Internship Proposition
Curie Institute – Research center (Paris)
Department: Physical-Chemistry of the cell

Mapping nuclear environment by 3D single particle tracking

We are seeking a motivated candidate to join our lab for an internship on single particle tracking inside the nucleus of living cells.

The nucleus of a living cell is a crowded environment where nuclear factors such as transcription factors are in constant search for specific DNA sequences. DNA is organized at different levels, from topologically associated domains (TADs) to chromosomes territories. It is known that DNA organization and compaction plays a role in orchestrating the different nuclear functions and gene expression by restricting the accessibility of nuclear players to specific genes. In cancerous cells, it was shown that DNA compaction and chromosome territories are massively altered. However, a single cell characterization of the nuclear environment is still missing.

In order to map the 3D environment and study different properties of the nucleus, we will perform single particle imaging and tracking. Efficient 3D tracking of single particles in the nucleus requires 3D imaging with fast frame rates. Multifocus microscopy (MFM) allows simultaneous acquisition of 9 different focal planes on the same camera, thus covering the whole volume of a nucleus in a single image. With MFM it is possible to acquire volumetric images with hundreds of frames per second.

In this project, the student will benefit from the latest technological advancements in volumetric microscopy to image efficiently the nuclear environment. He or she will inject different particles of different sizes in the nucleus, image them in 3D and follow their dynamics. New approaches for inferring nature and properties of 3D random walks of the particles at high density will be explored using the TRamWAy platform (https://goo.gl/McgJXR) in collaboration with Jean-Baptiste Masson at Pasteur Institute. Moreover, a combination of advanced statistical approaches implemented within a virtual reality software platform (https://goo.gl/dnNueu) will be accessible to analyze and visualize complex 3D pattern of random walk properties. These 3D maps of nucleus will be compared between different cell types.

We are looking for a motivated candidate with the will to learn single particle data processing, optical microscopy, and cell culture. Interested candidates can send a CV and motivation letter to: bassam.hajj@curie.fr

More information about our research group can be found here: https://science.institut-curie.org/research/multiscale-physics-biology-chemistry/umr168-physical-chemistry/team-coppey/