13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

Please describe the specific strategic objectives of the centre for the future period, and their rationale. Among others, you may refer to objectives related to improve governance and management; foster or create new research areas, lines or programmes, including horizontal ones; increase internal coherence through, for instance, coordination, collaboration and creating synergies across the centre' units; upgrade research outcomes - publications and of other research outputs, etc.
Elaborate on research priorities and action foreseen. Emphasize the relationship between the planned research strategic actions and the centre research capabilities and resources. You should provide a description of the main research action lines and specific targets attached to each strategic goal.
Elaborate on future actions regarding ethics and scientific integrity within the centre.
Describe the approach foreseen in those cases where, for the topic of the research, gender must be introduced as a variable of the subject studied.
Provide a clear description on how the specific actions of the Centre's Strategic Plan will contribute to strengthen the centre's scientific base and the potential impact of its outcomes.
Include also an estimate of the allocation of this proposal budget, and also a prevision of the amount of funding expected in the period from the different sources.
In this section you should also describe the Strategic Plan milestones, as well as the monitoring provisions and their corresponding indicators, and a contingency action plan.
Additionally:
Further information about the Strategic Plan milestones and monitoring indicators are to be included in annex 2.

INMA's Severo Ochoa Strategic Plan (2023-2026) has three Strategic Objectives (SOs) aligned with the three pillars of Horizon Europe: (i) reinforce INMA research excellence, (ii) Reinforce INMA Talent Environment, and (iii) Strengthen the Impact of INMA Research.
By pursuing these core objectives in a coordinated manner, we expect to establish an effective approach to advance research and innovation towards becoming a world-class research centre while fostering a sustainable and impactful research ecosystem that benefits society.

STRATEGIC OBJECTIVE 1: REINFORCE INMA RESEARCH EXCELLENCE
Strategic Objective 1 includes three Research Priorities (RPs) addressing key societal challenges aligned with several United Nations Sustainable Development Goals (SDG). These carefully selected RPs build upon the excellent scientific foundation developed within the institute after almost 40 years of multidisciplinary research and have the potential to advance cutting-edge science and technological developments.

Each Research Priority is structured into beyond-state-of-the-art Research Action Lines (RAL), each one with Specific Targets (ST), which will drive us towards key project Milestones (M), where Risk Analysis and Contingency Plans (CP) are described. SO Guarantors are marked with (*).

The proposed RPs are:
- RP1. Advanced technologies for CO2 capture and reutilisation.
Societal challenge: Ensure access to affordable, reliable, sustainable and modern energy for all (SDG7)
- RP2. Advanced nanomaterials for overcoming drug resistance.
Societal challenge: Improve global health and well-being (SDG3)
- RP3. Quantum technologies.
Societal challenge: Quantum technologies have the potential to facilitate research excellence and innovation

13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

actions and thus accelerate the achievement of numerous SDGs.

RP1: ADVANCED TECHNOLOGIES FOR CO2 CAPTURE AND REUTILISATION

CO2 capture and utilisation will play a fundamental role in our transition to a more sustainable energy generation scenario, contributing to the attainment of the ambitious EU's climate neutrality objectives recently fixed for 2050 (European Green Deal). This involves capturing CO2 and converting it into useful products such as fuels and chemicals, thereby transforming it from a pollutant into an abundant carbon source. However, capturing CO2 from different effluents (i.e. flue gases, air) together with its transformation remains a challenge, as the high stability of CO2 requires high-energy input, impeding carbon neutrality.

We aim to explore and develop innovative, flexible, carbon-neutral CO2 capture and transformation technologies, thereby contributing to the EU's climate neutrality objectives.

Within this goal, RP1 contains two transversal research action lines.

RAL1.1. High-performance molecular separation devices for CO2 capture.

To provide a selective, flexible, and effective pathway for CO2 separation from different effluents and at different concentrations, we propose using high-performance stimuli-responsive nanoporous hybrid membranes that combine the versatility and dynamism of liquid crystals (LCs) with the specific transport properties of CO2-philic metal-organic frameworks (MOFs).

This groundbreaking membrane technology stems from recent collaborative research, currently carried out by the INMA teams, i.e. led by T. Sierra* (responsive LCs), J. Coronas* (MOF particle engineering), O. Roubeau (MOF functionalisation), M.A. Laguna (fabrication of structured microtubular supports), and C. Tellez (membrane separation testing).

However, pore alignment to optimise membrane selectivity/permeability constitutes a challenging issue that must still be addressed. This can be done either by intrinsically controlling the LC-support surface anchoring conditions, e.g. using self-assembled monolayers (SAMs) or by applying extrinsic stimuli, e.g., temperature, magnetic or electric fields.

This part of the work will also involve the expertise and synergy of research teams headed by J. L. Serrano (design of LCs), P. Cea (SAMs), R.I. Merino (electric properties) and A. Camon (magnetic properties).

The specific targets are:

- ST1.1.1. Prepare functionalised nanoporous stimuli-responsive hybrid membranes by i) combing LCs (isolated/integrated into polymeric films) with different porous supporting materials (inorganic/polymeric, hybrids ones) and ii) modifying their physicochemical properties (laser machining).
#Addressing: poor stability and low separation performance.
- ST1.1.2. Control the response and separation performance of the prepared membranes to light, electric fields and pH changes.
#Addressing: influencing the path of light inside the membrane architectures (involving photosensitive chemical groups or nanoscale fillers) or controlling the applied electric field impact (adding conductive metallic NPs or oxides such as cobaltites or graphene oxide).

RAL1.2. CO2 conversion using renewable electricity as energy input

Renewable electricity can provide the energy needed to activate the CO2 molecule, transforming it into valuable and reusable goods. For example, the application of high-voltage electric or electromagnetic fields results, under certain conditions, in the ionisation of the reaction media, i.e. in the formation of a plasma phase, a complex mixture of free electrons and charged species.

13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

RAL1.2 proposes to use radiofrequency, high voltage AC and DC currents (M.E. Galvez*) and cold or warm plasmas, such as microwave plasmas (J. Santamaria*, R. Mallada, A. Monzon), to activate the CO2 molecule in splitting or hydrogenation reactions. This will produce molecules such as CO, H2, CH4, and NH3, as well as alcohols and hydrocarbons. Ultra-short (fs) pulse lasers (L.A. Angurel, G. de la Fuente) will also be used for CO production. All these compounds are considered energy vectors or carriers and can solve the critical drawback of the intrinsic intermittency and unequal distribution of renewable energy resources (storage & transport). However, plasma-catalysis yield, selectivity, and energy efficiencies must be improved to develop synergies between ionised media and the solid material. Similarly, laser irradiation needs the development of materials able to capture energy input and direct catalysis towards the desired products.
The specific targets are:
ST1.2.1. Develop radiofrequency-, plasma- and laser-catalytic systems for CO2 transformation.
#Addressing: i) the use of energy inputs with different energetic states and features, ii) their interaction (individually or synergistically) with the reaction media, iii) the control over their impact on the catalyst.
ST1.2.2. Evaluate the response of the developed materials to these alternative energy inputs; #Addressing: evaluation of their yield, selectivity and efficiency towards scale-up & implementation.

-Milestones
*M1.1 Continuous and oriented LC films (<100 nm thick) on microtubular supports (RAL1.1, month 24)
*M1.2 Ordered composite LC-containing membranes for enhanced and tailorable CO2 separation upon exposure to external stimuli (RAL1.1, month 36)
*M1.3 Beyond state-of-the-art permeance and gas separation selectivity (RAL 1.1, month 48)
*M1.4 Catalytic materials able to interact with diverse stimuli, offering optimal physicochemical properties, as well as adequate dielectric behaviour/laser light adsorption properties (RAL 1.2, month 36)
*M1.5. Stimuli-responsive catalytic processes for CO2 conversion into CO, H2, CH4, NH3, higher hydrocarbon and alcohols at high yields (50-90%) and energy efficiencies (>50%) (RAL 1.2, month 48)

-Risk analysis and Contingency Plans
*R1: Inappropriate CO2 capture or low adsorption/rejection selectivity;
CP1: Redesign chemical groups on the membrane pores by LC building block and MOF-LC interaction.
*R2: Slow or non-selective responsiveness of the pore to external stimuli;
CP2: Revise the structure/composition of the LC network to adjust factors such as viscosity or position of the stimuli-active groups.
*R3: Poor or non-desired synergistic effects on CO2 catalysis by combined use of energy inputs;
CP3: Explore and design new materials based on plasma and laser diagnosis, characterisation and expected reaction mechanism to channel electrons and light. Their re-optimisation could be helped by AI and DFT simulations.
*R4: Low yield and selectivity towards the desired CO2 conversion products;
CP4: Combine the use of plasma and laser with advanced reactor configurations (i.e. fluidised or entrained bed) or alternative intensification approaches (i.e. membrane reactors, microreactor engineering).

RP2. ADVANCED NANOMATERIALS FOR OVERCOMING DRUG RESISTANCE
Many current therapeutic regimens often fail to reach their full potential in real-world clinical practice because drug resistance greatly reduces the probability of controlling malignancies.

13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

Our main aim within the SO proposal is to develop innovative smart-tuneable materials to provide a holistic approach against multifaceted resistance mechanisms to fight cancer or microbial infection. This aim is aligned with Horizon Europe Pillar 2 Global Challenges (Cluster 1 Health: Mission Cancer, One-Health Antimicrobial Resistance).
In our approach, drug resistance will be tackled by combining the development of i) smart nanotherapeutics to evade multiresistance in pancreatic cancer (PaCa) and bacterial infection; and ii) innovative point of care (PoC) sensing tools for monitoring in real-time the treatment efficacy of both malignancies so that the therapeutic regime can be rapidly adjusted to prevent drug resistance.
This ambitious holistic objective will be achieved by a multidisciplinary team involving researchers accustomed to implementing synergistic high-gain/high-impact strategies. INMA offers an ideal environment for the development of this RP by providing access to necessary infrastructures, research support services and an established network of clinical researchers/clinicians in reputed biomedical centres and hospitals.

The Research Action Lines are:

RAL2.1. Advanced materials for pancreatic cancer treatment based on Bioorthogonal Catalysis. PaCa is a challenging malignancy with poor survival rates.
Researchers at INMA are developing a new generation of smart metal- (J. Santamaria*, G. Goya) or enzyme-based- (V. Grazú) nanocatalysts, capable of catalysing reactions within living cells with therapeutical effects, such as the specific conversion of prodrugs or host-metabolites/biomolecules that are key for tumour survival (dynamic/starving therapy). To mitigate side effects caused by off-target therapy activity and drug-transport alteration resistance, these nanocatalysts will incorporate spatiotemporal control properties for in situ activation via remote stimuli (light, magnetic field) or by singular conditions of the tumour extracellular matrix. Synergies among different catalytic approaches will be explored to target PaCa's multi-resistance mechanisms (high fibrosis and immunosuppression).
The Specific Targets we propose are:
-ST2.1.1: Design of multifunctional nanocatalysts to activate multiple anti-PaCa toxic responses by i) combining enzyme and nanoparticle-based catalysis; ii) endowing nanocatalyst with specifically targeted delivery properties (exosome-based, multi-biofunctionalisation-based).
#Addressing: i) off-target therapy side-effects and ii) resistance issues derived from monotherapy and immunosuppression.
-ST2.1.2: Develop combined nanotherapies also targeting PaCa fibrosis in addition to tumoral cells (multifunctional nanocatalysts + magnetic hyperthermia/remote activation of stroma hydrolases).
#Addressing: additional physical and biological resistance mechanisms related to the dense fibrotic extracellular matrix.

RAL2.2. Synergistic nanoformulations for targeting and preventing the spread of multidrug-resistant infectious diseases. INMA will develop bioactive hybrid nanostructured materials with broad-spectrum antimicrobial activity against model fungal & bacterial pathogens classified within the "critical groups" by the WHO. This will be achieved by developing new chemical routes to integrate several mechanisms of action into one nanomaterial, promoting synergistic effects, and by developing a range of antimicrobial coatings to prevent nosocomial and community-associated pathogenic biofilm formation and improve wound healing. This line involves the expertise of M. Arruebo* (drug encapsulation, preclinical infection models), J. Santamaria* (aerosolised drug-based formulations), M. Moros* (nano-bio-actuators, wound healing) and S. Mitchell (self-assembled hybrid

13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

antimicrobial nanoactuators).
This defines the following Specific Targets:
-ST2.2.1: Development of i) hybrid nanoparticles functionalised with biomolecules targeting surface receptors of specific bacteria and ii) naturally occurring gastro-resistant polymer nanocapsules incorporating synthetic antimicrobial peptides and quorum sensing inhibitors.
#Addressing: resistant phenotypes, improving oral administration and targeted delivery.
-ST2.2.2: Design of remotely activated nanostructures embedded within adhesive polymeric materials. #Addressing: preventing biofilm formation and improving wound healing using anti-adherent coatings with spatiotemporal activation.

RAL2.3 Ultrasensitive PoC Nanosensors for monitoring real-time therapy resistance (transversal action with Quantum Technologies RP).
Highly specific and ultrasensitive sensors are needed to combat drug resistance successfully. We will collaborate with Quantum Technologies RP to explore the creation of Point-of-Care (PoC) quantum sensors for directly detecting electron paramagnetic resonance (EPR) active species generated if our therapies are successful. Here, INMA expertise in functionalisation with diverse biomolecules (J. M. de la Fuente*, M. Moros*) will be critical for developing functional nano-EPR probes that amplify the signal and give access to intracellular information. Surface Enhanced Raman Spectroscopy detection will also be explored, involving developing novel materials and signal amplification strategies (P. Pina, J. Santamaria*). To speed up therapy monitoring, a more mature PoC biosensing technology previously developed by INMA will also be used (JM de la Fuente*, V. Grazu). It consists in a lateral flow biosensor called TLFA, which uses gold nanoparticles as thermal transducers (Patents: WO2014016465A1, EP21382818). It has already shown exceptional sensitivity for protein antigens (femtomolar range) and nucleic acids (PCR sensitivity).

The Specific Targets we propose are:
-ST2.3.1 Provide support to the Quantum Technologies line in developing EPR sensors.
#Addressing: i) preparation of biological samples for validation of Radical Oxygen Species (ROS) direct EPR detection; ii) biofunctionalisation of nano-EPR probes for specific intracellular compartments.
-ST2.3.2 Develop sensors for real-time therapeutic efficiency monitoring.
#Addressing: i) a liquid biopsy strategy for detecting extracellular vesicles and their contents for anti-PaCa therapies (RAL2.1); ii) anti-microbial therapies (RAL2.2) based on the detection of specific pathogen proteins or nucleic acid biomarkers. The proposed technologies will be benchmarked against standard healthcare analytics.

-Milestones
*M2.1. Begin: i) pre-clinical biocompatibility tests of selected therapeutical nanoformulations using in vitro/animal models; ii) initial assessments of environmental/ eco-toxicity evaluation (sustainable materials design and life cycle analysis) (RAL2.1 & RAL 2.2, month 36).
*M2.2. Begin clinical validation of real-time monitoring of a selected therapy (anti-tumoral or antimicrobial) using at least one of the proposed biosensing methods (RAL2.3, month 36)
*M2.3. Synergistic therapeutic effects at least twice as effective as the individual therapies for at least one therapy combination (RAL2.1, month 48)
*M2.4. Successfully integrate/encapsulate non-resistance promoting antimicrobial materials into at least two support materials, for wound healing, air/water purification, active packaging, protective clothing, and face

13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

coverings applications (RAL2.2, month 42)
*M2.5. Begin the establishment of Good Laboratory Practice (GLP) methodologies to produce and scale up those selected developed materials (RAL2.1-2.3, month 42).

-Risk analysis and Contingency Plans
*R1: Synergistic effect is not achieved.
CP1: the combination therapy will be modified by adjusting the dosing regimen, changing the nanotherapeutics, or activation mode.
*R2: Antimicrobial nanosystems are ineffective in eradicating biofilm-forming/resistant microorganisms. CP2: re-purposed or repositioned drugs can be incorporated into nanoparticulated systems to increase efficacy, reduce toxicity, prevent resistance, and revert their phenotype.
*R3. Targeted biomarkers selected for real-time monitoring fail to correlate with therapy efficacy.
CP3: alternative potential biomarkers will be tested.
*R4. Logistical issues arise due to reliance on external infrastructures.
CP4: a proposal will be submitted to Open Innovation Test Beds that support the development of therapeutic nanoformulations (e.g., phoenix-oitb.eu).
*R5. Scale-up production problems.
CP5: reoptimisation of methodologies or outsourcing to qualified third-party facilities with established GLP protocols.

RP3. QUANTUM TECHNOLOGIES
This priority comprises two research lines that exploit quantum effects in materials and devices for sensing and information processing. It benefits from INMA's strong expertise and leadership in these fields and its outstanding micro- and nano-fabrication facilities. The results will contribute to solving specific challenges of the EU digital industry strategy, including developing an EU quantum web linking quantum sensors and quantum computing centres.
The Research Action Lines are:

RAL3.1. Quantum Sensors.
This line aims to create sensors based on quantum states to achieve an extreme sensibility and the potential to detect single excitations.
The following Specific Targets are aimed at three different applications:
-ST3.1.1: Nano-magnetic resonance (Transversal target connected with RP2). It exploits (sub-) micron-sized, tuneable superconducting resonators to detect paramagnetic species with sensitivities close to a few tens of spins. It will be combined with recognising characteristic spectra, with the possibility to direct spin labels to specific sites in biomolecules and with spin-trapping methods.
#Addressing: opportunities for material characterisation, (bio-)chemical analysis and even resonance imaging at the micro-and nanoscopic levels. It also provides a promising nano-diagnostic tool to evaluate the success of cancer nanotherapies based on ROS production described under RP2, either in vitro or eventually in-cell conditions.
The work will involve the expertise of F. Luis* (superconducting resonators), M. J. Martinez-Perez* (readout superconducting circuits), I. Garcia-Rubio (Electron Paramagnetic Resonance laboratory), J. Sese (fabrication of superconducting circuits) and A. Gracia (molecular integration).
-ST3.1.2: Magnetic microscope capable of sensing 3D magnetic maps with high spatial (nanometer) and temporal

13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

(nanosecond) resolutions. It involves integrating nano-SQUID sensors into micro- and nano-scanning probes and extending their temporal resolutions down to the nanosecond regime. #Address: with this instrument, we will explore new topological states in magnetic nanostructures and superconducting vortices, which have potential as memories and/or for microwave applications and quantum electronics. This work will involve the expertise of M. J. Martinez-Perez* (nano-SQUIDS and magnons), J. M. de Teresa (fabrication of nanostructures, nanoSQUIDs), D. Serrate (tip probes and STM), P. Cea (fabrication of nanostructures), J. Sese (MEMS & electronics) and D. Zueco (theory).
-ST3.1.3: Transition Edge Sensors are state-of-the-art X-ray detectors due to their single-photon sensitivity, spectral resolution, and negligible dark current. A. Camon has been providing these detectors for space missions, and he will lead a collaborative effort within INMA to extend the applicability to other frequency regimes.
#Addressing: single photon detectors are suitable for quantum optics and quantum communication applications. This goal involves L. Martin-Moreno* (design of nanophotonics devices) and J. Sese (fabrication of superconducting circuits).

RAL3.2. Hybrid quantum processor
Taking the performance of quantum computation to a level that can tackle problems with socioeconomic relevance is still challenging, mainly because of the inherent errors of current intermediate-size processors and of the vast resources that they would need to pile up to correct them. We aim to employ an alternative approach and demonstrate its potential to solve these challenges.
We propose the following Specific Target:
-ST3.2.1: Validating a novel hybrid Quantum Processor Unit (QPU) based on magnetic molecules coupled to superconducting circuits and exploring its potential advantages over other solid-state schemes. A molecule can be designed to encode several qubits or d-dimensional qudits in their multiple nuclear and electronic spin states. Each of them then acts as a microscopic-size quantum processor. Using these systems as building blocks of QPU introduces two competitive advantages: 1) it simplifies its operation, and 2) it gives additional resources, e.g. embedding error correction within each repetitive unit. The coupling to superconducting lines and on-chip resonators provides the architecture to control the quantum spin states and read out the results.
#Address: novel, more resource-efficient implementations of quantum error correction and quantum optimisation algorithms. In the longer term, create a scalable architecture for large-scale quantum computation by linking several of these units. The work involves multidisciplinary teams led by F. Luis* (spin qubits and qudits, quantum implementations), L. Martin-Moreno* (photon-matter interaction), M. J. Martinez-Perez* (superconducting circuits), O. Roubeau (chemical design and synthesis), J. Sese (fabrication of superconducting circuits), J. M. de Teresa (nanofabrication) and D. Zueco (theory and algorithms).

-Milestones
*M1.3.1. Nano-spin resonance chip working at the level of femtoliter samples (RAL3.1 and with impact on RAL2.3; Month 24)
*M1.3.2. Magnetic microscope with a sub-10-nm resolution (RAL3.1; Month 24)
*M1.3.3. Single-photon detector operating in the optical and infrared frequencies (RAL3.1; Month 24)
*M1.3.4. Proof-of-concept of a universal operations set (Month 24) and of a quantum error correction code (Month 36) in a d = 12-16 qudit-based hybrid QPU (RAL3.2)

-Risk analysis and Contingency Plans

13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

*R1: These developments depend critically on applying state-of-the-art micro- and nano-fabrication techniques, which might eventually introduce some bottlenecks.
CP1: Besides the outstanding fabrication facilities available at INMA, the groups involved have fruitful collaborations and access to the Spanish networks of electron microscopy (ELECMI) and of micro- and nano-fabrication (micronanofabs), which help to find alternative solutions (RAL3.1 and RAL3.2).
*R2: Combination of spin coherence and spin-photon couplings does not reach what is needed for implementing gate-based algorithms (in particular, error correction).
CP2: The same physical platform can be used as a quantum simulator or a quantum annealer (RAL3.2).

WHY SHOULD INMA LEAD THIS PROJECT? This ambitious scientific and strategic project, with a significant potential for disruptive applications, is a realistic one given the proven INMA strengths:
- The DIVERSITY and RICHNESS OF ITS RESEARCH LINES TOGETHER WITH REMARKABLE SYNERGIES and a CRITICAL MASS OF RESEARCHERS (> 250), making INMA one of the largest research institutes in Europe in the field of Nanoscience and Material Science. As mentioned before, INMA is a highly multidisciplinary research centre that includes physicists (both theoreticians and experimentalists), chemists, chemical engineers, biochemists and biotechnologists.
- WORLD-CLASS FACILITIES AND DEVELOPED TECHNOLOGIES in synthesis, assembly, characterisation of materials, nanofabrication, biology laboratories with biological security, cytometry, optical microscopy, etc. [see section 12.1].
- REMARKABLE EXPERIENCE IN KNOWLEDGE-TRANSFER, with a significant number of licensed patents and company contracts. Importantly, long-term spin-offs have been created by INMA's researchers.
- INMA PROVEN EXPERTISE TO DEVELOP AND LEAD PROJECTS, as shown by the successful run of European projects.

SCIENTIFIC OBJECTIVE 2 (Reinforce INMA Talent Environment) and SCIENTIFIC OBJECTIVE 3 (Strengthen the Impact of INMA Research), and the actions programmed to achieve them, are described in section 13.2.

Next, we list all actions with funding allocated from the SO project (which we will refer to as funded actions) for Scientific Objective 1. The milestones associated with these actions are presented in Annex II. Actions not directly related to the scientific goals are stated in section 13.2.

FUNDED ACTIONS (A) WITHIN THE SO PROJECT FOR SCIENTIFIC OBJECTIVE 1.
The rationale behind these funded actions is to use the SO funding as a seed with multiplicative potential for further developments.
These seed actions are oriented to: the incorporation of talented groups leaders, the development of proofs of concept and prototypes that can give rise to applications for additional funding, the strengthening of our capacity to raise funds through competitive calls, enhancing our interaction with industry, and the attraction of talented researchers at an early stage of their career.
INMA has all the essential infrastructure in place, and if needed, we will obtain new equipment through devoted calls within the regional and national governments. Thus, we do not include any funded action associated with infrastructure or equipment.
However, we allow the use for this purpose of the budgeted start-up packages and the collaborative projects (in the budget, we have estimated that 80% of funds allocated to collaborative projects will be devoted to personnel and 20% to equipment).

13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

The funded actions concerning scientific goals are:

- A1.1. Initiate two new research lines through the recruitment of group leaders.

The chosen lines are:
(i) Artificial Intelligence (AI). AI can nowadays help find the best material for a given functionality, analyse images, optimise the device geometry, and create "self-thinking" devices that can process data in real time and react accordingly. Some researchers at INMA (L. Martin-Moreno*, D. Zueco) are already working on AI. Still, creating a research group devoted to this topic would greatly benefit all Research Priorities.

(ii) Experimental nanophotonics. While many groups at INMA work with plasmonic nanostructures for catalysis, chemical sensors, biosensors and biomedical applications, they mostly rely on external collaborations when optical characterisations are needed. An experimental nanophotonics group would complement the theoretical group headed by L. Martin-Moreno* and allow us to develop a more complete and integrated process of device design and characterisation, increasing the efficiency and impact of our research on all 3 Research Priorities.

We aim to attract researchers that already hold ERC grants, Ramon y Cajal (RyC) national contracts (a highly-regarded and highly competitive tenure track post-doctoral contract in Spain), or brilliant young researchers with high options to obtain them.
To attract such scientists, we budget a start-up package comprising a professor-level salary, one PhD-Student for 3 years, plus 100 kEUR. Additionally, the two new group leaders will have access to all actions undertaken by INMA, both within and outside the SO Project.
Importantly, UNIZAR will include the group leaders hired by INMA within the SO project into the tenure track that UNIZAR has for high-profile researchers. The availability of this stabilisation process is a significant asset for talent attraction to our centre. In this regard, it must also be noted that CSIC offers a permanent civil-servant position to researchers that obtain an ERC grant. If a recruited researcher secures their salary through these alternative funding sources, we would add the freed funds to their start-up package to make our offer even more attractive.

- Milestone.
Full incorporation of these group leaders to INMA by the end of the first year. The monitoring of the group leaders will include standard measures such as high-impact publications, projects obtained and patents filed, plus the level of synergistic collaboration with other research groups at INMA.

- Contingency Plan.
If we cannot fill one of the positions at the end of the first year due to a shortage of candidates with the required qualifications, we will launch a call to hire a group leader in Microfluidic Technology to manipulate liquids, gases, droplets, cells and particles within micro-channel geometries. This is an essential component of point-of-care and point-of-need testing devices, which we are also covering via collaborations, but the in-house know-how would greatly benefit the centre and impulse synergistic actions.

This funded action has a budget of 755 kEUR. We expect that these researchers will start working at INMA by month 8th. With the inclusion of the start-up packages, the yearly distribution of the budget is 105 + 260 +

13.1. SCIENTIFIC AND STRATEGIC GOALS LINKED TO THE SCIENTIFIC ACTIVITIES OF THE CENTRE, FEASIBILITY AND MONITORING PLAN

220 + 170 kEUR (where each amount represents the budget in consecutive years; this is, the budget is 105 kEUR for the first year, 260 kEUR for the second and so on; we will use this notation for all funded actions in what follows.)

A1.2 Internal projects.
We will launch 3 competitive internal calls for projects related to Research Priorities. These intramural projects aim to provide an agile way of funding good ideas within the institute, which otherwise would have to go through the lengthy process of applying for national or European funds. A dual aim is to promote synergistic and novel interactions between research teams in the institute. Thus, the projects will be granted to consortia formed by teams that have not collaborated in the recent past on the proposed topic of the project. Potential for application will be considered of paramount importance in the evaluation.
To foster collaborations with national and international institutions, groups external to INMA can form part of the collaborative consortia (with a SO budget covering travel costs and short-term stays at INMA).
An external panel will select the projects. The proposals will involve a minimum of bureaucracy to promote the agile selection of good ideas.
We will launch the first call in the first two months of the SO project to select 8 one-year exploratory projects. At the end of this period, the selected projects will be evaluated, and a second call will be launched, this time for 8 projects lasting approximately one and a half years. Finally, the process of the second call will be repeated in a third call, to be launched about one and a half years before the end of the SO project. Beyond these guidelines, the selection panel will determine the number of funded projects and their budget, depending on the size and quality of the best proposals.
We envision most proposals will request hiring personnel, so we have reserved an average budget of 50 kEUR per project and year (above the cost of hiring a postdoc in Spain). Nevertheless, restrictions on spending the budget will not be imposed so that the applicant consortium may request funding for equipment.

- Milestones.
An increase in high-impact publications and the number of patents by the end of the second internal call. The evaluation at the end of the projects and the selection of projects in new calls automatically monitor this action, where unsuccessful ideas are discontinued.

This funded action has a total budget of 1200 kEUR, with a yearly distribution of 400 + 250 + 275 + 275 kEUR (a larger budget is devoted to exploratory projects in the first year)