

FICHE A COMPLETER POUR PUBLICATION D'EMPLOIS SCIENTIFIQUES (hors BIATSS) DANS LE PORTAIL « EURAXESS JOBS »

A COMPLTER EN ANGLAIS ET A RENVOYER à : drv-euraxess@univ-amu.fr en FORMAT WORD

Cochez la case si vous souhaitez **aussi** publier dans **Academic Positions**, plateforme internationale d'emploi scientifique (si visibilité internationale requise par le poste) : dans ce cas **la durée de publication** – durée entre la date de publication et la date limite de candidature - **DOIT IMPERATIVEMENT être supérieure à 3 (TROIS) MOIS.**

Autres sites ou plateformes d'emplois où votre offre a été publiée

1. Euraxess

2. ABG

3.

JOB TITLE Ultrafast nonlinear optical response and dynamics of 2D thin films

RESEARCHER PROFILE

- PhD / R1: First stage Researcher
 Postdoc / R2: PhD holders
 Researcher, Assistant Professor/ Senior Lecturer / R3: Established Researcher
 Professor, Tenure track / R4: Leading Researcher

RESEARCH FIELD(S)¹: Physics

MAIN SUB RESEARCH FIELD OR DISCIPLINES¹: Optics, Nonlinear optics, Thin films

JOB /OFFER DESCRIPTION (max. 3,500 characters) (Work environment, Funding (ANR grant, A*midex funding, ...), duty, etc.

Two-dimensional thin films are well-known for their high optical nonlinearities. For this reason, they are currently the best candidates for mode-locking of laser systems.¹ Recently, during two PhD thesis, we optimized Sb_2Te_3 and Bi_2Se_3 layers to obtain significant nonlinear absorption. More specifically, the saturable absorption behavior obtained was the highest ever reported in the field of nonlinear optics by similar experimental techniques.²⁻⁵

These high optical nonlinearities are emanating from the topological insulator character of the layers which can be observed in 2D structures. However, the relation between the structural characteristics of topological insulators and their optical nonlinearities is still not sufficiently explored. The target of the thesis is to shed light on the origins of the nonlinear optical properties of 2D topological insulators (like Sb_2Te_3 , Bi_2Te_3 and Bi_2Se_3). This will allow a better understanding of the physical mechanisms that give rise to the nonlinear refraction and absorption of the thin films. The objectives of the thesis are the following:

¹ **Academic Positions Research fields:** Agricultural Sciences – Anthropology – Architecture and Design – Arts and Culture – Biology – Chemistry – Computer Science – Business and Economics – Education – Engineering – Geosciences – History – Law – Linguistics – Literature – Mathematics – Medicine – Philosophy – Physics – Political Science – Psychology – Social Science – Space Science – Theology

Euraxess Research fields: Agricultural Sciences – Anthropology – Architecture – Arts– Astronomy – Biological sciences – Chemistry – Communication sciences - Computer Science – Criminology – Cultural Studies – Demography - Economics – Educational Science – Engineering – Environmental science – Ethics in Health sciences – Ethics in natural sciences – Ethics in physical sciences - – Geography - Geosciences – History – Information science – Juridical science – Language science – Literature Management sciences – Technology – Religious science – Sociology – Psychological sciences – Neurosciences – Pharmacological sciences – Mathematics – Philosophy – Medical sciences – Political sciences - Physics

FICHE A COMPLETER POUR PUBLICATION D'EMPLOIS SCIENTIFIQUES (hors BIATSS) DANS LE PORTAIL « EURAXESS JOBS »

A COMPLTER EN ANGLAIS ET A RENVOYER à : drv-euraxess@univ-amu.fr en FORMAT WORD

Objective 1: Thin film deposition and preparation. The thin films will be deposited by the electron beam deposition technique available in a modern facility established in Fresnel Institute (Espace Photonique). An optimal crystallization of the thin film layers is necessary in order to enhance the optical nonlinearities. This is currently done by our group by heating the thin films in an oven. During this thesis a new experimental setup will be built, which will allow a higher precision annealing by using a high repetition rate femtosecond laser.

Objective 2: Nonlinear optical studies. The deposited and optimized 2D layers will be studied by means of the Z-scan technique, already existing in Institute Fresnel. For these studies a femtosecond laser system will be employed. This is a hybrid (crystal/fiber), passively mode-locked laser delivering 400 fs duration pulses at 1030 nm. The oscillator provides pulses at a 40 MHz repetition rate. An optical parametric amplifier has been very recently installed at the exit of the femtosecond laser, which will allow tuning the laser wavelength at the UV, visible and IR parts of the spectrum (200 nm to 2.5 μm). This is an ideal laser system for the thesis, as it will allow the investigation of the impact of the repetition rate (tunable between 1 Hz and 40 MHz), the wavelength and the pulse duration (the latter can be adjusted from 80 fs up to 20 ps) on the nonlinear optical responses.

Objective 3: Ultrafast dynamics of the 2D layers. A deeper understanding of the laser-matter interaction will be achieved through a thorough study of the carrier dynamics of the topological insulators during their excitation with light. For this reason, a pump-probe optical spectroscopy setup will be built by the PhD student. Briefly, the higher energy pump pulses will allow to generate photo-excited carriers, while less intense probe pulses will detect the transmittance change of the sample. These studies will allow a precise study for several different delays between the pump and the probe pulses.

The combination of these two approaches will allow retrieving the full spectral dependence of the investigated topological insulators and understand the underlying photon/ electron interactions.

Apart from the nonlinear optical investigations the student will participate at all the experimental steps required for obtaining giant optical nonlinearities. This procedure includes thin film deposition, annealing, X-Ray Diffraction studies (XRD), Scanning Electron Microscopy (SEM) studies and Atomic Force Microscopy (AFM) investigations.

Bibliography:

- 1) M. Kowalczyk *et al.* Optical Materials Express 6, 2273-2282 (2016).
- 2) R.-N. Verrone *et al.* ACS Applied Nano Materials 3, 7963-7972 (2020).
- 3) C. Moisset *et al.* Nanoscale Adv. 2, 1427-1430 (2020)
- 4) A. Karimbana-Kandy *et al.* Optical Materials 143, 114211 (2023).

¹ **Academic Positions Research fields:** Agricultural Sciences – Anthropology – Architecture and Design – Arts and Culture – Biology – Chemistry – Computer Science – Business and Economics – Education – Engineering – Geosciences – History – Law – Linguistics – Literature – Mathematics – Medicine – Philosophy – Physics – Political Science – Psychology – Social Science – Space Science – Theology

Euraxess Research fields: Agricultural Sciences – Anthropology – Architecture – Arts– Astronomy – Biological sciences – Chemistry – Communication sciences - Computer Science – Criminology – Cultural Studies – Demography - Economics – Educational Science – Engineering – Environmental science – Ethics in Health sciences – Ethics in natural sciences – Ethics in physical sciences - – Geography - Geosciences – History – Information science – Juridical science – Language science – Literature Management sciences – Technology – Religious science – Sociology – Psychological sciences – Neurosciences – Pharmacological sciences – Mathematics – Philosophy – Medical sciences – Political sciences - Physics

FICHE A COMPLETER POUR PUBLICATION D'EMPLOIS SCIENTIFIQUES (hors BIATSS) DANS LE PORTAIL « EURAXESS JOBS »

A COMPLTER EN ANGLAIS ET A RENVOYER à : drv-euraxess@univ-amu.fr en FORMAT WORD

5) A. Karimbana-Kandy *et al.* « Pulse Duration Dependent Optical Nonlinearities of Bi₂Se₃ Thin Films »
accepted in Optics Express (2023).

TYPE OF CONTRACT: PERMANENT TEMPORARY TO BE DEFINED

JOB STATUS: FULL TIME PART TIME NEGOTIABLE

HOURS PER WEEK _____

APPLICATION DEADLINE (If not applicable, report the envisaged starting date): (31/03/2024) & TIME
(00:00)

ENVISAGED STARTING DATE: (01/09/2024)

ENVISAGED DURATION: 36 months

IS THE JOB FUNDED THROUGH AN EU RESEARCH FRAMEWORK PROGRAMME? YES NO

If yes, please specify:

HOW TO APPLY (Please report ONE value; more contacts may be mentioned in the application process)

E-mail: konstantinos.iliopoulos@fresnel.fr

Website:

WORK LOCATION(S): Institut Fresnel, 52 Av. Escadrille Normandie Niemen, 13013 Marseille, France

WHAT WE OFFER: Salary

.....

Additional information: The Euraxess Center of Aix-Marseille Université informs foreign visiting professors, researchers, postdoc and PhD candidates about the administrative steps to be undertaken prior to arrival at AMU and the various practical formalities to be completed once in France: visas and entry requirements, insurance, help finding accommodation, support in opening a bank account, etc. More information on [AMU EURAXESS Portal](#)

QUALIFICATIONS, REQUIRED RESEARCH FIELDS, REQUIRED EDUCATION LEVEL, PROFESSIONAL SKILLS, OTHER RESEARCH REQUIREMENTS (years of research experience (max. 3000 characters)

The candidate shall have a solid background related with optics/ nonlinear optics.

Soft skills: (Ex.: Autonomy, Teamwork, Analytical and critical thinking, Listening and observing, Empathy, Flexibility and adaptability, Linguistics, communicative and plurilingual, Co-operation, Conflict-resolution, Required languages ...):

.....

¹ **Academic Positions Research fields:** Agricultural Sciences – Anthropology – Architecture and Design – Arts and Culture – Biology – Chemistry – Computer Science – Business and Economics – Education – Engineering – Geosciences – History – Law – Linguistics – Literature – Mathematics – Medicine – Philosophy – Physics – Political Science – Psychology – Social Science – Space Science – Theology

Euraxess Research fields: Agricultural Sciences – Anthropology – Architecture – Arts– Astronomy – Biological sciences – Chemistry – Communication sciences - Computer Science – Criminology – Cultural Studies – Demography - Economics – Educational Science – Engineering – Environmental science – Ethics in Health sciences – Ethics in natural sciences – Ethics in physical sciences - – Geography - Geosciences – History – Information science – Juridical science – Language science – Literature Management sciences – Technology – Religious science – Sociology – Psychological sciences – Neurosciences – Pharmacological sciences – Mathematics – Philosophy – Medical sciences – Political sciences - Physics

**FICHE A COMPLETER POUR PUBLICATION D'EMPLOIS SCIENTIFIQUES (hors BIATSS) DANS
LE PORTAIL « EURAXESS JOBS »**

A COMPLTER EN ANGLAIS ET A RENVOYER à : drv-euraxess@univ-amu.fr en FORMAT WORD

REQUESTED DOCUMENTS OF APPLICATION, ELIGIBILITY CRITERIA, SELECTION PROCESS
CV, grades, motivation letter

¹ **Academic Positions Research fields:** Agricultural Sciences – Anthropology – Architecture and Design – Arts and Culture – Biology – Chemistry – Computer Science – Business and Economics – Education – Engineering – Geosciences – History – Law – Linguistics – Literature – Mathematics – Medicine – Philosophy – Physics – Political Science – Psychology – Social Science – Space Science – Theology

Euraxess Research fields: Agricultural Sciences – Anthropology – Architecture – Arts– Astronomy – Biological sciences – Chemistry – Communication sciences - Computer Science – Criminology – Cultural Studies – Demography - Economics – Educational Science – Engineering – Environmental science – Ethics in Health sciences – Ethics in natural sciences – Ethics in physical sciences - – Geography - Geosciences – History – Information science – Juridical science – Language science – Literature Management sciences – Technology – Religious science – Sociology – Psychological sciences – Neurosciences – Pharmacological sciences – Mathematics – Philosophy – Medical sciences – Political sciences - Physics

FO-DRV-911 EURAXESS JOBS / ACADEMIC POSITIONS AMU_DRV_MàJ Juillet 2023