LabEx Tec21 2026 call for research proposals
PhD@Tec21 COFUND programme

Tec21 (www.tec21.fr) brings together the research community in mechanical and process engineering in Grenoble. Tec21 has been selected as a "Laboratoire d'Excellence (LabEx)" and is supported by the IdeX Univ. Grenoble Alpes for the 2025-2032 period in the frame of the "France 2030" programme. The LabEx Tec21 has been awarded a MSCA COFUND programme supported by the European Union.

The PhD@Tec21 COFUND programme will take place in two steps:

- ***Step 1***: Selection of research proposals submitted by the potential PhD supervisors (this call)
- ***Step 2:*** Selection of students for the PhD fellowships (call for applications launched in November 2025)

The present call concerns step 1 of the PhD@Tec21 COFUND programme.
It is aimed at future potential PhD supervisors. It concerns research proposals for
6 PhD fellowships to be funded under this COFUND programme.

1) Information concerning PhD@Tec21 COFUND programme

The PhD contracts will start in October 2026, with the application and selection process of the PhD fellows starting in November 2025 (step 2).
The EU imposes strict rules regarding the eligibility of candidates (mobility, diploma, etc.) and the selection procedures. Recruited fellows will also have to complete a mandatory 2-months secondment period to either an international academic institution (academic secondment) or a private company (industrial secondment).
Please, download and consult the information document about the call here
. Two webinars will also be organised by the Board of Tec21 to present these specific modalities and answer questions.

Webinars on COFUND modalities:
Tuesday 6 May 2025, 16-17h;
Tuesday 10 June 2025, 11h30-12h30

PIs interested in submitting a proposal to this call are strongly encouraged
to attend one of these webinars.

Connections links will be made available on the Tec21 website.

2) Who can apply

The PI and the co-PI of the project should be permanent researchers affiliated to Tec21, and the project should involve collaboration between two Tec21 laboratories. Additional collaborations with external national or international teams are welcome.

=> The Board of Tec21 can help potential applicants to build a project in collaboration with one or more research teams within the Tec21 perimeter. If interested, please contact: Mathieu.Tilquin@tec21.fr

3) Call for research proposals: objectives

The Tec21 community advances knowledge and develops new methods and technologies in mechanical and in process engineering. The main objective of the LabEx is to address new scientific challenges arising from today's societal issues in areas such as sustainable development, alternative resource management, green technologies, environmental impact, risk management, health care, etc.

Tackling such challenges often involves considering new mechanisms, new objects, complex interactions, etc., and requires:

- improving macroscopic descriptions by integrating of increasingly refined fundamental mechanisms arising at small scale(s), down to the molecular level if necessary,
- developing links between mechanics and disciplines such as chemistry and biology, using multi-physics approaches, often in a multi-scale context.

Such multi-scale and multi-physics approaches will help to produce more reliable and versatile predictive tools for engineers, decision-makers or public services. They should also facilitate the emergence of new technologies. The present call for proposals is therefore mainly oriented towards fundamental research with the following overarching objectives:

- to fund projects of the highest quality, with the potential to advance the frontiers of knowledge and/or to develop innovative methods,
- to foster the emergence within the Tec21 community of strong pluridisciplinary groups on specific challenging scientific issues,
- to promote synergies between modelling, experimentation and simulation,
- to develop long-term international cooperations.

Within this framework, the following subjects/areas are given priority:
WP1 - Coupling solid and fluid mechanics
WP2 - Coupling fluid mechanics with bio-physical-chemical phenomena
WP3 - Mechanics of and for the living matter
WP4 - Advanced numerical and experimental methods, including coupling with AI tools

WP1 - Coupling solid and fluid mechanics

This WP aims to improve the understanding and modelling of systems involving strong interactions between solid and liquid phases: geomaterials (soils, rocks, concrete, snow, clays, etc.), complex industrial media (pastes, fibre suspensions, porous media, metallic alloys, etc.), dense multiphase flows (avalanches, mudflows, multiphase reactors, etc.), biological and bio-inspired matter (wood, etc.). These systems are generally characterised by strong heterogeneities, anisotropy, and/or polydispersity, which can be pre-existing, induced by processes such as biocementation, suffusion, solidification, etc., or dynamically created by deformation and flow through feedback mechanisms such as migration, segregation, aggregation, fragmentation, etc. Progress is expected from the use and development of advanced characterisation techniques such as multiresolution and phase-contrast X-ray tomography, coupled Neutron and X-ray imaging, etc. Proper consideration of micro-macro couplings also requires the development of enriched multi-scale theoretical and numerical modelling approaches based on generalized continua, numerical homogenization, out-of-equilibrium statistical physics, etc. Extension of models and characterisation techniques to nano-scales is also needed to better account for interactions between objects, boundary and interfacial conditions, etc. Five research axes are put forward.

a. Solids in fluids. Specific attention will be devoted to the rheology of dense, complex suspensions involving non-Newtonian fluids (viscoelastic, viscoplastic) and/or objects characterised by large deformability, highly-anisotropic shapes, heterogeneous mechanical properties, etc. Research efforts will also concern problems related to particle transport, erosion, and deposition. A common theme is the need to better account for the couplings between flow, microstructure and disorder.
b. Fluids in solids. Systems involving highly-confined flows (flows at small scales or flow characterised by small-scale separations) as well as percolation of complex fluids in the presence of multi-physical interactions with the solid skeleton, will be particularly studied. This encompasses problems related to, e.g., impregnation and drying in (nano-)porous or fibrous materials and diphasic flows in porous networks.
c. Solid-fluid transition and associated instabilities. This axis concerns the characterisation of mechanical bifurcations (shear-banding, diffuse instabilities, liquefaction, etc.) and dynamical phase transitions in yield-stress and amorphous materials. Specific challenges are raised by the rheological transitions and fluidization processes of tri-phasic solid-liquid-gas systems (e.g., unsaturated soils, wet snow).

d. Fracture and rupture. This axis concerns open issues related to fracture propagation and fragmentation in heterogeneous media, the statistical and mechanical characterisation of (micro-)damage in soft matter, and the study of precursory processes at the micro- and macro-scale.
e. Flow-structure interactions. Specific efforts will be put into the characterisation of the mechanical properties and deformability (e.g. elasto-hydrodynamics) of the matrix and interfaces in micro- and nano-porous systems. At larger scales, the interactions between flows of complex rheology and highly deformable structures raise several fundamental issues: energy dissipation and impact forces as a function of flow regime, dynamical couplings in presence of large deformations, etc.

WP2 - Coupling fluid mechanics with bio-physical-chemical phenomena

The goal of the WP2 is to understand, predict and control complex flows, especially those involving mass, momentum and energy transfers and those coupled with chemical reactions, biochemical transformations or other physical fields such as electromagnetism and acoustics. More precisely, four research axes are put forward.

a. Advanced fluid mechanics. It includes the structure and control of turbulence in single or two-phase media, inducing changes in local viscosity at the particle scale and high Reynolds numbers, the occurrence of intermittent extreme events induced by abrupt variations of gradients of physical quantities (velocity, density, temperature, stress), or at very low temperatures which can induce super fluidity (cryogenics domain), mixing and dispersion, turbulence-inclusion interactions, drag reduction and collective effects in suspensions. A first challenge, in connection with WP4, concerns the acquisition of experimental data in these complex systems which will be possible only thanks to advanced technical developments necessary to yield highly precise measurements, resolved simultaneously, thus requiring fast imaging measurements. These experimental data will feed partnerships between experimentalists and theoreticians of the perimeter using approaches of statistical physics of non-equilibrium systems. A second challenge, also in connection with WP4, concerns the optimization of these data in connection with big data and machine learning techniques.
b. Interfacial dynamics and transfers. Writing a boundary condition at an interface in fluid mechanics remains an open field of research, whether in the field of heat and mass transfer, phase changes, chemical reactions, or adsorption-desorption. More particularly, the researchers of the perimeter will endeavour to maintain their leadership concerning the coupling with phenomena taking place at nanometric scales. For this, the expertise in fluid mechanics developed via original dedicated experimental devices: surface force apparatus, methods of multiscale and *in situ* structural characterisation (radiation scattering: WAXS, SAXS, USAXS, XPCS, SANS, SALS) coupled with external field solicitations (light, electric or acoustic fields) in the laboratory or using the large Grenoble Instruments Facilities (ESRF, ILL). This detailed knowledge of the nanometric scale will allow an efficient bottom-up approach to apprehend problems related to transport at interfaces, in particular in membrane processes (recovery of electrical energy from saline gradients or optimization of fluid-particle transfers in the vicinity of the walls). This bottom-up approach can be implemented thanks to microfluidic technologies allowing the integration of a large number of functionalities.
c. Flow of active micronic objects. This includes problems related to the swimming of a single particle but also of an assembly of active particles at low or high Reynolds number. This theme, closely related to WP3, also concerns the flow of biological objects such as red blood cells, bacteria, and the formation of biofilms incident to these flows, bacterial growth, and assisted drug delivery via artificial microcapsules. Here again, microfluidics and X-ray tomography will be valuable techniques.
d. Development and understanding of new processes linked to sustainable development and based on fluid mechanics and interfacial phenomena. This axis is in close interaction with the PEI platform (Processes Environment and Industry) which aims to strengthen the connections between research, training and industrial actors in the field of clean processes and environment. A first example of a process of societal interest concerns biorefinery, *i.e.* the deconstruction and purification to extract molecules of interest from plant biomass, and new bio-sourced materials with controlled structure and orientation, in particular based on nanofibrils and/or cellulose nanocrystals. In this field, Tec21 researchers have internationally recognized expertise on the control of such processes (chemical, physicochemical and mechanical) of extraction of the elementary bricks on the one hand and on the development of new

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structuring processes by external fields on the other hand. The problems related to 3D printing and to the processes inherent to recycling such as the separation of materials in liquids, flotation processes, mechanical turbulence of fluids in recycling, will also be addressed.

WP3 - Mechanics of and for the living matter

The objective of this WP is to improve the understanding and control of mechanical processes in living organisms from the cell to the macroscopic tissue scale. Recent developments in biology and life sciences reveal the relevance of multi-scale approaches to tackle these problems and that the combination of multidisciplinary approaches mixing mechanics, physics, biology and medicine is necessary to produce significant advances. These different communities which are present in Tec21 can address a wide range of issues such as the understanding of cell deformation under flow, the analysis of cell motility, the development of new diagnostics and new biomaterials, by mobilizing experiment, theory and simulation. The vast field of research of the WP3 of Tec21 is declined in two distinct axes: mechanics of the living matter and mechanics for the living matter.

a. Mechanics of the living matter: Several scales can be distinguished. The cell is particularly relevant and raises various questions: how is the mechanical response of a cell modified by its environment (adhesion/interaction on a substrate or not, presence of other cells, rigidity and geometry of the surrounding environment)? How is the conversion of a mechanical stimulus into a physiological response that may be a change in gene expression or motility (at the cell level) or a reorganization of the environment (regeneration, healing, remodelling at the tissue level) realized to achieve mechano-transduction? Multimodal methods coupling optics, magnetism, flows, opto-genetics, various mechanical solicitations (AFM, controlled stretching experiments) will be used to understand how these signals are transmitted, what are the resulting mechanical behaviours, and what are the forces exerted by the cells in contact with their environment.
   At the scale of tissues or organs, an emerging issue is the complexity of the mechanical behaviour which is often non-linear, dependent on the speed of solicitation, non-homogeneous and anisotropic. One of the issues is therefore the determination of rheological laws (visco-elasticity, hyper-elasticity, poroelasticity, etc.) for systems capable of mimicking the deformations of living tissues. Moreover, when these tissues are active (tissues with muscular activity such as the heart, or growing tissues such as tumours, bacterial colonies or embryos), it is necessary to develop adapted models. In particular, characterising and mechanically modelling the appearance of spatial structures during growth (organoid, embryo) or biological fluid flows (organization of red blood cells in complex networks, clot formation in the bloodstream, transport of intestinal mucus) is essential to elucidate the mechanisms of tissue organization.
b. Mechanics for the living matter: This axis includes scientific issues associated with the mechanics of biomaterials for the living, particularly prostheses, considering the specific anatomy of patients (posture, movement, pathology) and their interactions with biological tissues. The conditions at the interfaces between these different elements are often ignored and need to be addressed precisely. In addition, this theme also includes questions related to the mechanics of organoids (organs on a chip) and the design of new matrices/substrates for cell growth and the development of fibrous substitutes (laryngeal, vessels), using modern methods (electro-spinning, additive printing, etc.). Assisted drug delivery via active artificial microcapsules (in connection with WP2) is also a subject of study, which could be based on recent concepts based on controlled changes in the shape of capsules leading to effective displacement (micro-robots).

WP4 – Advanced numerical and experimental methods

This WP is devoted to transverse methodological developments needed to address the scientific challenges targeted in WP 1, 2, 3. This includes advances in modelling concepts, numerical methods, and simulations, measuring techniques, signal processing, data analysis, etc. Whenever possible, the goal is to promote original methods and tools that are sufficiently versatile to be used in, or adapted to, a wide range of situations (materials, scales, etc.). Three research axes are put forward:

a. Advanced modeling and simulations. Efforts will be put into developing original numerical methods and improving computational performances for the modeling of diverse multi-scale and multi-physical processes: coupled fluid-solid simulations in the presence of complex flows (turbulence, non-Newtonian fluids, etc.) and/or deformable objects (flexible fibres, wall deformation in aneurysms, etc.), coupling of numerical methods (continuous and discrete, etc.), interface tracking in presence of phase changes (cavitation, etc.). Among future challenges, specific attention will be devoted to micro-macro homogenization approaches based on statistical physics, numerical homogenization (hierarchical methods), generalized continua, etc. Efforts will also be put into the development of fluid-structure simulations accounting for the full deformability of objects and interfaces at different scales, including contact line and adhesion forces, with applications related to industrial processes, civil engineering, protection structures, or vegetation-flow interactions. The inclusion of specific couplings with physico-chemical and biological processes (ATP release from red blood cells, role of glycocalyx in cell interactions with the endothelium, role of the Extra Cellular Matrix in multicellular spheroids) will also be tackled. Implementation of these numerical advances into collaborative codes (such as Yales2, YADE) will continue to be particularly promoted.

b. Multiscale characterisation and field measurements. This theme concerns the development of original experimental methods to obtain highly-resolved 2D-3D field measurements covering large dynamics (e.g., high-speed ultrasonic imaging or Doppler phase interferometry for particle-laden turbulent flows, high-resolution 3D PIV for confined systems using confocal microscopy, coupled X-ray/neutron tomography, etc.), as well as sophisticated conditional measurements (coupled Eulerian/Lagrangian measurements). Enormous challenges remain to be tackled to extend the dynamical range and the space/time resolution of measuring techniques, to simultaneously explore 2D-3D fields of two or more variables (displacements/strains/velocities, density/temperature, etc.), and to adapt these techniques to large-scale systems. The development of nano-scale observations and measurements (surface force apparatus, force feedback microscopy, radiation scattering WAXS/SAXS/USAXS, contactless probes) will be pursued together with specific devices (stress responsive micro-systems, intracellular nanorheology) for the identification of local stresses and constitutive parameters of complex, active or biological media.

c. Coupling with AI. Methods and tools coming from Artificial Intelligence (machine learning, deep learning, etc.) are quickly becoming staples for handling big data, improving data processing, and interpretation, and simulating complex systems. An important objective in future years will be to further support efforts and promote fruitful synergies between AI and traditional mechanical approaches through the development of specific, physically-constrained AI methods (physics-informed neural networks, etc.). Foreseen applications concern, e.g., the control of experimental setups, the multi-resolution characterisation of materials, the simultaneous processing of heterogeneous data, or the simulation and control of multiscale flows and deformation processes (turbulence, geomaterials, etc.).

4) Opportunities

The 2026 COFUND PhD@Tec21 call for proposals concerns the funding of 6 PhD fellowships:

Grant	Topics supported	# of grants	Proposal submission deadline		Results calendar
PhD grant: 100% of the PhD salary (3 years) is funded by Tec21[(1)] !! Involvement of two laboratories from the Tec21 perimeter is mandatory !! All PhD fellowships will include a 2-month secondment period to an international academic institution or a private company[(2)]	All WPs	6 PhD fellowships	15 June 2025		15 October 2025

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(1) Each PhD fellowship includes a fixed amount of 18 K€ for small equipment, running costs, travels, conferences, including expenses related to the secondment period.

(2) Applicants are asked to indicate possible options for this academic or industrial secondment (existing partnerships, etc.). No formal commitment is required at the application stage, but letters of support from potential hosting partners may be included.

5) Proposal preparation and submission instructions

Proposals should be sent to cecile.bordier@tec21.fr
before June 15 2025.

Each proposal (in English) will be submitted as a single pdf file (maximum size 10 Mo) organised as follows (see template):

Front page

- Project title
- Project PI and co-PI (with name, address, phone numbers, e-mail)
- Selected research theme(s) - select 1 or 2 maximum

Second page

- Summary (1/2 page): project content and expected breakthrough
- Summary (1/2 page): structuring effect and collaborative aspects for the Tec21 research community

Next pages – project description (max 6 pages excluding annexes)

- Context and objectives (1 page)
- Scientific program, including the research strategy (3 pages)
- Project organisation: tasks, schedule, work program of the PhD student, including possible secondment options and their benefits to the project (1 page)
- Potential impact of expected research results (benefits to society) if relevant (1/2 page)
- Involved participants (1/2 page): names, institutions, involvement (% time), skills and role in the project. Specify the role of the PhD student.
- Annex: Curriculum Vitae of the main investigators including significant publications related to the topics of the proposals. References and letters of support can be added.

6) Evaluation of proposals

Proposals will be evaluated by at least two external reviewers selected by Tec21 Board. The reviewers are experts in the topic of the proposal and disclose any potential conflicts of interest with the applicants. They are asked to provide feedback on the following items:

i. Scientific quality and originality: The potential for the project to advance knowledge and understanding, to propose new methods (in modelling, simulation, instrumentation), to explore creative and original concepts; the relevance of the international positioning of the project.
ii. Project organisation: Is the research strategy convincing? Is the proposed scientific program well organised and realistic?
iii. The qualification of the team and its ability to conduct the project.
iv. Project feasibility: The adequacy between the available resources and the project's objectives, the description of the PhD student's contribution.
v. Potential impact of expected research results.

Based on these reports, the final decision of funding is made by the Tec21 Board of Directors. The committee will pay particular attention to proposals that give rise to the development of multidisciplinary groups on specific challenging scientific issues and contribute to strengthen the Tec21 community.

Successful funded proposals will be announced in October 2025 (provisional schedule).