

## 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:**  
An optical nanosource based on the strong coupling of surface plasmons and excitons

**Possible starting month(s):**

Sep	Oct	Nov	Dec	Jan	Fev	Mar	Apr	May	Jun	Jul	Aug
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**Possible duration in months:**

1	2	3	4	5	6	7	8	9	10	11	12
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**Alternatively, exact starting and end date:** from    date    to    date

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

**Prerequisites:**  
Physics background; a desire to do experiments; good communication skills in English (or French).

**Restrictions:**

**Description (maximum 2,000 characters):**

Just as individual atoms can exchange *electrons* and thus create “hybridized” molecular states of different energies, a surface plasmon and a semiconductor nanocrystal can create new states of matter by exchanging *photons*. A surface plasmon is an electromagnetic wave coupled to a collective oscillation of the free electrons in a metal. On the other hand, when a semiconducting nanocrystal is excited (e.g., with a laser), a delocalized electron-hole pair known as an *exciton* is created. It is the strong coupling of these two entities (plasmon and exciton) that is expected to lead to new electronic states of light and matter exhibiting new properties such as enhanced coherence.

The goal of this internship is to fabricate and demonstrate the operation of novel one dimensional (1D) hybrid optical nanosources based on the strong coupling of plasmons and excitons. Such a nanosource will combine plasmonic



Comprendre le monde,  
construire l'avenir



and excitonic nanostructures in a nanowire geometry and will be driven either optically or electrically.

During this internship, the student will investigate the electrical and optical excitation of the hybrid plasmon-exciton nanosource. The student will acquire experience in (i) atomic force microscopy (imaging and manipulation of the gold nanotube filled with semiconductor nanocrystals) (ii) optical excitation (i.e., laser) and optical microscopy (for the optical excitation and detection of the light emitted from the nanosource) and (iii) scanning tunneling microscopy (for the electrical excitation).

**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:**

Starting date and length of internship may be flexible.