INTERNSHIP PROGRAM FOR INTERNATIONAL STUDENTS

INTERNSHIP SUBJECT FORM

Name of the Host Laboratory	Laboratory of Plasma Physics
Website of the Host Laboratory	www.lpp.fr
Research Group	Group of Low Temperature Plasma, team of kinetics of nanosecond discharges
Internship Supervisor	Svetlana STARIKOVSKAIA (DR1 CNRS at LPP, Dr.Sc., Prof., PhD in plasma physics from MIPT, Moscow, 1993)
Internship Subject	Development of atmospheric pressure plasma source for stem cells treatment
Student's level	Advanced Undergraduate Students (3rd or 4th year) or Master's students (1st or 2nd year)
Proposed Duration	3 to 6 months
Prerequisites	Plasma medicine is an actively developing area of knowledge [1]. Treatment with cold atmospheric plasma (CAP) has been reported to promote wound healing in animals [2]. However, how this process is mediated remains unclear. The supervisor of this project, Dr. Svetlana Starikovskaia, has more than 5 years collaboration contacts with scientists working with cell cultures [3]. To further study the interaction of plasma and cells / tissue, a source of cold atmospheric plasma with a controlled electric field and electron density is required. [1] H.-R. Metelmann, Th. von Woedtke, K.-D. Weltmann, Eds., 2018, "Comprehensive Clinical Plasma Medicine. Cold Physical Plasma for Medical Application", Springer International Publishing AG, part of Springer Nature 2018, ISBN 978-3-319-67626-5, doi: 10.1007/978-3-319-67627-2 [2] C.Duchesne, S.Banzet, J.-J.Lataillade, A.Rousseau and N.Frescaline, 2019, "Cold atmospheric plasma modulates endothelial nitric oxide synthase signalling and enhances burn wound neovascularisation ", Journal of Pathology, doi: 10.1002/path.5323 [3] Y.Ohene, I.Marinov, L.de Laulanié, C.Dupuy, B.Wattelier and S.Starikovskaia, 2015, "Phase imaging microscopy for the diagnostics of plasma-cell interaction", Applied Physics Letters 106, 233703 (2015); doi: 10.1063/1.4922525
Internship description (max. 15 lines)	The internship will start from measuring the electric field behavior and distribution of absolute densities of electronically excited nitrogen molecules in commercial cold atmospheric plasma source (@PlasmaWise), available in the group. A collaborator from the side of biology sciences is Prof. Halima Kerdjoudj from BIOS laboratory (Reims University), having the same plasma source in her laboratory. If the coronavirus situation allows, a join campaign with Reims Univesrity will be possible. In parallel, the student will work on conception of a new plasma source. The source will be developed for the research purposes. The minimum time of plasma exposure to cells / tissue and the maximum controllability of the

	process will be the key points. For this reason, nanosecond electrical power will be used in the new plasma source. Traditionally, two configurations of gas discharges are used in plasma medicine at atmospheric pressure: dielectric barrier discharges (DBDs) and plasma jets. These discharges are powered by a sinusoidal voltage with an amplitude of several kV, the frequency being from 50 Hz up to a few tens of kHz, or by radiofrequency (RF) source. DBDs are ignited in surrounding air, and jets use a rare gas (Ar or He) flow. When developing a new nanosecond source for bio applications, we will rely on available publications on the mentioned discharges. Possible toxicity of certain dielectric materials for living cells should be taken into account when developing the plasma source. The plasma source should provide controlled electric field [and] electron density.