Course: *Fluctuations, kinetic processes and single molecule experiments*

Duration: 24 hours

Teacher(s): ORIAN Laura (8 hours)

FREZZATO Diego (16 hours)

Curriculum:

Description: Chemists usually deal with molecules and their transformations (kinetic processes) in condensed fluid phases. This calls for the picture of molecules in a fluctuating environment which controls their behavior. The course intends to supply a general framework for the description of molecular fluctuations, their effects on activated processes, and their relevance in nonequilibrium contexts. The course also introduces the experimental techniques that allow the observation of fluctuations at the molecular level.

Additional information:

1. What are fluctuations and how do they emerge?

2. Stochastic description of fluctuations

3. Kinetics controlled by fluctuations: Kramers theory of activated processes

4. Jump processes among sites: Master Equation dynamics

5. Fluctuations in nonequilibrium steady states: entropy production and “Thermodynamic Uncertainty Relations”

7. Stochastic chemical kinetics

8. Enzyme kinetics from the viewpoint of individual enzyme molecules

9. Fluctuations meet function: molecular motors

10. How to probe the molecular energy landscape: “force spectroscopies” and application of work-fluctuations-theorems

11. From the molecular mechanism to the kinetic constants: overview of computational applications to molecules and biomolecules and open issues

12. ATP-Synthase: an incredibly efficient rotary molecular motor in our cells

13. From E-representation to k-representation: *in silico*: examples of conceptualization of catalytic cycles.

At the end of the course the participants are invited to present ant to discuss a research article on these topics