

UC3M R&D IN THE technology and knowledge map in the area of semiconductors and microelectronics

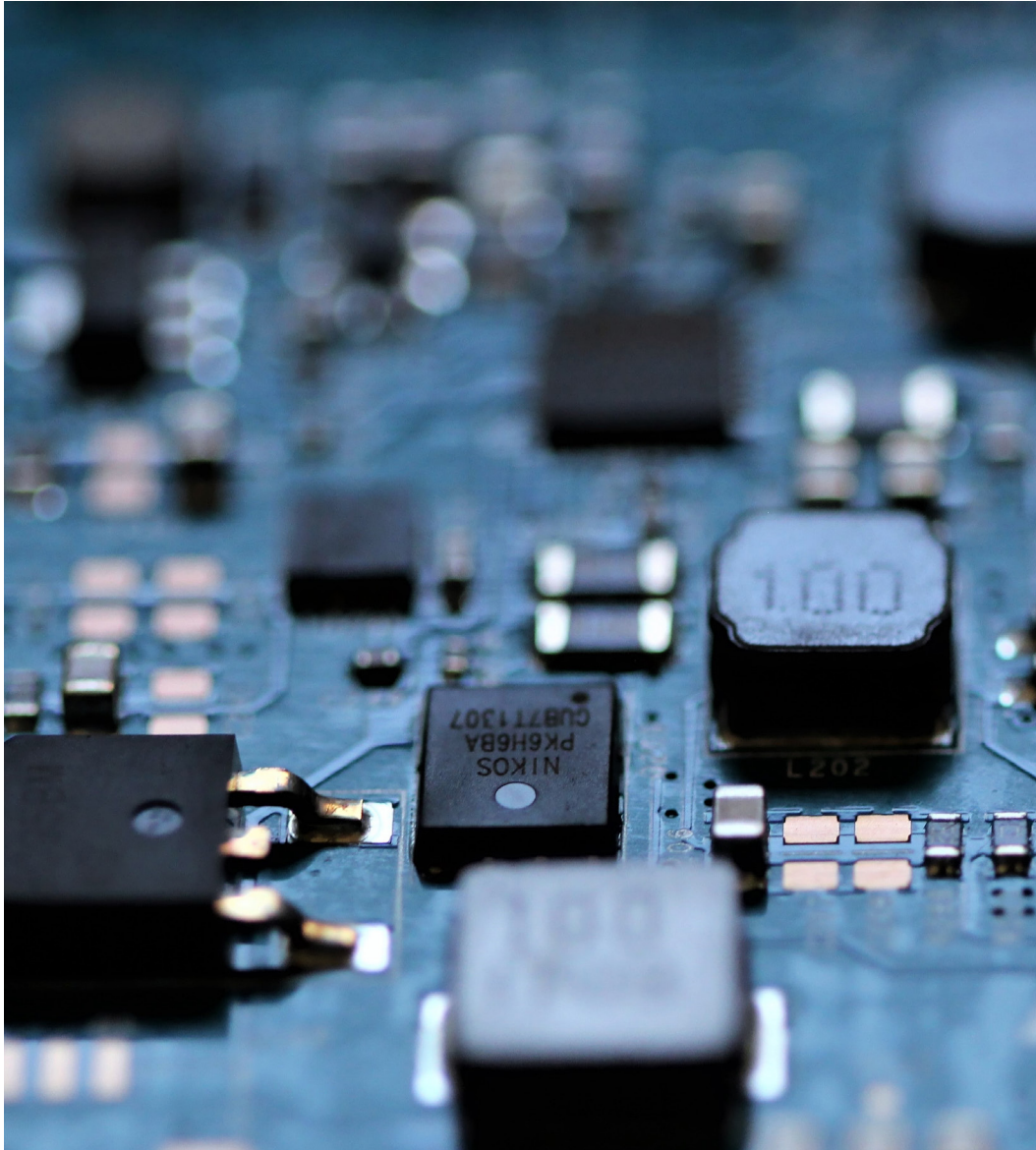
IDENTIFICATION OF THE RESEARCH ACTIVITY,
TECHNOLOGIES, PATENTS, INFRASTRUCTURES,
AND OTHER UC3M CAPABILITIES IN THE AREA
OF SEMICONDUCTORS AND MICROELECTRONICS

uc3m

Universidad **Carlos III** de Madrid

Vicerrectorado de Política Científica

Servicio de Apoyo al Emprendimiento y la Innovación



The Entrepreneurship and Innovation Support Service of Universidad Carlos III of Madrid (UC3M) presents UC3M potential in this "technology map" through the lines of research conducted within the framework of the National and international R&D projects, patents, and other results attained by UC3M researchers in the area of semiconductors and microelectronics.

The overall knowledge achieved, experience in collaborating with the industry, the existence of internally owned infrastructures and laboratories, and above all else, the multidisciplinary nature of UC3M are unique characteristics which provide an added value for the provision of a comprehensive support to innovation in institutions, large companies, and small- and medium-sized enterprises.

We would like you to learn more about the know-how at UC3M and to collaborate in new R&D&I projects.

**Entrepreneurship and Innovation Support Service,
Universidad Carlos III de Madrid**

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R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Microelectronic Design and Applications (DMA)</u></p> <hr/> <p>PIs: Luis Entrena Arrontes, Luis Hernández Corporales</p>	<ul style="list-style-type: none"> • Design with FPGAs and applications. Hardware acceleration • Design for low consumption • CAD tools for electronic design (EDA) • Design of A/D and D/A converters for audio and communications applications. Continuous-time Sigma-Delta architectures and VCO-ADC • Design of integrated circuits in CMOS technology for MEMS sensor interface • Design of high-speed A/D converters for RF • Fault tolerant circuits. Validation of fault tolerance by means of simulation and emulation • Reconfigurable computing • Smart cards and applications • Biometric and cryptographic identification systems 	<p>European Projects</p> <ul style="list-style-type: none"> • TEVI: Time Encoded Voice Interfaces • RADNEXT - RADiation facility Network for the EXploration of effects for indusTry and research <p>National Projects</p> <ul style="list-style-type: none"> • Temporal coding-based edge computing • Analog signal acquisition and processing with maximally-digital circuits • Time data acquisition interfaces for sensors, medical imaging, and communications • Design and verification of heterogenous computing systems-on-chip for space and terrestrial applications under radiation <p>Regional Projects (Community of Madrid)</p> <ul style="list-style-type: none"> • Design of fault tolerant SoCs (Systems-on-Chip) for space applications <p>Private funding</p> <ul style="list-style-type: none"> • System and circuit architectures for wide-band time-based analog-to-digital converters • Sigma Delta ADC topologies optimized for Microphones in the presence of Ultrasonic signals • Design and characterization of main building blocks for Medical instrumentation ADCs • Online detection and diagnosis for radiation-induced errors in COTS microprocessors 	<p>The DMA is a group which specializes in providing comprehensive services for the customized design of integrated circuits and integration of electronic control solutions (built-in systems) in mechanical and other types of systems.</p> <p>The group also provides services relating to the design of digital electronic circuits, including both application-specific integrated circuits (ASIC) and implemented circuits by means of programable hardware (FPGA, CPLD).</p> <p>Technological offer</p> <ul style="list-style-type: none"> • Conception, design, and development of data converters • Integrated test circuit or ASIC complete design flow • Design of mixed signal integrated circuits in CMOS technologies. Experience in 130 nm, 55 nm, 0.35u BiCMOS, 40 nm, and 16 nm FinFET technologies. • Experience in designing integrated circuits for pressure and microphone MEMS sensors. • Experience in designing A/D converters for VDSL and RF communications systems • Design and development of specific circuits for low power consumption and/or high scalability in different CMOS technologies • Electronic communications and sensing data acquisition systems, with IP generation at the system level and the microelectronic level • Hardware acceleration for biometry and cryptography • TRNGs and "lightweight" cryptographic modules for RFID

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Microelectronic Design and Applications (DMA)</u></p> <hr/> <p>PIs: Luis Entrena Arrontes, Luis Hernández Corporales</p>			<p>Patents</p> <ul style="list-style-type: none"> • Device and method for the univocal identification of an integrated circuit (<i>Dispositivo y procedimiento para la identificación unívoca de un circuito integrado</i>) (ES2684846B1)

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Optoelectronics and Laser Technology Group (GOTL)</u></p> <hr/> <p>PIs: Guillermo Carpintero del Barrio, Horacio Lamela Rivera</p>	<ul style="list-style-type: none"> • Integrated microwave photonics through design, implementation, and characterization of photonic integrated circuits (PICs) for the generation of signals with frequencies ranging from microwave up to the Terahertz range • Broadband wireless communications using photonic-enabled transmitters and electronic Schottky receivers • Design, modelling, and characterization of photonic integrated semiconductor lasers for both with continuous-wave (CW) emission and with mode lock • Photonic driven mm-wave and Terahertz phase array antennas for beam steering in 5G applications • Design and development of diode laser systems for high-power nanosecond pulse generation using high-power diode lasers (HPDL) and high-current short pulse drivers • Optoacoustic imaging systems for biomedical applications based on high-power diode lasers for ultrasound generation and optical fiber sensors for ultrasound detection • Ultra-broadband ultrasound generation for biomedical imaging using high-power diode lasers • Interferometric instrumentation systems with high-sensitivity optical fibers for the measurement of ultrasounds, vibrations, and temperatures 	<p>European Projects</p> <ul style="list-style-type: none"> • TERAOPTICS: Terahertz Photonics for Communications, Space, Security, Radio-Astronomy, and Material Science • Integrated microwave photonic technology for wide-frequency tuning signal generation • TERAmesure: Non-contact millimeter and Terahertz frequency measurement paradigm for instrumentation and sensing applications unlocking metrology-grade results • TRIPOD: Training and Research Involving Polymer Optical Devices (RTD) <p>National Projects</p> <ul style="list-style-type: none"> • Photonic integrated circuits for advanced radiometers in the millimeter range for new generation instruments in earth observation • Integrated photonics for microwave: From photonic integrated circuits to systems through new coupling diagrams for applications in wireless communications • Photonic signal generation for integrated transmitter and receiver wireless communications modules in the Terahertz range <p>Regional Projects (Community of Madrid)</p> <ul style="list-style-type: none"> • MARTINLARA-CM. Millimeter wave Array at Room Temperature for INstruments in Leo Altitude Radio Astronomy 	<p>The GOTL group has extensive experience in semiconductor laser-based systems and photonic instrumentation for applications ranging from wireless communications links to novel biomedical imaging applications.</p> <p>GOTL's research in broadband wireless links has pioneered the use of photonic integrated circuits (PICs) for the generation of carrier frequencies in the millimeter and Terahertz ranges.</p> <p>The field of application of the group lies in the development of broadband wireless communications links for the latest mobile networks. The group also works on the use of microwave photonics techniques to enable network analyzers to reach frequencies in the Terahertz range. The group's research contributes to the development of the field of integrated microwave photonics (iMWP).</p> <p>Technological offer</p> <p>Development of telemetry and 2D/3D vision systems for robotics, development, characterization, and modelling of laterally coupled lasers, development of optical sensors and optoelectronic instrumentation, optical communications, laser interferometry, and high-speed communications systems.</p> <p>Equipment</p> <ul style="list-style-type: none"> • Chip mounting <ul style="list-style-type: none"> · TPT-HB10 Wire bonder · TRESKY T-3000 PRO Die bonder and component placer

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ELECTRONIC TECHNOLOGY			
<p><u>Optoelectronics and Laser Technology Group (GOTL)</u></p> <p>PIs: Guillermo Carpintero del Barrio, Horacio Lamela Rivera</p>		<ul style="list-style-type: none"> Development of agile and compact wireless communications links for the aerospace environment through the integration of photonics and microwave techniques <p>Private funding</p> <ul style="list-style-type: none"> Photonic rf tuneable demultiplexer for broadband satellites (THORMUX) 	<ul style="list-style-type: none"> Chip characterization <ul style="list-style-type: none"> Wentworth Probe station, Custom chip characterization setup Equipment <ul style="list-style-type: none"> ANRITSU MS974.0A Optical Spectrum Analyzer (OSA) – from 957 to 2157 nm R&S FSW50 Electrical Spectrum Analyzer (ESA) – from 0 to 50 GHz, with external harmonic mixers FS-Z75, 75 – 110 GHz KEYSIGHT E8527D PSD Analog signal generator – from 250 kHz to 50 GHz. Optical linewidth measurement PULSECHECK 150 Optical pulses measurement ANRITSU MS4647B Vector Network Analyzer (VNA) – from 0 to 70 GHz ANRITSU MP2100A Bit Error Rate Tester (BERT) Current and voltage sources <p>Patents</p> <ul style="list-style-type: none"> Hybrid structure for ultra-wideband terahertz generation and reception with semiconductor devices (EP22382348) Dielectric radio frequency (RF) bidirectional coupler with power divider/combiner functionality (EP21382573) Ultra-wideband interconnection probes (EP20382960) Controller and control method for a diode battery (<i>Controlador y método de control de una pila de diodos</i>) (ES2710080B2) Compact optical multiplexer and demultiplexer with a high number of channels (<i>Multiplexor y demultiplexor óptico compacto de elevado número de canales</i>) (ES2684177B1)

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p>Sensors and Instrumentation Techniques (SIT)</p> <p>PI: Pablo Acedo Gallardo</p>	<ul style="list-style-type: none"> • Sensors Design, development, and electronics test for electrochemical, optical, and quantum sensors • Novel optical sources and photonic architectures Design and characterization of photonic devices and architectures for the generation, processing, and detection of signals in the optical, millimeter wave, and THz ranges • Spectroscopy (UV/VIS/NIR/MIR/THz) and instrumentation for applications (biomedical, environmental, and industrial) 	<p>European Projects</p> <ul style="list-style-type: none"> • AEROMIC: Development of New digital Microphone-MEMS-Sensors for wind tunnels with open/closed test sections and flight tests • CELTA: Convergence of Electronics and Photonics Technologies • Consumer-driven demands to reframe farming systems <p>National Projects</p> <ul style="list-style-type: none"> • Dual optical frequency comb linear and non-linear spectroscopy for biomedical, environmental, and industrial applications • Development, validation, and evaluation of a novel non-invasive flap monitoring system in reconstructive surgery • Development, validation, and evaluation of a novel non-invasive tool for measuring sustained hyperglycemia using millimeter wave spectroscopy • Real-time water quality parameter evaluation using novel photonic architectures and components <p>Private funding</p> <ul style="list-style-type: none"> • Research of a new NV center-based quantum sensing platform. Preliminary study of the experimental scheme • Optical Backbone Future Aircraft 2021H1 • ESCAPHIB: Tail structures and systems for a hybrid propulsion passenger aircraft 	<p>The SIT group has extensive experience in instrumentation and optical sensors</p> <ul style="list-style-type: none"> • Spectroscopy (UV/VIS/NIR/MIR/THz) and applications (biomedical, environmental, and industrial) • Novel optical sources and photonic architectures <p>Technological offer</p> <ul style="list-style-type: none"> • Development of instrumentation systems. Development of the complete system • Laser emitters, detectors, and illumination optics for optical sensors • Pre-amplification and conditioning • System integration in FPGAs • SVM-based classification algorithms. Neural networks, PCA, ICA, etc. • Electrochemical sensors for biomedical applications • Use of fluorescence techniques and multimode optical sources <p>Patentes</p> <ul style="list-style-type: none"> • Hyperspectral imaging based on dual frequency comb (<i>Imagen hiperspectral basada en peine doble de frecuencias</i>) (ES2800823) • Device for monitoring the perfusion state of skin flaps (<i>Dispositivo de monitorización del estado de perfusión de colgajos de piel</i>) (P202130486) • Road condition sensor and method for detecting the state condition of the roadway (EP3742155B1)

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Displays and Photonic Applications Group (GDAF)</u></p> <p>PI: José Manuel Sánchez Pena, Carmen Vázquez García</p>	<ul style="list-style-type: none"> • Advanced Instrumentation and Sensors • Analog-radio-over-fiber (ARoF) Communications with 5G-NR signals • Light powering over optical fiber (PoF) • Optical access network monitoring and integration with fronthaul for mobile communications • Device modelling with nanoparticles and optical forces • Sensors and communications with plastic optical fiber • LiFi communications 	<p>European Projects</p> <ul style="list-style-type: none"> • BlueSpace: Building on the Use of Spatial Multiplexing 5G Networks Infrastructures and Showcasing Advanced technologies and Networking Capabilities <p>National Projects</p> <ul style="list-style-type: none"> • Nano-assembled materials for light sensing and manipulation (I): Adaptive phase devices and metasurfaces • Thin-film, sub-wavelength structures for photonic circuits • New technologies for the sustainable development of 6G in extreme environments - Subproject 1 - 6G-Xtreme I: PoF - New technologies for the sustainable development of 6G in extreme environments with optical fibers and "Power over Fiber" technology • Advanced, optical fiber-based smart technologies • Sustainable optical fiber-based sensing and communications technologies in the sector of transport and biomedicine <p>Regional Projects (Community of Madrid)</p> <ul style="list-style-type: none"> • SINFOTON2-CM. Sensors and instrumentation in photonic technologies 2 • Photovoltaic telepowering by optical fiber for measurement and control in extreme environments 	<p>GDAF is a group which focuses on research in photonic and electronic devices and systems for communications and industrial applications with relevant contributions in the characterization of different display technologies and the manufacture of directing circuits for high-end displays. The group develops an intense activity in the field of low-cost optical sensors for industrial applications and rehabilitation technology. The group is also developing sensor networks using developed devices.</p> <p>In the communications sector, devices based on optical fiber technology with amplification and integrated optics are developed for use in transparent optical networks. Radio over fiber systems integrating 5G-NR signal transmission in FR1 and FR2 bands, light powering with different multimode, single-mode, and multicore fibers, and secure monitoring of delivered power, are developed. Said systems use advanced semiconductor components in CMOS, as well as InGaAsP/InP and GaAs semiconductor-based devices such as lasers, photodetectors, photovoltaic converters, among others.</p> <p>Conditioning and control electronics based on electronic designs are included in the different developments.</p> <p>The group has prior experience in the design and characterization of integrated optics circuits in III-V and silicon photonics, the latter in technologies compatible with CMOS integration.</p>

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ELECTRONIC TECHNOLOGY			
<p><u>Displays and Photonic Applications Group (GDAF)</u></p> <hr/> <p>PI: José Manuel Sánchez Pena, Carmen Vázquez García</p>			<p>Technological offer</p> <ul style="list-style-type: none"> • System for monitoring WDM-PON optical access networks and self-referencing techniques • Remote powering with fiber using light to power low-consumption sensor networks and antennas integrated in fronthaul radio over fiber in mobile networks • Development of instrumentation systems which allow monitoring multiple points by means of the development of optical fiber-based quasi-distributed systems • Software applications and hardware designs for a deep space optical communications link <p>Equipment/software</p> <ul style="list-style-type: none"> • Specialty Fiber Fusion Splicer FSM100P+, Fujikura • 2 W, 5 W, 40 W high-power lasers. Tunable DFB 1460-1560 nm • Lightwave Component Analyzer (20 GHz@1550 nm) • Vector Signal Generator up to 20GHz • RF spectrum analyzer (31.5GHz). RF signal generator up to 20 GHz • BER Tester 12.5Gbs. OSA 650-1700 nm • RSoft Fullwave. BeamPROP. FemSIM. Optimizer. COMSOL. VPI. Altium

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ELECTRONIC TECHNOLOGY			
<p><u>Displays and Photonic Applications Group (GDAF)</u></p> <hr/> <p>PI: José Manuel Sánchez Pena, Carmen Vázquez García</p>			<p>Patents</p> <ul style="list-style-type: none"> • Method and system for monitoring optical fiber networks (<i>Método y sistema para la monitorización de redes de fibra óptica</i>) (PCT/ES2015/070914, WO2016110604A1) • Two color fiber optic pyrometer (<i>Pirómetro de fibra óptica a dos colores</i>) (PCT/ES2016/070269) • System and method for monitoring power and temperature in optical fiber networks (<i>Sistema y método de monitorización de potencia y temperatura en redes de fibra óptica</i>) (ES2760798-B2) • High spatial resolution pyrometer (<i>Pirómetro con alta resolución espacial</i>) (P202130347)

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p><u>Electronic Power Systems Group (GSEP)</u></p> <p>PIs: Andrés Barrado Bautista, Emilio Olías Ruiz</p>	<ul style="list-style-type: none"> • Electronic power conversion systems. • Hybrid renewable power systems. • Magnetic component design and optimization. • Electromagnetic compatibility. 	<p>European Projects</p> <ul style="list-style-type: none"> • ESSIAL: Electrical Steel Structuring, Insulating and Assembling by means of the Laser technologies <p>National Projects</p> <ul style="list-style-type: none"> • Power distribution system for hydrogen-powered drones • Integrated smart power electronics for power control and management in IIoT • Modelling and control strategies for stabilizing the interCONNECTION of electronic POver converters • ELECTRA: Electric Aircraft Platform • Powering systems for on-board and portable applications based on emerging energy storage devices and sources • Modular converters applying advanced control strategies implemented in digital platforms • Energy storage and management system for hybrid electric cars based on fuel cell, battery, and supercapacitors <p>Regional Projects (Community of Madrid)</p> <ul style="list-style-type: none"> • Development of new solid-state lithium batteries and electronic system for charging and managing the energy of said batteries to be applied in biomedical devices and unmanned aircrafts 	<p>The GSEP group provides comprehensive services which encompass consultation, analysis, design customization, and optimization in the field of electronic power systems, magnetic components, hybrid renewable power systems, and electromagnetic compatibility.</p> <p>Electronic power conversion systems</p> <ul style="list-style-type: none"> • Converter design, modelling, and optimization. • Converter behavioral modeling and stability analysis. • Semiconductor behavioral modeling. • Modelling of fuel cells, batteries, supercapacitors, and protections. • Analog and digital control design. • Regulator calculation. • Stability of converter-based systems. • Total harmonic distortion reduction using modulation techniques. • Hardware in the loop. • CAD tools for designing power electronic equipment and systems. • Laboratory prototype design and prefabrication. • For applications such as: <ul style="list-style-type: none"> · Energy storage · Modular converters · Medical equipment · Telecommunications equipment · Electric vehicles · Photovoltaic and wind power systems · Electric railway systems · Grid-connected systems

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ELECTRONIC TECHNOLOGY			
<p><u>Electronic Power Systems Group (GSEP)</u></p> <p>PIs: Andrés Barrado Bautista, Emilio Olías Ruiz</p>		<ul style="list-style-type: none"> Advanced control unit for electronic power converters based on Zynq and UltraSCALE technologies, applicable to multiconverter systems New bidirectional DC-DC converters with galvanic isolation for high-power applications <p>Private funding</p> <ul style="list-style-type: none"> MAGICBOX Energy Processing Center (<i>Centro Procesador de Energía - CPE</i>) Portable from various sources Hydrogen fuel cell drone propulsion system. Verification of FCC converter behavior in the case of new voltage specifications BCM control for DC-DC converters for energy storage Advising on the design and reliability testing of a fuel cell-based hybrid electric vehicle powering system Development of new technologies for manufacturing solid electrolyte fuel cells (DEIMOS) ECOTRANS: Green technologies for urban transport Characterization of commercial electric energy meters in the presence of harmonics Auxiliary electric propulsion system for general light-sport aircraft Application of identification techniques for the characterization of switched DC-DC converters 	<p>Design of magnetic components</p> <ul style="list-style-type: none"> Design of magnetic components (coils and transformers). Optimization of volume, losses, and temperature of a magnetic component. Analytical and finite element-based models of high frequency magnetic components Contactless powering systems. <p>Hybrid renewable power systems</p> <ul style="list-style-type: none"> Power electronics optimization in photovoltaic and wind power systems. Design of power control, regulation, and conditioning systems for stand-alone and grid-connected systems. Hybrid systems. Electric mobility. Electric aircraft. Railway power systems. Pure and hybrid electric vehicles. Hydrogen-powered electric vehicles. <p>IIoT – Industrial Internet of Things</p> <ul style="list-style-type: none"> Power management and control for terminals, servers and actuators. Very high frequency power converters. Magnetic component design and characterization Electromagnetic compatibility Pre-certification testing of electromagnetic compatibility of equipment. Development of EMI filters. Environmental measurement.

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ELECTRONIC TECHNOLOGY			
<p><u>Electronic Power Systems Group (GSEP)</u></p> <p>PIs: Andrés Barrado Bautista, Emilio Olías Ruiz</p>		<ul style="list-style-type: none"> • Development and innovation in polymer membrane and solid oxide fuel cells • Resonant heating DC-DC converter for portable X-ray equipment • 30kW and 40kV-130kV resonant DC-DC converter for portable X-Ray equipment. High-performance SIC-based AC-DC converter for TV and RADIO transmitters 	<p>Technological offer (Patents)</p> <ul style="list-style-type: none"> • Converter and method for direct current-direct current bidirectional conversion without galvanic isolation (<i>Convertidor y método de conversión bidireccional de corriente continua a corriente continua sin aislamiento galvánico</i>) (Patent ES2706391 B2). • Step-up and step-down DC-DC converter, method for DC-DC conversion, and photovoltaic plant incorporating said converter (<i>Convertidor CC-CC reductor y elevador, método de conversión CC-CC, y planta fotovoltaica que incorpora dicho convertidor</i>) (Patent ES2681127 B2). • Method and device for direct current-alternating current transformation (<i>Método y dispositivo de transformación de corriente continua en corriente alterna</i>) (Patent ES2395460) • Method and system for powering a load made up of a plurality of fundamental loads, particularly LED loads (<i>Método y sistema de alimentación de una carga constituida por una pluralidad de cargas elementales, en particular de LED</i>) (Patent ES2391218) • Active control procedures for the connection of very capacitive loads using SSPCs (<i>Procedimientos de control activo para la conexión de cargas altamente capacitivas mediante SSPCs</i>) (Patent ES2398884) • Single-phase alternating-direct current converter with power factor correction (<i>Convertidor de corriente alterna-continua de una etapa con corrección de factor de potencia</i>) (Patent ES2192992)

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
ELECTRONIC TECHNOLOGY			
<p>University Technological Identification Group (GUTI)</p> <p>PI: Raúl Sánchez Reillo</p>	<ul style="list-style-type: none"> • Monomodal biometric identification (iris, fingerprint, hand geometry, vascular, signature) • Multimodal biometric identification • Smart cards and other identification devices • Identification devices with Match-on-Card / Match-on-Token technology • Security in identification systems • Security assessment and performance of identification systems 	<p>European Projects</p> <ul style="list-style-type: none"> • PYCSEL: "Development of a new fingerprint active thermal sensor using PVDF-based pyroelectric material" • AMBER ("enhAnced Mobile BiomEtRics"). A Marie Skłodowska-Curie Innovative Training Network addressing a range of current issues facing biometric solutions on mobile devices • MobilePass: A secure, modular and distributed mobile border control solution for European land border crossing points • EKSISTENZ: Harmonized framework allowing a sustainable and robust identity for European Citizens • ORIGINS: Recommendations for Reliable Breeder Documents Restoring e-Passport Confidence and Leveraging Extended Border Security • BEST NETWORK: Biometric European Stakeholders NETWORK • BioSec: "Biometrics and Security" • eEpoch: European Smart Card Charter proof of concept and holistic solution <p>Private funding (international)</p> <ul style="list-style-type: none"> • Telebiometric Authentication Technologies using ECG • Performance and Security Evaluation of Fingerprint Sensors and Algorithms • Definition of an Evaluation Framework for Biometric Technologies 	<ul style="list-style-type: none"> • Mobility identification solutions (smart phones, tablets, netbooks, etc.) • Identification devices (particularly smartcards and RFID), since 1994. • Security and cryptographic instruments (both secret and public key), since 1995. • Biometric Identification Systems, since 1996: <ul style="list-style-type: none"> · Biometric modalities: iris, hand geometry, vascular systems, handwritten signature, and fingerprint. · Multibiometrics: multimodality, multisensor, multi-algorithm. Both fusion and complementarity. · Integration of biometrics in smartcards and tokens. · Biometrics protection: process, storage, communications, etc. • Evaluation methodology: in both performance and security. <p>Publications</p> <ul style="list-style-type: none"> • 195 international publications • 2982 international citations • 2 Best International Publication awards • 18 international book chapters • 11 articles in Spanish journals • 2 edited Spanish books • 8 Spanish book chapters • Editors of 17 international standards or technical specification documents

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ELECTRONIC TECHNOLOGY			
<p><u>University Technological Identification Group (GUTI)</u></p> <hr/> <p>PI: Raúl Sánchez Reillo</p>		<ul style="list-style-type: none"> • Advances in the Human Biometric Sensor Interaction Model - Mobile Biometrics and Operator Training • Smartcard. New information system 	<ul style="list-style-type: none"> • Co-editors of 12 international standards or technical specification documents <p>Technological offer</p> <ul style="list-style-type: none"> • Biometric identification technologies • Methodology for evaluating the functionality and security of different identification systems (following the Common Criteria methodology) <p>Patents</p> <ul style="list-style-type: none"> • System of vein location for medical interventions and biometric recognition using mobile devices (EP2238253.4)

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATHEMATICS			
<p><u>Modelling, Numerical Simulation and Industrial Mathematics</u></p> <p>PI: Luis López Bonilla</p>	<ul style="list-style-type: none"> • Computational materials: Defects in solids and multiscale simulations. Graphene. Materials for nuclear fusion. Molecular dynamics, Monte Carlo, density-functional theory • Semiconductors: load transport and spin in nanostructures, non-linear dynamics for nanoelectromechanical systems, non-linear dynamics for topological quantum computing 	<p>European Projects</p> <ul style="list-style-type: none"> • Quantum transport in terahertz detectors • Thermodynamics in the quantum regime <p>National Projects</p> <ul style="list-style-type: none"> • Hybrid models for nanosystems and biosystems, • Collective and stochastic behavior in nanomaterials and biomaterials • Network of excellence in non-equilibrium physics • Network of excellence in non-equilibrium physics and its interdisciplinary applications • Floquet engineering for quantum technologies • Quantum bits of electron spin and gaps in quantum dot lattices: effect of AC fields, dissipation, and topology • Quantum information and energy transport in nanostructures • Coherent charge and spin transport in nanodevices 	<p>The GMSMI is a multidisciplinary group offering comprehensive solutions which comprise formulating a mathematical model, performing the mathematical and numerical study of said model, and elaborating specific software. This group is part of the Unit Associated with the Materials Sciences Institute of Madrid, CSIC "Mathematics Applied to the Theory of Condensed Matter Physics Group" led by L. L. Bonilla (UC3M) and Gloria Platero (ICMM-CSIC).</p> <ul style="list-style-type: none"> • Nanotechnology and computational materials science <ul style="list-style-type: none"> · Modeling and numerical simulation of electronic transport in semiconductor nanostructures subject to intense fields (UC3M, ICMM-CSIC) · Non-linear dynamics for nanoelectromechanical systems (semiconductor nanotubes) (UC3M, ICMM-CSIC) · Non-linear dynamics for topological quantum computing (ICMM-CSIC, UC3M) · Modeling of semiconductor-superconductor hybrid systems for q-bits transmission over long distances (ICMM-CSIC, UC3M) · Modeling and numerical simulation of topological quantum dot lattices for quantum information transmission and computing (ICMM-CSIC) · Modeling and numerical simulation of dislocations, cracks, and other defects in computational materials science (UC3M)

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MATHEMATICS			
<p><u>Modelling, Numerical Simulation and Industrial Mathematics</u></p> <hr/> <p>PI: Luis López Bonilla</p>			<p>Innovative technological solutions</p> <ul style="list-style-type: none"> • Modeling and numerical simulation of quantum and semiclassical kinetic equations describing electron transport in superlattices and other semiconductor nanodevices (UC3M) • Modeling and numerical simulation of partial derivative or difference balance equations for charge transport in nanodevices subject to high electric and magnetic fields (UC3M, ICMM-CSIC) • Atomistic models of dynamics of dislocations, cracks, and other defects in crystalline materials of the cubic system, both for simple metals and semiconductors (UC3M) • Design of ultrafast true random number generators by means of semiconductor superlattices (UC3M) • Platforms for quantum computing based on semiconductor quantum dot lattices (ICMM-CSIC) <p>Some publications</p> <ul style="list-style-type: none"> • Uncovering spatio-temporal patterns in semiconductor superlattices by efficient data processing tools, Physical Review E 104, 035303, 2021 (UC3M). • Designing Hyperchaos and Intermittency in Semiconductor Superlattices, Physical Review Letters 127, 096601, 2021 (UC3M). • Simulation of 1D topological phases in driven quantum dot arrays, Physical Review Letters 123, 126401, 2019 (ICMM-CSIC). <p style="text-align: right;">+</p>

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MATHEMATICS			
<p><u>Modelling, Numerical Simulation and Industrial Mathematics</u></p> <hr/> <p>PI: Luis López Bonilla</p>			<ul style="list-style-type: none"> • Unconventional quantum optics in topological waveguide QED, Science Advances 5(7), aaw0297, 2019 (ICMM-CSIC). • Effects of noise on hysteresis and resonance width in graphene and nanotubes resonators. Physical Review B 87, 235424, 2013 (UC3M, ICMM-CSIC) • Temperature dependent dynamical nuclear polarization bistabilities in double quantum dots in the spin-blockade regime. Physical Review B 88, 035317, 2013 (UC3M, ICMM-CSIC)

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
PHYSICS			
<p><u>Semiconductor Nanostructures</u></p> <p>PI: Rosa M^a de la Cruz Fernández</p>	<ul style="list-style-type: none"> • Semiconductor nanostructures: quantum wells, threads, and dots • Theory (numerical simulation) • Network vibrations (phonons): study of the electron - phonon interaction mechanism • Growth mechanisms: modeling and prediction of physical magnitudes related to the control of growth and characterization in the laboratory • Electronic and spin transport: simulation and theoretical design of optoelectronic devices based on electron and spin transport • Study of the optical properties of III-V semiconductors which are the basis of photovoltaic cells 	<p>National Projects</p> <ul style="list-style-type: none"> • Analysis and development of materials for integration in III-V nanowire-based solar cells <p>Regional Projects (Community of Madrid)</p> <ul style="list-style-type: none"> • Development of R&D activity program for Center of Fusion Technologies (TechnoFusion) 	<ul style="list-style-type: none"> • Energy • Fusion technologies • Analysis and development of materials for integration in solar cells

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PHYSICS			
<p><u>Advanced materials for solar energy applications</u></p> <p>PI: Beatriz Galiana Blanco</p>	<ul style="list-style-type: none"> • Solid state physics • Integration of fluorescent materials in solar cells • Photovoltaic device quantum efficiency measurements • Modeling of optical and electrical properties of nanostructures and thin layers • Sputtering growth of fluorescent and photoactive materials • Synthesis of fluorescent and photoactive nanoparticles • Advanced characterization of III-V semiconductors • Transmission and scanning electron microscopy. • Atomic force microscopy in tapping and conductive mode. • Electrical properties of thin layers • Solar cell design and modelling 	<p>National Projects</p> <ul style="list-style-type: none"> • Analysis and development of materials for integration in III-V nanowire-based solar cells • Development and irradiation of high-entropy alloys, ODS steel- and copper-based nanostructured materials for fusion reactors <p>Regional Projects (Community of Madrid)</p> <ul style="list-style-type: none"> • Development of multidisciplinary R&D activity program for Center of Fusion Technologies (TechnoFusion) <p>Private funding</p> <ul style="list-style-type: none"> • Simulation modernization: slow target visualization (MS-VOL) 	<p>This group which specializes in the field of applied physics includes experts in solar cells, thin layer (MBE, MOVPE; sputtering), advanced material characterization (TEM, AFM, PL, etc.), semiconductor material modelling, and study of rare earth-based luminescent materials.</p> <p>Equipment</p> <ul style="list-style-type: none"> • TEM, sputtering equipment with two magnetrons (co-sputtering), C-AFM, optical measurement laboratory, quantum efficiency equipment, spectrophotometer

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
SIGNAL AND COMMUNICATIONS THEORY			
<p><u>Radiofrequency, Electromagnetics, Microwaves, and Antenna Group (GREMA)</u></p> <hr/> <p>PI: Daniel Segovia Vargas</p>	<ul style="list-style-type: none"> • Antennas and Radiofrequency • Computational electromagnetics • Terahertz 	<p>European Projects</p> <ul style="list-style-type: none"> • Terahertz technology for ultra-broadband and ultra-wideband operation of backhaul and fronthaul links in systems with SDN management of network and radio resources. <p>National Projects</p> <ul style="list-style-type: none"> • Building an ecosystem for research and development in non-terrestrial networks (satellite and HAP) and B5G (3GPP rel. 17 and beyond) - Subproject 1 - 6G-INTEGRATION-1 Integration of NTN in mobile devices and backhauling for B5G • Building an ecosystem for research and development in non-terrestrial networks (satellite and HAP) and B5G (3GPP rel. 17 and beyond) - Subproject 4 - 6G-INTEGRATION-4: B5G onboarding in NTN including HAPs • Radiometers based on photon up-conversion in next-generation submillimeter range for Earth observation • Base station antenna to support new 5G Carrier Aggregation services <p>Regional Projects (Community of Madrid)</p> <ul style="list-style-type: none"> • Microwave Materials Characterization Using Heterogeneous Systems-on-Chip for the Space Environment (MIMACUHSPACE-CM-UC3M) • MARTINLARA-CM. Millimeter wave Array at Room Temperature for INstruments in Leo Altitude Radio Astronomy 	<ul style="list-style-type: none"> • Antennas & RF <ul style="list-style-type: none"> · Measuring facilities · Manufacturing facilities • Laser circuit structuring and milling machine. • High precision microwave circuits prototyping. • SMD (Surface Mounted Device) soldering bench (up to 0201 sizes). • Computational electromagnetics <ul style="list-style-type: none"> · HOFEM: Higher-Order FEM · HPC facilities · Computational resources flexibility with virtualization technologies • Terahertz <ul style="list-style-type: none"> · Increase THz emitted power. · Increase detectors sensibility. · Photonic Integrated Circuits (PICs) for photoconductive antennas · Design and characterization of novel structures and antenna geometries · Submm wave active antennas on SiGe Technology · Ultra-wideband antennas. · Arrays. <p>Applications:</p> <ul style="list-style-type: none"> • Communications • Space

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SIGNAL AND COMMUNICATIONS THEORY			
<p><u>Radiofrequency, Electromagnetics, Microwaves, and Antenna Group (GREMA)</u></p> <hr/> <p>PI: Daniel Segovia Vargas</p>		<p>Private funding</p> <ul style="list-style-type: none"> • INDRA-UC3M Chair in radiofrequency technologies • Miniaturised Antennas for Planetary Mission Probes • DRA-based MIMO antenna array 	

R&D GROUP	LINES OF RESEARCH	RESEARCH PROJECTS	EXPERIENCE AND CAPABILITIES
MATERIAL SCIENCE AND ENGINEERING			
<p>Powder Technology</p> <hr/> <p>PI: Elena Gordo Odériz, José Manuel Torralba Castelló</p>	<ul style="list-style-type: none"> • Particle Synthesis and Powder Production • Coating and Surface Treatment • Kinetic and Thermodynamic Simulation • Additive Manufacturing • MIM and PIM • Materials Characterization • Sintered Materials 	<p>European Projects</p> <ul style="list-style-type: none"> • Powder Metallurgy Approaches for Next-Generation Bipolar Plate Materials (PERMEABLE) <p>National Projects</p> <ul style="list-style-type: none"> • Inorganic composite materials processing using links-based additive manufacturing techniques <p>Regional Projects (Community of Madrid)</p> <ul style="list-style-type: none"> • ADITIMAT-CM. Additive Manufacturing: from material to application • Smart manufacture of advanced materials for transport, power, health • High-entropy alloys for applications in high temperature and extreme conditions <p>Private funding</p> <ul style="list-style-type: none"> • Study for the addition of graphene and ceramic nanoparticles for the preparation of alternative hard metals • Development of novel optimized nanomaterials for improving photocatalytic activity 	<p>The Powder Technology group is a multidisciplinary group with expertise in the development of solutions for the field of powder technology/powder metallurgy. Their facilities house advanced equipment to perform all types of studies and analyses relating to metallic, ceramic, and composite materials.</p> <p>The group has proven experience in offering comprehensive R&D, consultancy, technical assistance, and customized training services aimed at optimizing material manufacturing processes through powder technology/powder metallurgy, studying the behavior of materials in service, and characterizing and designing new materials with improved performance and high added value.</p> <p>Infrastructure</p> <ul style="list-style-type: none"> • Epitaxy Controlled atmosphere ovens/hydro reactors/solvothermal reactors/spin coating equipment • Top-side manufacture Controlled atmosphere ovens/hydro reactors/solvothermal reactors/spin coating equipment <p>Training</p> <ul style="list-style-type: none"> • Epitaxy Technologies applied to nanomaterials • Top-side manufacture Technologies applied to nanomaterials

Co-funding:

Activity of the Project "UC3M Plan for Promoting Innovation and R&D Result Transfer in the Production Sector of the Community of Madrid with Priority in the Southern Metropolitan Area" with Ref.: OI2018/PC-UC3M-5152 and the acronym PC-UC3M. This project was awarded in the 2018 Call for Grants for fostering technological innovation and promoting technology transfer to the production sector comprised within the priorities of the Regional Research and Innovation Strategy for Smart Specialization (RIS3) of the Community of Madrid through technological innovation coordinating entities. It is co-funded by the European Regional Development Fund which provides 25% of the funding and by the Community of Madrid which provides another 25% within the framework of the FEDER 2014-2020 operational program.



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