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Supervisor Expression of Interest
MSCA - Marie Sklodowska Curie Action - (PF) Postdoctoral Fellowship 2021

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Link pagina docente:	https://www.cmic.polimi.it/en/persone/docenti-e-ricercatori/vena-pasquale/ Micro_biomechanics LaBS
Department Name:	Dept. of Chemistry, Materials and Chemical Engineering 'Giulio Natta'
Research topic: (https://www.polimi.it/en/scientific-research/research-at-the-politecnico/departments/)	Bone biomechanics, Osteoporotic Bone models and translational medicine.
MSCA-PF Research Area Panels:	☐ CHE_Chemistry ☐ ECO_Economic Sciences ☐ **X ENG_Information Science and Engineering** ☐ ENV_Environmental and Geosciences ☐ LIF_Life Sciences ☐ MAT_Mathematics ☐ PHY_Physics ☐ SOC_Social Sciences and Humanities
Politecnico di Milano Areas:	☐ Cultural Heritage ☐ Smart Cities ☐ Horizon Europe Missions ☐ **X Health** ☐ Industry 4.0
Title and brief description of the Department and Research Group (including URL if applicable):	The Department of Chemistry, Materials and Chemical Engineering 'Giulio Natta' conjugates competences in chemistry, chemical engineering, biological–biomechanical engineering, materials science and engineering. The Laboratory of Biological Structure Biomechanics (LaBS) was established in Feb. 2000 and has the mission to carry out applied research in diverse areas of biomechanics, with a main focus on

	implantable devices as well as tissue mechanics. LaBS has a significant expertise in the use of computational solid and fluid dynamics modelling techniques starting from medical imaging as well as in mechanical laboratory tests also at the micro and nano-scale.

Brief project description: **(max 1 page)**	***Integration of Synchrotron radiation micro-computed tomography and bone mechanical characterization methods in mice models for primary and secondary osteoporosis.*** The proposed research will be carried out at the Politecnico di Milano in collaboration with the intergovernmental organisation "International Center for Genetic Engineering and Biotechnology-CGEB" in Trieste and the European Research Infrastructure Elettra-Synchrotron in Trieste. **Background** Osteoporosis is a widespread skeletal disorder characterized by compromised bone strength owed to a change of mineral content at the nano-scale as well as to microarchitectural changes of the bone tissue. Bone loss is also a significant medical problem for prolonged bed rest and astronauts (1-2 percent per month). In this case bone mineral loss occurs as secondary osteoporosis due to the unloading of weight bearing bones. The standard test to diagnose osteoporosis is the evaluation of bone mineral density (BMD) using dual-energy x-ray absorptiometry (DXA). This approach can provide a relative risk but cannot identify patients at risk of fracture. Furthermore, although DXA-derived BMD has high specificity in predicting fracture risk, its sensitivity is low. As novel early diagnosis approaches are needed, advances in models for diseased bone and characterization methods are still needed. **Aims** In this project we propose to evaluate histomorphometric parameters and mechanical properties of bones on two validated models of osteoporosis: mouse ovariectomy for primary osteoporosis and hindlimb suspension for secondary osteoporosis. Approved animal models will be available at the CGEB. The collected Bones will be studied by means of high resolution computed micro-tomography (micro-CT) at the SYRMEP beamline of Elettra. Scans at multiscale resolution scales will be performed to evaluate the main histomorphometric parameters. Thanks to an effective use of monochromatic X-rays beamline and use of calibrated phantoms, an assessment of tissue mineral density (TMD) will be performed as well and complemented with ashing techniques. Mechanical properties of all samples subjected to quantitative micro-CT will be characterized. To this purpose, morphometric parameters will be determined on trabecular bone and on cortical bone of the OVX, suspended and control groups. These parameters will include, but will not limited to bone volume fraction, cortical thickness, trabecular thickness and spacing and degree of anisotropy. Elastic properties of the tissues will be inferred from the TMD estimation through simple analytical models allowing for tissue component volume fractions as well as validated experimentally through nanoindantation tests. Furthermore, bending tests on the whole bone segments will be carried out. Experimental tests will be complemented with micro-CT based finite element analyses of bone samples belonging to

	different groups. **Expected results and impact** We expect to identify morphological features (at the micro-scale) and mechanical properties of the tissue at multiple scale which are mostly affected by simulated primary and secondary osteoporosis in animal models. These finding are expected to cast new light on advanced diagnostic methodologies for early detection of the bone disease.