UNIVERSITÀ
POLITECNICA
DELLE MARCHE

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

Prof. Luca Pierantoni

Department of Information Engineering (DII) - www.dii.univpm.it/

Supervisor: Prof. Luca Pierantoni
Research Group Description

Prof. Luca Pierantoni; Full Professor of Electromagnetic Fields
ORCID: https://orcid.org/0000-0002-2536-7613

- Founder of the IEEE MTT-S RF Nanotechnology tech. committee
- IEEE MTT-S Distinguished Microwave Lecturer/ and Emeritus
- IEEE Nanotechnology Council (NTC) Distinguished Lecturer
- IEEE Nanotechnology Council (NTC) Vice-President
- Member of the Italian Institute of Nuclear Physics (INFN)

Research Group

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

DII

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

SIMAU

Supervisor: Prof. Luca Pierantoni
Research Group Description

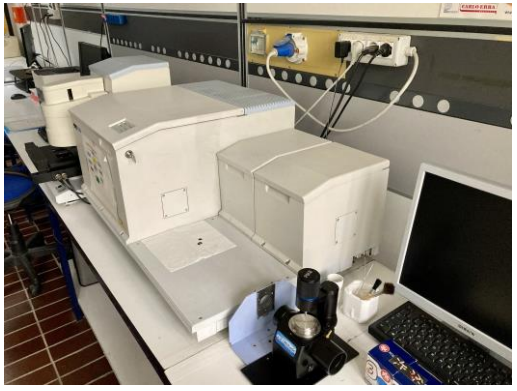
- **Microwave Laboratory:** two vector network analyzers (VNA) Agilent, model E5071C. **Photonics Laboratory:** active anti-vibration tables, laser sources, detectors, fiber optic components, optical spectrum analyser working in the THz range
- **Microscopy Laboratory:** AFM Microscope, Scanning Capacitance Microscopy and Kelvin Probe Microscopy, STM and broadband Scanning Microwave Microscope (SMM). CAD Lab for IC Design **Chemistry Laboratory:** Perkin Elmer Spectrum GX1 Fourier Transform Infra-Red (IR) spectrometer, Bruker EMX/Xenon Electron Paramagnetic Resonance (EPR) spectrometer. atomistic simulation techniques based on ab-initio, Density Functional
- **Modeling and Simulation Laboratory:** 16-core central processing unit (CPU) of type Intel I9 10900K workstations for atomistic simulations

European Grants

- **PLASNANO, HORIZON-RIA (2023-2026)**
- **HIMMODA, EDA, n. 20.RTI.OP. (2021-2023)**
- **GREENERGY, H2020-LC-SC3-2020-RES-RIA (2022-2025)**
- **NANO EH, H2020 FET PROACTIVE (2021-2024)**
- **NANOPOLY, H2020 FETOPEN (2019-2023)**
- **NANOSMART, H2020 ICT (2019-2023)**
- **NTX H2020 FETOPEN (2017-2018)**
- **PHENOMEN, H2020 FETOPEN (2016-2019)**
- **NANO RF, FP7 ICT (2012-2016)**
- **TW-CNT, QUÉBEC-ITALIE Project (2011-2012)**

Supervisor: Prof. Luca Pierantoni

Research Group Description SIMAU Lab



Perkin Elmer FT-IR spectrometer

Bruker EPR spectrometer

Chemistry Laboratory

Modeling and Simulation Laboratory

Supervisor: Prof. Luca Pierantoni

Research Group Description: DII Lab

Antenna laboratory

Scanning Probe Microscopy

Microwave laboratory

Optics laboratory

UNIVERSITÀ POLITECNICA DELLE MARCHE

The Department of Information Engineering

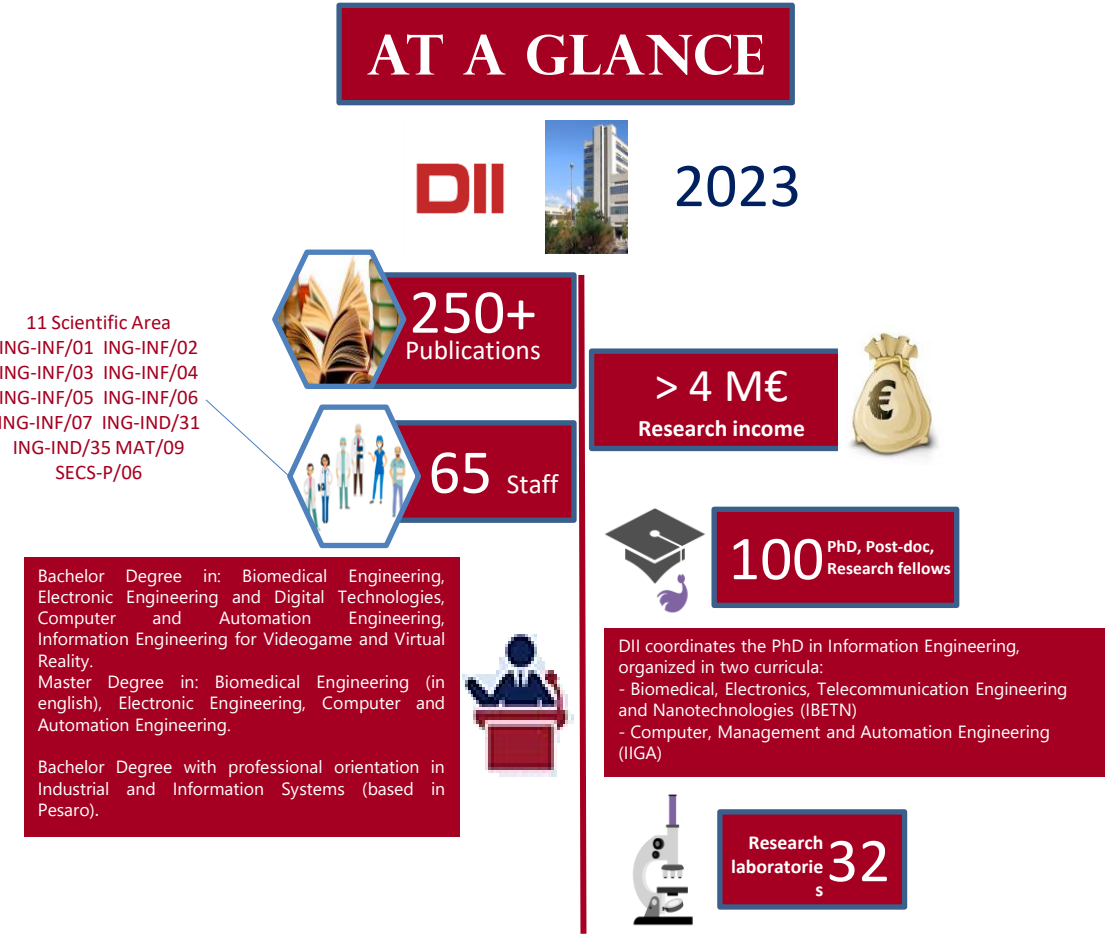
Director: Prof. Franco Chiaraluce

The Department of Information Engineering (DII) was established in 2011 following the merge of the previous DIBET (Department of Biomedical, Electronics and Telecommunication engineering) and DIIGA (Department of Computer, Management and Automation engineering).

The Department is a self-managing organizational branch of the university which is dedicated to scientific research, teaching, and contributing to the so called Third Mission of the Higher Education Institution through the dissemination of scientific research findings amongst the community.

Its main aims are to plan, organize and regularly assess the quality of the research activities carried out in the scientific sectors and disciplines under its jurisdiction; to plan, organize and manage bachelor and master courses in Information Engineering and, last but not least, to provide cultural and educational activities and contribute to training and guidance issues according to the students needs.

https://www.dii.univpm.it



UNIVERSITÀ POLITECNICA DELLE MARCHE

Department of Science and Engineering of Matter, Environment and Urban Planning (SIMAU)

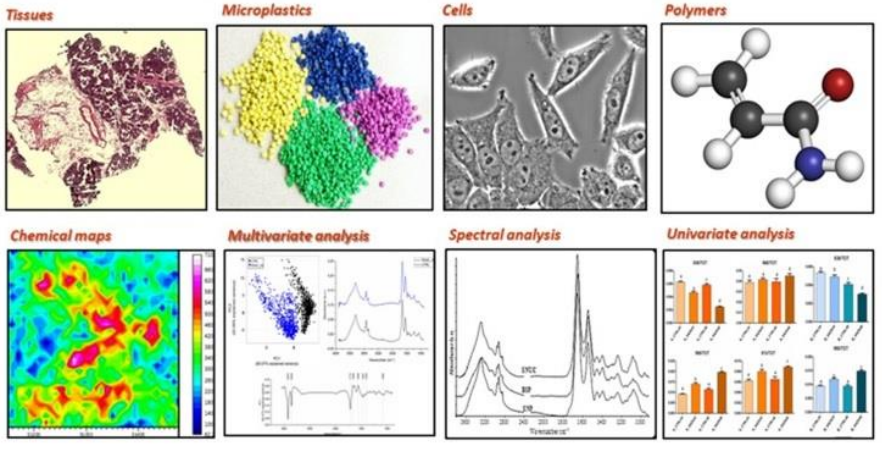
Director: Prof. Pierluigi Stipa

(http://simau.univpm.it/)

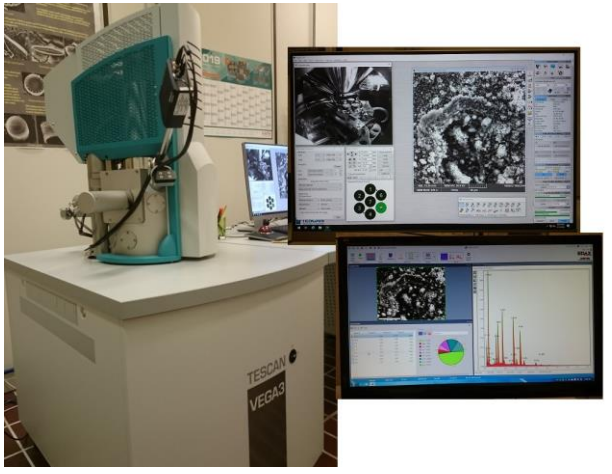
Structure in which the **confluence of different expertises** yield high-level teaching and high-profile international research in the field of **Science of Matter** and **Earth Sciences** with a special focus toward the **Environment**.

It operates within the **Engineering Faculty** offering teachers specialised in the so-called «hard sciences» (**Chemistry** and **Physics**) as well as theachers involved in more «applicative» fields, such as **Materials Engineering**, **Geotechnics**, **Geology**, **Environmental Engineering** and **Urban Planning**.

- **TECHNICAL ARCHITECTURE**
- **APPLIED GEOLOGY AND HYDROGEOLOGY**
- **ENVIRONMENTAL CHEMICAL ENGINEERING**
- **GEOTECHNICAL ENGINEERING**



Research Area



- **CHEMISTRY (ORGANIC)**
- **MATERIALS SCIENCE AND TECHNOLOGY**
- **EXPERIMENTAL PHYSICS**

Supervisor: Prof. Luca Pierantoni

Project Idea:Development of novel Materials-based Devices and Systems for Ultra-Fast 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 final aim 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 the amount of waste