

Post-Doctoral Position

«Stress transmission and fracture in collagen networks»

Summary of the project

The complex aggregation of proteins organizes collagen fibers into a hierarchical network capable of withstanding mechanical loads. This rigid and resilient material serves as a protective barrier for tissues, skin or cartilage. Although the linear and non-linear elastic properties of these networks are well established, the plastic processes leading to fracture under local or global loads remain poorly understood. The aim of this project is to model the impact of fiber buckling and sliding as well as local mechanical forcing on the long-range stress propagation and the plastic response of the network. An innovative combination of techniques will be employed, with coarse-grained molecular dynamics simulations of a model gel, containing minimal and generic ingredients to capture the mechanical response of collagen fiber networks, serving as the basis for theoretical efforts. The main tasks of this post-doctoral position will be to:

- Simulate a fiber network model gel and characterize the impact of the gelation protocol on its microstructure (Fig.1).
- Identify the microscopic mechanisms of stress propagation and plastic rearrangements close to the fracture regime.
- Develop of a micromechanical model.

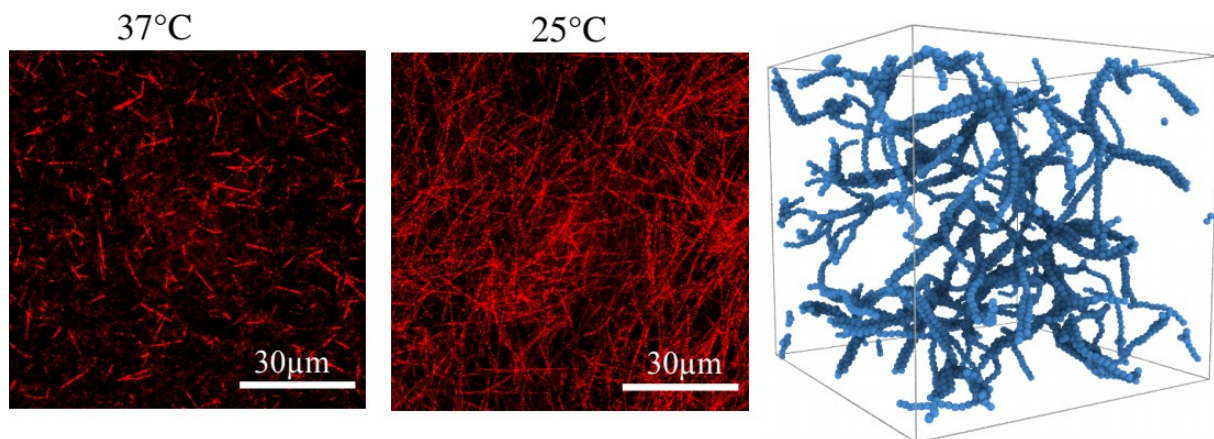


Figure 1: (left) Micrometer intensity projection of collagen fiber networks prepared at different temperature (data from our collaborators at LIPhy). (right) Simulated fiber network obtained at a fixed volume fraction of 1%.

Location and practical aspects

This project will benefit from an existing collaboration between researchers in physics of biological systems, imaging and mechanical engineering.

The successful applicant will work under the supervision of Dr. M. Bouzid at **3SR Laboratory** (Soils, Solids, Structures, Risks – Grenoble, France – <https://3sr.univ-grenoble-alpes.fr/en/research/comhet-team>) in the “CoMHet” team and Dr. J. Etienne at **LIPhy** (Interdisciplinary Laboratory of Physics – Grenoble, France – <https://liphy.univ-grenoble-alpes.fr/en/mc2>) in the “MC2” team, in collaboration with Dr. P. Recho, Dr. K. John and Dr. A. Erlich. The candidate will be initially assigned to 3SR and will then stay at LIPhy depending on the progress of the project. He/she will also interact with experimentalists at LIPhy (Dr. C. Verdier, Dr. V. Laurent, Dr. G. Cappello), at 3SR (Dr. L. Bailly and Dr. L. Orgéas) and at the Laboratoire de Biologie du Développement, Paris-Sorbonne (Dr. J. Fouchard).

The post-doctoral fellowship offer is available starting before **June 2023** for a period of **12 months**. The gross salary is 2750 euros/month, equivalent to a net salary of 2210 euros/month.

Required qualification

The post-doctoral candidate must have a numerical and theoretical background in soft matter physics, mechanics or statistical physics with a strong motivation to work at the interface between physics and biology. Specific skills in numerical tools (Python, C++, Lammps) will be highly appreciated.

Applications

Interested candidates should send their CV, a cover letter and recommendation letters to Dr. Mehdi Bouzid (mehdi.bouzid@univ-grenoble-alpes.fr) and Dr. Jocelyn Etienne (jocelyn.etienne@univ-grenoble-alpes.fr). Deadline for the application: **1/05/2023**.