

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: LPENS

CNRS identification code:

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Internship location: ENS (IPGG)

Thesis possibility after internship: **YES**

Funding: **YES**

If YES, which type of funding: Startup

Title

Summary (half a page maximum) Programmable Materials: Folding of DNA-coated Droplet Chains into Functional Architectures

The hydrophobic collapse of polypeptides into a molten globule state is one of the key features of the “funnel” landscape picture that is commonly used to describe protein folding. This process is driven by solvent-mediated interactions that can either speed up folding by reducing the conformational space or impede folding through the creation of geometric bottle necks. To gain predictive power, this project will design and build an artificial system comprised of short chains of micron-sized droplets coated with DNA to microscopically map out all possible folding pathways as a function of temperature protocols and DNA interaction strengths. These experimental data will then be used to calibrate a Markov state model capable of predicting optimal non-equilibrium protocols to achieve a target structure in the folding tree. We will experimentally compare folding via only native interactions (those found in the target structure) and folding that includes non-native interactions. Molecular dynamics simulations will further validate the model to show that tuning specific non-native interactions broadens the design space of foldable structures (*foldamers*). Akin to biology, we aim to show that the temperature protocol, i.e. the external environment, is coupled to the optimization of interactions to accelerate folding.

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics NO

Soft Matter and Biological Physics: YES

Quantum Physics: NO

Theoretical Physics: YES