density Functional Theory (DFT).

Title and goals

Provide the title of the topic and a short summary of the project idea. max 200 words

Development of novel Materials-based Devices and Systems for Ultra-Fast electronics Electronics.

The first target of the present project will include the study of **nanomaterials** to identify the best configurations for reconfigurable antennas encompassing oxide-based RF-switches, which can change their characteristics on ns and ps time scales.
These switches preferably design in a coplanar structure that will show ultra-low insertion losses (<0.2 dB), high isolation (>25dB), and switching times in the range of 100 ps up to 100 ns. Hence, devices based on phase change materials are expected to be characterized by a wide bandwidth from 1 GHz up to 100 GHz.
The main **goal** is to integrate such kind of devices in an ultrafast reconfigurable phased antenna array
Regarding the ferroelectrics (FE)-based ultra-high frequency devices, it is expected the realization of low TRL prototypes of miniaturized phase shifters, filters, antennas, and antenna array. Another outcome is represented by the fabrication of rectennas, and RF harvesters based on metal-insulator-metal (MIM) tunnelling diodes.
The project is based on a combined computational-experimental approach able to provide all the required information to fabricate prominent devices saving costs, times, and promoting a major sustainability reducing

Contact details (*including email address of the supervisor*)

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