



**Research fellowship on “PATH - Patterning of Antiferromagnets for THz operation” –  
Università Ca' Foscari Venezia**

(Italian law 30 December 2010, n.240, art. 22 and subsequent amendments and additions)

The present document in English is to be considered as a mere summary of the main provisions of the notice of competition which is available in Italian at the following ([link](#)) The text in Italian is the official text of the notice of competition for all legal intents and purposes and, in the event of non-conformity with the present document, it shall prevail.

## Description

The Department of Molecular Sciences and Nanosystems at Università Ca' Foscari Venezia invites applications for a fellowship lasting 12 months titled “PATH - Patterning of Antiferromagnets for THz operation”, PHYS-03/A, project PRIN 2022 titled “PATH - Patterning of Antiferromagnets for THz operation”, cod. 2022ZRLA8F, CUP: H53D23000890006, tutor and principal investigator: prof. Stefano Bonetti.

The fellowship is intended to provide the successful candidate with the opportunity to pursue his/her own research while benefiting from the range of expertise at Università Ca' Foscari Venezia.

## Abstract:

With the end of Moore's law and the fast growth of Internet of Things applications, information technology needs to find new efficient mechanisms for information transmission and processing, enabling nanoscale integration and power saving. Spintronics is considered as one of the promising candidates for beyond CMOS computing. However, the GHz operation speed of ferromagnets and their difficulties in achieving high packing density due to their stray fields represent fundamental limitations in the path towards application. In this framework, antiferromagnets (AF), with their THz dynamics and absence of net magnetization, have been proposed for overcoming these limitations. However, the absence of straightforward ways to control the magnetic properties of Afs and the difficulties in probing their magnetic order has strongly limited the development of AF magnonics. In this context, the PATH The recent project proposes a new approach to control and study the static and dynamic magnetic properties of Afs development of thermally assisted scanning probe lithography (t-SPL) opened the extraordinary opportunity to control magnetic properties in AFs with unprecedented sub-10 nm resolution. In addition, the recent pioneering works on the use of THz radiation on magnetic materials, gave the possibility to access the dynamics of AFs and study coherent magnon modes. By using t-SPL in combination with THz spectroscopy, the PATH project aims to establish a new paradigm for exploiting AFs in spintronics, through the following ambitious objectives:

- a. To achieve nanoscale control of the static magnetic properties in AFs, by using the recently developed t-SPL technique to directly pattern with nanometer resolution spin textures and anisotropy landscapes.
- b. To tune the dynamic properties and magnonic response of AFs by exploiting either tailored spin textures or magnonic crystals based on the modulation of the magnetic anisotropy or exchange interaction.

To achieve these challenging objectives, the team will work on three scientific workpackages:

1. Growth of AF films and characterization of their dynamic properties via THz pump – magneto-

optical probe.

2. Patterning of spin textures in AFs via t-SPL exploiting nanoscale crystallization, thermal magneto-elastic effects and localized field cooling; development of a Scanning Thermal Gradient Microscopy at the nanoscale to characterize the patterns.

3. Stabilization of different domain walls and study their effect on the non-linear coupling of magnonic modes; realization of a periodic modulation of the magnetic anisotropy/exchange interaction to tune the magnonic dispersion of the AF; characterization of these system with THz pump-probe and imaging. By merging sub-10 nm resolution, AFs and THz characterization, this challenging project will open the path to the application of AFs for ultrafast, compact and energy efficient novel devices.

The fellowship will be involved in WPs:

WP1.2: characterization of the dynamics of antiferromagnetic films

WP3.2: Terahertz characterization of the patterned antiferromagnets

### Who can apply

Prospective candidates are expected to hold a **Ph.D. degree in physics, materials science or engineering**, with scientific-professional curriculum suitable for carrying out the research activities. Ca' Foscari encourages applications from researchers with positive evaluation in all the criteria in individual proposals such as Marie Skłodowska Curie Actions - Individual Fellowships/ERC Starting Grants/FIRB (Italian Fund for basic research investments)/SIR (Scientific Young Independence Research) or similar.

Researchers having successfully completed Marie Skłodowska Curie Actions - Individual Fellowships/ERC Starting Grants/FIRB (Italian Fund for basic research investments)/SIR (Scientific Young Independence Research) or similar funded projects are warmly encouraged to apply.

### The following qualifications are considered as evaluation criteria:

- b. specialization diplomas and certificates of attendance of post-graduate specialization courses, obtained both in Italy and abroad, the carrying out of documented research activities at public and private entities with contracts, scholarships or assignments both in Italy and abroad;
- c. at least one publication in the field of magnetism dynamics studied with terahertz radiation;
- d. at least one publication on antiferromagnetic materials

**Duration of contract: 12 months**, approximately starting in: **December 2024**.

**Salary:** The research fellowship amounts to **Euro € 30.795,94** per year gross of the recipient, net of the expenses to be sustained by the Provider.

**Deadline for submission of applications: 31<sup>th</sup> October 2024, at 12.00 a.m.(Rome CET)**

### How to apply:

Candidates shall submit:

1. The application form;
  2. A motivation letter (max 1 page) along with their CV in European format, duly dated and signed, both to be enclosed as a single.pdf file ([link](#)); a declaration must be appended in the footnote of the curriculum, pursuant to the Italian DPR 445/2000 and subsequent amendments and additions, that the information provided corresponds to the truth. Moreover, the candidates have to consent to the use of their personal data for the purposes of this selection procedure pursuant to the Italian Legislative Decree 196/2003 and to the EU Regulations 2016/679;
  3. The attachments called “obligations and understanding” and “participation and compatibility”;
  4. All documents, qualifications and publications relevant for the selection procedure (please, see the notice - [link](#));
  5. A copy of a valid identity document (either Identity Card or Passport);
  6. (If available) Evaluation Summary Reports of Marie Skłodowska Curie Actions - Individual Fellowships/ ERC Starting Grants/FIRB (Italian Fund for basic research investments)/SIR (Scientific Young Independence Research) individual proposals having passed all the evaluation thresholds;
  7. (If available) Details of Marie Skłodowska Curie Actions - Individual Fellowships, ERC Starting Grants, FIRB (Italian Fund for basic research investments)/ SIR Scientific Young Independence Research funded projects;
  8. Declaration on availability to hold the interview in remote ([Link](#)) to be sent via email at the following address: [ricerca.dsmn@unive.it](mailto:ricerca.dsmn@unive.it)
- All the schemes of the quoted documentation are available on the website ([link](#)).

**Incomplete applications will be rejected.**

### **How to submit your application**

Applications should be submitted by the online procedure, available on this link:

<https://apps.unive.it/domandeconcorso-en/accesso/prin22-bonett-ar2-2024>

The candidate, after the uploading, will receive a submission number and an e-mail acknowledging receipt of his/her application.

The candidate, if necessary, could access the procedures for updating any data and materials by the link provided by the e-mail, in any case any updates must be made no later than the deadline October 31<sup>st</sup> 2024, at 12.00 a.m.

**If you don't have an Italian tax identification code, please click on “Calculate Italian tax identification code (codice fiscale)”, (<https://apps.unive.it/utills/cf>).**

Please note that the University can be contacted for any support needs by the candidate until 24 hours prior to the deadline.

Please note that in case of a high number of applications and / or weight of the materials loaded by the candidates the system might become slower, therefore it is suggested not to start the process close to the deadline.

**NB:** the University does not take on responsibility for wrong or late communication of addresses, nor for any communication problem not depending on the University.

### **Topics of the interview:**

-knowledge in solid state physics, in particular dynamics and out-of-equilibrium states;

- knowledge about ultrafast lasers, in the terahertz and visible range
  - Assessment of knowledge of the foreign language English by carrying out part of the interview in English
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### Evaluation

Up to 100 points, specifically:

For qualifications, publications and possible tests, from 0 to 60;

For interview, from 0 to 40.

### Selection procedure

The interview will be on **13/11/2024 at 10:30 a.m.**

by remote at the link:

<https://meet.google.com/kmo-facj-mnp>

The list of candidates admitted to the interview or any postponements will be made known on November 8<sup>th</sup> 2024 through a notice that will be published on the website of this University ([link](#)) and on the web pages required by current legislation.

### Information and contacts

Candidates may find further details about the application process and the research project in the official call published on the following ([link](#))

For further information please contact the Research Office, email: [ricerca.dsmn@unive.it](mailto:ricerca.dsmn@unive.it), Ph: 0412348633/8514.

The Head of Department of Molecular Sciences and Nanosystems  
Prof. Maurizio Selva

Responsible for administrative procedure  
The Secretary of Department  
Mrs. Sonia Barizza