# STudent REseArch Mobility Programme (STREAM)
# Project proposal

**Host University:**
Université Paris-Sud

**Field (drop-down list):**
Natural sciences, mathematics and statistics

**Specified field, subject:**
Physics

**Research project title:**
Entanglement and mechanics in fractal actin networks

**Possible starting month(s):**

| Sep | Oct | Nov | Dec | Jan | Fev | Mar | Apr | May | Jun | Jul | Aug |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | ☐ | X | X | X | X | ☐ | ☐ | ☐ | ☐ |

**Possible duration in months:**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ☐ | ☐ | ☐ | X | X | X | X | X | ☐ | ☐ | ☐ | ☐ |

**Alternatively, exact starting and end date:** from date to date

**Suitable for students in:** ☐ Bachelor level X Master level

**Prerequisites:**
BS in Physics

**Restrictions:**
none

**Description (maximum 2,000 characters):**
The architecture of living cells is largely determined by a microscopic networks of semiflexible filaments : the actin cytoskeleton. In addition to ensuring the cell's mechanical integrity, its growth enables cellular motion and force exertion. These crucial roles are played by so-called branched actin networks, which are random fractal assemblies of filaments and branching points.

Despite its importance within the cell, the rigidity of these networks is not understood from a theoretical standpoint. Indeed, taking into account the sole rigidity of the filaments and attachment points, we would predict a vanishing elastic modulus, in contradiction with experiments. We will examine the origin of these networks' rigidity, considering in particular the effects of the entanglement of the network with itself, which generates nonlocal interactions between the points of the elastic network. Given the difficulty of treating such interactions exactly, we will resort to both mean-field/effective medium analytical approaches and numerical validations.

From an experimental perspective, our collaborators Olivia du Roure and Julien Heuvingh (ESPCI) operate a setup allowing the first clean

characterization of the branched network. We will work with them to relate our models to the microstructure of a network grown under force (similar to in vivo conditions), its nonlinear elasticity, and its ability to actively generate forces.

**Faculty and/or Department:**
UFR de Sciences, Département de Physique
http://www.sciences.u-psud.fr

**Contact person, including position:**
Séverine Fogel, Head of International Relations

**Contact email:**
severine.fogel@u-psud.fr

**Deadline for nomination to reach host university:**
2 months before the starting date

**Notification of admission given by the end of:**
Within 3 weeks

**Additional information:**
http://lptms.u-psud.fr/membres/mlenz/